Appendix E
Traffic Analysis Worksheets

2038 Design Year

Build River Center Site Alternatives 5-7

Interstate 526

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3010-EB Off to PaulCantrell EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 340	V_D = veh/h
	Freeway Volume, V_F: 2939	
	Ramp Volume, V_R: 28	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2939	0.90	Level	3	0	0.985	1.00	3315
Ramp	28	0.90	Level	36	0	0.847	1.00	37
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3315 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3315	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3278	Exhibit 13-8	4600	No
V_R	37	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3315	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.301 (Exhibit 13-12)

S_R= 54.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3010-EB Off to PaulCantrell EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 340	V_D = veh/h
	Freeway Volume, V_F: 2659	
	Ramp Volume, V_R: 55	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2659	0.90	Level	3	0	0.985	1.00	2999
Ramp	55	0.90	Level	15	0	0.930	1.00	66
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2999 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2999	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2933	Exhibit 13-8	4600	No
V_R	66	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2999	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.304 (Exhibit 13-12)

S_R= 54.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3020-EB Off to PaulCantrell WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	600	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2911	V_D =	veh/h
		Ramp Volume, V_R	182		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2911	0.90	Level	9	0	0.957	1.00	3380
Ramp	182	0.90	Level	7	0	0.966	1.00	209
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3380 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3380	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3171	Exhibit 13-8	4600	No
V_R	209	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3380	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.9 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.577 (Exhibit 13-12)

S_R= 49.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3020-EB Off to PaulCantrell WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	600	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2604	V_D =	veh/h
		Ramp Volume, V_R	600		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2604	0.90	Level	8	0	0.962	1.00	3009
Ramp	600	0.90	Level	2	0	0.990	1.00	673
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3009 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3009	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2336	Exhibit 13-8	4600	No
V_R	673	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3009	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 24.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.619 (Exhibit 13-12)

S_R= 48.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.9 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3025- PaulC WB Off to PaulC On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2729*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1584*	pc/h/ln	Design LOS		
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*26.4*	pc/mi/ln	S		mph
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3025- PaulC WB Off to PaulC On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2004*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1158*	pc/h/ln	Design LOS		
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*19.3*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3030-EB On from Paul Cantrell
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 850	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2729	
	Ramp Volume, V_R: 1764	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2729	0.90	Level	9	0	0.957	1.00	3169
Ramp	1764	0.90	Level	17	0	0.922	1.00	2127
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3169 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5296	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5296	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 40.5 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = 1.023 (Exibit 13-11)

S_R= 41.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 41.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3030-EB On from Paul Cantrell
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 850	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2004	
	Ramp Volume, V_R: 1546	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2004	0.90	Level	8	0	0.962	1.00	2316
Ramp	1546	0.90	Level	17	0	0.922	1.00	1864
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2316 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4180	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4180	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 31.9 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.499 (Exibit 13-11)

S_R= 51.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3040 - Paul Cantrell to Leeds*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4493*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2608*	pc/h/ln
S	*41.5*	mph
D = v_p / S	*62.8*	pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3040 - Paul Cantrell to Leeds*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3550*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2051*	pc/h/ln	Design LOS		
S	*56.3*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*36.4*	pc/mi/ln	S		mph
LOS	*E*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3050-EB Off to Leeds
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	325	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	4493	V_D =	veh/h
		Ramp Volume, V_R	713		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4493	0.90	Level	9	0	0.957	1.00	5217
Ramp	713	0.90	Level	8	0	0.962	1.00	824
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 5217 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5217	Exhibit 13-8	4600	Yes
$V_{FO} = V_F - V_R$	4393	Exhibit 13-8	4600	No
V_R	824	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	5217	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 46.2 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.372 (Exhibit 13-12)

S_R= 53.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3050-EB Off to Leeds
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 325	V_D = veh/h
	Freeway Volume, V_F: 3550	
	Ramp Volume, V_R: 337	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3550	0.90	Level	8	0	0.962	1.00	4102
Ramp	337	0.90	Level	14	0	0.935	1.00	401
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4102 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4102	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3701	Exhibit 13-8	4600	No
V_R	401	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4102	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 36.6 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.334 (Exhibit 13-12)

S_R= 54.0 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.0 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3055 - Leeds Off to Leeds On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3780*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2195*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*53.6*	mph	S	mph
D = v_p / S	*41.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3055 - Leeds Off to Leeds On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3213*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1856*	pc/h/ln
S	*58.8*	mph
D = v_p / S	*31.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4443

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3060 - Leeds to Dorchester
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2020ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3478	0.90	8	0	1.5	1.2	0.962	1.00	4019
V_{RF}	250	0.90	8	0	1.5	1.2	0.962	1.00	289
V_{FR}	302	0.90	12	0	1.5	1.2	0.943	1.00	356
V_{RR}	22	0.90	12	0	1.5	1.2	0.943	1.00	26
V_{NW}	4045							V =	4690
V_W	645								
VR	0.138								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	645 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	898 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1350 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2248 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	817

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4690 pc/h	Weaving intensity factor, W	0.246
Weaving segment capacity, c_w	6219 veh/h	Weaving segment speed, S	48.3 mph
Weaving segment v/c ratio	0.725	Average weaving speed, S_W	51.1 mph
Weaving segment density, D	32.4 pc/mi/ln	Average non-weaving speed, S_{NW}	47.9 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	3907 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3060 - Leeds to Dorchester
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2020ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2856	0.90	7	0	1.5	1.2	0.966	1.00	3284
V_{RF}	875	0.90	7	0	1.5	1.2	0.966	1.00	1006
V_{FR}	357	0.90	7	0	1.5	1.2	0.966	1.00	411
V_{RR}	109	0.90	7	0	1.5	1.2	0.966	1.00	125
V_{NW}	3409							V =	4826
V_W	1417								
VR	0.294								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1417 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1670 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1219 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2889 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	689

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4826 pc/h	Weaving intensity factor, W	0.300
Weaving segment capacity, c_w	5893 veh/h	Weaving segment speed, S	44.0 mph
Weaving segment v/c ratio	0.791	Average weaving speed, S_W	49.6 mph
Weaving segment density, D	36.5 pc/mi/ln	Average non-weaving speed, S_{NW}	42.1 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5516 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3065-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3728*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2154*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*54.4*	mph	S	mph
D = v_p / S	*39.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3065-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3731*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*7*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2145*	pc/h/ln	Design LOS	
S	*54.6*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*39.3*	pc/mi/ln	S	mph
LOS	*E*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3070 - Dorchester to Montague
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1515ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3030	0.90	8	0	1.5	1.2	0.962	1.00	3501
V_{RF}	619	0.90	18	0	1.5	1.2	0.917	1.00	750
V_{FR}	698	0.90	10	0	1.5	1.2	0.952	1.00	814
V_{RR}	142	0.90	18	0	1.5	1.2	0.917	1.00	172
V_{NW}	3673							V =	5237
V_W	1564								
VR	0.299								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1564 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1760 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1000 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2760 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	445

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5237 pc/h	Weaving intensity factor, W	0.363
Weaving segment capacity, c_w	5740 veh/h	Weaving segment speed, S	42.4 mph
Weaving segment v/c ratio	0.877	Average weaving speed, S_W	48.0 mph
Weaving segment density, D	41.2 pc/mi/ln	Average non-weaving speed, S_{NW}	40.4 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5569 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3070 - Dorchester to Montague
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1515ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2845	0.90	7	0	1.5	1.2	0.966	1.00	3272
V_{RF}	875	0.90	10	0	1.5	1.2	0.952	1.00	1021
V_{FR}	886	0.90	7	0	1.5	1.2	0.966	1.00	1019
V_{RR}	273	0.90	10	0	1.5	1.2	0.952	1.00	319
V_{NW}	3591							V =	5631
V_W	2040								
VR	0.362								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	2040 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	2236 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	983 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3219 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	435

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5631 pc/h	Weaving intensity factor, W	0.410
Weaving segment capacity, c_w	5614 veh/h	Weaving segment speed, S	39.5 mph
Weaving segment v/c ratio	0.969	Average weaving speed, S_W	46.9 mph
Weaving segment density, D	47.5 pc/mi/ln	Average non-weaving speed, S_{NW}	36.3 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6262 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3080-Montague to International*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3649*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2108*	pc/h/ln
S	*55.3*	mph
D = v_p / S	*38.1*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3080-Montague to International*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3720*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2149*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*54.5*	mph	S	mph
D = v_p / S	*39.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3090-EB Off to InternationalWB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	3649
Ramp Volume, V_R	944
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	25.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3649	0.90	Level	8	0	0.962	1.00	4217
Ramp	944	0.90	Level	8	0	0.962	1.00	1091
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4217 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4217	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3126	Exhibit 13-8	4600	No
V_R	1091	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4217	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.656 (Exhibit 13-12)

S_R= 48.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3090-EB Off to InternationalWB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	3720
Ramp Volume, V_R	969
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	25.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3720	0.90	Level	8	0	0.962	1.00	4299
Ramp	969	0.90	Level	6	0	0.971	1.00	1109
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 4299 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4299	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3190	Exhibit 13-8	4600	No
V_R	1109	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4299	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.9 (pc/mi/ln)
LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.658 (Exhibit 13-12)
S_R= 48.2 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 48.2 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3095- Inter WB Off to Inter On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2705*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1563*	pc/h/ln	Design LOS		
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*60.0*	mph	S		mph
D = v_p / S	*26.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3095- Inter WB Off to Inter On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2751*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1589*	pc/h/ln	Design LOS		
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*60.0*	mph	S		mph
D = v_p / S	*26.5*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3100 - International to I-26
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2025ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1197	0.90	8	0	1.5	1.2	0.962	1.00	1383
V_{RF}	717	0.90	8	0	1.5	1.2	0.962	1.00	829
V_{FR}	1508	0.90	9	0	1.5	1.2	0.957	1.00	1751
V_{RR}	903	0.90	9	0	1.5	1.2	0.957	1.00	1048
V_{NW}	2431							V =	5011
V_W	2580								
VR	0.515								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	829 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1083 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1021 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	2104 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	492

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5011 pc/h	Weaving intensity factor, W	0.233
Weaving segment capacity, c_w	5518 veh/h	Weaving segment speed, S	44.1 mph
Weaving segment v/c ratio	0.873	Average weaving speed, S_W	47.4 mph
Weaving segment density, D	37.9 pc/mi/ln	Average non-weaving speed, S_{NW}	41.0 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6435 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3100 - International to I-26
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2025ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1267	0.90	7	0	1.5	1.2	0.966	1.00	1457
V_{RF}	1112	0.90	7	0	1.5	1.2	0.966	1.00	1279
V_{FR}	1484	0.90	7	0	1.5	1.2	0.966	1.00	1707
V_{RR}	1302	0.90	7	0	1.5	1.2	0.966	1.00	1497
V_{NW}	2954							V =	5940
V_W	2986								
VR	0.503								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	578

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5940 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	5577 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.029	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	6292 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3105-I-26 Off to I-26 EB CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1914*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*16*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.926*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1148*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*20.9*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3105-I-26 Off to I-26 EB CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2379*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*14*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1414*	pc/h/ln	Design LOS		
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*25.7*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4459

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3110-EB On from I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☑ No ☐ Off		☑ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h		V_D = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	625
Deceleration Lane Length L_D	
Freeway Volume, V_F	1914
Ramp Volume, V_R	1422
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	25.0

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1914	0.90	Level	16	0	0.926	1.00	2297
Ramp	1422	0.90	Level	53	0	0.791	1.00	1999
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2297 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4296	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4296	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 34.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.576 (Exibit 13-11)

S_R= 47.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 47.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3110-EB On from I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 625	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2379	
	Ramp Volume, V_R: 1163	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2379	0.90	Level	14	0	0.935	1.00	2828
Ramp	1163	0.90	Level	55	0	0.784	1.00	1648
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2828 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4476	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4476	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 35.7 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

M_S = 0.632 (Exibit 13-11)

S_R= 46.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 46.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3120 - I-26 WB to Rivers Ave
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1615ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3112	0.90	16	0	1.5	1.2	0.926	1.00	3734
V_{RF}	466	0.90	16	0	1.5	1.2	0.926	1.00	559
V_{FR}	224	0.90	16	0	1.5	1.2	0.926	1.00	269
V_{RR}	33	0.90	16	0	1.5	1.2	0.926	1.00	40
V_{NW}	3774							V =	4602
V_W	828								
VR	0.180								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.2 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	828 lc/h
Weaving lane changes, LC_W	1067 lc/h
Non-weaving lane changes, LC_{NW}	1075 lc/h
Total lane changes, LC_{ALL}	2142 lc/h
Non-weaving vehicle index, I_{NW}	731

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4602 pc/h
Weaving segment capacity, c_w	5672 veh/h
Weaving segment v/c ratio	0.751
Weaving segment density, D	36.2 pc/mi/ln
Level of Service, LOS	E
Weaving intensity factor, W	0.282
Weaving segment speed, S	42.4 mph
Average weaving speed, S_W	46.2 mph
Average non-weaving speed, S_{NW}	41.7 mph
Maximum weaving length, L_{MAX}	4332 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3120 - I-26 WB to Rivers Ave
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1615ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3179	0.90	14	0	1.5	1.2	0.935	1.00	3779
V_{RF}	403	0.90	14	0	1.5	1.2	0.935	1.00	479
V_{FR}	363	0.90	14	0	1.5	1.2	0.935	1.00	432
V_{RR}	46	0.90	9	0	1.5	1.2	0.957	1.00	53
V_{NW}	3832							V =	4743
V_W	911								
VR	0.192								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	911 lc/h
Interchange density, ID	1.2 int/mi	Weaving lane changes, LC_W	1150 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1087 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2237 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	743

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4743 pc/h	Weaving intensity factor, W	0.292
Weaving segment capacity, c_w	5700 veh/h	Weaving segment speed, S	41.7 mph
Weaving segment v/c ratio	0.778	Average weaving speed, S_W	46.0 mph
Weaving segment density, D	37.9 pc/mi/ln	Average non-weaving speed, S_{NW}	40.9 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	4455 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3130-EB Off to Rivers NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 800	V_D = veh/h
	Freeway Volume, V_F: 3578	
	Ramp Volume, V_R: 171	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3578	0.90	Level	16	0	0.926	1.00	4294
Ramp	171	0.90	Level	22	0	0.901	1.00	211
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4294 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4294	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	4083	Exhibit 13-8	4500	No
V_R	211	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4294	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.0 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.577 (Exhibit 13-12)

S_R= 47.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 47.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3130-EB Off to Rivers NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 800	V_D = veh/h
	Freeway Volume, V_F: 3582	
	Ramp Volume, V_R: 352	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3582	0.90	Level	14	0	0.935	1.00	4259
Ramp	352	0.90	Level	9	0	0.957	1.00	409
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4259 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4259	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	3850	Exhibit 13-8	4500	No
V_R	409	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4259	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.595 (Exhibit 13-12)

S_R= 47.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 47.3 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3135-RiversNB Off to Rivers On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3407*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*16*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.926*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2044*	pc/h/ln
S	*53.5*	mph
D = v_p / S	*38.2*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3135-RiversNB Off to Rivers On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3230*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*14*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1920*	pc/h/ln
S	*54.6*	mph
D = v_p / S	*35.1*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3140-EB On from Rivers
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 825	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3407	
	Ramp Volume, V_R: 545	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3407	0.90	Level	16	0	0.926	1.00	4088
Ramp	545	0.90	Level	2	0	0.990	1.00	612
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 4088 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4700	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4700	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 36.7 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = 0.676 (Exibit 13-11)

S_R= 46.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 46.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3140-EB On from Rivers
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 825	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3230	
	Ramp Volume, V_R: 531	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3230	0.90	Level	14	0	0.935	1.00	3840
Ramp	531	0.90	Level	2	0	0.990	1.00	596
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3840 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4436	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4436	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 34.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.576 (Exibit 13-11)

S_R= 47.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 47.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3150-Rivers to Rhett*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs				
Volume, V	*3952*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments			
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2360*	pc/h/ln	Design LOS	
S	*49.5*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*47.7*	pc/mi/ln	S	mph
LOS	*F*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3150-Rivers to Rhett*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs				
Volume, V	*3761*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2225*	pc/h/ln	Design LOS	
S	*52.9*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*42.1*	pc/mi/ln	S	mph
LOS	*E*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3160-EB Off to Rhett
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	225	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3952	V_D =	veh/h
		Ramp Volume, V_R	545		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3952	0.90	Level	15	0	0.930	1.00	4720
Ramp	545	0.90	Level	6	0	0.971	1.00	624
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4720 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4720	Exhibit 13-8	4600	Yes
$V_{FO} = V_F - V_R$	4096	Exhibit 13-8	4600	No
V_R	624	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4720	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 42.8 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.354 (Exhibit 13-12)

S_R= 53.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3160-EB Off to Rhett
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 225	V_D = veh/h
	Freeway Volume, V_F: 3761	
	Ramp Volume, V_R: 755	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3761	0.90	Level	13	0	0.939	1.00	4451
Ramp	755	0.90	Level	4	0	0.980	1.00	856
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4451 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4451	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3595	Exhibit 13-8	4600	No
V_R	856	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4451	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 40.5 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.375 (Exhibit 13-12)

S_R= 53.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.2 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3165 - Rhett Off to Rhett On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3407*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2035*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*56.6*	mph	S	mph
D = v_p / S	*36.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3165 - Rhett Off to Rhett On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3006*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1779*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.4*	mph	S	mph
D = v_p / S	*29.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3170 - Rhett to Virginia
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1090ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2927	0.90	14	0	1.5	1.2	0.935	1.00	3480
V_{RF}	1202	0.90	14	0	1.5	1.2	0.935	1.00	1429
V_{FR}	480	0.90	14	0	1.5	1.2	0.935	1.00	571
V_{RR}	197	0.90	12	0	1.5	1.2	0.943	1.00	232
V_{NW}	3712							V =	5712
V_W	2000								
VR	0.350								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	2000 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	2151 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	778 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2929 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	283

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5712 pc/h	Weaving intensity factor, W	0.493
Weaving segment capacity, c_w	5369 veh/h	Weaving segment speed, S	39.1 mph
Weaving segment v/c ratio	0.994	Average weaving speed, S_W	45.1 mph
Weaving segment density, D	48.7 pc/mi/ln	Average non-weaving speed, S_{NW}	36.5 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6128 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3170 - Rhett to Virginia
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1090ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2855	0.90	13	0	1.5	1.2	0.939	1.00	3378
V_{RF}	1002	0.90	14	0	1.5	1.2	0.935	1.00	1191
V_{FR}	151	0.90	34	0	1.5	1.2	0.855	1.00	196
V_{RR}	53	0.90	34	0	1.5	1.2	0.855	1.00	69
V_{NW}	3447							V =	4834
V_W	1387								
VR	0.287								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1387 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	1538 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	723 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2261 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	263

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4834 pc/h	Weaving intensity factor, W	0.402
Weaving segment capacity, c_w	5541 veh/h	Weaving segment speed, S	43.6 mph
Weaving segment v/c ratio	0.819	Average weaving speed, S_W	47.1 mph
Weaving segment density, D	37.0 pc/mi/ln	Average non-weaving speed, S_{NW}	42.3 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5444 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3180-Virginia to ClementsFerry*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4129*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2432*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*47.4*	mph	S	mph
D = v_p / S	*51.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*F*		Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4478

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3180-Virginia to ClementsFerry*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3857*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2271*	pc/h/ln	Design LOS	
S	*51.8*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*43.8*	pc/mi/ln	S	mph
LOS	*E*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3190-EB Off to ClementsFerrySB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 250	V_D = veh/h
	Freeway Volume, V_F: 4129	
	Ramp Volume, V_R: 491	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4129	0.90	Level	12	0	0.943	1.00	4863
Ramp	491	0.90	Level	9	0	0.957	1.00	570
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4863 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4863	Exhibit 13-8	4600	Yes
$V_{FO} = V_F - V_R$	4293	Exhibit 13-8	4600	No
V_R	570	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4863	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 43.8 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.349 (Exhibit 13-12)

S_R= 53.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3190-EB Off to ClementsFerrySB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 250	V_D = veh/h
	Freeway Volume, V_F: 3857	
	Ramp Volume, V_R: 255	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3857	0.90	Level	12	0	0.943	1.00	4543
Ramp	255	0.90	Level	15	0	0.930	1.00	305
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4543 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4543	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	4238	Exhibit 13-8	4600	No
V_R	305	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4543	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 41.1 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.325 (Exhibit 13-12)

S_R= 54.1 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3200-EB Off to ClementsFerryNB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	900
Freeway Volume, V_F	3638
Ramp Volume, V_R	908
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	25.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3638	0.90	Level	12	0	0.943	1.00	4285
Ramp	908	0.90	Level	21	0	0.905	1.00	1115
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4285 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4285	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3170	Exhibit 13-8	4600	No
V_R	1115	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4285	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.0 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.658 (Exhibit 13-12)

S_R= 48.1 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3200-EB Off to ClementsFerryNB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	900	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3602	V_D =	veh/h
		Ramp Volume, V_R	833		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3602	0.90	Level	12	0	0.943	1.00	4242
Ramp	833	0.90	Level	20	0	0.909	1.00	1018
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4242 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4242	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3224	Exhibit 13-8	4600	No
V_R	1018	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4242	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.650 (Exhibit 13-12)

S_R= 48.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.3 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3205-ClemFerry NB Off to NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2730*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1608*	pc/h/ln	Design LOS		
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*26.8*	pc/mi/ln	S		mph
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3205-ClemFerry NB Off to NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2769*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1631*	pc/h/ln	Design LOS	
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*27.2*	pc/mi/ln	S	mph
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3210-EB On from Clements Ferry
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1025	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2730	
	Ramp Volume, V_R: 447	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2730	0.90	Level	12	0	0.943	1.00	3215
Ramp	447	0.90	Level	11	0	0.948	1.00	524
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3215 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3739	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3739	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 28.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.393 (Exibit 13-11)

S_R= 52.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 52.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3210-EB On from Clements Ferry
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1025	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2769	
	Ramp Volume, V_R: 686	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2769	0.90	Level	12	0	0.943	1.00	3261
Ramp	686	0.90	Level	6	0	0.971	1.00	785
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3261 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4046	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4046	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.452 (Exibit 13-11)

S_R= 51.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3220-ClementsFerrytoRiversLand*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3177*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*11*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1862*	pc/h/ln
S	*58.8*	mph
D = v_p / S	*31.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3220-ClementsFerrytoRiversLand*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3455*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2006*	pc/h/ln
S	*57.0*	mph
D = v_p / S	*35.2*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	mph
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3230-EB Off to River Landing
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 800	V_D = veh/h
	Freeway Volume, V_F: 3177	
	Ramp Volume, V_R: 808	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3177	0.90	Level	11	0	0.948	1.00	3724
Ramp	808	0.90	Level	4	0	0.980	1.00	916
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3724 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3724	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	2808	Exhibit 13-8	4700	No
V_R	916	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3724	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.380 (Exhibit 13-12)

S_R= 56.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 56.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3230-EB Off to River Landing
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 800	V_D = veh/h
	Freeway Volume, V_F: 3455	
	Ramp Volume, V_R: 836	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3455	0.90	Level	9	0	0.957	1.00	4012
Ramp	836	0.90	Level	3	0	0.985	1.00	943
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4012 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4012	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	3069	Exhibit 13-8	4700	No
V_R	943	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4012	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.383 (Exhibit 13-12)

S_R= 56.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 56.2 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3235-RiverLa Off to RiverLa On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2369*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1395*	pc/h/ln	Design LOS		
S	*65.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*21.5*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3235-RiverLa Off to RiverLa On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2619*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*11*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1535*	pc/h/ln
S	*64.7*	mph
D = v_p / S	*23.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3240-EB On from River Landing
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1400	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2369	
	Ramp Volume, V_R: 629	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2369	0.90	Level	12	0	0.943	1.00	2790
Ramp	629	0.90	Level	10	0	0.952	1.00	734
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2790 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3524	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3524	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.383 (Exibit 13-11)

S_R= 56.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 56.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3240-EB On from River Landing
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1400	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2619	
	Ramp Volume, V_R: 518	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2619	0.90	Level	11	0	0.948	1.00	3070
Ramp	518	0.90	Level	10	0	0.952	1.00	604
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3070 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3674	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3674	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 25.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.405 (Exibit 13-11)

S_R= 55.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3250-RiverLanding to LongPoint*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2998*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1765*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*63.1*	mph	S	mph
D = v_p / S	*28.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3250-RiverLanding to LongPoint*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3137*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1839*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*62.3*	mph	S	mph
D = v_p / S	*29.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3260-EB Off to Long Point
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 225	V_D = veh/h
	Freeway Volume, V_F: 2998	
	Ramp Volume, V_R: 1148	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2998	0.90	Level	12	0	0.943	1.00	3531
Ramp	1148	0.90	Level	23	0	0.897	1.00	1422
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3531 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3531	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	2109	Exhibit 13-8	4700	No
V_R	1422	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3531	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.426 (Exhibit 13-12)

S_R= 55.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 55.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3260-EB Off to Long Point
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	3137
Ramp Volume, V_R	1230
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3137	0.90	Level	11	0	0.948	1.00	3677
Ramp	1230	0.90	Level	19	0	0.913	1.00	1497
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 3677 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3677	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	2180	Exhibit 13-8	4700	No
V_R	1497	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3677	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.8 (pc/mi/ln)
LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.433 (Exhibit 13-12)
S_R= 55.0 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 55.0 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3265-LongPt Off to LongPtWB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1850*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1089*	pc/h/ln	Design LOS		
S	*65.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*16.8*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3265-LongPt Off to LongPtWB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1907*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1118*	pc/h/ln	Design LOS		
S	*65.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*17.2*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3270-EB On from Long Point WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☑ No ☐ Off		☑ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h		V_D = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	925
Deceleration Lane Length L_D	
Freeway Volume, V_F	1850
Ramp Volume, V_R	634
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	25.0

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1850	0.90	Level	12	0	0.943	1.00	2179
Ramp	634	0.90	Level	11	0	0.948	1.00	743
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2179 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2922	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2922	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.347 (Exibit 13-11)

S_R= 57.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 57.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3270-EB On from Long Point WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	925
Deceleration Lane Length L_D	
Freeway Volume, V_F	1907
Ramp Volume, V_R	634
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	25.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1907	0.90	Level	11	0	0.948	1.00	2235
Ramp	634	0.90	Level	10	0	0.952	1.00	740
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = 1.000 using Equation (Exhibit 13-6)
V_{12} = 2235 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2975	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2975	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.5 (pc/mi/ln)
LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.351 (Exibit 13-11)
S_R= 56.9 mph (Exhibit 13-11)
S_0= N/A mph (Exhibit 13-11)
S = 56.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = using Equation (Exhibit 13-7)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)
S_R= mph (Exhibit 13-12)
S_0= mph (Exhibit 13-12)
S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3280-EB On from Long Point EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 625	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2484	
	Ramp Volume, V_R: 350	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2484	0.90	Level	12	0	0.943	1.00	2926
Ramp	350	0.90	Level	23	0	0.897	1.00	434
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2926 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3360	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3360	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.377 (Exibit 13-11)

S_R= 56.3 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 56.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3280-EB On from Long Point EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 625	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2541	
	Ramp Volume, V_R: 678	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2541	0.90	Level	11	0	0.948	1.00	2979
Ramp	678	0.90	Level	10	0	0.952	1.00	791
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2979 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3770	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3770	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.434 (Exibit 13-11)

S_R= 55.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3290-LongPt.toUS17/Hungryneck*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2834*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*11*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1661*	pc/h/ln
S	*64.0*	mph
D = v_p / S	*25.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3290-LongPt.toUS17/Hungryneck*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3219*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1860*	pc/h/ln
S	*62.0*	mph
D = v_p / S	*30.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3300-EB Off to US17/Hungryneck
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	225	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2834	V_D =	veh/h
		Ramp Volume, V_R	1203		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2834	0.90	Level	11	0	0.948	1.00	3322
Ramp	1203	0.90	Level	5	0	0.976	1.00	1370
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3322 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3322	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	1952	Exhibit 13-8	4500	No
V_R	1370	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3322	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.421 (Exhibit 13-12)

S_R= 49.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3300-EB Off to US17/Hungryneck
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 225	V_D = veh/h
	Freeway Volume, V_F: 3219	
	Ramp Volume, V_R: 1030	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3219	0.90	Level	8	0	0.962	1.00	3720
Ramp	1030	0.90	Level	5	0	0.976	1.00	1173
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3720 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3720	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	2547	Exhibit 13-8	4500	No
V_R	1173	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3720	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.404 (Exhibit 13-12)

S_R= 49.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.8 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3310-US17/Hungryneck to US17*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1631*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*10*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*951*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*17.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3310-US17/Hungryneck to US17*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2189*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*7*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1259*	pc/h/ln	Design LOS		
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*22.9*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3320-EB Off to US17 SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	250	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	1631	V_D =	veh/h
		Ramp Volume, V_R	1174		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1631	0.90	Level	10	0	0.952	1.00	1903
Ramp	1174	0.90	Level	16	0	0.926	1.00	1409
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1903 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1903	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	494	Exhibit 13-8	4500	No
V_R	1409	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1903	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 18.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.425 (Exhibit 13-12)

S_R= 49.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3320-EB Off to US17 SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 250	V_D = veh/h
	Freeway Volume, V_F: 2189	
	Ramp Volume, V_R: 1151	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2189	0.90	Level	7	0	0.966	1.00	2517
Ramp	1151	0.90	Level	14	0	0.935	1.00	1368
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2517 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2517	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	1149	Exhibit 13-8	4500	No
V_R	1368	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2517	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.421 (Exhibit 13-12)

S_R= 49.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.5 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3325-US17 SB Off to US17 SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*457*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*10*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*267*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*4.9*	pc/mi/ln	S	mph
LOS	*A*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3325-US17 SB Off to US17 SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1038*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*7*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*597*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*10.9*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3330-EB On from US17 SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 725	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 457	
	Ramp Volume, V_R: 397	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	457	0.90	Level	10	0	0.952	1.00	533
Ramp	397	0.90	Level	3	0	0.985	1.00	448
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 533 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	981	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	981	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 8.4 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.295 (Exibit 13-11)

S_R= 51.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3330-EB On from US17 SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 725	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1038	
	Ramp Volume, V_R: 320	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1038	0.90	Level	7	0	0.966	1.00	1194
Ramp	320	0.90	Level	3	0	0.985	1.00	361
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1194 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1555	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1555	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.303 (Exibit 13-11)

S_R= 51.1 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3340-EB On from US17 NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 550	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 854	
	Ramp Volume, V_R: 24	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	854	0.90	Level	10	0	0.952	1.00	996
Ramp	24	0.90	Level	4	0	0.980	1.00	27
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 996 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1023	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1023	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 10.0 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.282 (Exibit 13-11)

S_R= 51.3 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3340-EB On from US17 NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 550	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1358	
	Ramp Volume, V_R: 32	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1358	0.90	Level	7	0	0.966	1.00	1562
Ramp	32	0.90	Level	3	0	0.985	1.00	36
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1562 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1598	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1598	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.291 (Exibit 13-11)

S_R= 51.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4010-WB Off to US17 NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	300	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	1123	V_D =	veh/h
		Ramp Volume, V_R	333		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1123	0.90	Level	10	0	0.952	1.00	1310
Ramp	333	0.90	Level	12	0	0.943	1.00	392
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1310 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1310	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	918	Exhibit 13-8	4500	No
V_R	392	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1310	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 12.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.333 (Exhibit 13-12)

S_R= 50.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4010-WB Off to US17 NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	300
Freeway Volume, V_F	1151
Ramp Volume, V_R	477
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1151	0.90	Level	7	0	0.966	1.00	1324
Ramp	477	0.90	Level	7	0	0.966	1.00	549
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1324 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1324	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	775	Exhibit 13-8	4500	No
V_R	549	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1324	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 12.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.347 (Exhibit 13-12)

S_R= 50.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.5 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4015-US17 NB off to US17 NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*790*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*10*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*461*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*8.4*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4015-US17 NB off to US17 NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*674*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*7*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*388*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*7.1*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4020-WB On from US17 NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 775	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 790	
	Ramp Volume, V_R: 977	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	790	0.90	Level	10	0	0.952	1.00	922
Ramp	977	0.90	Level	8	0	0.962	1.00	1129
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 922 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2051	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2051	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 16.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.313 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4020-WB On from US17 NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 775	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 674	
	Ramp Volume, V_R: 954	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	674	0.90	Level	7	0	0.966	1.00	775
Ramp	954	0.90	Level	7	0	0.966	1.00	1097
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 775 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1872	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1872	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.308 (Exibit 13-11)

S_R= 51.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4030-US17 to US17/Hungryneck*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1767*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1031*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*18.7*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4030-US17 to US17/Hungryneck*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1628*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*936*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*17.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4527

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4020-WB On from US17/Hungrynec
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 425	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 1767	
	Ramp Volume, V_R: 910	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1767	0.90	Level	10	0	0.952	1.00	2062
Ramp	910	0.90	Level	25	0	0.889	1.00	1138
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2062 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3200	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3200	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.378 (Exibit 13-11)

S_R= 50.1 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4020-WB On from US17/Hungrynec
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☑ No ☐ Off		☑ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h		V_D = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	425
Deceleration Lane Length L_D	
Freeway Volume, V_F	1628
Ramp Volume, V_R	1315
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1628	0.90	Level	7	0	0.966	1.00	1872
Ramp	1315	0.90	Level	15	0	0.930	1.00	1571
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1872 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3443	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3443	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 28.9 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.405 (Exibit 13-11)

S_R= 49.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 49.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4050-US17/Hungryneck to LongPt*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2677*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*11*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1569*	pc/h/ln
S	*64.6*	mph
D = v_p / S	*24.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4050-US17/Hungryneck to LongPt*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2943*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1700*	pc/h/ln
S	*63.7*	mph
D = v_p / S	*26.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4060-WB Off to Long Point
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 250	V_D = veh/h
	Freeway Volume, V_F: 2677	
	Ramp Volume, V_R: 589	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2677	0.90	Level	11	0	0.948	1.00	3138
Ramp	589	0.90	Level	21	0	0.905	1.00	723
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3138 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3138	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	2415	Exhibit 13-8	4700	No
V_R	723	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3138	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.0 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.363 (Exhibit 13-12)

S_R= 56.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 56.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4060-WB Off to Long Point
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	250
Freeway Volume, V_F	2943
Ramp Volume, V_R	1345
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2943	0.90	Level	8	0	0.962	1.00	3401
Ramp	1345	0.90	Level	8	0	0.962	1.00	1554
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 3401 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3401	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1847	Exhibit 13-8	4700	No
V_R	1554	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3401	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.3 (pc/mi/ln)
LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.438 (Exhibit 13-12)
S_R= 54.9 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 54.9 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4065-LongPt Off to LongPtEB On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2088*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1230*	pc/h/ln	Design LOS		
S	*65.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*18.9*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4065-LongPt Off to LongPtEB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1598*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*11*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*937*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*14.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4070-WB On from Long Point EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☑ No ☐ Off		☑ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h		V_D = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	950
Deceleration Lane Length L_D	
Freeway Volume, V_F	2088
Ramp Volume, V_R	626
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	25.0

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2088	0.90	Level	12	0	0.943	1.00	2459
Ramp	626	0.90	Level	18	0	0.917	1.00	758
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2459 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3217	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3217	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 24.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.371 (Exibit 13-11)

S_R= 56.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 56.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4070-WB On from Long Point EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 950	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1598	
	Ramp Volume, V_R: 695	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1598	0.90	Level	11	0	0.948	1.00	1873
Ramp	695	0.90	Level	14	0	0.935	1.00	826
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1873 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2699	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2699	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 20.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.331 (Exibit 13-11)

S_R= 57.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 57.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4080-WB On from Long Point WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1025
Deceleration Lane Length L_D	
Freeway Volume, V_F	2714
Ramp Volume, V_R	1448
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2714	0.90	Level	12	0	0.943	1.00	3196
Ramp	1448	0.90	Level	6	0	0.971	1.00	1657
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3196 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4853	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4853	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 36.1 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = 0.728 (Exibit 13-11)

S_R= 48.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 48.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4080-WB On from Long Point WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1025
Deceleration Lane Length L_D	
Freeway Volume, V_F	2293
Ramp Volume, V_R	1051
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2293	0.90	Level	11	0	0.948	1.00	2688
Ramp	1051	0.90	Level	6	0	0.971	1.00	1203
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2688 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3891	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3891	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 28.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.420 (Exibit 13-11)

S_R= 55.3 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4090-Long Point to Island Park*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4162*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2451*	pc/h/ln	Design LOS	
S	*49.3*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*49.7*	pc/mi/ln	S	mph
LOS	*F*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4090-Long Point to Island Park*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3344*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1960*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.6*	mph	S	mph
D = v_p / S	*32.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4100-WB Off to Island Park
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	775
Freeway Volume, V_F	4162
Ramp Volume, V_R	1121
Freeway Free-Flow Speed, S_{FF}	65.0
Ramp Free-Flow Speed, S_{FR}	25.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4162	0.90	Level	12	0	0.943	1.00	4902
Ramp	1121	0.90	Level	10	0	0.952	1.00	1308
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 4902 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4902	Exhibit 13-8	4700	Yes
$V_{FO} = V_F - V_R$	3594	Exhibit 13-8	4700	No
V_R	1308	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4902	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 39.4 (pc/mi/ln)
LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.676 (Exhibit 13-12)
S_R= 49.5 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 49.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4100-WB Off to Island Park
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 775	V_D = veh/h
	Freeway Volume, V_F: 3344	
	Ramp Volume, V_R: 607	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3344	0.90	Level	11	0	0.948	1.00	3920
Ramp	607	0.90	Level	16	0	0.926	1.00	728
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3920 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3920	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	3192	Exhibit 13-8	4700	No
V_R	728	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3920	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.0 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.624 (Exhibit 13-12)

S_R= 50.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.7 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4105 - Is. Pk Off to Is. Pk On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3041*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1791*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*62.8*	mph	S	mph
D = v_p / S	*28.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4105 - Is. Pk Off to Is. Pk On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2737*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1604*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*64.4*	mph	S	mph
D = v_p / S	*24.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4110-WB On from Island Park Dr
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1400	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3041	
	Ramp Volume, V_R: 615	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3041	0.90	Level	12	0	0.943	1.00	3582
Ramp	615	0.90	Level	7	0	0.966	1.00	707
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3582 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4289	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4289	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.479 (Exibit 13-11)

S_R= 54.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 54.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4110-WB On from Island Park Dr
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1400	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2737	
	Ramp Volume, V_R: 713	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2737	0.90	Level	11	0	0.948	1.00	3208
Ramp	713	0.90	Level	5	0	0.976	1.00	812
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3208 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4020	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4020	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.412 (Exibit 13-11)

S_R= 55.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4120-IslandParktoClementsFerry*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3656*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*11*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*65.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*65.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2143*	pc/h/ln
S	*57.2*	mph
D = v_p / S	*37.5*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4120-IslandParktoClementsFerry*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3450*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*65.0*	mph	FFS	*65.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2003*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.8*	mph	S	mph
D = v_p / S	*33.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4130-WB Off to Clements Ferry
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	240	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3656	V_D =	veh/h
		Ramp Volume, V_R	548		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3656	0.90	Level	11	0	0.948	1.00	4286
Ramp	548	0.90	Level	17	0	0.922	1.00	661
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4286 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4286	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3625	Exhibit 13-8	4600	No
V_R	661	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4286	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 39.0 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.357 (Exhibit 13-12)

S_R= 53.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4130-WB Off to Clements Ferry
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	240	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3450	V_D =	veh/h
		Ramp Volume, V_R	454		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3450	0.90	Level	9	0	0.957	1.00	4006
Ramp	454	0.90	Level	17	0	0.922	1.00	547
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4006 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4006	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3459	Exhibit 13-8	4600	No
V_R	547	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4006	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 36.5 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.347 (Exhibit 13-12)

S_R= 53.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.7 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4135-ClFerry Off to ClFerry On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3108*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1830*	pc/h/ln
S	*59.0*	mph
D = v_p / S	*31.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4135-ClFerry Off to ClFerry On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2996*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1764*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.5*	mph	S	mph
D = v_p / S	*29.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4553

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-526 WB
Analysis Year	2038 Build-River Center Site	Junction	From Clements Ferry
Analysis Time Period:	AM Peak	Segment ID	4140
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	60	60	45
Volume, V (veh/h)	3,108	4,284	1,176
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	12%	12%	19%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.94	0.94	0.91
Demand Flow Rate, v_p (pc/h/ln)	1,830	1,682	1,431
Capacity Flow Rate, c (pc/h/ln)	2,300	2,300	2,100
v/c ratio	0.80	0.73	0.68
Density, D_{MD} (pc/mi/ln)	32.0	29.4	25.0
LOS	D	D	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-526 WB
Analysis Year	2038 Build-River Center Site	Junction	From Clements Ferry
Analysis Time Period:	PM Peak	Segment ID	4140
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	60	60	45
Volume, V (veh/h)	2,996	3,432	436
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	12%	12%	43%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.94	0.94	0.82
Demand Flow Rate, v_p (pc/h/ln)	1,764	1,347	589
Capacity Flow Rate, c (pc/h/ln)	2,300	2,300	2,100
v/c ratio	0.77	0.59	0.28
Density, D_{MD} (pc/mi/ln)	30.9	23.6	10.3
LOS	D	C	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4150-ClementsFerry to Virginia*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4284*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2523*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*44.5*	mph	S	mph
D = v_p / S	*56.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*F*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4150-ClementsFerry to Virginia*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3432*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*12*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2021*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*56.8*	mph	S	mph
D = v_p / S	*35.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4160 - Virginia to Rhett
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1415ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3220	0.90	14	0	1.5	1.2	0.935	1.00	3828
V_{RF}	133	0.90	58	0	1.5	1.2	0.775	1.00	191
V_{FR}	1064	0.90	14	0	1.5	1.2	0.935	1.00	1265
V_{RR}	44	0.90	58	0	1.5	1.2	0.775	1.00	63
V_{NW}	3891							V =	5347
V_W	1456								
VR	0.272								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1456 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	1635 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	991 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2626 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	385

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5347 pc/h	Weaving intensity factor, W	0.368
Weaving segment capacity, c_w	5619 veh/h	Weaving segment speed, S	42.6 mph
Weaving segment v/c ratio	0.889	Average weaving speed, S_W	47.9 mph
Weaving segment density, D	41.8 pc/mi/ln	Average non-weaving speed, S_{NW}	41.0 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5289 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4160 - Virginia to Rhett
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1415ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2420	0.90	13	0	1.5	1.2	0.939	1.00	2864
V_{RF}	663	0.90	13	0	1.5	1.2	0.939	1.00	785
V_{FR}	1012	0.90	13	0	1.5	1.2	0.939	1.00	1198
V_{RR}	277	0.90	9	0	1.5	1.2	0.957	1.00	322
V_{NW}	3186							V =	5169
V_W	1983								
VR	0.384								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1983 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	2162 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	845 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3007 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	316

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5169 pc/h	Weaving intensity factor, W	0.410
Weaving segment capacity, c_w	5383 veh/h	Weaving segment speed, S	40.6 mph
Weaving segment v/c ratio	0.902	Average weaving speed, S_W	46.9 mph
Weaving segment density, D	42.4 pc/mi/ln	Average non-weaving speed, S_{NW}	37.5 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6498 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4165-Rhett Off to Rhett On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3353*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2002*	pc/h/ln	Design LOS	
S	*57.1*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*35.1*	pc/mi/ln	S	mph
LOS	*E*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4165-Rhett Off to Rhett On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3083*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1824*	pc/h/ln	Design LOS	
S	*59.1*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*30.9*	pc/mi/ln	S	mph
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4170-WB On from Rhett
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 625	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3353	
	Ramp Volume, V_R: 749	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3353	0.90	Level	15	0	0.930	1.00	4005
Ramp	749	0.90	Level	6	0	0.971	1.00	857
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 4005 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4862	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4862	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 39.1 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = 0.769 (Exibit 13-11)

S_R= 46.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 46.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4170-WB On from Rhett
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 625	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3083	
	Ramp Volume, V_R: 617	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3083	0.90	Level	13	0	0.939	1.00	3648
Ramp	617	0.90	Level	6	0	0.971	1.00	706
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3648 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4354	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4354	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 35.2 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

M_S = 0.568 (Exibit 13-11)

S_R= 49.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 49.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4180-Rhett to Rivers*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs					
Volume, V	*4102*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*15*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments			
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2450*	pc/h/ln	Design LOS	
S	*44.6*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*55.0*	pc/mi/ln	S	mph
LOS	*F*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4180-Rhett to Rivers*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs				
Volume, V	*3700*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2189*	pc/h/ln	Design LOS	
S	*51.3*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*42.7*	pc/mi/ln	S	mph
LOS	*E*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4190-WB Off to Rivers NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	725	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	4102	V_D =	veh/h
		Ramp Volume, V_R	348		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4102	0.90	Level	15	0	0.930	1.00	4900
Ramp	348	0.90	Level	2	0	0.990	1.00	391
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4900 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4900	Exhibit 13-8	4500	Yes
$V_{FO} = V_F - V_R$	4509	Exhibit 13-8	4500	Yes
V_R	391	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4900	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 39.9 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.333 (Exhibit 13-12)

S_R= 50.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4190-WB Off to Rivers NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	725	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3700	V_D =	veh/h
		Ramp Volume, V_R	262		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3700	0.90	Level	13	0	0.939	1.00	4378
Ramp	262	0.90	Level	2	0	0.990	1.00	294
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4378 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4378	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	4084	Exhibit 13-8	4500	No
V_R	294	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4378	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.4 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.324 (Exhibit 13-12)

S_R= 50.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4200-WB Off to Rivers SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	700	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3754	V_D =	veh/h
		Ramp Volume, V_R	235		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3754	0.90	Level	16	0	0.926	1.00	4505
Ramp	235	0.90	Level	6	0	0.971	1.00	269
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4505 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4505	Exhibit 13-8	4500	Yes
$V_{FO} = V_F - V_R$	4236	Exhibit 13-8	4500	No
V_R	269	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4505	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 36.7 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.582 (Exhibit 13-12)

S_R= 47.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 47.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4200-WB Off to Rivers SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	700	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3438	V_D =	veh/h
		Ramp Volume, V_R	71		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3438	0.90	Level	14	0	0.935	1.00	4087
Ramp	71	0.90	Level	15	0	0.930	1.00	85
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4087 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4087	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	4002	Exhibit 13-8	4500	No
V_R	85	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4087	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.566 (Exhibit 13-12)

S_R= 47.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 47.6 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4205-RiversSB Off to Rivers On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3519*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*16*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.926*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2111*	pc/h/ln	Design LOS	
S	*52.6*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*40.1*	pc/mi/ln	S	mph
LOS	*E*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4205-RiversSB Off to Rivers On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3367*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*14*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2001*	pc/h/ln
S	*54.0*	mph
D = v_p / S	*37.1*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4210 - Rivers to I-26 WB
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	725ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2313	0.90	16	0	1.5	1.2	0.926	1.00	2776
V_{RF}	365	0.90	16	0	1.5	1.2	0.926	1.00	438
V_{FR}	1206	0.90	53	0	1.5	1.2	0.791	1.00	1695
V_{RR}	190	0.90	53	0	1.5	1.2	0.791	1.00	267
V_{NW}	3043							V =	5176
V_W	2133								
VR	0.412								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	2133 lc/h
Interchange density, ID	1.2 int/mi	Weaving lane changes, LC_W	2269 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	442 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2711 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	265

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5176 pc/h	Weaving intensity factor, W	0.640
Weaving segment capacity, c_w	4956 veh/h	Weaving segment speed, S	34.2 mph
Weaving segment v/c ratio	0.967	Average weaving speed, S_W	39.4 mph
Weaving segment density, D	50.4 pc/mi/ln	Average non-weaving speed, S_{NW}	31.4 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6817 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4210 - Rivers to I-26 WB
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	725ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1912	0.90	14	0	1.5	1.2	0.935	1.00	2273
V_{RF}	296	0.90	14	0	1.5	1.2	0.935	1.00	352
V_{FR}	1455	0.90	37	0	1.5	1.2	0.844	1.00	1916
V_{RR}	226	0.90	37	0	1.5	1.2	0.844	1.00	298
V_{NW}	2571							V =	4839
V_W	2268								
VR	0.469								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	2268 lc/h
Interchange density, ID	1.2 int/mi	Weaving lane changes, LC_W	2404 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	345 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2749 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	224

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4839 pc/h	Weaving intensity factor, W	0.647
Weaving segment capacity, c_w	4786 veh/h	Weaving segment speed, S	34.4 mph
Weaving segment v/c ratio	0.945	Average weaving speed, S_W	39.3 mph
Weaving segment density, D	47.0 pc/mi/ln	Average non-weaving speed, S_{NW}	30.9 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	7463 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4215-I-26 WB Off to I-26 WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2678*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*16*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.926*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1607*	pc/h/ln	Design LOS		
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*29.2*	pc/mi/ln	S		mph
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4215-I-26 WB Off to I-26 WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2208*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1313*	pc/h/ln	Design LOS		
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*23.9*	pc/mi/ln	S		mph
LOS	*C*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4220 - I-26 WB to I-26 EB C-D
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	550ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2122	0.90	16	0	1.5	1.2	0.926	1.00	2546
V_{RF}	275	0.90	7	0	1.5	1.2	0.966	1.00	316
V_{FR}	556	0.90	8	0	1.5	1.2	0.962	1.00	642
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	2546							V =	3504
V_W	958								
VR	0.273								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	958 lc/h
Interchange density, ID	1.2 int/mi	Weaving lane changes, LC_W	1062 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	245 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1307 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	168

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3504 pc/h	Weaving intensity factor, W	0.447
Weaving segment capacity, c_w	5242 veh/h	Weaving segment speed, S	42.5 mph
Weaving segment v/c ratio	0.619	Average weaving speed, S_W	42.6 mph
Weaving segment density, D	27.5 pc/mi/ln	Average non-weaving speed, S_{NW}	42.5 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5300 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4220 - I-26 WB to I-26 EB C-D
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	550ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1718	0.90	14	0	1.5	1.2	0.935	1.00	2043
V_{RF}	338	0.90	5	0	1.5	1.2	0.976	1.00	385
V_{FR}	490	0.90	8	0	1.5	1.2	0.962	1.00	566
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	2043							V =	2994
V_W	951								
VR	0.318								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	951 lc/h
Interchange density, ID	1.2 int/mi	Weaving lane changes, LC_W	1055 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	141 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1196 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	135

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2994 pc/h	Weaving intensity factor, W	0.417
Weaving segment capacity, c_w	5187 veh/h	Weaving segment speed, S	43.3 mph
Weaving segment v/c ratio	0.539	Average weaving speed, S_W	43.2 mph
Weaving segment density, D	23.0 pc/mi/ln	Average non-weaving speed, S_{NW}	43.4 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5774 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4225-I-26 EB CD Off to On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2397*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*16*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.926*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1438*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*26.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4225-I-26 EB CD Off to On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2056*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1222*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*22.2*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4230-I-26EBCD to International
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	3135ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1493	0.90	8	0	1.5	1.2	0.962	1.00	1725
V_{RF}	1580	0.90	17	0	1.5	1.2	0.922	1.00	1905
V_{FR}	904	0.90	10	0	1.5	1.2	0.952	1.00	1055
V_{RR}	957	0.90	17	0	1.5	1.2	0.922	1.00	1154
V_{NW}	2879							V =	5839
V_W	2960								
VR	0.507								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	520

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5839 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	4552 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.233	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	7908 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4230-I-26EBCD to International
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	3135ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	993	0.90	7	0	1.5	1.2	0.966	1.00	1142
V_{RF}	983	0.90	18	0	1.5	1.2	0.917	1.00	1191
V_{FR}	1063	0.90	7	0	1.5	1.2	0.966	1.00	1222
V_{RR}	1052	0.90	18	0	1.5	1.2	0.917	1.00	1274
V_{NW}	2416							V =	4829
V_W	2413								
VR	0.500								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	724

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4829 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	4641 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.005	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	7823 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4235-Interna Off to Interna On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3073*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1776*	pc/h/ln	Design LOS		
S	*59.4*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*29.9*	pc/mi/ln	S		mph
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4235-Interna Off to Interna On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1976*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1142*	pc/h/ln	Design LOS	
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*19.0*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4583

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4240-WB On from International
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 875	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3073	
	Ramp Volume, V_R: 621	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3073	0.90	Level	8	0	0.962	1.00	3551
Ramp	621	0.90	Level	17	0	0.922	1.00	749
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3551 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4300	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4300	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 33.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.530 (Exibit 13-11)

S_R= 50.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4240-WB On from International
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 875	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1976	
	Ramp Volume, V_R: 928	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1976	0.90	Level	8	0	0.962	1.00	2283
Ramp	928	0.90	Level	10	0	0.952	1.00	1083
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2283 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3366	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3366	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 25.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.355 (Exibit 13-11)

S_R= 53.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 53.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4250-Montague to Dorchester
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	950ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2863	0.90	8	0	1.5	1.2	0.962	1.00	3308
V_{RF}	535	0.90	8	0	1.5	1.2	0.962	1.00	618
V_{FR}	831	0.90	13	0	1.5	1.2	0.939	1.00	983
V_{RR}	155	0.90	13	0	1.5	1.2	0.939	1.00	183
V_{NW}	3491							V =	5092
V_W	1601								
VR	0.314								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1601 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1757 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	656 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2413 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	332

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5092 pc/h	Weaving intensity factor, W	0.472
Weaving segment capacity, c_w	5579 veh/h	Weaving segment speed, S	41.8 mph
Weaving segment v/c ratio	0.878	Average weaving speed, S_W	45.6 mph
Weaving segment density, D	40.6 pc/mi/ln	Average non-weaving speed, S_{NW}	40.3 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5739 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4250-Montague to Dorchester
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	950ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2322	0.90	7	0	1.5	1.2	0.966	1.00	2670
V_{RF}	746	0.90	7	0	1.5	1.2	0.966	1.00	858
V_{FR}	582	0.90	14	0	1.5	1.2	0.935	1.00	692
V_{RR}	187	0.90	14	0	1.5	1.2	0.935	1.00	222
V_{NW}	2892							V =	4442
V_W	1550								
VR	0.349								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1550 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1706 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	533 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2239 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	275

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4442 pc/h	Weaving intensity factor, W	0.445
Weaving segment capacity, c_w	5522 veh/h	Weaving segment speed, S	43.2 mph
Weaving segment v/c ratio	0.777	Average weaving speed, S_W	46.2 mph
Weaving segment density, D	34.3 pc/mi/ln	Average non-weaving speed, S_{NW}	41.7 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	6115 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4255-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3398*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1963*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*57.6*	mph	S	mph
D = v_p / S	*34.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4255-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3068*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*7*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1764*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.5*	mph	S	mph
D = v_p / S	*29.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4260-Dorchester to Leeds
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1750ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2497	0.90	8	0	1.5	1.2	0.962	1.00	2885
V_{RF}	469	0.90	17	0	1.5	1.2	0.922	1.00	565
V_{FR}	901	0.90	8	0	1.5	1.2	0.962	1.00	1041
V_{RR}	170	0.90	17	0	1.5	1.2	0.922	1.00	205
V_{NW}	3090							V =	4696
V_W	1606								
VR	0.342								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1606 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1839 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1007 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2846 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	541

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4696 pc/h	Weaving intensity factor, W	0.332
Weaving segment capacity, c_w	5688 veh/h	Weaving segment speed, S	43.3 mph
Weaving segment v/c ratio	0.794	Average weaving speed, S_W	48.8 mph
Weaving segment density, D	36.1 pc/mi/ln	Average non-weaving speed, S_{NW}	40.9 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6039 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 WB
Weaving Segment Location	4260-Dorchester to Leeds
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1750ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2788	0.90	7	0	1.5	1.2	0.966	1.00	3206
V_{RF}	493	0.90	17	0	1.5	1.2	0.922	1.00	594
V_{FR}	280	0.90	7	0	1.5	1.2	0.966	1.00	322
V_{RR}	50	0.90	17	0	1.5	1.2	0.922	1.00	60
V_{NW}	3266							V =	4182
V_W	916								
VR	0.219								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	916 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1149 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1043 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2192 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	572

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4182 pc/h	Weaving intensity factor, W	0.270
Weaving segment capacity, c_w	6006 veh/h	Weaving segment speed, S	47.5 mph
Weaving segment v/c ratio	0.673	Average weaving speed, S_W	50.4 mph
Weaving segment density, D	29.4 pc/mi/ln	Average non-weaving speed, S_{NW}	46.7 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	4732 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4265-Leeds Off to Leeds On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2966*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1722*	pc/h/ln
S	*59.7*	mph
D = v_p / S	*28.8*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4265-Leeds Off to Leeds On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3281*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1896*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*58.4*	mph	S	mph
D = v_p / S	*32.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4270-WB On from Leeds
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 825	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2966	
	Ramp Volume, V_R: 227	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2966	0.90	Level	9	0	0.957	1.00	3444
Ramp	227	0.90	Level	19	0	0.913	1.00	276
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3444 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3720	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3720	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.408 (Exibit 13-11)

S_R= 52.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 52.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4270-WB On from Leeds
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 825	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3281	
	Ramp Volume, V_R: 709	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3281	0.90	Level	8	0	0.962	1.00	3791
Ramp	709	0.90	Level	5	0	0.976	1.00	807
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3791 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4598	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4598	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 35.8 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

M_S = 0.634 (Exibit 13-11)

S_R= 48.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 48.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4280-Leeds to Paul Cantrell*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3193*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1854*	pc/h/ln
S	*58.8*	mph
D = v_p / S	*31.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4280-Leeds to Paul Cantrell*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3990*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2305*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*51.0*	mph	S	mph
D = v_p / S	*45.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*F*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4290-WB Off to PaulCantrell WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 825	V_D = veh/h
	Freeway Volume, V_F: 3193	
	Ramp Volume, V_R: 1238	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3193	0.90	Level	9	0	0.957	1.00	3707
Ramp	1238	0.90	Level	26	0	0.885	1.00	1554
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3707 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3707	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2153	Exhibit 13-8	4600	No
V_R	1554	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3707	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 28.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.438 (Exhibit 13-12)

S_R= 52.1 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 52.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4290-WB Off to PaulCantrell WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 825	V_D = veh/h
	Freeway Volume, V_F: 3990	
	Ramp Volume, V_R: 1987	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3990	0.90	Level	8	0	0.962	1.00	4611
Ramp	1987	0.90	Level	14	0	0.935	1.00	2362
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4611 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4611	Exhibit 13-8	4600	Yes
$V_{FO} = V_F - V_R$	2249	Exhibit 13-8	4600	No
V_R	2362	Exhibit 13-10	2100	Yes

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4611	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 36.5 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.511 (Exhibit 13-12)

S_R= 50.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4300-WB Off to PaulCantrell EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 525	V_D = veh/h
	Freeway Volume, V_F: 1955	
	Ramp Volume, V_R: 791	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1955	0.90	Level	9	0	0.957	1.00	2270
Ramp	791	0.90	Level	5	0	0.976	1.00	901
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2270 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2270	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	1369	Exhibit 13-8	4600	No
V_R	901	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2270	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 19.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.639 (Exhibit 13-12)

S_R= 48.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4300-WB Off to PaulCantrell EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 525	V_D = veh/h
	Freeway Volume, V_F: 2003	
	Ramp Volume, V_R: 842	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2003	0.90	Level	8	0	0.962	1.00	2315
Ramp	842	0.90	Level	4	0	0.980	1.00	954
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2315 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2315	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	1361	Exhibit 13-8	4600	No
V_R	954	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2315	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 19.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.644 (Exhibit 13-12)

S_R= 48.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.4 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4305-PaulCEB Off to PaulCEB On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1164*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*9*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*676*	pc/h/ln	Design LOS		
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*11.3*	pc/mi/ln	S		mph
LOS	*B*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 WB*
Agency or Company	*Atkins*	From/To	*4305-PaulCEB Off to PaulCEB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1161*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*671*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*11.2*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4310-WB On from PaulCantrellEB
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 700	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1164	
	Ramp Volume, V_R: 344	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1164	0.90	Level	9	0	0.957	1.00	1352
Ramp	344	0.90	Level	6	0	0.971	1.00	394
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1352 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1746	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1746	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.280 (Exibit 13-11)

S_R= 55.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 WB
Agency or Company	Atkins	Junction	4310-WB On from PaulCantrellEB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 700	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1161	
	Ramp Volume, V_R: 276	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1161	0.90	Level	8	0	0.962	1.00	1342
Ramp	276	0.90	Level	7	0	0.966	1.00	317
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1342 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1659	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1659	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 13.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.278 (Exibit 13-11)

S_R= 55.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 55.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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Appendix E
Traffic Analysis Worksheets

2038 Design Year

Build River Center Site Alternatives 5-7

US Highway 17

MAJOR MERGE SEGMENTS ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US 17 NB
Analysis Year	2038 Build-River Center Site	Junction	From I-26 EB & WB
Analysis Time Period:	AM Peak	Segment ID	5010
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Number of Lanes, N	2	4	2
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	2,078	3,554	1,476
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	3%	4%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.99	0.98
Demand Flow Rate, v_p (pc/h/ln)	1,178	1,002	836
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.52	0.45	0.38
	Below Capacity	Below Capacity	Below Capacity

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

MAJOR MERGE SEGMENTS ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US 17 NB
Analysis Year	2038 Build-River Center Site	Junction	From I-26 EB & WB
Analysis Time Period:	PM Peak	Segment ID	5010
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Number of Lanes, N	2	4	2
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	2,256	3,020	764
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,272	851	439
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.57	0.38	0.20
	Below Capacity	Below Capacity	Below Capacity

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 NB
Agency or Company	Atkins	Junction	5020-NB On from Meeting
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	4	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A	1125	☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3554	V_D =	veh/h
		Ramp Volume, V_R	516		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3554	0.90	Level	3	0	0.985	1.00	4008
Ramp	516	0.90	Level	10	0	0.952	1.00	602
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.143 using Equation (Exhibit 13-6)

V_{12} = 571 pc/h

V_3 or V_{av34} 1718 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1603 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4610	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2205	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 15.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.255 (Exibit 13-11)

S_R= 51.7 mph (Exhibit 13-11)

S_0= 52.5 mph (Exhibit 13-11)

S = 52.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 NB
Agency or Company	Atkins	Junction	5020-NB On from Meeting
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 4	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1125	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3020	
	Ramp Volume, V_R: 928	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3020	0.90	Level	3	0	0.985	1.00	3406
Ramp	928	0.90	Level	5	0	0.976	1.00	1057
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.086 using Equation (Exhibit 13-6)

V_{12} = 292 pc/h

V_3 or V_{av34} 1557 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1362 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4463	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2419	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 16.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.264 (Exibit 13-11)

S_R= 51.6 mph (Exhibit 13-11)

S_0= 53.1 mph (Exhibit 13-11)

S = 52.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 NB
Agency or Company	Atkins	Junction	5030-NB On from E Bay
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 4	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 925	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4070	
	Ramp Volume, V_R: 346	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4070	0.90	Level	5	0	0.976	1.00	4635
Ramp	346	0.90	Level	15	0	0.930	1.00	413
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.166 using Equation (Exhibit 13-6)

V_{12} = 770 pc/h

V_3 or V_{av34} 1932 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1854 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5048	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2267	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 17.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.275 (Exibit 13-11)

S_R= 51.4 mph (Exhibit 13-11)

S_0= 51.8 mph (Exhibit 13-11)

S = 51.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 NB
Agency or Company	Atkins	Junction	5030-NB On from E Bay
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 4	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 925	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3948	
	Ramp Volume, V_R: 1210	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3948	0.90	Level	4	0	0.980	1.00	4474
Ramp	1210	0.90	Level	4	0	0.980	1.00	1371
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.046 using Equation (Exhibit 13-6)

V_{12} = 208 pc/h

V_3 or V_{av34} 2133 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1789 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5845	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3160	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.330 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= 52.0 mph (Exhibit 13-11)

S = 51.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 NB*
Agency or Company	*Atkins*	From/To	*5040-E Bay to SC-703*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4416*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1263*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*23.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4613

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 NB*
Agency or Company	*Atkins*	From/To	*5040-E Bay to SC-703*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5158*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1469*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*26.7*	pc/mi/ln	S	mph
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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MAJOR DIVERGE SEGMENTS ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 NB
Analysis Year	2038 Build-River Center Site	Junction	Off to SC-703
Analysis Time Period:	AM Peak	Segment ID	5050
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Off-Ramp	Freeway Downstream of Off-Ramp	Off-Ramp
Number of Lanes, N	4	2	2
Free-Flow Speed, FFS (mph)	55	45	40
Volume, V (veh/h)	4,416	3,256	1,160
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	6%	5%	8%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.97	0.98	0.96
Demand Flow Rate, v_p (pc/h/ln)	1,263	1,854	670
Capacity Flow Rate, c (pc/h/ln)	2,200	2,100	2,000
v/c ratio	0.57	0.88	0.34
Density, D_{MD} (pc/mi/ln)	22.1	32.4	11.7
LOS	C	D	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

MAJOR DIVERGE SEGMENTS ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 NB
Analysis Year	2038 Build-River Center Site	Junction	Off to SC-703
Analysis Time Period:	PM Peak	Segment ID	5050
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Off-Ramp	Freeway Downstream of Off-Ramp	Off-Ramp
Number of Lanes, N	4	2	2
Free-Flow Speed, FFS (mph)	55	45	40
Volume, V (veh/h)	5,158	3,521	1,637
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	5%	4%	5%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.98	0.98
Demand Flow Rate, v_p (pc/h/ln)	1,469	1,995	932
Capacity Flow Rate, c (pc/h/ln)	2,200	2,100	2,000
v/c ratio	0.67	0.95	0.47
Density, D_{MD} (pc/mi/ln)	25.7	34.9	16.3
LOS	C	D	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 NB
Analysis Year	2038 Build-River Center Site	Junction	Off to Bowman
Analysis Time Period:	AM Peak	Segment ID	5060
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	45	45	45
Volume, V (veh/h)	2,538	1,854	684
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	5%	8%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.96	0.99
Demand Flow Rate, v_p (pc/h/ln)	964	1,071	768
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	2,100
v/c ratio	0.46	0.51	0.37
Density, D_{MD} (pc/mi/ln)	16.9	18.7	13.4
LOS	B	B	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 NB
Analysis Year	2038 Build-River Center Site	Junction	Off to Bowman
Analysis Time Period:	PM Peak	Segment ID	5060
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	45	45	45
Volume, V (veh/h)	3,390	2,674	716
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	6%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.97	0.99
Demand Flow Rate, v_p (pc/h/ln)	1,281	1,530	804
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	2,100
v/c ratio	0.61	0.73	0.38
Density, D_{MD} (pc/mi/ln)	22.4	26.8	14.1
LOS	C	C	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 NB*
Agency or Company	*Atkins*	From/To	*5065-Bowman Off to Bowman On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1854*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1071*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*19.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 NB*
Agency or Company	*Atkins*	From/To	*5065-Bowman Off to Bowman On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2674*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1530*	pc/h/ln	Design LOS		
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*27.8*	pc/mi/ln	S		mph
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	US-17 NB
Weaving Segment Location	5070-Bowman On to I-526 WB Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	825ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1088	0.90	8	0	1.5	1.2	0.962	1.00	1257
V_{RF}	301	0.90	13	0	1.5	1.2	0.939	1.00	356
V_{FR}	766	0.90	8	0	1.5	1.2	0.962	1.00	885
V_{RR}	211	0.90	13	0	1.5	1.2	0.939	1.00	250
V_{NW}	1507							V =	2748
V_W	1241								
VR	0.452								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1241 lc/h
Interchange density, ID	0.3 int/mi	Weaving lane changes, LC_W	1340 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	180 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1520 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	37

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2748 pc/h	Weaving intensity factor, W	0.366
Weaving segment capacity, c_w	5068 veh/h	Weaving segment speed, S	33.9 mph
Weaving segment v/c ratio	0.521	Average weaving speed, S_W	37.0 mph
Weaving segment density, D	27.1 pc/mi/ln	Average non-weaving speed, S_{NW}	31.7 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	7266 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	US-17 NB
Weaving Segment Location	5070-Bowman On to I-526 WB Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	825ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1962	0.90	6	0	1.5	1.2	0.971	1.00	2245
V_{RF}	667	0.90	6	0	1.5	1.2	0.971	1.00	763
V_{FR}	712	0.90	7	0	1.5	1.2	0.966	1.00	819
V_{RR}	242	0.90	7	0	1.5	1.2	0.966	1.00	278
V_{NW}	2523							V =	4105
V_W	1582								
VR	0.385								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1582 lc/h
Interchange density, ID	0.3 int/mi	Weaving lane changes, LC_W	1681 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	389 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2070 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	62

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4105 pc/h	Weaving intensity factor, W	0.467
Weaving segment capacity, c_w	5283 veh/h	Weaving segment speed, S	29.8 mph
Weaving segment v/c ratio	0.754	Average weaving speed, S_W	35.4 mph
Weaving segment density, D	46.0 pc/mi/ln	Average non-weaving speed, S_{NW}	27.0 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6518 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 NB*
Agency or Company	*Atkins*	From/To	*5075-526 WB Off to 526 WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1389*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*803*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*14.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 NB*
Agency or Company	*Atkins*	From/To	*5075-526 WB Off to 526 WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2629*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1504*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*27.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US 17 NB
Analysis Year	2038 Build-River Center Site	Junction	From I-526 WB
Analysis Time Period:	AM Peak	Segment ID	5080
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	45	45	45
Volume, V (veh/h)	1,389	1,722	333
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	8%	8%	12%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.96	0.94
Demand Flow Rate, v_p (pc/h/ln)	803	663	392
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	2,100
v/c ratio	0.38	0.32	0.19
Density, D_{MD} (pc/mi/ln)	14.1	11.6	6.9
LOS	B	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US 17 NB
Analysis Year	2038 Build-River Center Site	Junction	From I-526 WB
Analysis Time Period:	PM Peak	Segment ID	5080
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	45	45	45
Volume, V (veh/h)	2,629	3,106	477
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	6%	6%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.97	0.97	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,504	1,185	549
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	2,100
v/c ratio	0.72	0.56	0.26
Density, D_{MD} (pc/mi/ln)	26.3	20.7	9.6
LOS	C	C	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6010-Off to I-526 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 450	V_D = veh/h
	Freeway Volume, V_F: 2519	
	Ramp Volume, V_R: 397	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2519	0.90	Level	8	0	0.962	1.00	2911
Ramp	397	0.90	Level	3	0	0.985	1.00	448
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2911 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2911	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	2463	Exhibit 13-8	4500	No
V_R	448	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2911	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.338 (Exhibit 13-12)

S_R= 50.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6010-Off to I-526 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	450
Freeway Volume, V_F	1905
Ramp Volume, V_R	320
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1905	0.90	Level	6	0	0.971	1.00	2180
Ramp	320	0.90	Level	3	0	0.985	1.00	361
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 2180 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2180	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	1819	Exhibit 13-8	4500	No
V_R	361	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2180	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 19.0 (pc/mi/ln)
LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.330 (Exhibit 13-12)
S_R= 50.7 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 50.7 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US 17 SB*
Agency or Company	*Atkins*	From/To	*6015-526 EB Off to 526 EB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2122*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1226*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*22.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 SB*
Agency or Company	*Atkins*	From/To	*6015-526 EB Off to 526 EB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1585*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*907*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*16.5*	pc/mi/ln	S	mph
LOS	*B*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	US-17 SB
Weaving Segment Location	6020-I-526 EB On to Bowman Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	650ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1676	0.90	8	0	1.5	1.2	0.962	1.00	1937
V_{RF}	927	0.90	16	0	1.5	1.2	0.926	1.00	1112
V_{FR}	446	0.90	11	0	1.5	1.2	0.948	1.00	523
V_{RR}	247	0.90	16	0	1.5	1.2	0.926	1.00	296
V_{NW}	2233							V =	3868
V_W	1635								
VR	0.423								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	1112 lc/h
Interchange density, ID	0.3 int/mi	Weaving lane changes, LC_W	1256 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	42 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1298 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	44

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3868 pc/h	Weaving intensity factor, W	0.390
Weaving segment capacity, c_w	7265 veh/h	Weaving segment speed, S	34.0 mph
Weaving segment v/c ratio	0.512	Average weaving speed, S_W	36.6 mph
Weaving segment density, D	28.4 pc/mi/ln	Average non-weaving speed, S_{NW}	32.4 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5371 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	US-17 SB
Weaving Segment Location	6020-I-526 EB On to Bowman Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	650ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1164	0.90	6	0	1.5	1.2	0.971	1.00	1332
V_{RF}	846	0.90	14	0	1.5	1.2	0.935	1.00	1006
V_{FR}	421	0.90	9	0	1.5	1.2	0.957	1.00	489
V_{RR}	305	0.90	14	0	1.5	1.2	0.935	1.00	363
V_{NW}	1695							V =	3190
V_W	1495								
VR	0.469								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	1006 lc/h
Interchange density, ID	0.3 int/mi	Weaving lane changes, LC_W	1150 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1150 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	33

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3190 pc/h	Weaving intensity factor, W	0.354
Weaving segment capacity, c_w	7181 veh/h	Weaving segment speed, S	35.4 mph
Weaving segment v/c ratio	0.431	Average weaving speed, S_W	37.1 mph
Weaving segment density, D	22.6 pc/mi/ln	Average non-weaving speed, S_{NW}	33.9 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	5896 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 SB*
Agency or Company	*Atkins*	From/To	*6025-Bowman Off to Bowman On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2603*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*8*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1504*	pc/h/ln	Design LOS		
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*27.3*	pc/mi/ln	S		mph
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4633

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 SB*
Agency or Company	*Atkins*	From/To	*6025-Bowman Off to Bowman On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2010*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1150*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*20.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6030-SB On from Bowman
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 900	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2603	
	Ramp Volume, V_R: 713	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2603	0.90	Level	8	0	0.962	1.00	3008
Ramp	713	0.90	Level	2	0	0.990	1.00	800
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3008 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3808	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3808	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.416 (Exibit 13-11)

S_R= 49.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 49.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6030-SB On from Bowman
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 900	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2010	
	Ramp Volume, V_R: 727	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2010	0.90	Level	6	0	0.971	1.00	2300
Ramp	727	0.90	Level	2	0	0.990	1.00	816
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2300 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3116	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3116	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.328 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6035-SB On from Wingo Way
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 875	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2515	
	Ramp Volume, V_R: 882	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2515	0.90	Level	5	0	0.976	1.00	2864
Ramp	882	0.90	Level	3	0	0.985	1.00	995
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2864 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3859	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3859	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.427 (Exibit 13-11)

S_R= 49.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 49.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6035-SB On from Wingo Way
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 875	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2395	
	Ramp Volume, V_R: 899	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2395	0.90	Level	4	0	0.980	1.00	2714
Ramp	899	0.90	Level	2	0	0.990	1.00	1009
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2714 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3723	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3723	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 28.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.404 (Exibit 13-11)

S_R= 49.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 49.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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MAJOR MERGE SEGMENTS ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US 17 SB
Analysis Year	2038 Build-River Center Site	Junction	From SC-703
Analysis Time Period:	AM Peak	Segment ID	6040
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Number of Lanes, N	2	4	2
Free-Flow Speed, FFS (mph)	55	55	40
Volume, V (veh/h)	3,397	4,866	1,469
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	5%	6%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.97	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,934	1,392	845
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,000
v/c ratio	0.86	0.62	0.42
	Below Capacity	Below Capacity	Below Capacity

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

MAJOR MERGE SEGMENTS ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US 17 SB
Analysis Year	2038 Build-River Center Site	Junction	From SC-703
Analysis Time Period:	PM Peak	Segment ID	6040
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Number of Lanes, N	2	4	2
Free-Flow Speed, FFS (mph)	55	55	40
Volume, V (veh/h)	3,294	4,604	1,310
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	5%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream of On-Ramp	Freeway Downstream of On-Ramp	On-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.98	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,867	1,311	753
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,000
v/c ratio	0.83	0.58	0.38
	Below Capacity	Below Capacity	Below Capacity

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 SB*
Agency or Company	*Atkins*	From/To	*6045-SC-703 to E Bay*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4866*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1392*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*25.3*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4641

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*US-17 SB*
Agency or Company	*Atkins*	From/To	*6045-SC-703 to E Bay*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2038 Build - River Center Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4604*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1311*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*23.8*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4642

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6050-Off to Morrison
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	4	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☐ No	☑ Off
L_{up} =	ft	Deceleration Lane Length L_D	200	L_{down} =	885 ft
V_u =	veh/h	Freeway Volume, V_F	4866	V_D =	511 veh/h
		Ramp Volume, V_R	642		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4866	0.90	Level	6	0	0.971	1.00	5569
Ramp	642	0.90	Level	11	0	0.948	1.00	753
UpStream								
DownStream	511	0.90	Level	9	0	0.957	1.00	593

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 2853 pc/h

V_3 or V_{av34} 1358 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5569	Exhibit 13-8	9000	No
$V_{FO} = V_F - V_R$	4816	Exhibit 13-8	9000	No
V_R	753	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2853	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.366 (Exhibit 13-12)

S_R= 50.2 mph (Exhibit 13-12)

S_0= 58.9 mph (Exhibit 13-12)

S = 54.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	US-17 SB
Agency or Company	Atkins	Junction	6050-Off to Morrison
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	4
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	200
Freeway Volume, V_F	4604
Ramp Volume, V_R	545
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 885 ft

V_D = 370 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4604	0.90	Level	5	0	0.976	1.00	5243
Ramp	545	0.90	Level	12	0	0.943	1.00	642
UpStream								
DownStream	370	0.90	Level	10	0	0.952	1.00	432

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 2648 pc/h

V_3 or V_{av34} 1297 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5243	Exhibit 13-8	9000	No
$V_{FO} = V_F - V_R$	4601	Exhibit 13-8	9000	No
V_R	642	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2648	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.356 (Exhibit 13-12)

S_R= 50.4 mph (Exhibit 13-12)

S_0= 59.2 mph (Exhibit 13-12)

S = 54.4 mph (Exhibit 13-13)

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FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 SB
Analysis Year	2038 Build-River Center Site	Junction	Off to Meeting
Analysis Time Period:	AM Peak	Segment ID	6060
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	4	3	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	4,224	3,713	511
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	5%	3%	9%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.99	0.96
Demand Flow Rate, v_p (pc/h/ln)	1,203	1,396	593
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,100
v/c ratio	0.53	0.62	0.28
Density, D_{MD} (pc/mi/ln)	21.1	24.4	10.4
LOS	C	C	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 SB
Analysis Year	2038 Build-River Center Site	Junction	Off to Meeting
Analysis Time Period:	PM Peak	Segment ID	6060
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	4	3	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	4,059	3,689	370
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	3%	10%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.99	0.95
Demand Flow Rate, v_p (pc/h/ln)	1,150	1,387	432
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,100
v/c ratio	0.51	0.62	0.21
Density, D_{MD} (pc/mi/ln)	20.1	24.3	7.6
LOS	C	C	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 SB
Analysis Year	2038 Build-River Center Site	Junction	Off to I-26 WB
Analysis Time Period:	AM Peak	Segment ID	6070
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	3,713	2,445	1,268
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,396	1,379	1,458
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.62	0.61	0.66
Density, D_{MD} (pc/mi/ln)	24.4	24.1	25.5
LOS	C	C	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	US-17 SB
Analysis Year	2038 Build-River Center Site	Junction	Off to I-26 WB
Analysis Time Period:	PM Peak	Segment ID	6070
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	3,689	2,438	1,251
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	6%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,387	1,375	1,432
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.62	0.61	0.65
Density, D_{MD} (pc/mi/ln)	24.3	24.1	25.1
LOS	C	C	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	162	2945	149	73	2449	69	0	0	152	0	0	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0			6.0			6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.95	1.00			1.00			1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85			0.86			0.86
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00			1.00			1.00
Satd. Flow (prot)	1719	4940	1538	1719	3438	1538			1565			1580
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00			1.00			1.00
Satd. Flow (perm)	1719	4940	1538	1719	3438	1538			1565			1580
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	180	3272	166	81	2721	77	0	0	169	0	0	73
RTOR Reduction (vph)	0	0	42	0	0	19	0	0	32	0	0	32
Lane Group Flow (vph)	180	3272	124	81	2721	58	0	0	137	0	0	41
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	5%	5%	5%	4%	4%	4%
Turn Type	Prot	NA	Perm	Prot	NA	Perm			Over			Over
Protected Phases	5	2		1	6				1			5
Permitted Phases			2			6			1			5
Actuated Green, G (s)	10.0	67.4	67.4	10.6	68.0	68.0			10.6			10.0
Effective Green, g (s)	10.0	67.4	67.4	10.6	68.0	68.0			10.6			10.0
Actuated g/C Ratio	0.11	0.75	0.75	0.12	0.76	0.76			0.12			0.11
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0			6.0			6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0			3.0			3.0
Lane Grp Cap (vph)	191	3699	1151	202	2597	1162			184			175
v/s Ratio Prot	c0.10	0.66		0.05	c0.79				0.09			0.03
v/s Ratio Perm			0.08			0.04						
v/c Ratio	0.94	0.88	0.11	0.40	1.05	0.05			0.75			0.23
Uniform Delay, d1	39.7	8.4	3.1	36.8	11.0	2.8			38.4			36.5
Progression Factor	1.00	1.00	1.00	1.11	2.49	2.34			1.00			1.00
Incremental Delay, d2	48.5	3.5	0.2	0.4	25.4	0.0			15.1			0.7
Delay (s)	88.2	11.9	3.3	41.3	52.8	6.6			53.5			37.2
Level of Service	F	B	A	D	D	A			D			D
Approach Delay (s)		15.3			51.2			53.5			37.2	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	31.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	120	3250	151	70	2329	41	0	0	152	0	0	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0			6.0			6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.95	1.00			1.00			1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85			0.86			0.86
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00			1.00			1.00
Satd. Flow (prot)	1736	4988	1553	1736	3471	1553			1580			1580
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00			1.00			1.00
Satd. Flow (perm)	1736	4988	1553	1736	3471	1553			1580			1580
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	133	3611	168	78	2588	46	0	0	169	0	0	73
RTOR Reduction (vph)	0	0	19	0	0	7	0	0	16	0	0	16
Lane Group Flow (vph)	133	3611	149	78	2588	39	0	0	153	0	0	57
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Turn Type	Prot	NA	Perm	Prot	NA	Perm			Over			Over
Protected Phases	5	2		1	6				1			5
Permitted Phases			2			6			1			5
Actuated Green, G (s)	17.6	146.9	146.9	21.1	150.4	150.4			21.1			17.6
Effective Green, g (s)	17.6	146.9	146.9	21.1	150.4	150.4			21.1			17.6
Actuated g/C Ratio	0.10	0.82	0.82	0.12	0.84	0.84			0.12			0.10
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0			6.0			6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0			3.0			3.0
Lane Grp Cap (vph)	169	4070	1267	203	2900	1297			185			154
v/s Ratio Prot	0.08	0.72		0.04	c0.75				c0.10			0.04
v/s Ratio Perm			0.10			0.03						
v/c Ratio	0.79	0.89	0.12	0.38	0.89	0.03			0.83			0.37
Uniform Delay, d1	79.4	11.0	3.4	73.4	9.6	2.5			77.7			76.0
Progression Factor	1.00	1.00	1.00	0.90	2.03	0.16			1.00			1.00
Incremental Delay, d2	21.0	3.3	0.2	0.6	2.3	0.0			25.1			1.5
Delay (s)	100.4	14.3	3.6	66.9	21.8	0.4			102.8			77.5
Level of Service	F	B	A	E	C	A			F			E
Approach Delay (s)		16.8			22.7			102.8			77.5	
Approach LOS		B			C			F			E	

Intersection Summary			
HCM 2000 Control Delay	21.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	180.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	472	2285	340	350	2324	137	176	262	172	70	286	91
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1810	1863	1863	1863	1845	1845	1845
Adj Flow Rate, veh/h	524	2539	378	389	2582	152	196	291	191	78	318	101
Adj No. of Lanes	2	3	1	2	3	1	1	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	5	5	5	2	2	2	3	3	3
Cap, veh/h	520	2747	1001	425	2607	889	208	472	412	178	312	383
Arrive On Green	0.31	1.00	1.00	0.13	0.53	0.53	0.09	0.13	0.13	0.05	0.09	0.09
Sat Flow, veh/h	3343	4940	1538	3343	4940	1538	1774	3539	1583	1757	3505	1568
Grp Volume(v), veh/h	524	2539	378	389	2582	152	196	291	191	78	318	101
Grp Sat Flow(s),veh/h/ln	1672	1647	1538	1672	1647	1538	1774	1770	1583	1757	1752	1568
Q Serve(g_s), s	28.0	0.0	0.0	20.7	93.1	8.3	17.0	14.0	18.3	7.2	16.0	9.4
Cycle Q Clear(g_c), s	28.0	0.0	0.0	20.7	93.1	8.3	17.0	14.0	18.3	7.2	16.0	9.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	520	2747	1001	425	2607	889	208	472	412	178	312	383
V/C Ratio(X)	1.01	0.92	0.38	0.91	0.99	0.17	0.94	0.62	0.46	0.44	1.02	0.26
Avail Cap(c_a), veh/h	520	2747	1001	446	2607	889	208	472	412	178	312	383
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.35	0.35	0.35	0.11	0.11	0.11	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	62.0	0.0	0.0	77.6	42.0	17.8	67.3	73.7	56.0	69.9	82.0	54.9
Incr Delay (d2), s/veh	25.3	2.6	0.4	3.7	4.1	0.0	46.8	2.4	0.8	1.7	56.4	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
%ile BackOfQ(50%),veh/ln	14.7	0.7	0.1	9.8	43.1	3.6	4.1	7.0	8.1	3.6	10.2	4.1
LnGrp Delay(d),s/veh	87.4	2.6	0.4	81.3	46.1	17.9	114.2	76.1	56.8	71.6	138.4	55.3
LnGrp LOS	F	A	A	F	D	B	F	E	E	E	F	E
Approach Vol, veh/h		3441			3123			678			497	
Approach Delay, s/veh		15.3			49.1			81.6			111.1	
Approach LOS		B			D			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	28.9	106.1	23.0	22.0	34.0	101.0	15.0	30.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	24.0	99.0	17.0	16.0	28.0	95.0	9.0	24.0
Max Q Clear Time (g_c+I1), s	22.7	2.0	19.0	18.0	30.0	95.1	9.2	20.3
Green Ext Time (p_c), s	0.2	95.3	0.0	0.0	0.0	0.0	0.0	1.7

Intersection Summary	
HCM 2010 Ctrl Delay	40.9
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	442	2643	317	304	2030	134	225	279	320	129	234	185
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1827	1827	1827	1827	1827	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	491	2937	352	338	2256	149	250	310	356	143	260	206
Adj No. of Lanes	2	3	1	2	3	1	1	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	4	4	4	2	2	2	2	2	2
Cap, veh/h	524	2854	1053	338	2578	906	243	452	361	192	315	387
Arrive On Green	0.31	1.00	1.00	0.10	0.52	0.52	0.11	0.13	0.13	0.07	0.09	0.09
Sat Flow, veh/h	3375	4988	1553	3375	4988	1553	1774	3539	1583	1774	3539	1583
Grp Volume(v), veh/h	491	2937	352	338	2256	149	250	310	356	143	260	206
Grp Sat Flow(s),veh/h/ln	1688	1663	1553	1688	1663	1553	1774	1770	1583	1774	1770	1583
Q Serve(g_s), s	25.5	103.0	0.0	18.0	71.8	8.0	19.0	15.1	23.0	12.0	13.0	16.0
Cycle Q Clear(g_c), s	25.5	103.0	0.0	18.0	71.8	8.0	19.0	15.1	23.0	12.0	13.0	16.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	524	2854	1053	338	2578	906	243	452	361	192	315	387
V/C Ratio(X)	0.94	1.03	0.33	1.00	0.88	0.16	1.03	0.69	0.99	0.74	0.83	0.53
Avail Cap(c_a), veh/h	563	2854	1053	338	2578	906	243	452	361	192	315	387
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.34	0.34	0.34	0.35	0.35	0.35	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	61.2	0.0	0.0	81.0	38.4	17.3	68.7	75.0	69.2	71.0	80.6	59.1
Incr Delay (d2), s/veh	10.3	18.5	0.3	29.3	1.7	0.1	65.9	4.3	43.8	14.5	16.4	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.6	4.9	0.1	9.8	33.4	3.4	4.4	7.6	22.1	1.9	7.1	9.1
LnGrp Delay(d),s/veh	71.4	18.5	0.3	110.3	40.0	17.4	134.6	79.3	113.0	85.5	97.0	60.5
LnGrp LOS	E	F	A	F	D	B	F	E	F	F	F	E
Approach Vol, veh/h		3780			2743			916			609	
Approach Delay, s/veh		23.7			47.4			107.5			82.0	
Approach LOS		C			D			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	24.0	109.0	25.0	22.0	34.0	99.0	18.0	29.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	18.0	103.0	19.0	16.0	30.0	91.0	12.0	23.0
Max Q Clear Time (g_c+I1), s	20.0	105.0	21.0	18.0	27.5	73.8	14.0	25.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.5	17.1	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	45.7
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	244	2109	174	213	2496	293	127	196	187	205	217	188
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1792	1792	1792	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	271	2343	193	237	2773	326	141	218	208	228	241	209
Adj No. of Lanes	1	3	1	1	3	1	1	1	1	2	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	6	6	6	2	2	2	2	2	2
Cap, veh/h	279	2731	970	253	2691	948	138	238	383	249	228	378
Arrive On Green	0.12	0.55	0.55	0.23	1.00	1.00	0.08	0.13	0.13	0.07	0.12	0.12
Sat Flow, veh/h	1723	4940	1538	1707	4893	1524	1774	1863	1583	3442	1863	1583
Grp Volume(v), veh/h	271	2343	193	237	2773	326	141	218	208	228	241	209
Grp Sat Flow(s),veh/h/ln	1723	1647	1538	1707	1631	1524	1774	1863	1583	1721	1863	1583
Q Serve(g_s), s	20.0	72.6	9.5	18.2	0.0	0.0	14.0	20.8	20.6	11.8	22.0	20.8
Cycle Q Clear(g_c), s	20.0	72.6	9.5	18.2	0.0	0.0	14.0	20.8	20.6	11.8	22.0	20.8
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	279	2731	970	253	2691	948	138	238	383	249	228	378
V/C Ratio(X)	0.97	0.86	0.20	0.94	1.03	0.34	1.02	0.92	0.54	0.92	1.06	0.55
Avail Cap(c_a), veh/h	279	2731	970	295	2691	948	138	238	383	249	228	378
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.36	0.36	0.36	0.40	0.40	0.40	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.9	34.2	14.0	50.5	0.0	0.0	83.0	77.5	59.6	83.0	79.0	60.1
Incr Delay (d2), s/veh	25.1	1.4	0.2	18.2	19.9	0.4	82.5	36.4	1.6	35.7	75.9	1.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	15.3	33.3	4.1	12.7	5.0	0.1	10.0	13.1	9.2	6.9	16.1	9.3
LnGrp Delay(d),s/veh	77.0	35.6	14.2	68.7	19.9	0.4	165.8	114.0	61.2	118.6	154.9	61.8
LnGrp LOS	E	D	B	E	F	A	F	F	E	F	F	E
Approach Vol, veh/h		2807			3336			567			678	
Approach Delay, s/veh		38.2			21.5			107.5			114.0	
Approach LOS		D			C			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	26.5	105.5	20.0	28.0	27.0	105.0	19.0	29.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	25.0	95.0	14.0	22.0	21.0	99.0	13.0	23.0
Max Q Clear Time (g_c+I1), s	20.2	74.6	16.0	24.0	22.0	2.0	13.8	22.8
Green Ext Time (p_c), s	0.3	20.3	0.0	0.0	0.0	95.4	0.0	0.1

Intersection Summary	
HCM 2010 Ctrl Delay	42.9
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	293	2674	125	220	2135	186	106	179	268	227	204	227
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1827	1827	1810	1810	1810	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	326	2971	139	244	2372	207	118	199	298	252	227	252
Adj No. of Lanes	1	3	1	1	3	1	1	1	1	2	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	5	5	5	2	2	2	2	2	2
Cap, veh/h	334	2882	1001	222	2580	914	118	207	343	249	217	440
Arrive On Green	0.16	0.58	0.58	0.14	0.69	0.69	0.07	0.11	0.11	0.07	0.12	0.12
Sat Flow, veh/h	1740	4988	1553	1723	4940	1538	1774	1863	1583	3442	1863	1583
Grp Volume(v), veh/h	326	2971	139	244	2372	207	118	199	298	252	227	252
Grp Sat Flow(s),veh/h/ln	1740	1663	1553	1723	1647	1538	1774	1863	1583	1721	1863	1583
Q Serve(g_s), s	28.0	104.0	6.3	19.0	73.1	7.7	12.0	19.1	20.0	13.0	21.0	21.0
Cycle Q Clear(g_c), s	28.0	104.0	6.3	19.0	73.1	7.7	12.0	19.1	20.0	13.0	21.0	21.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	334	2882	1001	222	2580	914	118	207	343	249	217	440
V/C Ratio(X)	0.98	1.03	0.14	1.10	0.92	0.23	1.00	0.96	0.87	1.01	1.04	0.57
Avail Cap(c_a), veh/h	334	2882	1001	222	2580	914	118	207	343	249	217	440
HCM Platoon Ratio	1.00	1.00	1.00	1.33	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.12	0.12	0.12	0.72	0.72	0.72	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	63.2	38.0	12.5	63.6	24.3	10.5	84.0	79.6	68.0	83.5	79.5	55.8
Incr Delay (d2), s/veh	12.0	16.1	0.0	80.7	5.0	0.4	82.0	51.4	20.5	60.7	73.2	1.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
%ile BackOfQ(50%),veh/ln	17.2	51.8	2.7	16.0	34.0	3.3	8.6	12.9	16.3	8.3	15.2	11.0
LnGrp Delay(d),s/veh	75.3	54.1	12.5	144.3	29.3	10.9	166.0	131.0	88.5	144.3	152.7	57.6
LnGrp LOS	E	F	B	F	C	B	F	F	F	F	F	E
Approach Vol, veh/h		3436			2823			615			731	
Approach Delay, s/veh		54.5			37.9			117.1			117.0	
Approach LOS		D			D			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	25.0	110.0	18.0	27.0	35.0	100.0	19.0	26.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	19.0	104.0	12.0	21.0	29.0	94.0	13.0	20.0
Max Q Clear Time (g_c+I1), s	21.0	106.0	14.0	23.0	30.0	75.1	15.0	22.0
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	18.9	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	59.4
HCM 2010 LOS	E

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	2381	120	137	2916	86	126
Number	2	12	1	6	3	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	1792	1792	1792	1845	1845
Adj Flow Rate, veh/h	2646	133	152	3240	96	140
Adj No. of Lanes	3	1	1	3	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	6	3	3
Cap, veh/h	2947	1070	268	3752	176	310
Arrive On Green	0.80	0.80	0.13	1.00	0.10	0.10
Sat Flow, veh/h	5055	1524	1707	5055	1757	1568
Grp Volume(v), veh/h	2646	133	152	3240	96	140
Grp Sat Flow(s),veh/h/ln	1631	1524	1707	1631	1757	1568
Q Serve(g_s), s	34.5	1.3	2.4	0.0	4.7	7.1
Cycle Q Clear(g_c), s	34.5	1.3	2.4	0.0	4.7	7.1
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	2947	1070	268	3752	176	310
V/C Ratio(X)	0.90	0.12	0.57	0.86	0.55	0.45
Avail Cap(c_a), veh/h	2947	1070	272	3752	176	310
HCM Platoon Ratio	1.33	1.33	1.33	1.33	1.00	1.00
Upstream Filter(I)	0.41	0.41	0.09	0.09	1.00	1.00
Uniform Delay (d), s/veh	7.0	2.1	19.2	0.0	38.6	31.8
Incr Delay (d2), s/veh	2.1	0.1	0.2	0.3	3.5	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	15.1	0.7	2.3	0.1	2.4	3.1
LnGrp Delay(d),s/veh	9.1	2.2	19.5	0.3	42.1	32.8
LnGrp LOS	A	A	B	A	D	C
Approach Vol, veh/h	2779			3392	236	
Approach Delay, s/veh	8.8			1.1	36.6	
Approach LOS	A			A	D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	14.8	60.2				75.0		15.0
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	9.0	54.0				69.0		9.0
Max Q Clear Time (g_c+I1), s	4.4	36.5				2.0		9.1
Green Ext Time (p_c), s	0.1	17.5				66.6		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	5.7
HCM 2010 LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	3062	107	137	2466	75	158
Number	2	12	1	6	3	18
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1845	1845
Adj Flow Rate, veh/h	3402	119	152	2740	83	176
Adj No. of Lanes	3	1	1	3	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	5	3	3
Cap, veh/h	3847	1300	169	4281	117	190
Arrive On Green	1.00	1.00	0.11	1.00	0.07	0.07
Sat Flow, veh/h	5103	1538	1723	5103	1757	1568
Grp Volume(v), veh/h	3402	119	152	2740	83	176
Grp Sat Flow(s),veh/h/ln	1647	1538	1723	1647	1757	1568
Q Serve(g_s), s	0.0	0.0	7.7	0.0	8.3	12.0
Cycle Q Clear(g_c), s	0.0	0.0	7.7	0.0	8.3	12.0
Prop In Lane		1.00	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	3847	1300	169	4281	117	190
V/C Ratio(X)	0.88	0.09	0.90	0.64	0.71	0.93
Avail Cap(c_a), veh/h	3847	1300	219	4281	117	190
HCM Platoon Ratio	2.00	2.00	2.00	2.00	1.00	1.00
Upstream Filter(I)	0.10	0.10	0.31	0.31	1.00	1.00
Uniform Delay (d), s/veh	0.0	0.0	47.3	0.0	82.3	78.3
Incr Delay (d2), s/veh	0.3	0.0	12.1	0.2	17.9	44.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.0	7.9	0.1	4.6	11.0
LnGrp Delay(d),s/veh	0.3	0.0	59.4	0.2	100.2	123.1
LnGrp LOS	A	A	E	A	F	F
Approach Vol, veh/h	3521			2892	259	
Approach Delay, s/veh	0.3			3.3	115.8	
Approach LOS	A			A	F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	15.8	146.2				162.0		18.0
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	15.0	135.0				156.0		12.0
Max Q Clear Time (g_c+I1), s	9.7	2.0				2.0		14.0
Green Ext Time (p_c), s	0.2	131.5				151.9		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	6.1
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	278	2107	122	196	2708	412	159	94	184	247	106	186
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	1792	1792	1810	1810	1810	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	309	2341	136	218	3009	458	177	104	204	274	118	207
Adj No. of Lanes	1	3	1	1	3	1	2	1	1	2	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	5	5	5	2	2	2	2	2	2
Cap, veh/h	268	3014	1074	238	2744	991	315	166	256	315	166	352
Arrive On Green	0.27	1.00	1.00	0.07	0.56	0.56	0.09	0.09	0.09	0.09	0.09	0.09
Sat Flow, veh/h	1707	4893	1524	1723	4940	1538	3548	1863	1583	3548	1863	1583
Grp Volume(v), veh/h	309	2341	136	218	3009	458	177	104	204	274	118	207
Grp Sat Flow(s),veh/h/ln	1707	1631	1524	1723	1647	1538	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	24.0	0.0	0.0	10.7	100.0	27.1	8.6	9.7	16.0	13.7	11.1	16.0
Cycle Q Clear(g_c), s	24.0	0.0	0.0	10.7	100.0	27.1	8.6	9.7	16.0	13.7	11.1	16.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	268	3014	1074	238	2744	991	315	166	256	315	166	352
V/C Ratio(X)	1.15	0.78	0.13	0.92	1.10	0.46	0.56	0.63	0.80	0.87	0.71	0.59
Avail Cap(c_a), veh/h	268	3014	1074	323	2744	991	315	166	256	315	166	352
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.37	0.37	0.37	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.1	0.0	0.0	28.6	40.0	16.2	78.6	79.1	72.6	81.0	79.8	62.6
Incr Delay (d2), s/veh	84.8	0.8	0.1	24.6	49.9	1.5	2.3	7.3	15.9	21.9	13.4	2.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	19.5	0.2	0.0	12.2	57.9	14.8	4.3	5.3	10.9	7.7	6.4	9.4
LnGrp Delay(d),s/veh	140.9	0.8	0.1	53.2	89.9	17.8	80.9	86.5	88.5	102.9	93.2	65.2
LnGrp LOS	F	A	A	D	F	B	F	F	F	F	F	E
Approach Vol, veh/h		2786			3685			485			599	
Approach Delay, s/veh		16.3			78.7			85.3			87.9	
Approach LOS		B			E			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	19.1	116.9		22.0	30.0	106.0		22.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	22.0	102.0		16.0	24.0	100.0		16.0
Max Q Clear Time (g_c+I1), s	12.7	2.0		18.0	26.0	102.0		18.0
Green Ext Time (p_c), s	0.4	99.0		0.0	0.0	0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	56.8
HCM 2010 LOS	E

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	247	2845	128	197	2266	274	120	96	196	349	180	217
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1827	1827	1827	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	274	3161	142	219	2518	304	133	106	218	388	200	241
Adj No. of Lanes	1	3	1	1	3	1	2	1	1	2	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	4	4	4	2	2	2	2	2	2
Cap, veh/h	275	2854	1025	195	2660	1001	315	166	281	394	207	387
Arrive On Green	0.18	0.77	0.77	0.09	0.53	0.53	0.09	0.09	0.09	0.11	0.11	0.11
Sat Flow, veh/h	1723	4940	1538	1740	4988	1553	3548	1863	1583	3548	1863	1583
Grp Volume(v), veh/h	274	3161	142	219	2518	304	133	106	218	388	200	241
Grp Sat Flow(s),veh/h/ln	1723	1647	1538	1740	1663	1553	1774	1863	1583	1774	1863	1583
Q Serve(g_s), s	23.9	104.0	3.5	16.0	85.6	15.6	6.4	9.9	16.0	19.6	19.2	20.0
Cycle Q Clear(g_c), s	23.9	104.0	3.5	16.0	85.6	15.6	6.4	9.9	16.0	19.6	19.2	20.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	275	2854	1025	195	2660	1001	315	166	281	394	207	387
V/C Ratio(X)	1.00	1.11	0.14	1.13	0.95	0.30	0.42	0.64	0.77	0.98	0.97	0.62
Avail Cap(c_a), veh/h	275	2854	1025	195	2660	1001	315	166	281	394	207	387
HCM Platoon Ratio	1.33	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.32	0.32	0.32	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	62.3	20.8	5.8	66.4	39.6	14.1	77.6	79.2	70.6	79.8	79.7	60.6
Incr Delay (d2), s/veh	29.6	50.3	0.1	102.1	8.8	0.8	0.9	8.0	12.6	41.0	52.7	3.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	15.9	59.5	1.9	15.2	41.3	9.0	3.2	5.5	11.3	11.9	13.0	11.0
LnGrp Delay(d),s/veh	91.9	71.2	5.9	168.5	48.4	14.9	78.5	87.3	83.2	120.8	132.4	63.7
LnGrp LOS	F	F	A	F	D	B	E	F	F	F	F	E
Approach Vol, veh/h		3577			3041			457			829	
Approach Delay, s/veh		70.2			53.7			82.8			107.0	
Approach LOS		E			D			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	22.0	110.0		26.0	30.0	102.0		22.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	16.0	104.0		20.0	24.0	96.0		16.0
Max Q Clear Time (g_c+I1), s	18.0	106.0		22.0	25.9	87.6		18.0
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	8.3		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	68.4
HCM 2010 LOS	E

Notes

User approved volume balancing among the lanes for turning movement.

Appendix E
Traffic Analysis Worksheets

2038 Design Year

Build River Center Site Alternatives 5-7

North Charleston Intersections

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	0	157	0	0	0	0	0	1867	398
Number				7	4	14				5	2	12
Initial Q (Qb), veh				0	0	0				0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00				1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				0	1827	0				0	1810	1810
Adj Flow Rate, veh/h				0	174	0				0	2074	442
Adj No. of Lanes				0	2	0				0	3	1
Peak Hour Factor				0.90	0.90	0.90				0.90	0.90	0.90
Percent Heavy Veh, %				0	4	0				0	5	5
Cap, veh/h				0	452	0				0	3403	1059
Arrive On Green				0.00	0.13	0.00				0.00	0.69	0.69
Sat Flow, veh/h				0	3654	0				0	5103	1538
Grp Volume(v), veh/h				0	174	0				0	2074	442
Grp Sat Flow(s),veh/h/ln				0	1736	0				0	1647	1538
Q Serve(g_s), s				0.0	3.0	0.0				0.0	14.9	8.3
Cycle Q Clear(g_c), s				0.0	3.0	0.0				0.0	14.9	8.3
Prop In Lane				0.00		0.00				0.00		1.00
Lane Grp Cap(c), veh/h				0	452	0				0	3403	1059
V/C Ratio(X)				0.00	0.38	0.00				0.00	0.61	0.42
Avail Cap(c_a), veh/h				0	680	0				0	4842	1508
HCM Platoon Ratio				1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)				0.00	1.00	0.00				0.00	1.00	1.00
Uniform Delay (d), s/veh				0.0	26.4	0.0				0.0	5.5	4.5
Incr Delay (d2), s/veh				0.0	0.5	0.0				0.0	0.2	0.3
Initial Q Delay(d3),s/veh				0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				0.0	1.5	0.0				0.0	6.6	3.5
LnGrp Delay(d),s/veh				0.0	26.9	0.0				0.0	5.7	4.8
LnGrp LOS					C						A	A
Approach Vol, veh/h					174						2516	
Approach Delay, s/veh					26.9						5.5	
Approach LOS					C						A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4				
Phs Duration (G+Y+Rc), s		51.7		14.6				
Change Period (Y+Rc), s		6.0		6.0				
Max Green Setting (Gmax), s		65.0		13.0				
Max Q Clear Time (g_c+I1), s		16.9		5.0				
Green Ext Time (p_c), s		28.7		0.5				

Intersection Summary	
HCM 2010 Ctrl Delay	6.9
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	0	232	0	0	0	0	0	1151	290
Number				7	4	14				5	2	12
Initial Q (Qb), veh				0	0	0				0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00				1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				0	1827	0				0	1827	1827
Adj Flow Rate, veh/h				0	258	0				0	1279	322
Adj No. of Lanes				0	2	0				0	3	1
Peak Hour Factor				0.90	0.90	0.90				0.90	0.90	0.90
Percent Heavy Veh, %				0	4	0				0	4	4
Cap, veh/h				0	694	0				0	2598	809
Arrive On Green				0.00	0.20	0.00				0.00	0.52	0.52
Sat Flow, veh/h				0	3654	0				0	5152	1553
Grp Volume(v), veh/h				0	258	0				0	1279	322
Grp Sat Flow(s),veh/h/ln				0	1736	0				0	1663	1553
Q Serve(g_s), s				0.0	2.8	0.0				0.0	7.1	5.4
Cycle Q Clear(g_c), s				0.0	2.8	0.0				0.0	7.1	5.4
Prop In Lane				0.00		0.00				0.00		1.00
Lane Grp Cap(c), veh/h				0	694	0				0	2598	809
V/C Ratio(X)				0.00	0.37	0.00				0.00	0.49	0.40
Avail Cap(c_a), veh/h				0	1858	0				0	6385	1988
HCM Platoon Ratio				1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)				0.00	1.00	0.00				0.00	1.00	1.00
Uniform Delay (d), s/veh				0.0	14.9	0.0				0.0	6.6	6.2
Incr Delay (d2), s/veh				0.0	0.3	0.0				0.0	0.1	0.3
Initial Q Delay(d3),s/veh				0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				0.0	1.4	0.0				0.0	3.2	2.3
LnGrp Delay(d),s/veh				0.0	15.2	0.0				0.0	6.8	6.5
LnGrp LOS					B						A	A
Approach Vol, veh/h					258						1601	
Approach Delay, s/veh					15.2						6.7	
Approach LOS					B						A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4				
Phs Duration (G+Y+Rc), s		28.4		14.6				
Change Period (Y+Rc), s		6.0		6.0				
Max Green Setting (Gmax), s		55.0		23.0				
Max Q Clear Time (g_c+I1), s		9.1		4.8				
Green Ext Time (p_c), s		13.3		1.4				

Intersection Summary	
HCM 2010 Ctrl Delay	7.9
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	393	0	0	0	0	0	920	152	0	0	0
Number	3	8	18				1	6	16			
Initial Q (Qb), veh	0	0	0				0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	0	1827	0				0	1810	1810			
Adj Flow Rate, veh/h	0	437	0				0	1022	169			
Adj No. of Lanes	0	2	0				0	3	1			
Peak Hour Factor	0.90	0.90	0.90				0.90	0.90	0.90			
Percent Heavy Veh, %	0	4	0				0	5	5			
Cap, veh/h	0	837	0				0	2142	667			
Arrive On Green	0.00	0.24	0.00				0.00	0.43	0.43			
Sat Flow, veh/h	0	3654	0				0	5103	1538			
Grp Volume(v), veh/h	0	437	0				0	1022	169			
Grp Sat Flow(s),veh/h/ln	0	1736	0				0	1647	1538			
Q Serve(g_s), s	0.0	4.0	0.0				0.0	5.5	2.6			
Cycle Q Clear(g_c), s	0.0	4.0	0.0				0.0	5.5	2.6			
Prop In Lane	0.00		0.00				0.00		1.00			
Lane Grp Cap(c), veh/h	0	837	0				0	2142	667			
V/C Ratio(X)	0.00	0.52	0.00				0.00	0.48	0.25			
Avail Cap(c_a), veh/h	0	2258	0				0	4552	1417			
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00			
Upstream Filter(I)	0.00	1.00	0.00				0.00	1.00	1.00			
Uniform Delay (d), s/veh	0.0	12.2	0.0				0.0	7.5	6.6			
Incr Delay (d2), s/veh	0.0	0.5	0.0				0.0	0.2	0.2			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	0.0	1.9	0.0				0.0	2.5	1.1			
LnGrp Delay(d),s/veh	0.0	12.7	0.0				0.0	7.6	6.8			
LnGrp LOS		B						A	A			
Approach Vol, veh/h		437						1191				
Approach Delay, s/veh		12.7						7.5				
Approach LOS		B						A				

Timer	1	2	3	4	5	6	7	8
Assigned Phs						6		8
Phs Duration (G+Y+Rc), s						22.0		14.9
Change Period (Y+Rc), s						6.0		6.0
Max Green Setting (Gmax), s						34.0		24.0
Max Q Clear Time (g_c+I1), s						7.5		6.0
Green Ext Time (p_c), s						8.0		2.6

Intersection Summary	
HCM 2010 Ctrl Delay	8.9
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	311	0	0	0	0	0	1608	220	0	0	0
Number	3	8	18				1	6	16			
Initial Q (Qb), veh	0	0	0				0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	0	1827	0				0	1827	1827			
Adj Flow Rate, veh/h	0	346	0				0	1787	244			
Adj No. of Lanes	0	2	0				0	3	1			
Peak Hour Factor	0.90	0.90	0.90				0.90	0.90	0.90			
Percent Heavy Veh, %	0	4	0				0	4	4			
Cap, veh/h	0	607	0				0	2943	916			
Arrive On Green	0.00	0.17	0.00				0.00	0.59	0.59			
Sat Flow, veh/h	0	3654	0				0	5152	1553			
Grp Volume(v), veh/h	0	346	0				0	1787	244			
Grp Sat Flow(s),veh/h/ln	0	1736	0				0	1663	1553			
Q Serve(g_s), s	0.0	4.7	0.0				0.0	11.7	3.9			
Cycle Q Clear(g_c), s	0.0	4.7	0.0				0.0	11.7	3.9			
Prop In Lane	0.00		0.00				0.00		1.00			
Lane Grp Cap(c), veh/h	0	607	0				0	2943	916			
V/C Ratio(X)	0.00	0.57	0.00				0.00	0.61	0.27			
Avail Cap(c_a), veh/h	0	1088	0				0	4102	1277			
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00			
Upstream Filter(I)	0.00	1.00	0.00				0.00	1.00	1.00			
Uniform Delay (d), s/veh	0.0	19.3	0.0				0.0	6.7	5.1			
Incr Delay (d2), s/veh	0.0	0.8	0.0				0.0	0.2	0.2			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	0.0	2.3	0.0				0.0	5.4	1.7			
LnGrp Delay(d),s/veh	0.0	20.1	0.0				0.0	6.9	5.2			
LnGrp LOS		C						A	A			
Approach Vol, veh/h		346						2031				
Approach Delay, s/veh		20.1						6.7				
Approach LOS		C						A				

Timer	1	2	3	4	5	6	7	8
Assigned Phs						6		8
Phs Duration (G+Y+Rc), s						36.1		14.9
Change Period (Y+Rc), s						6.0		6.0
Max Green Setting (Gmax), s						42.0		16.0
Max Q Clear Time (g_c+I1), s						13.7		6.7
Green Ext Time (p_c), s						16.4		1.4

Intersection Summary	
HCM 2010 Ctrl Delay	8.7
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	149	55	0	0	0	50	0	0	0	1583	433
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	1863	0	1863	0	1792	0	0	0	1810	1810
Adj Flow Rate, veh/h	0	166	61	0	0	0	56	0	0	0	1759	481
Adj No. of Lanes	0	1	1	0	1	0	1	0	0	0	3	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	2	2	0	2	0	6	0	0	0	5	5
Cap, veh/h	0	222	189	0	222	0	113	0	0	0	3546	1104
Arrive On Green	0.00	0.12	0.12	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.72	0.72
Sat Flow, veh/h	0	1863	1583	0	1863	0	1707	56		0	5103	1538
Grp Volume(v), veh/h	0	166	61	0	0	0	56	54.3		0	1759	481
Grp Sat Flow(s),veh/h/ln	0	1863	1583	0	1863	0	1707	D		0	1647	1538
Q Serve(g_s), s	0.0	9.7	4.0	0.0	0.0	0.0	3.6			0.0	17.6	14.5
Cycle Q Clear(g_c), s	0.0	9.7	4.0	0.0	0.0	0.0	3.6			0.0	17.6	14.5
Prop In Lane	0.00		1.00	0.00		0.00	1.00			0.00		1.00
Lane Grp Cap(c), veh/h	0	222	189	0	222	0	113			0	3546	1104
V/C Ratio(X)	0.00	0.75	0.32	0.00	0.00	0.00	0.50			0.00	0.50	0.44
Avail Cap(c_a), veh/h	0	396	336	0	396	0	166			0	3546	1104
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.00	0.00	0.00	1.00			0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	48.1	45.6	0.0	0.0	0.0	51.0			0.0	7.0	6.5
Incr Delay (d2), s/veh	0.0	5.0	1.0	0.0	0.0	0.0	3.4			0.0	0.5	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	5.3	1.8	0.0	0.0	0.0	1.8			0.0	8.0	6.4
LnGrp Delay(d),s/veh	0.0	53.0	46.5	0.0	0.0	0.0	54.3			0.0	7.5	7.8
LnGrp LOS		D	D				D				A	A
Approach Vol, veh/h		227			0						2240	
Approach Delay, s/veh		51.3			0.0						7.6	
Approach LOS		D									A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4				8
Phs Duration (G+Y+Rc), s	13.4	87.1		19.5				19.5
Change Period (Y+Rc), s	6.0	6.0		6.0				6.0
Max Green Setting (Gmax), s	11.0	67.0		24.0				24.0
Max Q Clear Time (g_c+I1), s	5.6	19.6		12.7				0.0
Green Ext Time (p_c), s	0.0	23.1		0.8				0.0

Intersection Summary	
HCM 2010 Ctrl Delay	12.5
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	345	75	0	0	0	66	0	0	0	963	223
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	1863	0	1863	0	1810	0	0	0	1827	1827
Adj Flow Rate, veh/h	0	383	83	0	0	0	73	0	0	0	1070	248
Adj No. of Lanes	0	1	1	0	1	0	1	0	0	0	3	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	2	2	0	2	0	5	0	0	0	4	4
Cap, veh/h	0	458	389	0	458	0	127	0	0	0	3104	966
Arrive On Green	0.00	0.25	0.25	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.62	0.62
Sat Flow, veh/h	0	1863	1583	0	1863	0	1723	73		0	5152	1553
Grp Volume(v), veh/h	0	383	83	0	0	0	73	52.5		0	1070	248
Grp Sat Flow(s),veh/h/ln	0	1863	1583	0	1863	0	1723	D		0	1663	1553
Q Serve(g_s), s	0.0	21.1	4.5	0.0	0.0	0.0	4.4			0.0	11.2	7.8
Cycle Q Clear(g_c), s	0.0	21.1	4.5	0.0	0.0	0.0	4.4			0.0	11.2	7.8
Prop In Lane	0.00		1.00	0.00		0.00	1.00			0.00		1.00
Lane Grp Cap(c), veh/h	0	458	389	0	458	0	127			0	3104	966
V/C Ratio(X)	0.00	0.84	0.21	0.00	0.00	0.00	0.57			0.00	0.34	0.26
Avail Cap(c_a), veh/h	0	774	658	0	774	0	207			0	3104	966
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.00	0.00	0.00	1.00			0.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	38.8	32.5	0.0	0.0	0.0	48.5			0.0	9.8	9.2
Incr Delay (d2), s/veh	0.0	4.1	0.3	0.0	0.0	0.0	4.0			0.0	0.3	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	11.4	2.0	0.0	0.0	0.0	2.3			0.0	5.1	3.5
LnGrp Delay(d),s/veh	0.0	42.9	32.8	0.0	0.0	0.0	52.5			0.0	10.1	9.8
LnGrp LOS		D	C				D				B	A
Approach Vol, veh/h		466			0						1318	
Approach Delay, s/veh		41.1			0.0						10.1	
Approach LOS		D									B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4				8
Phs Duration (G+Y+Rc), s	14.0	73.4		32.6				32.6
Change Period (Y+Rc), s	6.0	6.0		6.0				6.0
Max Green Setting (Gmax), s	13.0	44.0		45.0				45.0
Max Q Clear Time (g_c+I1), s	6.4	13.2		24.1				0.0
Green Ext Time (p_c), s	0.1	9.2		2.5				0.0

Intersection Summary	
HCM 2010 Ctrl Delay	19.5
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	0	21	332	0	550	97	151	0	0
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	0	0	1863	1863	0	1759	1900	1792	0	0
Adj Flow Rate, veh/h	0	0	0	0	23	369	0	611	108	168	0	0
Adj No. of Lanes	0	1	0	0	1	1	0	3	0	1	0	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	2	0	0	2	2	0	8	8	6	0	0
Cap, veh/h	0	251	0	0	251	1036	0	2138	372	211	0	0
Arrive On Green	0.00	0.00	0.00	0.00	0.13	0.13	0.00	0.52	0.52	0.12	0.00	0.00
Sat Flow, veh/h	0	1863	0	0	1863	1583	0	4276	717	1707	168	
Grp Volume(v), veh/h	0	0	0	0	23	369	0	473	246	168	41.2	
Grp Sat Flow(s),veh/h/ln	0	1863	0	0	1863	1583	0	1601	1633	1707	D	
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.9	8.5	0.0	6.7	6.9	7.7		
Cycle Q Clear(g_c), s	0.0	0.0	0.0	0.0	0.9	8.5	0.0	6.7	6.9	7.7		
Prop In Lane	0.00		0.00	0.00		1.00	0.00		0.44	1.00		
Lane Grp Cap(c), veh/h	0	251	0	0	251	1036	0	1663	848	211		
V/C Ratio(X)	0.00	0.00	0.00	0.00	0.09	0.36	0.00	0.28	0.29	0.80		
Avail Cap(c_a), veh/h	0	299	0	0	299	1077	0	1663	848	992		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	0.0	0.0	0.0	0.0	30.7	6.3	0.0	11.0	11.0	34.5		
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.4	0.9	6.8		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	0.0	0.5	8.2	0.0	3.1	3.3	4.0		
LnGrp Delay(d),s/veh	0.0	0.0	0.0	0.0	30.8	6.5	0.0	11.4	11.9	41.2		
LnGrp LOS					C	A		B	B	D		
Approach Vol, veh/h		0			392			719				
Approach Delay, s/veh		0.0			7.9			11.6				
Approach LOS					A			B				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4	5	6		8
Phs Duration (G+Y+Rc), s				16.9	16.0	48.0		16.9
Change Period (Y+Rc), s				6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s				13.0	47.0	42.0		13.0
Max Q Clear Time (g_c+I1), s				0.0	9.7	8.9		10.5
Green Ext Time (p_c), s				0.0	0.5	4.7		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	14.3
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	0	13	408	0	1104	119	98	0	0
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	0	0	1863	1863	0	1776	1900	1810	0	0
Adj Flow Rate, veh/h	0	0	0	0	14	453	0	1227	132	109	0	0
Adj No. of Lanes	0	1	0	0	1	1	0	3	0	1	0	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	2	0	0	2	2	0	7	7	5	0	0
Cap, veh/h	0	196	0	0	196	1095	0	2605	280	168	0	0
Arrive On Green	0.00	0.00	0.00	0.00	0.11	0.11	0.00	0.59	0.59	0.10	0.00	0.00
Sat Flow, veh/h	0	1863	0	0	1863	1583	0	4605	478	1723	109	
Grp Volume(v), veh/h	0	0	0	0	14	453	0	892	467	109	41.3	
Grp Sat Flow(s),veh/h/ln	0	1863	0	0	1863	1583	0	1616	1691	1723	D	
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.6	9.0	0.0	13.5	13.5	5.2		
Cycle Q Clear(g_c), s	0.0	0.0	0.0	0.0	0.6	9.0	0.0	13.5	13.5	5.2		
Prop In Lane	0.00		0.00	0.00		1.00	0.00		0.28	1.00		
Lane Grp Cap(c), veh/h	0	196	0	0	196	1095	0	1894	991	168		
V/C Ratio(X)	0.00	0.00	0.00	0.00	0.07	0.41	0.00	0.47	0.47	0.65		
Avail Cap(c_a), veh/h	0	196	0	0	196	1095	0	1894	991	869		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	0.0	0.0	0.0	0.0	34.4	5.4	0.0	10.1	10.1	37.1		
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.8	1.6	4.2		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	0.0	0.3	10.6	0.0	6.2	6.7	2.7		
LnGrp Delay(d),s/veh	0.0	0.0	0.0	0.0	34.5	5.7	0.0	10.9	11.7	41.3		
LnGrp LOS					C	A		B	B	D		
Approach Vol, veh/h		0			467			1359				
Approach Delay, s/veh		0.0			6.6			11.2				
Approach LOS					A			B				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4	5	6		8
Phs Duration (G+Y+Rc), s				15.0	14.3	56.0		15.0
Change Period (Y+Rc), s				6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s				9.0	43.0	50.0		9.0
Max Q Clear Time (g_c+I1), s				0.0	7.2	15.5		11.0
Green Ext Time (p_c), s				0.0	0.3	10.8		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	11.8
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	0	231	74	0	642	75	127	0	0
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	0	0	1743	1743	0	1759	1759	1759	0	0
Adj Flow Rate, veh/h	0	0	0	0	257	82	0	713	83	141	0	0
Adj No. of Lanes	0	1	0	0	1	1	0	3	1	1	0	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	2	0	0	9	9	0	8	8	8	0	0
Cap, veh/h	0	355	0	0	332	972	0	2237	696	186	0	0
Arrive On Green	0.00	0.00	0.00	0.00	0.19	0.19	0.00	0.47	0.47	0.11	0.00	0.00
Sat Flow, veh/h	0	1863	0	0	1743	1482	0	4961	1495	1675	141	
Grp Volume(v), veh/h	0	0	0	0	257	82	0	713	83	141	39.6	
Grp Sat Flow(s),veh/h/ln	0	1863	0	0	1743	1482	0	1601	1495	1675	D	
Q Serve(g_s), s	0.0	0.0	0.0	0.0	10.8	1.6	0.0	7.2	2.4	6.3		
Cycle Q Clear(g_c), s	0.0	0.0	0.0	0.0	10.8	1.6	0.0	7.2	2.4	6.3		
Prop In Lane	0.00		0.00	0.00		1.00	0.00		1.00	1.00		
Lane Grp Cap(c), veh/h	0	355	0	0	332	972	0	2237	696	186		
V/C Ratio(X)	0.00	0.00	0.00	0.00	0.77	0.08	0.00	0.32	0.12	0.76		
Avail Cap(c_a), veh/h	0	964	0	0	902	1457	0	2237	696	564		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	0.00	0.00	0.00	0.00	0.98	0.98	0.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	0.0	0.0	0.0	0.0	29.7	4.8	0.0	13.0	11.7	33.4		
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.4	0.3	6.3		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	0.0	5.6	1.5	0.0	3.2	1.1	3.3		
LnGrp Delay(d),s/veh	0.0	0.0	0.0	0.0	33.5	4.9	0.0	13.3	12.0	39.6		
LnGrp LOS					C	A		B	B	D		
Approach Vol, veh/h		0			339			796				
Approach Delay, s/veh		0.0			26.5			13.2				
Approach LOS					C			B				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4	5	6		8
Phs Duration (G+Y+Rc), s				20.7	14.6	42.0		20.7
Change Period (Y+Rc), s				6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s				40.0	26.0	36.0		40.0
Max Q Clear Time (g_c+I1), s				0.0	8.3	9.2		12.8
Green Ext Time (p_c), s				0.0	0.3	5.1		1.9

Intersection Summary	
HCM 2010 Ctrl Delay	19.7
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	0	159	110	0	1100	130	97	0	0
Number	7	4	14	3	8	18	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1863	0	0	1810	1810	0	1776	1776	1776	0	0
Adj Flow Rate, veh/h	0	0	0	0	177	122	0	1222	144	108	0	0
Adj No. of Lanes	0	1	0	0	1	1	0	3	1	1	0	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	2	0	0	5	5	0	7	7	7	0	0
Cap, veh/h	0	243	0	0	236	1093	0	2813	876	156	0	0
Arrive On Green	0.00	0.00	0.00	0.00	0.13	0.13	0.00	0.58	0.58	0.09	0.00	0.00
Sat Flow, veh/h	0	1863	0	0	1810	1538	0	5007	1509	1691	108	
Grp Volume(v), veh/h	0	0	0	0	177	122	0	1222	144	108	45.6	
Grp Sat Flow(s),veh/h/ln	0	1863	0	0	1810	1538	0	1616	1509	1691	D	
Q Serve(g_s), s	0.0	0.0	0.0	0.0	8.6	2.3	0.0	12.9	4.0	5.7		
Cycle Q Clear(g_c), s	0.0	0.0	0.0	0.0	8.6	2.3	0.0	12.9	4.0	5.7		
Prop In Lane	0.00		0.00	0.00		1.00	0.00		1.00	1.00		
Lane Grp Cap(c), veh/h	0	243	0	0	236	1093	0	2813	876	156		
V/C Ratio(X)	0.00	0.00	0.00	0.00	0.75	0.11	0.00	0.43	0.16	0.69		
Avail Cap(c_a), veh/h	0	571	0	0	555	1364	0	2813	876	389		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	0.00	0.00	0.00	0.00	0.95	0.95	0.00	1.00	1.00	1.00		
Uniform Delay (d), s/veh	0.0	0.0	0.0	0.0	38.3	4.1	0.0	10.8	8.9	40.2		
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.5	0.4	5.4		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	0.0	0.0	0.0	0.0	4.6	2.9	0.0	5.9	1.8	2.9		
LnGrp Delay(d),s/veh	0.0	0.0	0.0	0.0	42.8	4.2	0.0	11.2	9.3	45.6		
LnGrp LOS					D	A		B	A	D		
Approach Vol, veh/h		0			299			1366				
Approach Delay, s/veh		0.0			27.0			11.0				
Approach LOS					C			B				

Timer	1	2	3	4	5	6	7	8
Assigned Phs				4	5	6		8
Phs Duration (G+Y+Rc), s				17.9	14.4	59.0		17.9
Change Period (Y+Rc), s				6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s				28.0	21.0	53.0		28.0
Max Q Clear Time (g_c+I1), s				0.0	7.7	14.9		10.6
Green Ext Time (p_c), s				0.0	0.2	10.9		1.3

Intersection Summary	
HCM 2010 Ctrl Delay	15.8
HCM 2010 LOS	B

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	71	17	37	673	1128	139
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1557	1557	1792	1792	1759	1759
Adj Flow Rate, veh/h	79	19	41	748	1253	154
Adj No. of Lanes	2	1	1	3	3	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	22	22	6	6	8	8
Cap, veh/h	354	163	344	3442	3379	1052
Arrive On Green	0.12	0.12	0.70	0.70	0.70	0.70
Sat Flow, veh/h	2877	1324	367	5055	4961	1495
Grp Volume(v), veh/h	79	19	41	748	1253	154
Grp Sat Flow(s),veh/h/ln	1439	1324	367	1631	1601	1495
Q Serve(g_s), s	1.4	0.7	2.9	3.1	6.1	2.0
Cycle Q Clear(g_c), s	1.4	0.7	9.0	3.1	6.1	2.0
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	354	163	344	3442	3379	1052
V/C Ratio(X)	0.22	0.12	0.12	0.22	0.37	0.15
Avail Cap(c_a), veh/h	545	251	344	3442	3379	1052
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.90	0.90	1.00	1.00
Uniform Delay (d), s/veh	23.0	22.7	5.3	3.0	3.5	2.8
Incr Delay (d2), s/veh	0.3	0.3	0.6	0.1	0.3	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.3	0.4	1.4	2.8	0.9
LnGrp Delay(d),s/veh	23.3	23.0	5.9	3.1	3.8	3.1
LnGrp LOS	C	C	A	A	A	A
Approach Vol, veh/h	98			789	1407	
Approach Delay, s/veh	23.2			3.3	3.7	
Approach LOS	C			A	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		46.9				46.9		13.1
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		37.0				37.0		11.0
Max Q Clear Time (g_c+I1), s		8.1				11.0		3.4
Green Ext Time (p_c), s		18.1				16.9		0.1

Intersection Summary	
HCM 2010 Ctrl Delay	4.4
HCM 2010 LOS	A

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	134	49	39	1141	734	89
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1638	1638	1810	1810	1776	1776
Adj Flow Rate, veh/h	149	54	43	1268	816	99
Adj No. of Lanes	2	1	1	3	3	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	16	16	5	5	7	7
Cap, veh/h	453	208	488	3361	3298	1027
Arrive On Green	0.15	0.15	0.46	0.46	0.68	0.68
Sat Flow, veh/h	3026	1392	590	5103	5007	1509
Grp Volume(v), veh/h	149	54	43	1268	816	99
Grp Sat Flow(s),veh/h/ln	1513	1392	590	1647	1616	1509
Q Serve(g_s), s	2.5	2.0	2.6	9.8	3.7	1.3
Cycle Q Clear(g_c), s	2.5	2.0	6.3	9.8	3.7	1.3
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	453	208	488	3361	3298	1027
V/C Ratio(X)	0.33	0.26	0.09	0.38	0.25	0.10
Avail Cap(c_a), veh/h	680	313	488	3361	3298	1027
HCM Platoon Ratio	1.00	1.00	0.67	0.67	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.82	0.82	1.00	1.00
Uniform Delay (d), s/veh	22.0	21.8	7.9	7.7	3.6	3.2
Incr Delay (d2), s/veh	0.4	0.7	0.3	0.3	0.2	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.8	0.5	4.5	1.7	0.6
LnGrp Delay(d),s/veh	22.4	22.4	8.2	7.9	3.7	3.3
LnGrp LOS	C	C	A	A	A	A
Approach Vol, veh/h	203			1311	915	
Approach Delay, s/veh	22.4			8.0	3.7	
Approach LOS	C			A	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		45.3				45.3		14.7
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		35.0				35.0		13.0
Max Q Clear Time (g_c+I1), s		5.7				11.8		4.5
Green Ext Time (p_c), s		18.3				15.7		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	7.6
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	86	85	7	158	114	147	24	530	233	187	785	190
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1759	1759	1900	1863	1863	1863	1900	1827	1900	1792	1792	1792
Adj Flow Rate, veh/h	96	94	8	176	127	163	27	589	259	208	872	211
Adj No. of Lanes	1	1	0	1	1	1	0	3	0	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	8	8	8	2	2	2	4	4	4	6	6	6
Cap, veh/h	297	471	40	278	311	264	79	1620	692	449	2215	1105
Arrive On Green	0.07	0.29	0.29	0.17	0.17	0.17	0.52	0.52	0.52	0.16	1.00	1.00
Sat Flow, veh/h	1675	1599	136	1287	1863	1583	87	3121	1334	1707	3406	1524
Grp Volume(v), veh/h	96	0	102	176	127	163	311	287	277	208	872	211
Grp Sat Flow(s),veh/h/ln	1675	0	1735	1287	1863	1583	1602	1513	1427	1707	1703	1524
Q Serve(g_s), s	5.1	0.0	5.0	15.1	7.0	10.9	0.0	12.9	13.2	6.5	0.0	0.0
Cycle Q Clear(g_c), s	5.1	0.0	5.0	15.1	7.0	10.9	11.3	12.9	13.2	6.5	0.0	0.0
Prop In Lane	1.00		0.08	1.00		1.00	0.09		0.93	1.00		1.00
Lane Grp Cap(c), veh/h	297	0	511	278	311	264	866	785	741	449	2215	1105
V/C Ratio(X)	0.32	0.00	0.20	0.63	0.41	0.62	0.36	0.37	0.37	0.46	0.39	0.19
Avail Cap(c_a), veh/h	303	0	683	401	489	415	866	785	741	553	2215	1105
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Uniform Delay (d), s/veh	33.7	0.0	30.2	46.0	42.6	44.2	15.9	16.3	16.4	10.2	0.0	0.0
Incr Delay (d2), s/veh	0.6	0.0	0.2	2.4	0.9	2.3	1.2	1.3	1.4	0.7	0.5	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	0.0	2.4	5.6	3.7	4.9	6.0	5.6	5.5	3.0	0.2	0.1
LnGrp Delay(d),s/veh	34.3	0.0	30.4	48.3	43.4	46.6	17.1	17.6	17.8	10.9	0.5	0.4
LnGrp LOS	C		C	D	D	D	B	B	B	B	A	A
Approach Vol, veh/h		198			466			875			1291	
Approach Delay, s/veh		32.3			46.4			17.5			2.2	
Approach LOS		C			D			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4	5	6		8
Phs Duration (G+Y+Rc), s		80.3	14.6	25.1	15.0	65.3		39.7
Change Period (Y+Rc), s		6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		63.0	9.0	30.0	16.0	41.0		45.0
Max Q Clear Time (g_c+I1), s		2.0	7.1	17.1	8.5	15.2		7.0
Green Ext Time (p_c), s		21.0	0.0	2.0	0.3	14.6		2.5

Intersection Summary	
HCM 2010 Ctrl Delay	16.3
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	133	154	9	151	75	166	5	846	256	141	531	146
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1776	1776	1900	1863	1863	1863	1900	1845	1900	1810	1810	1810
Adj Flow Rate, veh/h	148	171	10	168	83	184	6	940	284	157	590	162
Adj No. of Lanes	1	1	0	1	1	1	0	3	0	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	7	7	7	2	2	2	3	3	3	5	5	5
Cap, veh/h	334	500	29	267	319	271	35	1879	564	345	2183	1097
Arrive On Green	0.08	0.30	0.30	0.17	0.17	0.17	0.50	0.50	0.50	0.16	1.00	1.00
Sat Flow, veh/h	1691	1661	97	1198	1863	1583	6	3721	1116	1723	3438	1538
Grp Volume(v), veh/h	148	0	181	168	83	184	466	387	377	157	590	162
Grp Sat Flow(s),veh/h/ln	1691	0	1759	1198	1863	1583	1834	1528	1482	1723	1719	1538
Q Serve(g_s), s	8.1	0.0	9.3	15.6	4.5	12.6	0.0	19.4	19.5	4.7	0.0	0.0
Cycle Q Clear(g_c), s	8.1	0.0	9.3	15.6	4.5	12.6	19.3	19.4	19.5	4.7	0.0	0.0
Prop In Lane	1.00		0.06	1.00		1.00	0.01		0.75	1.00		1.00
Lane Grp Cap(c), veh/h	334	0	530	267	319	271	958	771	748	345	2183	1097
V/C Ratio(X)	0.44	0.00	0.34	0.63	0.26	0.68	0.49	0.50	0.50	0.46	0.27	0.15
Avail Cap(c_a), veh/h	334	0	671	364	468	398	958	771	748	390	2183	1097
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98
Uniform Delay (d), s/veh	34.2	0.0	31.4	46.1	41.5	44.8	18.9	18.9	19.0	12.0	0.0	0.0
Incr Delay (d2), s/veh	0.9	0.0	0.4	2.4	0.4	3.0	1.8	2.3	2.4	0.9	0.3	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	0.0	4.5	5.4	2.3	5.7	10.3	8.7	8.5	2.2	0.1	0.1
LnGrp Delay(d),s/veh	35.1	0.0	31.8	48.5	41.9	47.8	20.7	21.3	21.4	12.9	0.3	0.3
LnGrp LOS	D		C	D	D	D	C	C	C	B	A	A
Approach Vol, veh/h		329			435			1230			909	
Approach Delay, s/veh		33.3			47.0			21.1			2.5	
Approach LOS		C			D			C			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4	5	6		8
Phs Duration (G+Y+Rc), s		79.3	15.0	25.7	15.0	64.3		40.7
Change Period (Y+Rc), s		6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		64.0	9.0	29.0	12.0	46.0		44.0
Max Q Clear Time (g_c+I1), s		2.0	10.1	17.6	6.7	21.5		11.3
Green Ext Time (p_c), s		20.9	0.0	2.1	0.2	14.2		2.8

Intersection Summary	
HCM 2010 Ctrl Delay	20.5
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	7	16	22	108	16	24	14	757	39	21	910	17
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1827	1900	1827	1827	1900	1827	1827	1900
Adj Flow Rate, veh/h	8	18	24	120	18	27	16	841	43	23	1011	19
Adj No. of Lanes	0	1	0	0	1	0	1	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	4	4	4	4	4	4	4	4	4
Cap, veh/h	104	192	209	360	57	61	308	1812	93	357	1880	35
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.54	0.54	0.54	0.54	0.54	0.54
Sat Flow, veh/h	130	740	803	984	219	235	535	3360	172	614	3485	66
Grp Volume(v), veh/h	50	0	0	165	0	0	16	434	450	23	503	527
Grp Sat Flow(s),veh/h/ln	1672	0	0	1438	0	0	535	1736	1797	614	1736	1815
Q Serve(g_s), s	0.0	0.0	0.0	4.2	0.0	0.0	1.2	9.2	9.2	1.4	11.3	11.3
Cycle Q Clear(g_c), s	1.3	0.0	0.0	5.5	0.0	0.0	12.5	9.2	9.2	10.6	11.3	11.3
Prop In Lane	0.16		0.48	0.73		0.16	1.00		0.10	1.00		0.04
Lane Grp Cap(c), veh/h	505	0	0	478	0	0	308	936	969	357	936	979
V/C Ratio(X)	0.10	0.00	0.00	0.35	0.00	0.00	0.05	0.46	0.46	0.06	0.54	0.54
Avail Cap(c_a), veh/h	816	0	0	747	0	0	476	1480	1532	549	1480	1548
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	16.9	0.0	0.0	18.3	0.0	0.0	13.0	8.5	8.5	11.7	8.9	8.9
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.4	0.0	0.0	0.1	0.4	0.3	0.1	0.5	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.0	2.3	0.0	0.0	0.2	4.4	4.6	0.3	5.4	5.7
LnGrp Delay(d),s/veh	16.9	0.0	0.0	18.7	0.0	0.0	13.0	8.8	8.8	11.8	9.4	9.4
LnGrp LOS	B			B			B	A	A	B	A	A
Approach Vol, veh/h		50			165			900			1053	
Approach Delay, s/veh		16.9			18.7			8.9			9.5	
Approach LOS		B			B			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		38.3		21.6		38.3		21.6
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		51.0		27.0		51.0		27.0
Max Q Clear Time (g_c+I1), s		13.3		7.5		14.5		3.3
Green Ext Time (p_c), s		18.1		1.2		17.8		1.3

Intersection Summary	
HCM 2010 Ctrl Delay	10.1
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	6	13	16	61	27	31	29	1010	77	19	682	11
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1845	1900	1845	1845	1900	1845	1845	1900
Adj Flow Rate, veh/h	7	14	18	68	30	34	32	1122	86	21	758	12
Adj No. of Lanes	0	1	0	0	1	0	1	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	3	3	3	3	3	3	3	3	3
Cap, veh/h	102	175	181	244	108	93	431	1911	146	276	2045	32
Arrive On Green	0.24	0.24	0.24	0.24	0.24	0.24	0.58	0.58	0.58	0.58	0.58	0.58
Sat Flow, veh/h	155	742	769	678	460	395	689	3300	253	456	3531	56
Grp Volume(v), veh/h	39	0	0	132	0	0	32	595	613	21	376	394
Grp Sat Flow(s),veh/h/ln	1666	0	0	1532	0	0	689	1752	1800	456	1752	1835
Q Serve(g_s), s	0.0	0.0	0.0	2.5	0.0	0.0	1.7	14.0	14.1	2.0	7.5	7.5
Cycle Q Clear(g_c), s	1.1	0.0	0.0	4.4	0.0	0.0	9.1	14.0	14.1	16.1	7.5	7.5
Prop In Lane	0.18		0.46	0.52		0.26	1.00		0.14	1.00		0.03
Lane Grp Cap(c), veh/h	458	0	0	445	0	0	431	1015	1043	276	1015	1063
V/C Ratio(X)	0.09	0.00	0.00	0.30	0.00	0.00	0.07	0.59	0.59	0.08	0.37	0.37
Avail Cap(c_a), veh/h	626	0	0	601	0	0	628	1515	1556	406	1515	1586
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.4	0.0	0.0	20.5	0.0	0.0	9.8	8.7	8.7	13.8	7.3	7.3
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.4	0.0	0.0	0.1	0.5	0.5	0.1	0.2	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.0	2.0	0.0	0.0	0.3	6.8	7.0	0.3	3.6	3.8
LnGrp Delay(d),s/veh	19.4	0.0	0.0	20.9	0.0	0.0	9.8	9.2	9.2	13.9	7.5	7.5
LnGrp LOS	B			C			A	A	A	B	A	A
Approach Vol, veh/h		39			132			1240			791	
Approach Delay, s/veh		19.4			20.9			9.2			7.7	
Approach LOS		B			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		43.5		21.3		43.5		21.3
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		56.0		22.0		56.0		22.0
Max Q Clear Time (g_c+I1), s		18.1		6.4		16.1		3.1
Green Ext Time (p_c), s		19.5		0.8		20.0		0.9

Intersection Summary	
HCM 2010 Ctrl Delay	9.6
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	40	56	15	133	84	114	9	698	295	166	951	52
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1776	1900	1900	1827	1827	1827	1827	1827	1827	1827	1827
Adj Flow Rate, veh/h	44	62	17	148	93	127	10	776	328	184	1057	58
Adj No. of Lanes	0	2	0	0	1	1	1	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	7	7	7	4	4	4	4	4	4	4	4	4
Cap, veh/h	140	322	89	251	127	408	322	1880	841	467	2330	1042
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	1.00	1.00	1.00	0.08	0.67	0.67
Sat Flow, veh/h	298	1227	339	763	482	1553	494	3471	1553	1740	3471	1553
Grp Volume(v), veh/h	45	0	78	241	0	127	10	776	328	184	1057	58
Grp Sat Flow(s),veh/h/ln	309	0	1556	1246	0	1553	494	1736	1553	1740	1736	1553
Q Serve(g_s), s	4.4	0.0	4.5	17.7	0.0	7.6	0.1	0.0	0.0	5.0	16.7	1.5
Cycle Q Clear(g_c), s	26.5	0.0	4.5	22.2	0.0	7.6	1.9	0.0	0.0	5.0	16.7	1.5
Prop In Lane	0.98		0.22	0.61		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	143	0	409	377	0	408	322	1880	841	467	2330	1042
V/C Ratio(X)	0.32	0.00	0.19	0.64	0.00	0.31	0.03	0.41	0.39	0.39	0.45	0.06
Avail Cap(c_a), veh/h	226	0	525	486	0	524	322	1880	841	588	2330	1042
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.89	0.00	0.89	0.92	0.92	0.92	0.74	0.74	0.74
Uniform Delay (d), s/veh	51.4	0.0	33.1	41.6	0.0	34.2	0.0	0.0	0.0	8.6	9.0	6.5
Incr Delay (d2), s/veh	1.3	0.0	0.2	1.6	0.0	0.4	0.2	0.6	1.2	0.4	0.5	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	2.0	7.3	0.0	3.3	0.0	0.2	0.3	2.4	8.1	0.7
LnGrp Delay(d),s/veh	52.7	0.0	33.3	43.2	0.0	34.6	0.2	0.6	1.2	9.0	9.5	6.6
LnGrp LOS	D		C	D		C	A	A	A	A	A	A
Approach Vol, veh/h		123			368			1114			1299	
Approach Delay, s/veh		40.4			40.3			0.8			9.3	
Approach LOS		D			D			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		8
Phs Duration (G+Y+Rc), s		83.6		36.4	15.0	68.7		36.4
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		69.0		39.0	17.0	46.0		39.0
Max Q Clear Time (g_c+I1), s		18.7		24.2	7.0	3.9		28.5
Green Ext Time (p_c), s		24.4		2.2	0.3	22.4		1.9

Intersection Summary	
HCM 2010 Ctrl Delay	11.3
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	32	52	29	184	95	262	31	899	180	106	590	50
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1792	1900	1900	1827	1827	1845	1845	1845	1845	1845	1845
Adj Flow Rate, veh/h	36	58	32	204	106	291	34	999	200	118	656	56
Adj No. of Lanes	0	2	0	0	1	1	1	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	4	4	4	3	3	3	3	3	3
Cap, veh/h	118	313	182	305	134	488	425	1774	794	414	2188	979
Arrive On Green	0.31	0.31	0.31	0.31	0.31	0.31	1.00	1.00	1.00	0.07	0.62	0.62
Sat Flow, veh/h	207	996	581	820	426	1553	728	3505	1568	1757	3505	1568
Grp Volume(v), veh/h	42	0	84	310	0	291	34	999	200	118	656	56
Grp Sat Flow(s),veh/h/ln	255	0	1529	1246	0	1553	728	1752	1568	1757	1752	1568
Q Serve(g_s), s	4.4	0.0	5.0	25.4	0.0	19.9	0.0	0.0	0.0	3.7	10.9	1.7
Cycle Q Clear(g_c), s	34.5	0.0	5.0	30.3	0.0	19.9	0.1	0.0	0.0	3.7	10.9	1.7
Prop In Lane	0.86		0.38	0.66		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	133	0	480	439	0	488	425	1774	794	414	2188	979
V/C Ratio(X)	0.31	0.00	0.18	0.71	0.00	0.60	0.08	0.56	0.25	0.29	0.30	0.06
Avail Cap(c_a), veh/h	202	0	584	535	0	593	425	1774	794	430	2188	979
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.84	0.00	0.84	0.83	0.83	0.83	0.94	0.94	0.94
Uniform Delay (d), s/veh	52.3	0.0	31.3	42.2	0.0	36.4	0.0	0.0	0.0	11.2	10.9	9.2
Incr Delay (d2), s/veh	1.3	0.0	0.2	2.8	0.0	1.0	0.3	1.1	0.6	0.4	0.3	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	2.2	10.3	0.0	8.6	0.0	0.3	0.1	1.8	5.3	0.8
LnGrp Delay(d),s/veh	53.7	0.0	31.5	45.0	0.0	37.4	0.3	1.1	0.6	11.6	11.2	9.3
LnGrp LOS	D		C	D		D	A	A	A	B	B	A
Approach Vol, veh/h		126			601			1233			830	
Approach Delay, s/veh		38.8			41.3			1.0			11.2	
Approach LOS		D			D			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		8
Phs Duration (G+Y+Rc), s		84.5		45.5	14.9	69.7		45.5
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		70.0		48.0	10.0	54.0		48.0
Max Q Clear Time (g_c+I1), s		12.9		32.3	5.7	2.1		36.5
Green Ext Time (p_c), s		21.0		3.4	0.1	20.4		2.9

Intersection Summary	
HCM 2010 Ctrl Delay	14.4
HCM 2010 LOS	B

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	209	148	128	682	907	124
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	1792	1810	1810	1827	1827
Adj Flow Rate, veh/h	232	164	142	758	1008	138
Adj No. of Lanes	1	1	1	2	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	5	5	4	4
Cap, veh/h	271	241	435	2696	2722	1218
Arrive On Green	0.16	0.16	1.00	1.00	1.00	1.00
Sat Flow, veh/h	1707	1524	475	3529	3563	1553
Grp Volume(v), veh/h	232	164	142	758	1008	138
Grp Sat Flow(s),veh/h/ln	1707	1524	475	1719	1736	1553
Q Serve(g_s), s	15.2	11.6	0.0	0.0	0.0	0.0
Cycle Q Clear(g_c), s	15.2	11.6	0.0	0.0	0.0	0.0
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	271	241	435	2696	2722	1218
V/C Ratio(X)	0.86	0.68	0.33	0.28	0.37	0.11
Avail Cap(c_a), veh/h	432	386	435	2696	2722	1218
HCM Platoon Ratio	1.00	1.00	2.00	2.00	2.00	2.00
Upstream Filter(I)	0.90	0.90	0.75	0.75	0.89	0.89
Uniform Delay (d), s/veh	47.0	45.5	0.0	0.0	0.0	0.0
Incr Delay (d2), s/veh	8.7	3.0	1.5	0.2	0.3	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.8	5.1	0.2	0.1	0.1	0.1
LnGrp Delay(d),s/veh	55.7	48.5	1.5	0.2	0.3	0.2
LnGrp LOS	E	D	A	A	A	A
Approach Vol, veh/h	396			900	1146	
Approach Delay, s/veh	52.7			0.4	0.3	
Approach LOS	D			A	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		95.8				95.8		24.2
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		79.0				79.0		29.0
Max Q Clear Time (g_c+I1), s		2.0				2.0		17.2
Green Ext Time (p_c), s		29.0				29.0		1.0

Intersection Summary	
HCM 2010 Ctrl Delay	8.8
HCM 2010 LOS	A

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	191	102	191	997	664	165
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1827	1827	1845	1845
Adj Flow Rate, veh/h	212	113	212	1108	738	183
Adj No. of Lanes	1	1	1	2	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	4	4	3	3
Cap, veh/h	270	241	521	2381	2404	1075
Arrive On Green	0.16	0.16	0.91	0.91	1.00	1.00
Sat Flow, veh/h	1723	1538	593	3563	3597	1568
Grp Volume(v), veh/h	212	113	212	1108	738	183
Grp Sat Flow(s),veh/h/ln	1723	1538	593	1736	1752	1568
Q Serve(g_s), s	7.4	4.2	3.8	3.1	0.0	0.0
Cycle Q Clear(g_c), s	7.4	4.2	3.8	3.1	0.0	0.0
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	270	241	521	2381	2404	1075
V/C Ratio(X)	0.79	0.47	0.41	0.47	0.31	0.17
Avail Cap(c_a), veh/h	383	342	521	2381	2404	1075
HCM Platoon Ratio	1.00	1.00	1.33	1.33	2.00	2.00
Upstream Filter(I)	0.96	0.96	0.55	0.55	0.96	0.96
Uniform Delay (d), s/veh	25.5	24.2	1.0	1.0	0.0	0.0
Incr Delay (d2), s/veh	6.6	1.4	1.3	0.4	0.3	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	1.9	0.7	1.4	0.1	0.1
LnGrp Delay(d),s/veh	32.1	25.5	2.3	1.4	0.3	0.3
LnGrp LOS	C	C	A	A	A	A
Approach Vol, veh/h	325			1320	921	
Approach Delay, s/veh	29.8			1.5	0.3	
Approach LOS	C			A	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		49.2				49.2		15.8
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		39.0				39.0		14.0
Max Q Clear Time (g_c+I1), s		2.0				5.8		9.4
Green Ext Time (p_c), s		23.1				21.6		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	4.7
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	414	738	349	38	370	39	129	410	19	80	654	314
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1792	1792	1900	1792	1792	1900	1810	1810	1810
Adj Flow Rate, veh/h	460	820	388	42	411	43	143	456	21	89	727	349
Adj No. of Lanes	1	2	0	1	2	0	1	2	0	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	6	6	6	6	6	6	5	5	5
Cap, veh/h	507	1045	492	129	552	58	295	1521	70	356	1141	867
Arrive On Green	0.23	0.46	0.46	0.18	0.18	0.18	0.03	0.15	0.15	0.66	0.66	0.66
Sat Flow, veh/h	1723	2270	1069	443	3114	324	1707	3316	152	888	3438	1538
Grp Volume(v), veh/h	460	620	588	42	224	230	143	234	243	89	727	349
Grp Sat Flow(s),veh/h/ln	1723	1719	1621	443	1703	1735	1707	1703	1766	888	1719	1538
Q Serve(g_s), s	24.6	35.8	36.1	10.4	14.6	14.8	6.1	14.3	14.4	5.0	14.5	10.7
Cycle Q Clear(g_c), s	24.6	35.8	36.1	13.3	14.6	14.8	6.1	14.3	14.4	5.0	14.5	10.7
Prop In Lane	1.00		0.66	1.00		0.19	1.00		0.09	1.00		1.00
Lane Grp Cap(c), veh/h	507	791	746	129	302	308	295	781	810	356	1141	867
V/C Ratio(X)	0.91	0.78	0.79	0.33	0.74	0.75	0.48	0.30	0.30	0.25	0.64	0.40
Avail Cap(c_a), veh/h	563	863	814	133	319	325	297	781	810	356	1141	867
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	0.33	0.33	0.33	2.00	2.00	2.00
Upstream Filter(I)	0.58	0.58	0.58	0.90	0.90	0.90	0.98	0.98	0.98	0.92	0.92	0.92
Uniform Delay (d), s/veh	28.3	26.8	26.9	46.6	45.8	45.8	24.1	33.1	33.1	14.1	15.7	6.8
Incr Delay (d2), s/veh	11.3	2.6	2.9	1.3	7.7	7.9	1.2	1.0	0.9	1.5	2.5	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.2	17.4	16.8	1.3	7.5	7.8	3.0	7.0	7.3	1.3	7.1	4.6
LnGrp Delay(d),s/veh	39.6	29.4	29.7	47.9	53.4	53.7	25.3	34.1	34.0	15.6	18.2	8.1
LnGrp LOS	D	C	C	D	D	D	C	C	C	B	B	A
Approach Vol, veh/h		1668			496			620			1165	
Approach Delay, s/veh		32.3			53.1			32.0			15.0	
Approach LOS		C			D			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4		6		8
Phs Duration (G+Y+Rc), s	14.9	45.0	33.2	26.9		59.9		60.1
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	9.0	34.0	31.0	22.0		49.0		59.0
Max Q Clear Time (g_c+I1), s	8.1	16.5	26.6	16.8		16.4		38.1
Green Ext Time (p_c), s	0.0	9.1	0.7	4.1		12.1		12.0

Intersection Summary	
HCM 2010 Ctrl Delay	29.8
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	423	408	169	33	717	84	341	643	52	55	438	335
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1827	1900	1810	1810	1900	1810	1810	1900	1827	1827	1827
Adj Flow Rate, veh/h	470	453	188	37	797	93	379	714	58	61	487	372
Adj No. of Lanes	1	2	0	1	2	0	1	2	0	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	5	5	5	5	5	5	4	4	4
Cap, veh/h	461	1292	532	255	811	95	352	1189	97	164	561	609
Arrive On Green	0.23	0.54	0.54	0.26	0.26	0.26	0.05	0.12	0.12	0.32	0.32	0.32
Sat Flow, veh/h	1740	2400	988	763	3103	362	1723	3221	261	681	3471	1553
Grp Volume(v), veh/h	470	327	314	37	442	448	379	381	391	61	487	372
Grp Sat Flow(s),veh/h/ln	1740	1736	1653	763	1719	1746	1723	1719	1763	681	1736	1553
Q Serve(g_s), s	30.0	13.9	14.1	4.9	33.2	33.2	21.0	27.3	27.3	9.7	17.2	21.0
Cycle Q Clear(g_c), s	30.0	13.9	14.1	4.9	33.2	33.2	21.0	27.3	27.3	10.0	17.2	21.0
Prop In Lane	1.00		0.60	1.00		0.21	1.00		0.15	1.00		1.00
Lane Grp Cap(c), veh/h	461	935	890	255	450	457	352	635	651	164	561	609
V/C Ratio(X)	1.02	0.35	0.35	0.15	0.98	0.98	1.08	0.60	0.60	0.37	0.87	0.61
Avail Cap(c_a), veh/h	461	935	890	255	450	457	352	635	651	164	561	609
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	0.33	0.33	0.33	2.00	2.00	2.00
Upstream Filter(I)	0.89	0.89	0.89	0.74	0.74	0.74	0.91	0.91	0.91	0.95	0.95	0.95
Uniform Delay (d), s/veh	39.8	17.1	17.1	37.3	47.7	47.7	42.5	48.0	48.0	40.4	42.7	26.4
Incr Delay (d2), s/veh	44.8	0.2	0.2	0.2	31.8	31.6	67.5	3.8	3.7	6.1	15.9	4.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	22.2	6.7	6.4	1.0	19.7	20.0	16.6	13.7	14.0	2.1	9.4	12.1
LnGrp Delay(d),s/veh	84.6	17.3	17.3	37.4	79.5	79.3	110.0	51.8	51.7	46.5	58.6	30.7
LnGrp LOS	F	B	B	D	E	E	F	D	D	D	E	C
Approach Vol, veh/h		1111			927			1151			920	
Approach Delay, s/veh		45.8			77.7			70.9			46.5	
Approach LOS		D			E			E			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4		6		8
Phs Duration (G+Y+Rc), s	27.0	27.0	36.0	40.0		54.0		76.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	21.0	21.0	30.0	34.0		48.0		70.0
Max Q Clear Time (g_c+I1), s	23.0	23.0	32.0	35.2		29.3		16.1
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0		9.7		14.3

Intersection Summary	
HCM 2010 Ctrl Delay	60.2
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	21	53	125	24	49	130	29	419	21	98	803	40
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1792	1900	1792	1792	1900	1792	1792	1792
Adj Flow Rate, veh/h	23	59	139	27	54	144	32	466	23	109	892	44
Adj No. of Lanes	0	1	0	0	1	0	1	2	0	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	6	6	6	6	6	6	6	6	6
Cap, veh/h	55	92	188	59	81	183	409	2230	110	742	2756	1233
Arrive On Green	0.18	0.18	0.18	0.18	0.18	0.18	0.67	0.67	0.67	0.03	0.27	0.27
Sat Flow, veh/h	104	516	1052	121	454	1022	573	3304	163	1707	3406	1524
Grp Volume(v), veh/h	221	0	0	225	0	0	32	240	249	109	892	44
Grp Sat Flow(s),veh/h/ln	1672	0	0	1596	0	0	573	1703	1764	1707	1703	1524
Q Serve(g_s), s	0.0	0.0	0.0	1.0	0.0	0.0	2.6	5.8	5.8	1.7	23.0	2.3
Cycle Q Clear(g_c), s	13.4	0.0	0.0	14.4	0.0	0.0	10.9	5.8	5.8	1.7	23.0	2.3
Prop In Lane	0.10		0.63	0.12		0.64	1.00		0.09	1.00		1.00
Lane Grp Cap(c), veh/h	336	0	0	323	0	0	409	1149	1191	742	2756	1233
V/C Ratio(X)	0.66	0.00	0.00	0.70	0.00	0.00	0.08	0.21	0.21	0.15	0.32	0.04
Avail Cap(c_a), veh/h	648	0	0	620	0	0	409	1149	1191	841	2756	1233
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.33	0.33	0.33
Upstream Filter(I)	1.00	0.00	0.00	0.94	0.00	0.00	1.00	1.00	1.00	0.69	0.69	0.69
Uniform Delay (d), s/veh	42.4	0.0	0.0	42.8	0.0	0.0	9.3	6.7	6.7	3.5	16.1	8.5
Incr Delay (d2), s/veh	2.2	0.0	0.0	2.6	0.0	0.0	0.4	0.4	0.4	0.1	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.5	0.0	0.0	6.7	0.0	0.0	0.5	2.9	3.0	0.8	10.9	1.0
LnGrp Delay(d),s/veh	44.6	0.0	0.0	45.3	0.0	0.0	9.7	7.1	7.1	3.6	16.3	8.5
LnGrp LOS	D			D			A	A	A	A	B	A
Approach Vol, veh/h		221			225			521			1045	
Approach Delay, s/veh		44.6			45.3			7.3			14.6	
Approach LOS		D			D			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		8
Phs Duration (G+Y+Rc), s		94.4		25.6	14.7	79.8		25.6
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		67.0		41.0	15.0	46.0		41.0
Max Q Clear Time (g_c+I1), s		25.0		16.4	3.7	12.9		15.4
Green Ext Time (p_c), s		13.0		3.1	0.2	12.1		3.2

Intersection Summary	
HCM 2010 Ctrl Delay	19.4
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	59	55	56	18	72	160	86	772	31	95	505	70
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1810	1900	1810	1810	1900	1810	1810	1810
Adj Flow Rate, veh/h	66	61	62	20	80	178	96	858	34	106	561	78
Adj No. of Lanes	0	1	0	0	1	0	1	2	0	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	5	5	5	5	5	5	5	5	5
Cap, veh/h	105	96	79	46	108	217	547	2154	85	494	2612	1169
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.64	0.64	0.64	0.05	0.51	0.51
Sat Flow, veh/h	317	467	383	68	523	1052	764	3371	134	1723	3438	1538
Grp Volume(v), veh/h	189	0	0	278	0	0	96	437	455	106	561	78
Grp Sat Flow(s),veh/h/ln	1167	0	0	1642	0	0	764	1719	1786	1723	1719	1538
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.0	6.3	15.1	15.1	2.2	11.0	3.1
Cycle Q Clear(g_c), s	20.2	0.0	0.0	19.5	0.0	0.0	6.3	15.1	15.1	2.2	11.0	3.1
Prop In Lane	0.35		0.33	0.07		0.64	1.00		0.07	1.00		1.00
Lane Grp Cap(c), veh/h	281	0	0	371	0	0	547	1098	1141	494	2612	1169
V/C Ratio(X)	0.67	0.00	0.00	0.75	0.00	0.00	0.18	0.40	0.40	0.21	0.21	0.07
Avail Cap(c_a), veh/h	467	0	0	575	0	0	547	1098	1141	554	2612	1169
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.67	0.67	0.67
Upstream Filter(I)	1.00	0.00	0.00	0.97	0.00	0.00	1.00	1.00	1.00	0.46	0.46	0.46
Uniform Delay (d), s/veh	45.5	0.0	0.0	46.3	0.0	0.0	9.1	10.7	10.7	6.5	9.9	8.0
Incr Delay (d2), s/veh	2.8	0.0	0.0	3.0	0.0	0.0	0.7	1.1	1.0	0.1	0.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.3	0.0	0.0	9.3	0.0	0.0	1.4	7.4	7.7	1.0	5.3	1.4
LnGrp Delay(d),s/veh	48.3	0.0	0.0	49.2	0.0	0.0	9.8	11.8	11.7	6.6	10.0	8.0
LnGrp LOS	D			D			A	B	B	A	A	A
Approach Vol, veh/h		189			278			988			745	
Approach Delay, s/veh		48.3			49.2			11.5			9.3	
Approach LOS		D			D			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		8
Phs Duration (G+Y+Rc), s		98.8		31.2	14.8	84.0		31.2
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		77.0		41.0	13.0	58.0		41.0
Max Q Clear Time (g_c+I1), s		13.0		21.5	4.2	17.1		22.2
Green Ext Time (p_c), s		15.6		3.1	0.1	14.3		3.1

Intersection Summary	
HCM 2010 Ctrl Delay	18.7
HCM 2010 LOS	B

Intersection	
Int Delay, s/veh	2.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	327	181	20	542	435
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	8	8	2	2	6	6
Mvmt Flow	0	363	201	22	602	483

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1658	112	0	0	223	0
Stage 1	212	-	-	-	-	-
Stage 2	1446	-	-	-	-	-
Critical Hdwy	6.96	7.06	-	-	4.22	-
Critical Hdwy Stg 1	5.96	-	-	-	-	-
Critical Hdwy Stg 2	5.96	-	-	-	-	-
Follow-up Hdwy	3.58	3.38	-	-	2.26	-
Pot Cap-1 Maneuver	83	901	-	-	1314	-
Stage 1	785	-	-	-	-	-
Stage 2	173	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	45	901	-	-	1314	-
Mov Cap-2 Maneuver	83	-	-	-	-	-
Stage 1	785	-	-	-	-	-
Stage 2	94	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.7		
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	901	1314	-
HCM Lane V/C Ratio	-	-	0.403	0.458	-
HCM Control Delay (s)	-	-	11.7	10	-
HCM Lane LOS	-	-	B	B	-
HCM 95th %tile Q(veh)	-	-	2	2	-

Intersection	
Int Delay, s/veh	7.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	483	387	37	329	186
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	7	7	2	2	5	5
Mvmt Flow	0	537	430	41	366	207

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1285	236	0	0	471	0
Stage 1	451	-	-	-	-	-
Stage 2	834	-	-	-	-	-
Critical Hdwy	6.94	7.04	-	-	4.2	-
Critical Hdwy Stg 1	5.94	-	-	-	-	-
Critical Hdwy Stg 2	5.94	-	-	-	-	-
Follow-up Hdwy	3.57	3.37	-	-	2.25	-
Pot Cap-1 Maneuver	150	750	-	-	1066	-
Stage 1	594	-	-	-	-	-
Stage 2	374	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	98	750	-	-	1066	-
Mov Cap-2 Maneuver	194	-	-	-	-	-
Stage 1	594	-	-	-	-	-
Stage 2	246	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	20.9		
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	750	1066	-
HCM Lane V/C Ratio	-	-	0.716	0.343	-
HCM Control Delay (s)	-	-	20.9	10.1	-
HCM Lane LOS	-	-	C	B	-
HCM 95th %tile Q(veh)	-	-	6	2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	7	60	6	58	10	35	8	271	14	82	486	16
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1827	1827	1776	1776	1776	1759	1759	1900
Adj Flow Rate, veh/h	8	67	7	64	11	39	9	301	16	91	540	18
Adj No. of Lanes	0	1	0	0	1	1	1	1	1	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	4	4	4	7	7	7	8	8	8
Cap, veh/h	99	488	47	489	73	473	302	798	679	485	761	25
Arrive On Green	0.30	0.30	0.30	0.30	0.30	0.30	0.45	0.45	0.45	0.45	0.45	0.45
Sat Flow, veh/h	58	1601	155	1156	241	1553	808	1776	1509	999	1693	56
Grp Volume(v), veh/h	82	0	0	75	0	39	9	301	16	91	0	558
Grp Sat Flow(s),veh/h/ln	1813	0	0	1397	0	1553	808	1776	1509	999	0	1749
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	0.9	0.4	5.5	0.3	3.2	0.0	12.6
Cycle Q Clear(g_c), s	1.6	0.0	0.0	1.5	0.0	0.9	13.0	5.5	0.3	8.7	0.0	12.6
Prop In Lane	0.10		0.09	0.85		1.00	1.00		1.00	1.00		0.03
Lane Grp Cap(c), veh/h	633	0	0	562	0	473	302	798	679	485	0	786
V/C Ratio(X)	0.13	0.00	0.00	0.13	0.00	0.08	0.03	0.38	0.02	0.19	0.00	0.71
Avail Cap(c_a), veh/h	783	0	0	676	0	604	750	1782	1514	1038	0	1755
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.4	0.0	0.0	12.3	0.0	12.1	16.1	8.9	7.5	11.8	0.0	10.9
Incr Delay (d2), s/veh	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.3	0.0	0.2	0.0	1.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	0.0	0.0	0.7	0.0	0.4	0.1	2.7	0.1	0.9	0.0	6.3
LnGrp Delay(d),s/veh	12.4	0.0	0.0	12.4	0.0	12.2	16.2	9.2	7.5	12.0	0.0	12.1
LnGrp LOS	B			B		B	B	A	A	B		B
Approach Vol, veh/h		82			114			326			649	
Approach Delay, s/veh		12.4			12.3			9.3			12.0	
Approach LOS		B			B			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		28.0		20.9		28.0		20.9
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		49.0		19.0		49.0		19.0
Max Q Clear Time (g_c+I1), s		14.6		3.5		15.0		3.6
Green Ext Time (p_c), s		6.9		0.8		6.9		0.8

Intersection Summary	
HCM 2010 Ctrl Delay	11.3
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	14	6	28	48	67	5	446	44	45	304	4
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1900	1900	1827	1827	1792	1792	1792	1776	1776	1900
Adj Flow Rate, veh/h	6	16	7	31	53	74	6	496	49	50	338	4
Adj No. of Lanes	0	1	0	0	1	1	1	1	1	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	4	4	4	6	6	6	7	7	7
Cap, veh/h	150	336	126	245	369	476	458	793	674	338	774	9
Arrive On Green	0.31	0.31	0.31	0.31	0.31	0.31	0.44	0.44	0.44	0.44	0.44	0.44
Sat Flow, veh/h	193	1095	410	463	1203	1553	995	1792	1524	818	1751	21
Grp Volume(v), veh/h	29	0	0	84	0	74	6	496	49	50	0	342
Grp Sat Flow(s),veh/h/ln	1698	0	0	1666	0	1553	995	1792	1524	818	0	1772
Q Serve(g_s), s	0.0	0.0	0.0	0.0	0.0	1.7	0.2	10.2	0.9	2.4	0.0	6.4
Cycle Q Clear(g_c), s	0.5	0.0	0.0	1.6	0.0	1.7	6.6	10.2	0.9	12.6	0.0	6.4
Prop In Lane	0.21		0.24	0.37		1.00	1.00		1.00	1.00		0.01
Lane Grp Cap(c), veh/h	612	0	0	614	0	476	458	793	674	338	0	784
V/C Ratio(X)	0.05	0.00	0.00	0.14	0.00	0.16	0.01	0.63	0.07	0.15	0.00	0.44
Avail Cap(c_a), veh/h	794	0	0	795	0	650	1017	1800	1530	797	0	1780
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	11.7	0.0	0.0	12.0	0.0	12.1	11.5	10.3	7.7	15.1	0.0	9.2
Incr Delay (d2), s/veh	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.8	0.0	0.2	0.0	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0	0.8	0.0	0.7	0.1	5.1	0.4	0.6	0.0	3.1
LnGrp Delay(d),s/veh	11.7	0.0	0.0	12.1	0.0	12.2	11.5	11.1	7.7	15.3	0.0	9.6
LnGrp LOS	B			B		B	B	B	A	B		A
Approach Vol, veh/h		29			158			551			392	
Approach Delay, s/veh		11.7			12.2			10.8			10.3	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		27.1		20.7		27.1		20.7
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		48.0		20.0		48.0		20.0
Max Q Clear Time (g_c+I1), s		14.6		3.7		12.2		2.5
Green Ext Time (p_c), s		6.5		0.7		6.6		0.8

Intersection Summary	
HCM 2010 Ctrl Delay	10.9
HCM 2010 LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	12	37	259	18	42	479
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1776	1776	1792	1900	1776	1776
Adj Flow Rate, veh/h	13	41	288	20	47	532
Adj No. of Lanes	2	1	2	0	1	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	7	7	6	6	7	7
Cap, veh/h	353	163	1648	114	699	1720
Arrive On Green	0.11	0.11	0.51	0.51	0.51	0.51
Sat Flow, veh/h	3281	1509	3322	223	1017	3463
Grp Volume(v), veh/h	13	41	151	157	47	532
Grp Sat Flow(s),veh/h/ln	1640	1509	1703	1753	1017	1687
Q Serve(g_s), s	0.1	0.8	1.5	1.5	0.8	2.9
Cycle Q Clear(g_c), s	0.1	0.8	1.5	1.5	2.3	2.9
Prop In Lane	1.00	1.00		0.13	1.00	
Lane Grp Cap(c), veh/h	353	163	868	894	699	1720
V/C Ratio(X)	0.04	0.25	0.17	0.18	0.07	0.31
Avail Cap(c_a), veh/h	1673	770	1737	1788	1218	3441
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.5	12.8	4.1	4.1	4.8	4.5
Incr Delay (d2), s/veh	0.0	0.8	0.1	0.1	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	0.4	0.7	0.7	0.2	1.4
LnGrp Delay(d),s/veh	12.6	13.6	4.2	4.2	4.8	4.6
LnGrp LOS	B	B	A	A	A	A
Approach Vol, veh/h	54		308			579
Approach Delay, s/veh	13.4		4.2			4.6
Approach LOS	B		A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		22.0				22.0		9.4
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		32.0				32.0		16.0
Max Q Clear Time (g_c+I1), s		3.5				4.9		2.8
Green Ext Time (p_c), s		6.1				6.0		0.1

Intersection Summary	
HCM 2010 Ctrl Delay	5.0
HCM 2010 LOS	A

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	7	31	477	27	48	295
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	1792	1810	1900	1792	1792
Adj Flow Rate, veh/h	8	34	530	30	53	328
Adj No. of Lanes	2	1	2	0	1	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	5	5	6	6
Cap, veh/h	292	134	1724	97	584	1774
Arrive On Green	0.09	0.09	0.52	0.52	0.52	0.52
Sat Flow, veh/h	3312	1524	3399	187	814	3495
Grp Volume(v), veh/h	8	34	275	285	53	328
Grp Sat Flow(s),veh/h/ln	1656	1524	1719	1777	814	1703
Q Serve(g_s), s	0.1	0.6	2.8	2.8	1.2	1.6
Cycle Q Clear(g_c), s	0.1	0.6	2.8	2.8	4.0	1.6
Prop In Lane	1.00	1.00		0.11	1.00	
Lane Grp Cap(c), veh/h	292	134	896	926	584	1774
V/C Ratio(X)	0.03	0.25	0.31	0.31	0.09	0.18
Avail Cap(c_a), veh/h	1618	744	1847	1909	1035	3660
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.8	13.1	4.2	4.2	5.3	3.9
Incr Delay (d2), s/veh	0.0	1.0	0.2	0.2	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.3	1.3	1.4	0.3	0.7
LnGrp Delay(d),s/veh	12.8	14.0	4.4	4.4	5.4	3.9
LnGrp LOS	B	B	A	A	A	A
Approach Vol, veh/h	42		560			381
Approach Delay, s/veh	13.8		4.4			4.2
Approach LOS	B		A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		22.0				22.0		8.7
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		33.0				33.0		15.0
Max Q Clear Time (g_c+I1), s		4.8				6.0		2.6
Green Ext Time (p_c), s		6.4				6.3		0.1

Intersection Summary	
HCM 2010 Ctrl Delay	4.7
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	21	243	260	211	169	15	82	60	288	23	129	21
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1845	1845	1900	1727	1727	1900	1863	1863	1900
Adj Flow Rate, veh/h	23	270	289	234	188	17	91	67	320	26	143	23
Adj No. of Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	3	3	3	10	10	10	2	2	2
Cap, veh/h	528	317	339	328	918	83	362	84	400	163	503	81
Arrive On Green	0.38	0.38	0.38	0.10	0.55	0.55	0.32	0.32	0.32	0.32	0.32	0.32
Sat Flow, veh/h	1172	824	883	1757	1667	151	1126	261	1246	992	1566	252
Grp Volume(v), veh/h	23	0	559	234	0	205	91	0	387	26	0	166
Grp Sat Flow(s),veh/h/ln	1172	0	1707	1757	0	1818	1126	0	1507	992	0	1818
Q Serve(g_s), s	1.2	0.0	28.0	7.1	0.0	5.3	6.1	0.0	21.9	2.3	0.0	6.4
Cycle Q Clear(g_c), s	1.2	0.0	28.0	7.1	0.0	5.3	12.5	0.0	21.9	24.2	0.0	6.4
Prop In Lane	1.00		0.52	1.00		0.08	1.00		0.83	1.00		0.14
Lane Grp Cap(c), veh/h	528	0	657	328	0	1001	362	0	484	163	0	583
V/C Ratio(X)	0.04	0.00	0.85	0.71	0.00	0.20	0.25	0.00	0.80	0.16	0.00	0.28
Avail Cap(c_a), veh/h	829	0	1095	524	0	1672	506	0	677	290	0	817
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	18.1	0.0	26.3	19.6	0.0	10.6	28.4	0.0	29.0	40.1	0.0	23.7
Incr Delay (d2), s/veh	0.0	0.0	3.5	2.9	0.0	0.1	0.4	0.0	4.7	0.5	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	13.8	3.6	0.0	2.7	1.9	0.0	9.8	0.6	0.0	3.2
LnGrp Delay(d),s/veh	18.1	0.0	29.8	22.5	0.0	10.7	28.8	0.0	33.7	40.5	0.0	24.0
LnGrp LOS	B		C	C		B	C		C	D		C
Approach Vol, veh/h		582			439			478			192	
Approach Delay, s/veh		29.3			17.0			32.7			26.2	
Approach LOS		C			B			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		8
Phs Duration (G+Y+Rc), s	15.5	42.0		36.0		57.5		36.0
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s	20.0	60.0		42.0		86.0		42.0
Max Q Clear Time (g_c+I1), s	9.1	30.0		26.2		7.3		23.9
Green Ext Time (p_c), s	0.5	6.0		3.8		6.4		4.0

Intersection Summary	
HCM 2010 Ctrl Delay	26.7
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	22	117	139	215	255	18	175	123	237	13	46	22
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1845	1845	1900	1727	1727	1900	1863	1863	1900
Adj Flow Rate, veh/h	24	130	154	239	283	20	194	137	263	14	51	24
Adj No. of Lanes	1	1	0	1	1	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	3	3	3	10	10	10	2	2	2
Cap, veh/h	374	191	227	452	808	57	492	181	347	220	409	193
Arrive On Green	0.25	0.25	0.25	0.14	0.47	0.47	0.34	0.34	0.34	0.34	0.34	0.34
Sat Flow, veh/h	1072	778	922	1757	1703	120	1223	530	1018	981	1199	564
Grp Volume(v), veh/h	24	0	284	239	0	303	194	0	400	14	0	75
Grp Sat Flow(s),veh/h/ln	1072	0	1700	1757	0	1823	1223	0	1548	981	0	1763
Q Serve(g_s), s	1.1	0.0	9.8	6.0	0.0	6.8	8.4	0.0	14.9	0.8	0.0	1.9
Cycle Q Clear(g_c), s	1.1	0.0	9.8	6.0	0.0	6.8	10.3	0.0	14.9	15.8	0.0	1.9
Prop In Lane	1.00		0.54	1.00		0.07	1.00		0.66	1.00		0.32
Lane Grp Cap(c), veh/h	374	0	418	452	0	865	492	0	528	220	0	602
V/C Ratio(X)	0.06	0.00	0.68	0.53	0.00	0.35	0.39	0.00	0.76	0.06	0.00	0.12
Avail Cap(c_a), veh/h	802	0	1097	861	0	2017	1127	0	1332	729	0	1517
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	18.9	0.0	22.2	14.4	0.0	10.8	18.3	0.0	19.0	26.1	0.0	14.8
Incr Delay (d2), s/veh	0.1	0.0	1.9	1.0	0.0	0.2	0.5	0.0	2.3	0.1	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	4.8	3.0	0.0	3.4	2.9	0.0	6.7	0.2	0.0	0.9
LnGrp Delay(d),s/veh	19.0	0.0	24.2	15.3	0.0	11.0	18.8	0.0	21.3	26.2	0.0	14.8
LnGrp LOS	B		C	B		B	B		C	C		B
Approach Vol, veh/h		308			542			594			89	
Approach Delay, s/veh		23.8			12.9			20.5			16.6	
Approach LOS		C			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		8
Phs Duration (G+Y+Rc), s	14.9	22.0		28.2		36.9		28.2
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s	24.0	42.0		56.0		72.0		56.0
Max Q Clear Time (g_c+I1), s	8.0	11.8		17.8		8.8		16.9
Green Ext Time (p_c), s	0.6	4.1		4.4		4.4		4.4

Intersection Summary	
HCM 2010 Ctrl Delay	18.2
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	163	48	304	112	69	54	144	491	166	125	794	137
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1827	1827	1863	1863	1900	1681	1681	1681	1681	1681	1681
Adj Flow Rate, veh/h	181	53	338	124	77	60	160	546	184	139	882	152
Adj No. of Lanes	1	1	1	1	2	0	1	1	1	1	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	2	2	2	13	13	13	13	13	13
Cap, veh/h	291	365	311	264	396	281	219	1093	929	404	1093	929
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.65	0.65	0.65	0.65	0.65	0.65
Sat Flow, veh/h	1223	1827	1553	989	1978	1406	490	1681	1429	652	1681	1429
Grp Volume(v), veh/h	181	53	338	124	68	69	160	546	184	139	882	152
Grp Sat Flow(s),veh/h/ln	1223	1827	1553	989	1770	1615	490	1681	1429	652	1681	1429
Q Serve(g_s), s	11.6	1.9	16.0	9.5	2.6	2.9	21.1	13.5	4.1	11.2	30.9	3.3
Cycle Q Clear(g_c), s	14.5	1.9	16.0	11.4	2.6	2.9	52.0	13.5	4.1	24.7	30.9	3.3
Prop In Lane	1.00		1.00	1.00		0.87	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	291	365	311	264	354	323	219	1093	929	404	1093	929
V/C Ratio(X)	0.62	0.15	1.09	0.47	0.19	0.21	0.73	0.50	0.20	0.34	0.81	0.16
Avail Cap(c_a), veh/h	291	365	311	264	354	323	219	1093	929	404	1093	929
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.8	26.4	32.0	31.0	26.6	26.7	31.5	7.3	5.6	13.7	10.3	5.5
Incr Delay (d2), s/veh	4.0	0.2	76.7	1.3	0.3	0.3	11.6	0.4	0.1	0.5	4.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.2	1.0	13.4	2.7	1.3	1.3	4.2	6.2	1.6	2.1	15.4	1.3
LnGrp Delay(d),s/veh	36.8	26.5	108.7	32.3	26.9	27.1	43.1	7.6	5.7	14.2	14.9	5.6
LnGrp LOS	D	C	F	C	C	C	D	A	A	B	B	A
Approach Vol, veh/h		572			261			890			1173	
Approach Delay, s/veh		78.4			29.5			13.6			13.6	
Approach LOS		E			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		58.0		22.0		58.0		22.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		52.0		16.0		52.0		16.0
Max Q Clear Time (g_c+I1), s		32.9		13.4		54.0		18.0
Green Ext Time (p_c), s		13.5		1.1		0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	27.8
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	139	56	144	166	48	127	305	796	114	52	496	174
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1827	1827	1863	1863	1900	1727	1727	1727	1712	1712	1712
Adj Flow Rate, veh/h	154	62	160	184	53	141	339	884	127	58	551	193
Adj No. of Lanes	1	1	1	1	2	0	1	1	1	1	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	2	2	2	10	10	10	11	11	11
Cap, veh/h	231	365	311	288	354	317	410	1123	954	234	1113	946
Arrive On Green	0.20	0.20	0.20	0.20	0.20	0.20	0.65	0.65	0.65	0.65	0.65	0.65
Sat Flow, veh/h	1161	1827	1553	1154	1770	1583	661	1727	1468	510	1712	1455
Grp Volume(v), veh/h	154	62	160	184	53	141	339	884	127	58	551	193
Grp Sat Flow(s),veh/h/ln	1161	1827	1553	1154	1770	1583	661	1727	1468	510	1712	1455
Q Serve(g_s), s	9.7	2.2	7.4	12.6	2.0	6.3	38.7	29.4	2.7	7.4	13.3	4.3
Cycle Q Clear(g_c), s	16.0	2.2	7.4	14.8	2.0	6.3	52.0	29.4	2.7	36.7	13.3	4.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	231	365	311	288	354	317	410	1123	954	234	1113	946
V/C Ratio(X)	0.67	0.17	0.52	0.64	0.15	0.45	0.83	0.79	0.13	0.25	0.50	0.20
Avail Cap(c_a), veh/h	231	365	311	288	354	317	410	1123	954	234	1113	946
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.5	26.5	28.5	32.6	26.4	28.1	21.7	10.0	5.4	23.2	7.2	5.6
Incr Delay (d2), s/veh	7.0	0.2	1.5	4.6	0.2	1.0	13.1	3.8	0.1	0.5	0.3	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.8	1.2	3.3	4.4	1.0	2.8	8.9	14.9	1.1	1.1	6.2	1.7
LnGrp Delay(d),s/veh	42.6	26.7	30.0	37.3	26.6	29.1	34.8	13.8	5.4	23.7	7.6	5.8
LnGrp LOS	D	C	C	D	C	C	C	B	A	C	A	A
Approach Vol, veh/h		376			378			1350			802	
Approach Delay, s/veh		34.6			32.7			18.3			8.3	
Approach LOS		C			C			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		58.0		22.0		58.0		22.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		52.0		16.0		52.0		16.0
Max Q Clear Time (g_c+I1), s		38.7		16.8		54.0		18.0
Green Ext Time (p_c), s		10.4		0.0		0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	19.5
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	474	147	200	8	67	9	99	327	7	8	698	344
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	950	1792	950	950	1900	1667	1640	1900	950	1681	1681
Adj Flow Rate, veh/h	527	163	222	9	74	10	110	363	8	9	776	382
Adj No. of Lanes	2	1	1	1	1	0	1	1	0	1	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	100	6	100	100	100	14	14	14	100	13	13
Cap, veh/h	575	339	544	128	109	15	125	867	19	270	912	1024
Arrive On Green	0.17	0.36	0.36	0.13	0.13	0.13	0.54	0.54	0.54	0.54	0.54	0.54
Sat Flow, veh/h	3312	950	1524	507	820	111	432	1599	35	514	1681	1429
Grp Volume(v), veh/h	527	163	222	9	0	84	110	0	371	9	776	382
Grp Sat Flow(s),veh/h/ln	1656	950	1524	507	0	930	432	0	1634	514	1681	1429
Q Serve(g_s), s	18.7	15.9	13.1	1.9	0.0	10.3	18.0	0.0	16.1	1.3	47.0	12.4
Cycle Q Clear(g_c), s	18.7	15.9	13.1	1.9	0.0	10.3	65.0	0.0	16.1	17.4	47.0	12.4
Prop In Lane	1.00		1.00	1.00		0.12	1.00		0.02	1.00		1.00
Lane Grp Cap(c), veh/h	575	339	544	128	0	124	125	0	886	270	912	1024
V/C Ratio(X)	0.92	0.48	0.41	0.07	0.00	0.68	0.88	0.00	0.42	0.03	0.85	0.37
Avail Cap(c_a), veh/h	581	341	547	128	0	124	125	0	886	270	912	1024
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	48.6	29.9	29.0	45.8	0.0	49.4	54.6	0.0	16.2	21.4	23.3	6.6
Incr Delay (d2), s/veh	19.4	1.1	0.5	0.2	0.0	13.6	45.9	0.0	0.3	0.0	7.7	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.1	4.3	5.6	0.3	0.0	3.1	5.2	0.0	7.3	0.2	23.7	4.9
LnGrp Delay(d),s/veh	68.0	30.9	29.5	46.0	0.0	63.0	100.5	0.0	16.5	21.4	31.0	6.8
LnGrp LOS	E	C	C	D		E	F		B	C	C	A
Approach Vol, veh/h		912			93			481			1167	
Approach Delay, s/veh		52.0			61.4			35.7			23.0	
Approach LOS		D			E			D			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6		8
Phs Duration (G+Y+Rc), s		71.0	26.8	22.0		71.0		48.8
Change Period (Y+Rc), s		6.0	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s		65.0	21.0	16.0		65.0		43.0
Max Q Clear Time (g_c+I1), s		49.0	20.7	12.3		67.0		17.9
Green Ext Time (p_c), s		9.5	0.1	0.9		0.0		2.5

Intersection Summary	
HCM 2010 Ctrl Delay	36.6
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	457	62	97	22	135	9	241	744	8	9	371	500
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	950	1810	950	950	1900	1696	1682	1900	950	1727	1727
Adj Flow Rate, veh/h	508	69	108	24	150	10	268	827	9	10	412	556
Adj No. of Lanes	2	1	1	1	1	0	1	1	0	1	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	100	5	100	100	100	12	12	12	100	10	10
Cap, veh/h	529	356	577	162	147	10	258	872	9	78	907	1003
Arrive On Green	0.16	0.38	0.38	0.17	0.17	0.17	0.52	0.52	0.52	0.52	0.52	0.52
Sat Flow, veh/h	3343	950	1538	613	881	59	527	1661	18	334	1727	1468
Grp Volume(v), veh/h	508	69	108	24	0	160	268	0	836	10	412	556
Grp Sat Flow(s),veh/h/ln	1672	950	1538	613	0	940	527	0	1679	334	1727	1468
Q Serve(g_s), s	18.1	5.9	5.7	4.1	0.0	20.0	45.1	0.0	56.5	3.5	17.9	23.2
Cycle Q Clear(g_c), s	18.1	5.9	5.7	4.1	0.0	20.0	63.0	0.0	56.5	60.0	17.9	23.2
Prop In Lane	1.00		1.00	1.00		0.06	1.00		0.01	1.00		1.00
Lane Grp Cap(c), veh/h	529	356	577	162	0	157	258	0	881	78	907	1003
V/C Ratio(X)	0.96	0.19	0.19	0.15	0.00	1.02	1.04	0.00	0.95	0.13	0.45	0.55
Avail Cap(c_a), veh/h	529	356	577	162	0	157	258	0	881	78	907	1003
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	50.1	25.3	25.2	43.4	0.0	50.0	42.7	0.0	27.0	55.4	17.8	9.7
Incr Delay (d2), s/veh	29.1	0.3	0.2	0.4	0.0	77.7	66.4	0.0	19.0	0.7	0.4	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.5	1.6	2.4	0.7	0.0	8.6	13.3	0.0	30.7	0.3	8.6	9.5
LnGrp Delay(d),s/veh	79.2	25.5	25.4	43.8	0.0	128.0	109.0	0.0	45.9	56.1	18.1	10.4
LnGrp LOS	E	C	C	D		F	F		D	E	B	B
Approach Vol, veh/h		685			184			1104			978	
Approach Delay, s/veh		65.3			117.0			61.3			14.1	
Approach LOS		E			F			E			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6		8
Phs Duration (G+Y+Rc), s		69.0	25.0	26.0		69.0		51.0
Change Period (Y+Rc), s		6.0	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s		63.0	19.0	20.0		63.0		45.0
Max Q Clear Time (g_c+I1), s		62.0	20.1	22.0		65.0		7.9
Green Ext Time (p_c), s		0.9	0.0	0.0		0.0		2.3

Intersection Summary	
HCM 2010 Ctrl Delay	50.0
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	51	45	92	5	30	9	74	378	16	7	714	114
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1792	1900	1827	1827	1900	1652	1652	1900	1667	1667	1900
Adj Flow Rate, veh/h	57	50	102	6	33	10	82	420	18	8	793	127
Adj No. of Lanes	0	1	0	1	1	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	4	4	4	15	15	15	14	14	14
Cap, veh/h	113	88	140	259	251	76	217	1059	45	554	944	151
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.67	0.67	0.67	0.67	0.67	0.67
Sat Flow, veh/h	318	471	752	1207	1347	408	537	1573	67	847	1402	225
Grp Volume(v), veh/h	209	0	0	6	0	43	82	0	438	8	0	920
Grp Sat Flow(s),veh/h/ln	1542	0	0	1207	0	1755	537	0	1640	847	0	1627
Q Serve(g_s), s	7.2	0.0	0.0	0.0	0.0	1.7	11.6	0.0	10.2	0.4	0.0	36.4
Cycle Q Clear(g_c), s	10.8	0.0	0.0	0.5	0.0	1.7	48.0	0.0	10.2	10.6	0.0	36.4
Prop In Lane	0.27		0.49	1.00		0.23	1.00		0.04	1.00		0.14
Lane Grp Cap(c), veh/h	341	0	0	259	0	327	217	0	1104	554	0	1096
V/C Ratio(X)	0.61	0.00	0.00	0.02	0.00	0.13	0.38	0.00	0.40	0.01	0.00	0.84
Avail Cap(c_a), veh/h	342	0	0	260	0	328	245	0	1188	597	0	1178
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	32.6	0.0	0.0	28.5	0.0	29.0	28.6	0.0	6.2	8.6	0.0	10.5
Incr Delay (d2), s/veh	3.2	0.0	0.0	0.0	0.0	0.2	1.1	0.0	0.2	0.0	0.0	5.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.9	0.0	0.0	0.1	0.0	0.9	1.8	0.0	4.6	0.1	0.0	17.7
LnGrp Delay(d),s/veh	35.8	0.0	0.0	28.6	0.0	29.2	29.6	0.0	6.5	8.6	0.0	15.8
LnGrp LOS	D			C		C	C		A	A		B
Approach Vol, veh/h		209			49			520			928	
Approach Delay, s/veh		35.8			29.1			10.1			15.7	
Approach LOS		D			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		63.6		22.0		63.6		22.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		62.0		16.0		62.0		16.0
Max Q Clear Time (g_c+I1), s		38.4		3.7		50.0		12.8
Green Ext Time (p_c), s		11.9		1.2		7.6		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	16.9
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	64	32	99	14	47	15	129	734	4	21	349	83
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1810	1900	1827	1827	1900	1696	1696	1900	1696	1696	1900
Adj Flow Rate, veh/h	71	36	110	16	52	17	143	816	4	23	388	92
Adj No. of Lanes	0	1	0	1	1	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	4	4	4	12	12	12	12	12	12
Cap, veh/h	153	84	175	345	299	98	467	1018	5	242	800	190
Arrive On Green	0.23	0.23	0.23	0.23	0.23	0.23	0.60	0.60	0.60	0.60	0.60	0.60
Sat Flow, veh/h	377	373	771	1213	1319	431	830	1687	8	605	1326	315
Grp Volume(v), veh/h	217	0	0	16	0	69	143	0	820	23	0	480
Grp Sat Flow(s),veh/h/ln	1521	0	0	1213	0	1751	830	0	1695	605	0	1641
Q Serve(g_s), s	5.3	0.0	0.0	0.0	0.0	2.2	8.2	0.0	26.2	2.1	0.0	11.6
Cycle Q Clear(g_c), s	8.9	0.0	0.0	0.9	0.0	2.2	19.8	0.0	26.2	28.3	0.0	11.6
Prop In Lane	0.33		0.51	1.00		0.25	1.00		0.00	1.00		0.19
Lane Grp Cap(c), veh/h	412	0	0	345	0	396	467	0	1023	242	0	990
V/C Ratio(X)	0.53	0.00	0.00	0.05	0.00	0.17	0.31	0.00	0.80	0.09	0.00	0.48
Avail Cap(c_a), veh/h	497	0	0	415	0	497	649	0	1395	375	0	1350
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	24.4	0.0	0.0	21.4	0.0	22.0	13.4	0.0	10.7	21.6	0.0	7.8
Incr Delay (d2), s/veh	1.0	0.0	0.0	0.1	0.0	0.2	0.4	0.0	2.5	0.2	0.0	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.9	0.0	0.0	0.2	0.0	1.1	1.9	0.0	12.8	0.4	0.0	5.3
LnGrp Delay(d),s/veh	25.4	0.0	0.0	21.5	0.0	22.2	13.8	0.0	13.2	21.8	0.0	8.2
LnGrp LOS	C			C		C	B		B	C		A
Approach Vol, veh/h		217			85			963			503	
Approach Delay, s/veh		25.4			22.0			13.3			8.8	
Approach LOS		C			C			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		48.5		22.0		48.5		22.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		58.0		20.0		58.0		20.0
Max Q Clear Time (g_c+I1), s		30.3		4.2		28.2		10.9
Green Ext Time (p_c), s		12.2		1.6		12.6		1.2

Intersection Summary	
HCM 2010 Ctrl Delay	13.9
HCM 2010 LOS	B

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	56	0	432	92	0	738
Number	7	14	6	16	5	2
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1743	1743	1652	1652	0	1652
Adj Flow Rate, veh/h	62	0	480	0	0	820
Adj No. of Lanes	1	1	1	1	0	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	9	9	15	15	0	15
Cap, veh/h	175	156	1065	905	0	1065
Arrive On Green	0.11	0.00	0.64	0.00	0.00	0.64
Sat Flow, veh/h	1660	1482	1652	1404	0	1652
Grp Volume(v), veh/h	62	0	480	0	0	820
Grp Sat Flow(s),veh/h/ln	1660	1482	1652	1404	0	1652
Q Serve(g_s), s	1.7	0.0	7.0	0.0	0.0	16.8
Cycle Q Clear(g_c), s	1.7	0.0	7.0	0.0	0.0	16.8
Prop In Lane	1.00	1.00		1.00	0.00	
Lane Grp Cap(c), veh/h	175	156	1065	905	0	1065
V/C Ratio(X)	0.35	0.00	0.45	0.00	0.00	0.77
Avail Cap(c_a), veh/h	311	278	2032	1727	0	2032
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	0.00	1.00
Uniform Delay (d), s/veh	19.9	0.0	4.3	0.0	0.0	6.0
Incr Delay (d2), s/veh	1.2	0.0	0.3	0.0	0.0	1.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	0.0	3.2	0.0	0.0	7.6
LnGrp Delay(d),s/veh	21.1	0.0	4.6	0.0	0.0	7.2
LnGrp LOS	C		A			A
Approach Vol, veh/h	62		480			820
Approach Delay, s/veh	21.1		4.6			7.2
Approach LOS	C		A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		36.9		11.1		36.9		
Change Period (Y+Rc), s		6.0		6.0		6.0		
Max Green Setting (Gmax), s		59.0		9.0		59.0		
Max Q Clear Time (g_c+I1), s		18.8		3.7		9.0		
Green Ext Time (p_c), s		12.1		0.0		12.6		

Intersection Summary	
HCM 2010 Ctrl Delay	6.9
HCM 2010 LOS	A

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	73	0	801	84	0	456
Number	7	14	6	16	5	2
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1776	1776	1696	1696	0	1696
Adj Flow Rate, veh/h	81	0	890	0	0	507
Adj No. of Lanes	1	1	1	1	0	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	7	7	12	12	0	12
Cap, veh/h	198	177	1120	952	0	1120
Arrive On Green	0.12	0.00	0.66	0.00	0.00	0.66
Sat Flow, veh/h	1691	1509	1696	1442	0	1696
Grp Volume(v), veh/h	81	0	890	0	0	507
Grp Sat Flow(s),veh/h/ln	1691	1509	1696	1442	0	1696
Q Serve(g_s), s	2.4	0.0	20.2	0.0	0.0	7.8
Cycle Q Clear(g_c), s	2.4	0.0	20.2	0.0	0.0	7.8
Prop In Lane	1.00	1.00		1.00	0.00	
Lane Grp Cap(c), veh/h	198	177	1120	952	0	1120
V/C Ratio(X)	0.41	0.00	0.79	0.00	0.00	0.45
Avail Cap(c_a), veh/h	282	252	1857	1579	0	1857
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	0.00	1.00
Uniform Delay (d), s/veh	22.0	0.0	6.6	0.0	0.0	4.4
Incr Delay (d2), s/veh	1.3	0.0	1.3	0.0	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	9.6	0.0	0.0	3.6
LnGrp Delay(d),s/veh	23.4	0.0	7.9	0.0	0.0	4.7
LnGrp LOS	C		A			A
Approach Vol, veh/h	81		890			507
Approach Delay, s/veh	23.4		7.9			4.7
Approach LOS	C		A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		41.6		12.3		41.6		
Change Period (Y+Rc), s		6.0		6.0		6.0		
Max Green Setting (Gmax), s		59.0		9.0		59.0		
Max Q Clear Time (g_c+I1), s		9.8		4.4		22.2		
Green Ext Time (p_c), s		14.4		0.1		13.3		

Intersection Summary	
HCM 2010 Ctrl Delay	7.6
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	32	4	111	4	4	4	74	507	4	4	706	63
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1827	1900	1900	1863	1900	1667	1667	1900	1652	1652	1900
Adj Flow Rate, veh/h	36	4	123	4	4	4	82	563	4	4	784	70
Adj No. of Lanes	0	2	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	2	2	2	14	14	14	15	15	15
Cap, veh/h	320	31	275	120	116	88	249	1085	8	447	982	88
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.66	0.66	0.66	0.66	0.66	0.66
Sat Flow, veh/h	1207	160	1413	308	595	452	576	1653	12	746	1495	133
Grp Volume(v), veh/h	40	0	123	12	0	0	82	0	567	4	0	854
Grp Sat Flow(s),veh/h/ln	1367	0	1413	1355	0	0	576	0	1665	746	0	1629
Q Serve(g_s), s	0.0	0.0	6.2	0.0	0.0	0.0	9.7	0.0	14.3	0.2	0.0	30.5
Cycle Q Clear(g_c), s	2.0	0.0	6.2	6.2	0.0	0.0	40.2	0.0	14.3	14.5	0.0	30.5
Prop In Lane	0.90		1.00	0.33		0.33	1.00		0.01	1.00		0.08
Lane Grp Cap(c), veh/h	351	0	275	323	0	0	249	0	1093	447	0	1069
V/C Ratio(X)	0.11	0.00	0.45	0.04	0.00	0.00	0.33	0.00	0.52	0.01	0.00	0.80
Avail Cap(c_a), veh/h	356	0	281	329	0	0	314	0	1281	531	0	1253
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.9	0.0	28.6	26.4	0.0	0.0	24.5	0.0	7.2	11.0	0.0	10.0
Incr Delay (d2), s/veh	0.1	0.0	1.1	0.0	0.0	0.0	0.8	0.0	0.4	0.0	0.0	3.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	2.5	0.2	0.0	0.0	1.6	0.0	6.6	0.0	0.0	14.5
LnGrp Delay(d),s/veh	27.0	0.0	29.8	26.4	0.0	0.0	25.3	0.0	7.6	11.0	0.0	13.2
LnGrp LOS	C		C	C			C		A	B		B
Approach Vol, veh/h		163			12			649			858	
Approach Delay, s/veh		29.1			26.4			9.8			13.2	
Approach LOS		C			C			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		58.9		21.7		58.9		21.7
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		62.0		16.0		62.0		16.0
Max Q Clear Time (g_c+I1), s		32.5		8.2		42.2		8.2
Green Ext Time (p_c), s		13.2		0.5		10.7		0.5

Intersection Summary	
HCM 2010 Ctrl Delay	13.5
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	33	4	87	4	4	4	120	771	4	4	581	35
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1827	1900	1900	1863	1900	1696	1696	1900	1696	1696	1900
Adj Flow Rate, veh/h	37	4	97	4	4	4	133	857	4	4	646	39
Adj No. of Lanes	0	2	0	0	1	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	2	2	2	12	12	12	12	12	12
Cap, veh/h	362	35	291	140	136	106	358	1068	5	245	1002	61
Arrive On Green	0.21	0.21	0.21	0.21	0.21	0.21	0.63	0.63	0.63	0.63	0.63	0.63
Sat Flow, veh/h	1313	168	1413	368	661	514	686	1687	8	582	1584	96
Grp Volume(v), veh/h	41	0	97	12	0	0	133	0	861	4	0	685
Grp Sat Flow(s),veh/h/ln	1480	0	1413	1543	0	0	686	0	1695	582	0	1680
Q Serve(g_s), s	0.0	0.0	4.3	0.0	0.0	0.0	11.1	0.0	28.2	0.4	0.0	18.8
Cycle Q Clear(g_c), s	1.5	0.0	4.3	4.4	0.0	0.0	29.9	0.0	28.2	28.5	0.0	18.8
Prop In Lane	0.90		1.00	0.33		0.33	1.00		0.00	1.00		0.06
Lane Grp Cap(c), veh/h	397	0	291	382	0	0	358	0	1073	245	0	1063
V/C Ratio(X)	0.10	0.00	0.33	0.03	0.00	0.00	0.37	0.00	0.80	0.02	0.00	0.64
Avail Cap(c_a), veh/h	410	0	304	397	0	0	496	0	1415	362	0	1402
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	24.0	0.0	25.2	23.6	0.0	0.0	17.7	0.0	10.2	20.8	0.0	8.5
Incr Delay (d2), s/veh	0.1	0.0	0.7	0.0	0.0	0.0	0.6	0.0	2.6	0.0	0.0	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	1.8	0.2	0.0	0.0	2.1	0.0	13.7	0.1	0.0	8.8
LnGrp Delay(d),s/veh	24.1	0.0	25.8	23.6	0.0	0.0	18.4	0.0	12.7	20.9	0.0	9.1
LnGrp LOS	C		C	C			B		B	C		A
Approach Vol, veh/h		138			12			994			689	
Approach Delay, s/veh		25.3			23.6			13.5			9.2	
Approach LOS		C			C			B			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		53.0		21.3		53.0		21.3
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		62.0		16.0		62.0		16.0
Max Q Clear Time (g_c+I1), s		30.5		6.4		31.9		6.3
Green Ext Time (p_c), s		15.5		0.5		15.1		0.5

Intersection Summary	
HCM 2010 Ctrl Delay	12.8
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	41	7	6	16	13	182	6	446	29	317	437	41
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1776	1776	1900	1638	1638	1900	1681	1681	1900	1667	1667	1900
Adj Flow Rate, veh/h	46	8	7	18	14	202	7	496	32	352	486	46
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	7	7	7	16	16	16	13	13	13	14	14	14
Cap, veh/h	144	346	265	313	296	265	484	1043	67	485	1001	95
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.67	0.67	0.67	0.67	0.67	0.67
Sat Flow, veh/h	1106	1821	1395	1225	1556	1392	784	1563	101	780	1500	142
Grp Volume(v), veh/h	46	7	8	18	14	202	7	0	528	352	0	532
Grp Sat Flow(s),veh/h/ln	1106	1687	1529	1225	1556	1392	784	0	1664	780	0	1642
Q Serve(g_s), s	3.5	0.3	0.3	1.0	0.6	11.6	0.4	0.0	13.0	33.7	0.0	13.4
Cycle Q Clear(g_c), s	15.0	0.3	0.3	1.4	0.6	11.6	13.8	0.0	13.0	46.8	0.0	13.4
Prop In Lane	1.00		0.91	1.00		1.00	1.00		0.06	1.00		0.09
Lane Grp Cap(c), veh/h	144	321	291	313	296	265	484	0	1110	485	0	1096
V/C Ratio(X)	0.32	0.02	0.03	0.06	0.05	0.76	0.01	0.00	0.48	0.73	0.00	0.49
Avail Cap(c_a), veh/h	144	321	291	313	296	265	538	0	1225	539	0	1209
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	39.4	27.7	27.8	28.3	27.9	32.3	10.3	0.0	6.8	18.2	0.0	6.9
Incr Delay (d2), s/veh	1.3	0.0	0.0	0.1	0.1	12.4	0.0	0.0	0.3	4.3	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.1	0.1	0.4	0.3	5.3	0.1	0.0	6.0	7.8	0.0	6.0
LnGrp Delay(d),s/veh	40.7	27.8	27.8	28.4	27.9	44.7	10.3	0.0	7.1	22.5	0.0	7.2
LnGrp LOS	D	C	C	C	C	D	B		A	C		A
Approach Vol, veh/h		61			234			535			884	
Approach Delay, s/veh		37.5			42.4			7.2			13.3	
Approach LOS		D			D			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		62.2		22.0		62.2		22.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		62.0		16.0		62.0		16.0
Max Q Clear Time (g_c+I1), s		15.8		17.0		48.8		13.6
Green Ext Time (p_c), s		12.9		0.0		7.4		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	16.2
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	54	9	6	29	5	323	4	499	17	174	424	27
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	1792	1900	1667	1667	1900	1712	1712	1900	1696	1696	1900
Adj Flow Rate, veh/h	60	10	7	32	6	359	4	554	19	193	471	30
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	14	14	14	11	11	11	12	12	12
Cap, veh/h	110	532	334	420	419	375	421	948	33	370	910	58
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.58	0.58	0.58	0.58	0.58	0.58
Sat Flow, veh/h	975	2009	1263	1244	1583	1417	821	1645	56	761	1578	101
Grp Volume(v), veh/h	60	8	9	32	6	359	4	0	573	193	0	501
Grp Sat Flow(s),veh/h/ln	975	1703	1570	1244	1583	1417	821	0	1702	761	0	1679
Q Serve(g_s), s	1.1	0.3	0.3	1.5	0.2	18.9	0.2	0.0	16.2	16.4	0.0	13.6
Cycle Q Clear(g_c), s	20.0	0.3	0.3	1.8	0.2	18.9	13.8	0.0	16.2	32.6	0.0	13.6
Prop In Lane	1.00		0.80	1.00		1.00	1.00		0.03	1.00		0.06
Lane Grp Cap(c), veh/h	110	451	416	420	419	375	421	0	981	370	0	968
V/C Ratio(X)	0.54	0.02	0.02	0.08	0.01	0.96	0.01	0.00	0.58	0.52	0.00	0.52
Avail Cap(c_a), veh/h	110	451	416	420	419	375	578	0	1307	516	0	1289
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	37.6	20.5	20.5	21.2	20.5	27.3	13.8	0.0	10.2	20.6	0.0	9.7
Incr Delay (d2), s/veh	5.5	0.0	0.0	0.1	0.0	35.3	0.0	0.0	0.6	1.1	0.0	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.1	0.1	0.5	0.1	11.1	0.1	0.0	7.6	3.5	0.0	6.4
LnGrp Delay(d),s/veh	43.1	20.5	20.6	21.3	20.5	62.7	13.8	0.0	10.8	21.8	0.0	10.1
LnGrp LOS	D	C	C	C	C	E	B		B	C		B
Approach Vol, veh/h		77			397			577			694	
Approach Delay, s/veh		38.1			58.7			10.8			13.3	
Approach LOS		D			E			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		49.5		26.0		49.5		26.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		58.0		20.0		58.0		20.0
Max Q Clear Time (g_c+I1), s		18.2		22.0		34.6		20.9
Green Ext Time (p_c), s		10.5		0.0		8.9		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	23.9
HCM 2010 LOS	C

Intersection	
Int Delay, s/veh	1.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	18	20	305	34	31	217
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	20	22	339	38	34	241

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	668	358	0	0	377	0
Stage 1	358	-	-	-	-	-
Stage 2	310	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	423	686	-	-	1181	-
Stage 1	707	-	-	-	-	-
Stage 2	744	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	409	686	-	-	1181	-
Mov Cap-2 Maneuver	409	-	-	-	-	-
Stage 1	707	-	-	-	-	-
Stage 2	719	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.6		1
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	519	1181	-
HCM Lane V/C Ratio	-	-	0.081	0.029	-
HCM Control Delay (s)	-	-	12.6	8.1	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	1.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	31	37	206	16	23	310
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	34	41	229	18	26	344

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	634	238	0	0	247	0
Stage 1	238	-	-	-	-	-
Stage 2	396	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	443	801	-	-	1319	-
Stage 1	802	-	-	-	-	-
Stage 2	680	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	432	801	-	-	1319	-
Mov Cap-2 Maneuver	432	-	-	-	-	-
Stage 1	802	-	-	-	-	-
Stage 2	664	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.2		0.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	577	1319	-
HCM Lane V/C Ratio	-	-	0.131	0.019	-
HCM Control Delay (s)	-	-	12.2	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	82	5	268	4	5	5	143	45	8
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	91	6	298	4	6	6	159	50	9

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	589	620	133	484	650	29	267	0	0
Stage 1	243	243	-	372	372	-	-	-	-
Stage 2	346	377	-	112	278	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-
Pot Cap-1 Maneuver	392	402	892	466	387	1039	1294	-	-
Stage 1	739	703	-	621	617	-	-	-	-
Stage 2	643	614	-	881	679	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	346	349	892	276	336	1039	1294	-	-
Mov Cap-2 Maneuver	346	349	-	276	336	-	-	-	-
Stage 1	645	699	-	542	539	-	-	-	-
Stage 2	553	536	-	579	676	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	13.1	14.1	
HCM LOS	B	B	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1294	-	-	346	892	410	1536	-	-
HCM Lane V/C Ratio	0.123	-	-	0.279	0.334	0.038	0.004	-	-
HCM Control Delay (s)	8.2	0.1	-	19.4	11	14.1	7.4	0	-
HCM Lane LOS	A	A	-	C	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	1	1	0	0	-	-

Intersection			
Int Delay, s/veh			

Movement	SBL	SBT	SBR
Vol, veh/h	5	177	63
Conflicting Peds, #/hr	0	0	0
Sign Control	Free	Free	Free
RT Channelized	-	-	None
Storage Length	-	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	90	90	90
Heavy Vehicles, %	3	3	3
Mvmt Flow	6	197	70

Major/Minor	Major2		
Conflicting Flow All	59	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.16	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.23	-	-
Pot Cap-1 Maneuver	1536	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	1536	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	SB
HCM Control Delay, s	
HCM LOS	

Minor Lane/Major Mvmt

Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	55	5	150	9	5	5	274	172	8
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	61	6	167	10	6	6	304	191	9

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	840	942	92	847	1000	100	184	0	0
Stage 1	133	133	-	804	804	-	-	-	-
Stage 2	707	809	-	43	196	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-
Pot Cap-1 Maneuver	258	261	947	255	242	936	1388	-	-
Stage 1	857	785	-	343	394	-	-	-	-
Stage 2	392	392	-	966	737	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	202	196	947	166	181	936	1388	-	-
Mov Cap-2 Maneuver	202	196	-	166	181	-	-	-	-
Stage 1	645	781	-	258	297	-	-	-	-
Stage 2	288	295	-	786	733	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	15.9	23.3	
HCM LOS	C	C	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1388	-	-	201	947	218	1370	-	-
HCM Lane V/C Ratio	0.219	-	-	0.332	0.176	0.097	0.004	-	-
HCM Control Delay (s)	8.3	0.2	-	31.6	9.6	23.3	7.6	0	-
HCM Lane LOS	A	A	-	D	A	C	A	A	-
HCM 95th %tile Q(veh)	1	-	-	1	1	0	0	-	-

Intersection			
Int Delay, s/veh			

Movement	SBL	SBT	SBR
Vol, veh/h	5	53	113
Conflicting Peds, #/hr	0	0	0
Sign Control	Free	Free	Free
RT Channelized	-	-	None
Storage Length	-	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	90	90	90
Heavy Vehicles, %	2	2	2
Mvmt Flow	6	59	126

Major/Minor	Major2		
Conflicting Flow All	200	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.14	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.22	-	-
Pot Cap-1 Maneuver	1370	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	1370	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	SB
HCM Control Delay, s	
HCM LOS	

Minor Lane/Major Mvmt

Intersection	
Intersection Delay, s/veh	40.1
Intersection LOS	E

Movement	WBU	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Vol, veh/h	0	15	112	0	221	17	0	246	382
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	17	124	0	246	19	0	273	424
Number of Lanes	0	1	1	0	1	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	2
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	2	0	2
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	2	0
HCM Control Delay	10.6	11.5	56.9
HCM LOS	B	B	F

Lane	NBLn1	NBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	0%	0%	100%	0%	39%
Vol Thru, %	100%	0%	0%	0%	61%
Vol Right, %	0%	100%	0%	100%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	221	17	15	112	628
LT Vol	221	0	0	0	382
Through Vol	0	17	0	112	0
RT Vol	0	0	15	0	246
Lane Flow Rate	246	19	17	124	698
Geometry Grp	7	7	7	7	4
Degree of Util (X)	0.382	0.026	0.034	0.212	1
Departure Headway (Hd)	5.607	4.898	7.362	6.141	5.167
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	641	727	487	582	698
Service Time	3.352	2.652	5.103	3.904	3.255
HCM Lane V/C Ratio	0.384	0.026	0.035	0.213	1
HCM Control Delay	11.8	7.8	10.4	10.6	56.9
HCM Lane LOS	B	A	B	B	F
HCM 95th-tile Q	1.8	0.1	0.1	0.8	16

Intersection	
Intersection Delay, s/veh	17.1
Intersection LOS	C

Movement	WBU	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Vol, veh/h	0	17	243	0	377	15	0	101	199
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	19	270	0	419	17	0	112	221
Number of Lanes	0	1	1	0	1	1	0	0	1

Approach	WB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	2
Conflicting Approach Left	NB		WB
Conflicting Lanes Left	2	0	2
Conflicting Approach Right	SB	WB	
Conflicting Lanes Right	1	2	0
HCM Control Delay	13.3	20.2	16.3
HCM LOS	B	C	C

Lane	NBLn1	NBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	0%	0%	100%	0%	34%
Vol Thru, %	100%	0%	0%	0%	66%
Vol Right, %	0%	100%	0%	100%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	377	15	17	243	300
LT Vol	377	0	0	0	199
Through Vol	0	15	0	243	0
RT Vol	0	0	17	0	101
Lane Flow Rate	419	17	19	270	333
Geometry Grp	7	7	7	7	4
Degree of Util (X)	0.687	0.024	0.038	0.446	0.555
Departure Headway (Hd)	5.908	5.198	7.171	5.95	5.996
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	612	687	498	605	600
Service Time	3.651	2.941	4.927	3.706	4.045
HCM Lane V/C Ratio	0.685	0.025	0.038	0.446	0.555
HCM Control Delay	20.7	8.1	10.2	13.5	16.3
HCM Lane LOS	C	A	B	B	C
HCM 95th-tile Q	5.4	0.1	0.1	2.3	3.4

Intersection	
Int Delay, s/veh	1.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	16	31	295	16	73	614
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	11	11	2	2	4	4
Mvmt Flow	18	34	328	18	81	682

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1181	337	0	0	346	0
Stage 1	337	-	-	-	-	-
Stage 2	844	-	-	-	-	-
Critical Hdwy	6.51	6.31	-	-	4.14	-
Critical Hdwy Stg 1	5.51	-	-	-	-	-
Critical Hdwy Stg 2	5.51	-	-	-	-	-
Follow-up Hdwy	3.599	3.399	-	-	2.236	-
Pot Cap-1 Maneuver	201	685	-	-	1202	-
Stage 1	703	-	-	-	-	-
Stage 2	407	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	179	685	-	-	1202	-
Mov Cap-2 Maneuver	179	-	-	-	-	-
Stage 1	703	-	-	-	-	-
Stage 2	363	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	17.1		0.9
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	349	1202	-
HCM Lane V/C Ratio	-	-	0.15	0.067	-
HCM Control Delay (s)	-	-	17.1	8.2	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	1	0	-

Intersection	
Int Delay, s/veh	2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	17	79	669	17	33	327
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	8	8	2	2	3	3
Mvmt Flow	19	88	743	19	37	363

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1190	753	0	0	762	0
Stage 1	753	-	-	-	-	-
Stage 2	437	-	-	-	-	-
Critical Hdwy	6.48	6.28	-	-	4.13	-
Critical Hdwy Stg 1	5.48	-	-	-	-	-
Critical Hdwy Stg 2	5.48	-	-	-	-	-
Follow-up Hdwy	3.572	3.372	-	-	2.227	-
Pot Cap-1 Maneuver	202	400	-	-	846	-
Stage 1	455	-	-	-	-	-
Stage 2	639	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	191	400	-	-	846	-
Mov Cap-2 Maneuver	191	-	-	-	-	-
Stage 1	455	-	-	-	-	-
Stage 2	604	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	20.7		0.9
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	335	846	-
HCM Lane V/C Ratio	-	-	0.318	0.043	-
HCM Control Delay (s)	-	-	20.7	9.4	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	1	0	-

Intersection	
Int Delay, s/veh	66.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	106	229	185	239	498	160
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	None
Storage Length	0	100	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	4	4	13	13	13	13
Mvmt Flow	118	254	206	266	553	178

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1622	-	0	0	471	0
Stage 1	338	-	-	-	-	-
Stage 2	1284	-	-	-	-	-
Critical Hdwy	6.44	-	-	-	4.23	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	-	-	-	2.317	-
Pot Cap-1 Maneuver	~ 112	0	-	-	1036	-
Stage 1	718	0	-	-	-	-
Stage 2	257	0	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 52	-	-	-	1036	-
Mov Cap-2 Maneuver	~ 52	-	-	-	-	-
Stage 1	718	-	-	-	-	-
Stage 2	120	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 748.2		
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	52	-	1036	-
HCM Lane V/C Ratio	-	-	2.265	-	0.534	-
HCM Control Delay (s)	-	-	$ 748.2	0	12.4	-
HCM Lane LOS	-	-	F	A	B	-
HCM 95th %tile Q(veh)	-	-	12	-	3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	8.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	197	610	115	178	138	203
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	None
Storage Length	0	100	-	-	0	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	3	3	11	11	10	10
Mvmt Flow	219	678	128	198	153	226

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	759	-	0	0	326	0
Stage 1	227	-	-	-	-	-
Stage 2	532	-	-	-	-	-
Critical Hdwy	6.43	-	-	-	4.2	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	-	-	-	2.29	-
Pot Cap-1 Maneuver	373	0	-	-	1190	-
Stage 1	808	0	-	-	-	-
Stage 2	587	0	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	325	-	-	-	1190	-
Mov Cap-2 Maneuver	325	-	-	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	512	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	36.2		
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	325	-	1190	-
HCM Lane V/C Ratio	-	-	0.674	-	0.129	-
HCM Control Delay (s)	-	-	36.2	0	8.5	-
HCM Lane LOS	-	-	E	A	A	-
HCM 95th %tile Q(veh)	-	-	5	-	0	-

Intersection	
Int Delay, s/veh	65.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	194	216	141	223	405	117
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	13	13	18	18
Mvmt Flow	216	240	157	248	450	130

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	952	290	580	0	-	0
Stage 1	515	-	-	-	-	-
Stage 2	437	-	-	-	-	-
Critical Hdwy	6.84	6.94	4.36	-	-	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	2.33	-	-	-
Pot Cap-1 Maneuver	257	707	918	-	-	-
Stage 1	565	-	-	-	-	-
Stage 2	619	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 213	707	918	-	-	-
Mov Cap-2 Maneuver	~ 213	-	-	-	-	-
Stage 1	565	-	-	-	-	-
Stage 2	513	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	207.8		
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	918	-	337	-	-
HCM Lane V/C Ratio	0.171	-	1.352	-	-
HCM Control Delay (s)	9.7	-	207.8	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	1	-	22	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	112.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	195	131	284	527	209	158
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	150	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	10	10	14	14
Mvmt Flow	217	146	316	586	232	176

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1244	204	408	0	-	0
Stage 1	320	-	-	-	-	-
Stage 2	924	-	-	-	-	-
Critical Hdwy	6.84	6.94	4.3	-	-	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	2.3	-	-	-
Pot Cap-1 Maneuver	~ 166	803	1092	-	-	-
Stage 1	709	-	-	-	-	-
Stage 2	347	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 118	803	1092	-	-	-
Mov Cap-2 Maneuver	~ 118	-	-	-	-	-
Stage 1	709	-	-	-	-	-
Stage 2	247	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	$ 517.3		
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1092	-	180	-	-
HCM Lane V/C Ratio	0.289	-	2.012	-	-
HCM Control Delay (s)	9.6	-	$ 517.3	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	1	-	28	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	26.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	412	265	0	444	270	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	350	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	12	12	18	18	18	18
Mvmt Flow	458	294	0	493	300	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	547	150	300	0	-	0
Stage 1	300	-	-	-	-	-
Stage 2	247	-	-	-	-	-
Critical Hdwy	7.04	7.14	4.46	-	-	-
Critical Hdwy Stg 1	6.04	-	-	-	-	-
Critical Hdwy Stg 2	6.04	-	-	-	-	-
Follow-up Hdwy	3.62	3.42	2.38	-	-	-
Pot Cap-1 Maneuver	~ 444	839	1150	-	-	-
Stage 1	696	-	-	-	-	-
Stage 2	742	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 444	839	1150	-	-	-
Mov Cap-2 Maneuver	~ 444	-	-	-	-	-
Stage 1	696	-	-	-	-	-
Stage 2	742	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	54.3		
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1150	-	444	839	-	-
HCM Lane V/C Ratio	-	-	1.031	0.351	-	-
HCM Control Delay (s)	0	-	81.8	11.6	-	-
HCM Lane LOS	A	-	F	B	-	-
HCM 95th %tile Q(veh)	0	-	14	2	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	99	105	0	663	200	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	350	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	34	34	14	14	18	18
Mvmt Flow	110	117	0	737	222	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	590	111	222	0	-	0
Stage 1	222	-	-	-	-	-
Stage 2	368	-	-	-	-	-
Critical Hdwy	7.48	7.58	4.38	-	-	-
Critical Hdwy Stg 1	6.48	-	-	-	-	-
Critical Hdwy Stg 2	6.48	-	-	-	-	-
Follow-up Hdwy	3.84	3.64	2.34	-	-	-
Pot Cap-1 Maneuver	371	828	1261	-	-	-
Stage 1	706	-	-	-	-	-
Stage 2	584	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	371	828	1261	-	-	-
Mov Cap-2 Maneuver	371	-	-	-	-	-
Stage 1	706	-	-	-	-	-
Stage 2	584	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.3		
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1261	-	371	828	-	-
HCM Lane V/C Ratio	-	-	0.296	0.141	-	-
HCM Control Delay (s)	0	-	18.7	10.1	-	-
HCM Lane LOS	A	-	C	B	-	-
HCM 95th %tile Q(veh)	0	-	1	0	-	-

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	0	100	756	270	77
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	225	-	-	325
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	18	18	24	24
Mvmt Flow	0	0	111	840	300	86

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	942	150	300	0	-	0
Stage 1	300	-	-	-	-	-
Stage 2	642	-	-	-	-	-
Critical Hdwy	6.84	6.94	4.46	-	-	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	2.38	-	-	-
Pot Cap-1 Maneuver	261	870	1150	-	-	-
Stage 1	725	-	-	-	-	-
Stage 2	486	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	236	870	1150	-	-	-
Mov Cap-2 Maneuver	236	-	-	-	-	-
Stage 1	725	-	-	-	-	-
Stage 2	439	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0		
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1150	-	-	-	-
HCM Lane V/C Ratio	0.097	-	-	-	-
HCM Control Delay (s)	8.5	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	0	384	378	200	556
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	225	-	-	325
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	18	18	20	20
Mvmt Flow	0	0	427	420	222	618

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1285	111	222	0	-	0
Stage 1	222	-	-	-	-	-
Stage 2	1063	-	-	-	-	-
Critical Hdwy	6.84	6.94	4.46	-	-	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	2.38	-	-	-
Pot Cap-1 Maneuver	156	921	1235	-	-	-
Stage 1	794	-	-	-	-	-
Stage 2	293	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	102	921	1235	-	-	-
Mov Cap-2 Maneuver	102	-	-	-	-	-
Stage 1	794	-	-	-	-	-
Stage 2	192	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0		
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1235	-	-	-	-
HCM Lane V/C Ratio	0.345	-	-	-	-
HCM Control Delay (s)	9.4	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	2	-	-	-	-

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	469	76	219	616	1214	970
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	1900	1792	1792	1827	1827
Adj Flow Rate, veh/h	599	0	243	684	1349	1078
Adj No. of Lanes	2	1	1	2	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	0	6	6	4	4
Cap, veh/h	576	273	147	2576	2625	1174
Arrive On Green	0.17	0.00	0.76	0.76	1.00	1.00
Sat Flow, veh/h	3414	1615	135	3495	3563	1553
Grp Volume(v), veh/h	599	0	243	684	1349	1078
Grp Sat Flow(s),veh/h/ln	1707	1615	135	1703	1736	1553
Q Serve(g_s), s	27.0	0.0	121.0	9.8	0.0	0.0
Cycle Q Clear(g_c), s	27.0	0.0	121.0	9.8	0.0	0.0
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	576	273	147	2576	2625	1174
V/C Ratio(X)	1.04	0.00	1.65	0.27	0.51	0.92
Avail Cap(c_a), veh/h	576	273	147	2576	2625	1174
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.09	0.09
Uniform Delay (d), s/veh	66.5	0.0	38.0	5.9	0.0	0.0
Incr Delay (d2), s/veh	48.2	0.0	320.6	0.3	0.1	1.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.6	0.0	19.6	4.7	0.0	0.5
LnGrp Delay(d),s/veh	114.7	0.0	358.6	6.2	0.1	1.5
LnGrp LOS	F		F	A	A	A
Approach Vol, veh/h	599			927	2427	
Approach Delay, s/veh	114.7			98.6	0.7	
Approach LOS	F			F	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		127.0				127.0		33.0
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		121.0				121.0		27.0
Max Q Clear Time (g_c+I1), s		2.0				123.0		29.0
Green Ext Time (p_c), s		105.7				0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	40.9
HCM 2010 LOS	D

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	606	149	201	882	938	631
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1900	1810	1810	1827	1827
Adj Flow Rate, veh/h	420	438	223	980	1042	701
Adj No. of Lanes	1	1	1	2	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	0	5	5	4	4
Cap, veh/h	443	411	236	2188	2209	988
Arrive On Green	0.25	0.25	0.64	0.64	1.00	1.00
Sat Flow, veh/h	1740	1615	268	3529	3563	1553
Grp Volume(v), veh/h	420	438	223	980	1042	701
Grp Sat Flow(s),veh/h/ln	1740	1615	268	1719	1736	1553
Q Serve(g_s), s	26.1	28.0	70.0	15.9	0.0	0.0
Cycle Q Clear(g_c), s	26.1	28.0	70.0	15.9	0.0	0.0
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	443	411	236	2188	2209	988
V/C Ratio(X)	0.95	1.07	0.95	0.45	0.47	0.71
Avail Cap(c_a), veh/h	443	411	236	2188	2209	988
HCM Platoon Ratio	1.00	1.00	1.00	1.00	2.00	2.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.24	0.24
Uniform Delay (d), s/veh	40.3	41.0	28.3	10.2	0.0	0.0
Incr Delay (d2), s/veh	30.0	62.9	46.1	0.7	0.2	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.2	19.6	9.8	7.7	0.1	0.3
LnGrp Delay(d),s/veh	70.2	103.9	74.4	10.8	0.2	1.1
LnGrp LOS	E	F	E	B	A	A
Approach Vol, veh/h	858			1203	1743	
Approach Delay, s/veh	87.4			22.6	0.5	
Approach LOS	F			C	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		76.0				76.0		34.0
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		70.0				70.0		28.0
Max Q Clear Time (g_c+I1), s		2.0				72.0		30.0
Green Ext Time (p_c), s		50.4				0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	27.1
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	571	327	118	967	1857	631
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1696	1900	1827	1827	1810	1810
Adj Flow Rate, veh/h	634	0	131	1074	2063	701
Adj No. of Lanes	2	1	1	2	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	12	0	4	4	5	5
Cap, veh/h	703	351	158	2563	2205	987
Arrive On Green	0.22	0.00	0.12	1.00	0.64	0.64
Sat Flow, veh/h	3231	1615	1740	3563	3529	1538
Grp Volume(v), veh/h	634	0	131	1074	2063	701
Grp Sat Flow(s),veh/h/ln	1616	1615	1740	1736	1719	1538
Q Serve(g_s), s	29.6	0.0	6.2	0.0	83.3	46.5
Cycle Q Clear(g_c), s	29.6	0.0	6.2	0.0	83.3	46.5
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	703	351	158	2563	2205	987
V/C Ratio(X)	0.90	0.00	0.83	0.42	0.94	0.71
Avail Cap(c_a), veh/h	918	459	158	2563	2205	987
HCM Platoon Ratio	1.00	1.00	2.00	2.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.71	0.71	1.00	1.00
Uniform Delay (d), s/veh	59.0	0.0	46.0	0.0	24.9	18.3
Incr Delay (d2), s/veh	9.9	0.0	22.5	0.4	9.0	4.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	14.2	0.0	6.3	0.1	42.0	20.9
LnGrp Delay(d),s/veh	68.9	0.0	68.5	0.4	33.9	22.6
LnGrp LOS	E		E	A	C	C
Approach Vol, veh/h	634			1205	2764	
Approach Delay, s/veh	68.9			7.8	31.0	
Approach LOS	E			A	C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	15.0	105.3				120.3		39.7
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	9.0	89.0				104.0		44.0
Max Q Clear Time (g_c+I1), s	8.2	85.3				2.0		31.6
Green Ext Time (p_c), s	0.0	3.7				83.1		2.1

Intersection Summary	
HCM 2010 Ctrl Delay	30.2
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	770	296	78	1410	1273	539
Number	3	18	1	6	2	12
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1743	1900	1827	1827	1827	1827
Adj Flow Rate, veh/h	856	0	87	1567	1414	599
Adj No. of Lanes	2	1	1	2	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	9	0	4	4	4	4
Cap, veh/h	963	469	244	2189	1699	760
Arrive On Green	0.29	0.00	0.11	0.84	0.49	0.49
Sat Flow, veh/h	3320	1615	1740	3563	3563	1553
Grp Volume(v), veh/h	856	0	87	1567	1414	599
Grp Sat Flow(s),veh/h/ln	1660	1615	1740	1736	1736	1553
Q Serve(g_s), s	26.2	0.0	2.3	19.4	37.3	34.1
Cycle Q Clear(g_c), s	26.2	0.0	2.3	19.4	37.3	34.1
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	963	469	244	2189	1699	760
V/C Ratio(X)	0.89	0.00	0.36	0.72	0.83	0.79
Avail Cap(c_a), veh/h	1185	577	244	2189	1699	760
HCM Platoon Ratio	1.00	1.00	1.33	1.33	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.66	0.66	1.00	1.00
Uniform Delay (d), s/veh	36.1	0.0	19.9	4.7	23.4	22.6
Incr Delay (d2), s/veh	7.3	0.0	0.6	1.4	4.9	8.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.0	0.0	1.3	9.3	19.0	16.2
LnGrp Delay(d),s/veh	43.5	0.0	20.5	6.1	28.3	30.7
LnGrp LOS	D		C	A	C	C
Approach Vol, veh/h	856			1654	2013	
Approach Delay, s/veh	43.5			6.9	29.0	
Approach LOS	D			A	C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2				6		8
Phs Duration (G+Y+Rc), s	15.0	58.1				73.1		36.9
Change Period (Y+Rc), s	6.0	6.0				6.0		6.0
Max Green Setting (Gmax), s	9.0	45.0				60.0		38.0
Max Q Clear Time (g_c+I1), s	4.3	39.3				21.4		28.2
Green Ext Time (p_c), s	0.1	5.5				34.0		2.6

Intersection Summary	
HCM 2010 Ctrl Delay	23.6
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	43	1106	285	33	1036	330	77	22	124	17	5	79
Number	1	6	16	5	2	12	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1827	1827	1827	1900	1743	1743	1863	1863	1900
Adj Flow Rate, veh/h	48	1229	317	37	1151	367	86	24	138	19	6	88
Adj No. of Lanes	1	2	0	1	2	1	0	1	1	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	4	4	4	9	9	9	2	2	2
Cap, veh/h	246	1742	443	202	2226	996	240	56	304	199	21	307
Arrive On Green	0.64	0.64	0.64	0.64	0.64	0.64	0.20	0.20	0.20	0.20	0.20	0.20
Sat Flow, veh/h	333	2716	690	327	3471	1553	770	276	1482	1219	102	1497
Grp Volume(v), veh/h	48	771	775	37	1151	367	110	0	138	19	0	94
Grp Sat Flow(s),veh/h/ln	333	1719	1688	327	1736	1553	1045	0	1482	1219	0	1599
Q Serve(g_s), s	7.1	22.8	23.8	6.6	13.9	8.7	5.3	0.0	6.4	1.1	0.0	3.9
Cycle Q Clear(g_c), s	20.9	22.8	23.8	30.4	13.9	8.7	9.2	0.0	6.4	10.3	0.0	3.9
Prop In Lane	1.00		0.41	1.00		1.00	0.78		1.00	1.00		0.94
Lane Grp Cap(c), veh/h	246	1102	1082	202	2226	996	296	0	304	199	0	328
V/C Ratio(X)	0.19	0.70	0.72	0.18	0.52	0.37	0.37	0.00	0.45	0.10	0.00	0.29
Avail Cap(c_a), veh/h	255	1145	1125	211	2313	1035	297	0	304	199	0	328
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	13.1	9.1	9.3	19.4	7.5	6.6	29.4	0.0	27.2	33.0	0.0	26.2
Incr Delay (d2), s/veh	0.4	1.8	2.1	0.4	0.2	0.2	0.8	0.0	1.1	0.2	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	11.1	11.4	0.6	6.6	3.7	2.2	0.0	2.7	0.4	0.0	1.7
LnGrp Delay(d),s/veh	13.5	10.9	11.4	19.8	7.7	6.8	30.1	0.0	28.3	33.2	0.0	26.7
LnGrp LOS	B	B	B	B	A	A	C		C	C		C
Approach Vol, veh/h		1594			1555			248			113	
Approach Delay, s/veh		11.2			7.8			29.1			27.8	
Approach LOS		B			A			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		56.0		22.0		56.0		22.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		52.0		16.0		52.0		16.0
Max Q Clear Time (g_c+I1), s		32.4		11.2		25.8		12.3
Green Ext Time (p_c), s		17.7		0.8		22.9		0.6

Intersection Summary	
HCM 2010 Ctrl Delay	11.5
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	87	1130	249	54	1006	377	130	21	130	27	14	54
Number	1	6	16	5	2	12	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1827	1900	1845	1845	1845	1900	1810	1810	1863	1863	1900
Adj Flow Rate, veh/h	97	1256	277	60	1118	419	144	23	144	30	16	60
Adj No. of Lanes	1	2	0	1	2	1	0	1	1	1	1	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	3	3	3	5	5	5	2	2	2
Cap, veh/h	247	1802	393	207	2228	997	283	37	322	162	72	270
Arrive On Green	0.64	0.64	0.64	0.64	0.64	0.64	0.21	0.21	0.21	0.21	0.21	0.21
Sat Flow, veh/h	330	2836	618	334	3505	1568	938	175	1538	1214	344	1291
Grp Volume(v), veh/h	97	763	770	60	1118	419	167	0	144	30	0	76
Grp Sat Flow(s),veh/h/ln	330	1736	1718	334	1752	1568	1114	0	1538	1214	0	1635
Q Serve(g_s), s	17.2	22.1	22.9	11.2	13.2	10.3	8.8	0.0	6.3	1.8	0.0	3.0
Cycle Q Clear(g_c), s	30.4	22.1	22.9	34.0	13.2	10.3	11.8	0.0	6.3	13.6	0.0	3.0
Prop In Lane	1.00		0.36	1.00		1.00	0.86		1.00	1.00		0.79
Lane Grp Cap(c), veh/h	247	1103	1092	207	2228	997	320	0	322	162	0	342
V/C Ratio(X)	0.39	0.69	0.71	0.29	0.50	0.42	0.52	0.00	0.45	0.19	0.00	0.22
Avail Cap(c_a), veh/h	250	1123	1112	211	2268	1015	352	0	358	191	0	381
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	15.7	9.2	9.3	20.5	7.5	7.0	30.0	0.0	26.7	35.3	0.0	25.3
Incr Delay (d2), s/veh	1.0	1.8	2.0	0.8	0.2	0.3	1.3	0.0	1.0	0.5	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	10.9	11.3	1.1	6.3	4.5	3.5	0.0	2.8	0.6	0.0	1.4
LnGrp Delay(d),s/veh	16.7	10.9	11.3	21.3	7.7	7.3	31.3	0.0	27.6	35.8	0.0	25.7
LnGrp LOS	B	B	B	C	A	A	C		C	D		C
Approach Vol, veh/h		1630			1597			311			106	
Approach Delay, s/veh		11.5			8.1			29.6			28.5	
Approach LOS		B			A			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		55.1		22.2		55.1		22.2
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		50.0		18.0		50.0		18.0
Max Q Clear Time (g_c+I1), s		36.0		13.8		32.4		15.6
Green Ext Time (p_c), s		13.1		0.8		16.2		0.5

Intersection Summary	
HCM 2010 Ctrl Delay	12.0
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	23	34	234	89	14	10	517	1401	170	21	1341	56
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1827	1827	1827	1624	1624	1900	1810	1810	1900	1810	1810	1810
Adj Flow Rate, veh/h	26	38	260	99	16	11	574	1557	189	23	1490	62
Adj No. of Lanes	1	1	1	1	1	0	2	3	0	1	3	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	17	17	17	5	5	5	5	5	5
Cap, veh/h	319	343	292	245	169	116	673	2484	301	76	1973	614
Arrive On Green	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.56	0.56	0.04	0.40	0.40
Sat Flow, veh/h	1351	1827	1553	939	898	617	3343	4466	541	1723	4940	1538
Grp Volume(v), veh/h	26	38	260	99	0	27	574	1148	598	23	1490	62
Grp Sat Flow(s),veh/h/ln	1351	1827	1553	939	0	1515	1672	1647	1714	1723	1647	1538
Q Serve(g_s), s	1.4	1.5	13.9	8.3	0.0	1.3	14.1	20.2	20.3	1.1	22.1	2.1
Cycle Q Clear(g_c), s	2.6	1.5	13.9	9.8	0.0	1.3	14.1	20.2	20.3	1.1	22.1	2.1
Prop In Lane	1.00		1.00	1.00		0.41	1.00		0.32	1.00		1.00
Lane Grp Cap(c), veh/h	319	343	292	245	0	285	673	1832	953	76	1973	614
V/C Ratio(X)	0.08	0.11	0.89	0.40	0.00	0.09	0.85	0.63	0.63	0.30	0.76	0.10
Avail Cap(c_a), veh/h	319	343	292	245	0	285	825	1832	953	182	2031	633
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.7	28.7	33.7	32.7	0.0	28.6	32.8	12.9	12.9	39.4	22.0	16.0
Incr Delay (d2), s/veh	0.1	0.1	26.9	1.1	0.0	0.1	7.3	0.7	1.3	2.2	1.6	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.8	8.1	2.2	0.0	0.5	7.1	9.3	9.8	0.6	10.2	0.9
LnGrp Delay(d),s/veh	29.8	28.8	60.6	33.8	0.0	28.7	40.1	13.5	14.2	41.6	23.6	16.1
LnGrp LOS	C	C	E	C		C	D	B	B	D	C	B
Approach Vol, veh/h		324			126			2320			1575	
Approach Delay, s/veh		54.4			32.7			20.3			23.6	
Approach LOS		D			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	23.1	40.0		22.0	9.8	53.3		22.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	21.0	35.0		16.0	9.0	47.0		16.0
Max Q Clear Time (g_c+I1), s	16.1	24.1		11.8	3.1	22.3		15.9
Green Ext Time (p_c), s	1.0	9.9		0.8	0.0	22.1		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	24.4
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	56	13	470	192	20	11	280	1399	74	7	1346	34
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1638	1638	1900	1827	1827	1900	1827	1827	1827
Adj Flow Rate, veh/h	62	14	522	213	22	12	311	1554	82	8	1496	38
Adj No. of Lanes	1	1	1	1	1	0	2	3	0	1	3	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	16	16	16	4	4	4	4	4	4
Cap, veh/h	513	611	519	330	327	179	388	2149	113	32	1726	537
Arrive On Green	0.33	0.33	0.33	0.33	0.33	0.33	0.12	0.44	0.44	0.02	0.35	0.35
Sat Flow, veh/h	1369	1863	1583	761	998	544	3375	4851	256	1740	4988	1553
Grp Volume(v), veh/h	62	14	522	213	0	34	311	1065	571	8	1496	38
Grp Sat Flow(s),veh/h/ln	1369	1863	1583	761	0	1542	1688	1663	1782	1740	1663	1553
Q Serve(g_s), s	2.8	0.4	28.0	22.5	0.0	1.3	7.7	22.4	22.4	0.4	23.9	1.4
Cycle Q Clear(g_c), s	4.1	0.4	28.0	22.9	0.0	1.3	7.7	22.4	22.4	0.4	23.9	1.4
Prop In Lane	1.00		1.00	1.00		0.35	1.00		0.14	1.00		1.00
Lane Grp Cap(c), veh/h	513	611	519	330	0	506	388	1473	789	32	1726	537
V/C Ratio(X)	0.12	0.02	1.01	0.65	0.00	0.07	0.80	0.72	0.72	0.25	0.87	0.07
Avail Cap(c_a), veh/h	513	611	519	330	0	506	435	1473	789	183	1928	600
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	21.1	19.4	28.7	27.2	0.0	19.7	36.8	19.5	19.5	41.3	26.1	18.7
Incr Delay (d2), s/veh	0.1	0.0	40.8	4.3	0.0	0.1	9.4	1.8	3.3	4.1	4.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.2	18.1	5.1	0.0	0.6	4.1	10.6	11.7	0.2	11.6	0.6
LnGrp Delay(d),s/veh	21.2	19.4	69.5	31.5	0.0	19.8	46.2	21.3	22.8	45.4	30.2	18.8
LnGrp LOS	C	B	F	C		B	D	C	C	D	C	B
Approach Vol, veh/h		598			247			1947			1542	
Approach Delay, s/veh		63.3			29.9			25.7			30.0	
Approach LOS		E			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	15.8	35.5		34.0	7.6	43.8		34.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	11.0	33.0		28.0	9.0	35.0		28.0
Max Q Clear Time (g_c+I1), s	9.7	25.9		24.9	2.4	24.4		30.0
Green Ext Time (p_c), s	0.2	3.6		1.3	0.0	9.9		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	32.6
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	600	0	301	258	1787	0	0	1505	159
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1712	0	1712	1776	1776	0	0	1810	1810
Adj Flow Rate, veh/h				667	0	334	287	1986	0	0	1672	177
Adj No. of Lanes				2	0	1	2	3	0	0	3	1
Peak Hour Factor				0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %				11	0	11	7	7	0	0	5	5
Cap, veh/h				825	0	379	354	3018	0	0	2255	702
Arrive On Green				0.26	0.00	0.26	0.11	0.62	0.00	0.00	0.46	0.46
Sat Flow, veh/h				3163	0	1455	3281	5007	0	0	5103	1538
Grp Volume(v), veh/h				667	0	334	287	1986	0	0	1672	177
Grp Sat Flow(s),veh/h/ln				1581	0	1455	1640	1616	0	0	1647	1538
Q Serve(g_s), s				20.3	0.0	22.7	8.8	27.0	0.0	0.0	28.6	7.3
Cycle Q Clear(g_c), s				20.3	0.0	22.7	8.8	27.0	0.0	0.0	28.6	7.3
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				825	0	379	354	3018	0	0	2255	702
V/C Ratio(X)				0.81	0.00	0.88	0.81	0.66	0.00	0.00	0.74	0.25
Avail Cap(c_a), veh/h				952	0	438	446	3155	0	0	2255	702
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh				35.6	0.0	36.5	44.9	12.4	0.0	0.0	23.0	17.2
Incr Delay (d2), s/veh				4.6	0.0	16.7	8.7	0.5	0.0	0.0	1.3	0.2
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				9.4	0.0	10.9	4.4	12.1	0.0	0.0	13.3	3.1
LnGrp Delay(d),s/veh				40.3	0.0	53.2	53.6	12.9	0.0	0.0	24.3	17.4
LnGrp LOS				D		D	D	B			C	B
Approach Vol, veh/h					1001			2273			1849	
Approach Delay, s/veh					44.6			18.0			23.7	
Approach LOS					D			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6		8
Phs Duration (G+Y+Rc), s		70.1			17.1	53.0		32.9
Change Period (Y+Rc), s		6.0			6.0	6.0		6.0
Max Green Setting (Gmax), s		67.0			14.0	47.0		31.0
Max Q Clear Time (g_c+I1), s		29.0			10.8	30.6		24.7
Green Ext Time (p_c), s		35.1			0.3	15.8		2.2

Intersection Summary	
HCM 2010 Ctrl Delay	25.3
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	0	748	0	257	584	1496	0	0	1744	264
Number				3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1743	0	1743	1792	1792	0	0	1827	1827
Adj Flow Rate, veh/h				831	0	286	649	1662	0	0	1938	293
Adj No. of Lanes				2	0	1	2	3	0	0	3	1
Peak Hour Factor				0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %				9	0	9	6	6	0	0	4	4
Cap, veh/h				820	0	377	632	3114	0	0	1950	607
Arrive On Green				0.25	0.00	0.25	0.19	0.64	0.00	0.00	0.39	0.39
Sat Flow, veh/h				3221	0	1482	3312	5055	0	0	5152	1553
Grp Volume(v), veh/h				831	0	286	649	1662	0	0	1938	293
Grp Sat Flow(s),veh/h/ln				1610	0	1482	1656	1631	0	0	1663	1553
Q Serve(g_s), s				28.0	0.0	19.6	21.0	20.6	0.0	0.0	42.6	15.6
Cycle Q Clear(g_c), s				28.0	0.0	19.6	21.0	20.6	0.0	0.0	42.6	15.6
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				820	0	377	632	3114	0	0	1950	607
V/C Ratio(X)				1.01	0.00	0.76	1.03	0.53	0.00	0.00	0.99	0.48
Avail Cap(c_a), veh/h				820	0	377	632	3114	0	0	1950	607
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00
Uniform Delay (d), s/veh				41.0	0.0	37.9	44.5	11.0	0.0	0.0	33.4	25.1
Incr Delay (d2), s/veh				34.9	0.0	8.6	42.7	0.2	0.0	0.0	18.9	0.6
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				16.4	0.0	8.9	13.3	9.3	0.0	0.0	22.8	6.8
LnGrp Delay(d),s/veh				75.9	0.0	46.5	87.2	11.2	0.0	0.0	52.3	25.7
LnGrp LOS				F		D	F	B			D	C
Approach Vol, veh/h					1117			2311			2231	
Approach Delay, s/veh					68.3			32.5			48.8	
Approach LOS					E			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6		8
Phs Duration (G+Y+Rc), s		76.0			27.0	49.0		34.0
Change Period (Y+Rc), s		6.0			6.0	6.0		6.0
Max Green Setting (Gmax), s		70.0			21.0	43.0		28.0
Max Q Clear Time (g_c+I1), s		22.6			23.0	44.6		30.0
Green Ext Time (p_c), s		43.0			0.0	0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	46.0
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	11	81	343	115	50	13	256	354	220	14	185	39
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1827	1827	1845	1845	1900	1792	1792	1792	1900	1792	1900
Adj Flow Rate, veh/h	12	90	381	128	56	14	284	393	244	16	206	43
Adj No. of Lanes	0	1	1	1	1	0	1	1	1	0	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	4	4	4	3	3	3	6	6	6	6	6	6
Cap, veh/h	72	399	610	449	593	148	500	777	660	67	523	106
Arrive On Green	0.23	0.23	0.23	0.11	0.42	0.42	0.16	0.43	0.43	0.20	0.20	0.20
Sat Flow, veh/h	92	1698	1553	1757	1425	356	1707	1792	1524	83	2607	527
Grp Volume(v), veh/h	102	0	381	128	0	70	284	393	244	140	0	125
Grp Sat Flow(s),veh/h/ln	1790	0	1553	1757	0	1782	1707	1792	1524	1679	0	1538
Q Serve(g_s), s	0.0	0.0	15.8	4.0	0.0	1.9	9.8	12.7	8.6	0.0	0.0	5.7
Cycle Q Clear(g_c), s	3.6	0.0	15.8	4.0	0.0	1.9	9.8	12.7	8.6	5.4	0.0	5.7
Prop In Lane	0.12		1.00	1.00		0.20	1.00		1.00	0.11		0.34
Lane Grp Cap(c), veh/h	471	0	610	449	0	742	500	777	660	387	0	308
V/C Ratio(X)	0.22	0.00	0.62	0.28	0.00	0.09	0.57	0.51	0.37	0.36	0.00	0.41
Avail Cap(c_a), veh/h	542	0	673	571	0	938	915	1482	1260	620	0	540
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	24.7	0.0	19.5	17.5	0.0	14.2	18.7	16.4	15.3	27.7	0.0	27.8
Incr Delay (d2), s/veh	0.2	0.0	1.6	0.3	0.0	0.1	1.0	0.5	0.3	0.6	0.0	0.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	0.0	7.0	2.0	0.0	0.9	4.6	6.3	3.7	2.7	0.0	2.5
LnGrp Delay(d),s/veh	25.0	0.0	21.1	17.9	0.0	14.2	19.7	16.9	15.6	28.2	0.0	28.6
LnGrp LOS	C		C	B		B	B	B	B	C		C
Approach Vol, veh/h		483			198			921			265	
Approach Delay, s/veh		21.9			16.6			17.4			28.4	
Approach LOS		C			B			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4	5	6		8
Phs Duration (G+Y+Rc), s		40.6	14.5	24.7	18.6	22.0		39.2
Change Period (Y+Rc), s		6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		66.0	14.0	22.0	32.0	28.0		42.0
Max Q Clear Time (g_c+I1), s		14.7	6.0	17.8	11.8	7.7		3.9
Green Ext Time (p_c), s		5.5	0.2	1.0	0.8	4.8		2.4

Intersection Summary	
HCM 2010 Ctrl Delay	20.1
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	19	53	398	194	77	6	269	269	170	4	325	30
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1845	1845	1863	1863	1900	1810	1810	1810	1900	1810	1900
Adj Flow Rate, veh/h	21	59	442	216	86	7	299	299	189	4	361	33
Adj No. of Lanes	0	1	1	1	1	0	1	1	1	0	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	3	3	3	2	2	2	5	5	5	5	5	5
Cap, veh/h	125	314	607	464	704	57	459	790	672	47	617	56
Arrive On Green	0.22	0.22	0.22	0.12	0.41	0.41	0.16	0.44	0.44	0.20	0.20	0.20
Sat Flow, veh/h	308	1403	1568	1774	1700	138	1723	1810	1538	9	3107	281
Grp Volume(v), veh/h	80	0	442	216	0	93	299	299	189	210	0	188
Grp Sat Flow(s),veh/h/ln	1711	0	1568	1774	0	1838	1723	1810	1538	1800	0	1597
Q Serve(g_s), s	0.0	0.0	18.0	7.1	0.0	2.5	10.4	9.0	6.4	0.0	0.0	8.6
Cycle Q Clear(g_c), s	2.8	0.0	18.0	7.1	0.0	2.5	10.4	9.0	6.4	8.5	0.0	8.6
Prop In Lane	0.26		1.00	1.00		0.08	1.00		1.00	0.02		0.18
Lane Grp Cap(c), veh/h	439	0	607	464	0	762	459	790	672	403	0	317
V/C Ratio(X)	0.18	0.00	0.73	0.47	0.00	0.12	0.65	0.38	0.28	0.52	0.00	0.59
Avail Cap(c_a), veh/h	439	0	607	632	0	936	862	1505	1279	689	0	575
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	25.4	0.0	21.1	18.7	0.0	14.6	19.3	15.3	14.6	29.3	0.0	29.3
Incr Delay (d2), s/veh	0.2	0.0	4.4	0.7	0.0	0.1	1.6	0.3	0.2	1.0	0.0	1.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	9.0	3.5	0.0	1.3	5.0	4.6	2.7	4.3	0.0	4.0
LnGrp Delay(d),s/veh	25.6	0.0	25.5	19.4	0.0	14.6	20.9	15.6	14.8	30.3	0.0	31.1
LnGrp LOS	C		C	B		B	C	B	B	C		C
Approach Vol, veh/h		522			309			787			398	
Approach Delay, s/veh		25.5			18.0			17.4			30.7	
Approach LOS		C			B			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4	5	6		8
Phs Duration (G+Y+Rc), s		41.2	15.4	24.0	19.2	22.0		39.4
Change Period (Y+Rc), s		6.0	6.0	6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		67.0	17.0	18.0	32.0	29.0		41.0
Max Q Clear Time (g_c+I1), s		11.0	9.1	20.0	12.4	10.6		4.5
Green Ext Time (p_c), s		5.4	0.4	0.0	0.8	4.6		2.7

Intersection Summary	
HCM 2010 Ctrl Delay	22.2
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	139	883	0	0	470	129	308	0	63	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0		6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95		0.97		1.00			
Frt	1.00	1.00			0.97		1.00		0.85			
Flt Protected	0.95	1.00			1.00		0.95		1.00			
Satd. Flow (prot)	1671	3343			3296		2894		1335			
Flt Permitted	0.31	1.00			1.00		0.95		1.00			
Satd. Flow (perm)	545	3343			3296		2894		1335			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	154	981	0	0	522	143	342	0	70	0	0	0
RTOR Reduction (vph)	0	0	0	0	21	0	0	0	56	0	0	0
Lane Group Flow (vph)	154	981	0	0	644	0	342	0	14	0	0	0
Heavy Vehicles (%)	8%	8%	8%	6%	6%	6%	21%	21%	21%	2%	2%	2%
Turn Type	custom	NA			NA		Prot		Prot			
Protected Phases	5 8	2 5 8			6		7		7			
Permitted Phases	2						7		7			
Actuated Green, G (s)	73.7	73.7			44.7		23.7		23.7			
Effective Green, g (s)	73.7	73.7			44.7		23.7		23.7			
Actuated g/C Ratio	0.63	0.63			0.38		0.20		0.20			
Clearance Time (s)					6.0		6.0		6.0			
Vehicle Extension (s)					3.0		3.0		3.0			
Lane Grp Cap (vph)	639	2098			1254		584		269			
v/s Ratio Prot	0.06	c0.29			c0.20		c0.12		0.01			
v/s Ratio Perm	0.09											
v/c Ratio	0.24	0.47			0.51		0.59		0.05			
Uniform Delay, d1	9.5	11.5			28.0		42.4		37.8			
Progression Factor	1.36	0.84			1.00		1.00		1.00			
Incremental Delay, d2	0.2	0.1			0.4		1.5		0.1			
Delay (s)	13.0	9.8			28.3		43.9		37.9			
Level of Service	B	A			C		D		D			
Approach Delay (s)		10.3			28.3			42.9			0.0	
Approach LOS		B			C			D			A	

Intersection Summary			
HCM 2000 Control Delay	21.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	117.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	275	627	0	0	823	316	334	0	113	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0			6.0		6.0		6.0			
Lane Util. Factor	1.00	0.95			0.95		0.97		1.00			
Frt	1.00	1.00			0.96		1.00		0.85			
Flt Protected	0.95	1.00			1.00		0.95		1.00			
Satd. Flow (prot)	1703	3406			3295		3045		1404			
Flt Permitted	0.10	1.00			1.00		0.95		1.00			
Satd. Flow (perm)	170	3406			3295		3045		1404			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	306	697	0	0	914	351	371	0	126	0	0	0
RTOR Reduction (vph)	0	0	0	0	33	0	0	0	108	0	0	0
Lane Group Flow (vph)	306	697	0	0	1232	0	371	0	18	0	0	0
Heavy Vehicles (%)	6%	6%	6%	5%	5%	5%	15%	15%	15%	2%	2%	2%
Turn Type	custom	NA			NA		Prot		Prot			
Protected Phases	5 8	2 5 8			6		7		7			
Permitted Phases	2						7		7			
Actuated Green, G (s)	74.6	74.6			52.0		17.5		17.5			
Effective Green, g (s)	74.6	74.6			52.0		17.5		17.5			
Actuated g/C Ratio	0.63	0.63			0.44		0.15		0.15			
Clearance Time (s)					6.0		6.0		6.0			
Vehicle Extension (s)					3.0		3.0		3.0			
Lane Grp Cap (vph)	514	2129			1436		446		205			
v/s Ratio Prot	c0.16	0.20			c0.37		c0.12		0.01			
v/s Ratio Perm	0.21											
v/c Ratio	0.60	0.33			0.86		0.83		0.09			
Uniform Delay, d1	25.0	10.5			30.3		49.5		44.0			
Progression Factor	1.89	0.76			1.00		1.00		1.00			
Incremental Delay, d2	1.4	0.1			5.3		12.5		0.2			
Delay (s)	48.7	8.1			35.6		61.9		44.2			
Level of Service	D	A			D		E		D			
Approach Delay (s)		20.5			35.6			57.4			0.0	
Approach LOS		C			D			E			A	

Intersection Summary			
HCM 2000 Control Delay	34.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	119.3	Sum of lost time (s)	24.0
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	690	647	72	706	0	0	0	0	332	0	233
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					1.00		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3282	1468	1671	3343					1612		1442
Flt Permitted		1.00	1.00	0.22	1.00					0.95		1.00
Satd. Flow (perm)		3282	1468	385	3343					1612		1442
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	767	719	80	784	0	0	0	0	369	0	259
RTOR Reduction (vph)	0	0	121	0	0	0	0	0	0	0	0	75
Lane Group Flow (vph)	0	767	598	80	784	0	0	0	0	369	0	184
Heavy Vehicles (%)	10%	10%	10%	8%	8%	8%	2%	2%	2%	12%	12%	12%
Turn Type		NA	custom	custom	NA					custom		custom
Protected Phases		2		1	1 6					7 8		7 8
Permitted Phases			2 7 8	6						7 8		7 8
Actuated Green, G (s)		42.7	94.4	55.7	55.7					45.7		45.7
Effective Green, g (s)		42.7	94.4	55.7	55.7					45.7		45.7
Actuated g/C Ratio		0.36	0.80	0.47	0.47					0.39		0.39
Clearance Time (s)		6.0		6.0								
Vehicle Extension (s)		3.0		3.0								
Lane Grp Cap (vph)		1193	1180	303	1586					627		561
v/s Ratio Prot		c0.23		0.02	c0.23					c0.23		0.13
v/s Ratio Perm			0.41	0.10								
v/c Ratio		0.64	0.51	0.26	0.49					0.59		0.33
Uniform Delay, d1		31.0	3.8	18.5	21.2					28.4		25.1
Progression Factor		1.00	1.00	0.47	1.10					1.00		1.00
Incremental Delay, d2		1.2	0.3	0.4	0.2					1.4		0.3
Delay (s)		32.2	4.1	9.1	23.6					29.8		25.4
Level of Service		C	A	A	C					C		C
Approach Delay (s)		18.6			22.2			0.0			28.0	
Approach LOS		B			C			A			C	

Intersection Summary			
HCM 2000 Control Delay	21.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	117.4	Sum of lost time (s)	24.0
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	712	431	123	1034	0	0	0	0	190	0	202
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0					6.0		6.0
Lane Util. Factor		0.95	1.00	1.00	0.95					1.00		1.00
Frt		1.00	0.85	1.00	1.00					1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95		1.00
Satd. Flow (prot)		3343	1495	1703	3406					1570		1404
Flt Permitted		1.00	1.00	0.19	1.00					0.95		1.00
Satd. Flow (perm)		3343	1495	334	3406					1570		1404
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	791	479	137	1149	0	0	0	0	211	0	224
RTOR Reduction (vph)	0	0	124	0	0	0	0	0	0	0	0	91
Lane Group Flow (vph)	0	791	355	137	1149	0	0	0	0	211	0	133
Heavy Vehicles (%)	8%	8%	8%	6%	6%	6%	2%	2%	2%	15%	15%	15%
Turn Type		NA	custom	custom	NA					custom		custom
Protected Phases		2		1	1 6					7 8		7 8
Permitted Phases			2 7 8	6						7 8		7 8
Actuated Green, G (s)		42.8	88.3	67.8	67.8					39.5		39.5
Effective Green, g (s)		42.8	88.3	67.8	67.8					39.5		39.5
Actuated g/C Ratio		0.36	0.74	0.57	0.57					0.33		0.33
Clearance Time (s)		6.0		6.0								
Vehicle Extension (s)		3.0		3.0								
Lane Grp Cap (vph)		1199	1106	407	1935					519		464
v/s Ratio Prot		c0.24		0.05	c0.34					c0.13		0.09
v/s Ratio Perm			0.24	0.14								
v/c Ratio		0.66	0.32	0.34	0.59					0.41		0.29
Uniform Delay, d1		32.1	5.3	14.9	16.8					30.8		29.5
Progression Factor		1.00	1.00	1.24	0.94					1.00		1.00
Incremental Delay, d2		1.3	0.2	0.2	0.3					0.5		0.3
Delay (s)		33.5	5.4	18.7	16.1					31.4		29.8
Level of Service		C	A	B	B					C		C
Approach Delay (s)		22.9			16.4			0.0			30.6	
Approach LOS		C			B			A			C	

Intersection Summary			
HCM 2000 Control Delay	21.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	119.3	Sum of lost time (s)	24.0
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	196	260	326	186	132	65	560	1263	290	39	644	109
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1776	1776	1776	1792	1792	1900	1810	1810	1810	1810	1810	1810
Adj Flow Rate, veh/h	218	289	362	207	147	72	622	1403	322	43	716	121
Adj No. of Lanes	1	2	1	1	2	0	1	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	7	7	7	6	6	6	5	5	5	5	5	5
Cap, veh/h	281	675	767	282	733	342	598	1977	884	119	745	333
Arrive On Green	0.20	0.20	0.20	0.08	0.32	0.32	0.31	0.57	0.57	0.22	0.22	0.22
Sat Flow, veh/h	1103	3374	1509	1707	2256	1053	1723	3438	1538	272	3438	1538
Grp Volume(v), veh/h	218	289	362	207	109	110	622	1403	322	43	716	121
Grp Sat Flow(s),veh/h/ln	1103	1687	1509	1707	1703	1607	1723	1719	1538	272	1719	1538
Q Serve(g_s), s	23.6	9.0	18.6	9.0	5.5	5.9	37.0	35.2	13.5	17.6	24.7	8.0
Cycle Q Clear(g_c), s	23.6	9.0	18.6	9.0	5.5	5.9	37.0	35.2	13.5	17.6	24.7	8.0
Prop In Lane	1.00		1.00	1.00		0.66	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	281	675	767	282	553	522	598	1977	884	119	745	333
V/C Ratio(X)	0.78	0.43	0.47	0.74	0.20	0.21	1.04	0.71	0.36	0.36	0.96	0.36
Avail Cap(c_a), veh/h	281	675	767	282	553	522	598	1977	884	119	745	333
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	47.9	42.0	19.1	37.9	29.2	29.3	33.3	18.3	13.7	43.7	46.5	40.0
Incr Delay (d2), s/veh	12.9	0.4	0.5	9.6	0.2	0.2	47.6	1.2	0.3	1.8	23.8	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	8.2	4.2	7.8	3.2	2.6	2.7	27.7	16.9	5.8	1.4	14.2	3.5
LnGrp Delay(d),s/veh	60.7	42.4	19.5	47.5	29.4	29.5	80.9	19.5	14.0	45.6	70.3	40.6
LnGrp LOS	E	D	B	D	C	C	F	B	B	D	E	D
Approach Vol, veh/h		869			426			2347			880	
Approach Delay, s/veh		37.5			38.2			35.0			65.0	
Approach LOS		D			D			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6	7	8
Phs Duration (G+Y+Rc), s	43.0	32.0		45.0		75.0	15.0	30.0
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s	37.0	26.0		39.0		69.0	9.0	24.0
Max Q Clear Time (g_c+I1), s	39.0	26.7		7.9		37.2	11.0	25.6
Green Ext Time (p_c), s	0.0	0.0		6.0		23.7	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	41.6
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	91	151	540	259	315	69	349	809	164	28	1207	138
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1792	1792	1792	1810	1810	1900	1827	1827	1827	1827	1827	1827
Adj Flow Rate, veh/h	101	168	600	288	350	77	388	899	182	31	1341	153
Adj No. of Lanes	1	2	1	1	2	0	1	2	1	1	2	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	5	5	5	4	4	4	4	4	4
Cap, veh/h	183	454	495	263	749	163	396	2198	983	260	1360	608
Arrive On Green	0.13	0.13	0.13	0.08	0.27	0.27	0.19	0.63	0.63	0.39	0.39	0.39
Sat Flow, veh/h	921	3406	1524	1723	2810	611	1740	3471	1553	510	3471	1553
Grp Volume(v), veh/h	101	168	600	288	213	214	388	899	182	31	1341	153
Grp Sat Flow(s),veh/h/ln	921	1703	1524	1723	1719	1702	1740	1736	1553	510	1736	1553
Q Serve(g_s), s	12.8	5.4	16.0	10.0	12.4	12.7	22.2	15.4	5.8	4.7	46.0	8.0
Cycle Q Clear(g_c), s	12.8	5.4	16.0	10.0	12.4	12.7	22.2	15.4	5.8	4.7	46.0	8.0
Prop In Lane	1.00		1.00	1.00		0.36	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	183	454	495	263	458	454	396	2198	983	260	1360	608
V/C Ratio(X)	0.55	0.37	1.21	1.09	0.46	0.47	0.98	0.41	0.19	0.12	0.99	0.25
Avail Cap(c_a), veh/h	183	454	495	263	458	454	396	2198	983	260	1360	608
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	50.6	47.4	40.5	46.3	36.8	36.9	38.6	10.9	9.1	23.6	36.2	24.6
Incr Delay (d2), s/veh	3.6	0.5	112.8	82.6	0.7	0.8	39.4	0.1	0.1	0.2	21.1	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.4	2.6	31.9	6.0	6.0	6.1	17.1	7.4	2.5	0.7	26.0	3.4
LnGrp Delay(d),s/veh	54.2	47.9	153.3	128.8	37.6	37.7	78.0	11.0	9.2	23.8	57.3	24.8
LnGrp LOS	D	D	F	F	D	D	E	B	A	C	E	C
Approach Vol, veh/h		869			715			1469			1525	
Approach Delay, s/veh		121.4			74.4			28.5			53.4	
Approach LOS		F			E			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6	7	8
Phs Duration (G+Y+Rc), s	29.0	53.0		38.0		82.0	16.0	22.0
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s	23.0	47.0		32.0		76.0	10.0	16.0
Max Q Clear Time (g_c+I1), s	24.2	48.0		14.7		17.4	12.0	18.0
Green Ext Time (p_c), s	0.0	0.0		6.3		35.0	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	61.6
HCM 2010 LOS	E

Intersection	
Int Delay, s/veh	1.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	47	22	324	62	35	346
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	200	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	36	36	12	12	3	3
Mvmt Flow	52	24	360	69	39	384

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	664	214	0	0	429	0
Stage 1	394	-	-	-	-	-
Stage 2	270	-	-	-	-	-
Critical Hdwy	7.52	7.62	-	-	4.16	-
Critical Hdwy Stg 1	6.52	-	-	-	-	-
Critical Hdwy Stg 2	6.52	-	-	-	-	-
Follow-up Hdwy	3.86	3.66	-	-	2.23	-
Pot Cap-1 Maneuver	326	696	-	-	1120	-
Stage 1	560	-	-	-	-	-
Stage 2	659	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	315	696	-	-	1120	-
Mov Cap-2 Maneuver	315	-	-	-	-	-
Stage 1	560	-	-	-	-	-
Stage 2	636	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16.1		
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	315	696	1120	-
HCM Lane V/C Ratio	-	-	0.166	0.035	0.035	-
HCM Control Delay (s)	-	-	18.7	10.4	8.3	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	1	0	0	-

Intersection	
Int Delay, s/veh	1.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	45	23	333	67	30	333
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	200	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	31	31	10	10	3	3
Mvmt Flow	50	26	370	74	33	370

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	659	222	0	0	444	0
Stage 1	407	-	-	-	-	-
Stage 2	252	-	-	-	-	-
Critical Hdwy	7.42	7.52	-	-	4.16	-
Critical Hdwy Stg 1	6.42	-	-	-	-	-
Critical Hdwy Stg 2	6.42	-	-	-	-	-
Follow-up Hdwy	3.81	3.61	-	-	2.23	-
Pot Cap-1 Maneuver	337	700	-	-	1105	-
Stage 1	563	-	-	-	-	-
Stage 2	687	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	327	700	-	-	1105	-
Mov Cap-2 Maneuver	327	-	-	-	-	-
Stage 1	563	-	-	-	-	-
Stage 2	666	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.4		
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	327	700	1105	-
HCM Lane V/C Ratio	-	-	0.153	0.037	0.03	-
HCM Control Delay (s)	-	-	18	10.3	8.4	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	1	0	0	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	177	137	249	383	237	156
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1681	1681	1727	1900	1696	1696
Adj Flow Rate, veh/h	197	152	277	426	263	173
Adj No. of Lanes	1	1	2	0	1	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	13	13	10	10	12	12
Cap, veh/h	240	214	1067	954	389	2095
Arrive On Green	0.15	0.15	0.21	0.21	0.65	0.65
Sat Flow, veh/h	1601	1429	1727	1468	675	3308
Grp Volume(v), veh/h	197	152	277	426	263	173
Grp Sat Flow(s),veh/h/ln	1601	1429	1641	1468	675	1612
Q Serve(g_s), s	7.2	6.1	8.4	15.1	23.1	1.2
Cycle Q Clear(g_c), s	7.2	6.1	8.4	15.1	38.2	1.2
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	240	214	1067	954	389	2095
V/C Ratio(X)	0.82	0.71	0.26	0.45	0.68	0.08
Avail Cap(c_a), veh/h	240	214	1067	954	389	2095
HCM Platoon Ratio	1.00	1.00	0.33	0.33	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.93	0.93	1.00	1.00
Uniform Delay (d), s/veh	24.7	24.3	11.6	14.2	17.8	3.9
Incr Delay (d2), s/veh	19.7	10.3	0.6	1.4	9.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.5	3.0	4.0	6.5	5.2	0.6
LnGrp Delay(d),s/veh	44.4	34.6	12.1	15.6	26.9	4.0
LnGrp LOS	D	C	B	B	C	A
Approach Vol, veh/h	349		703			436
Approach Delay, s/veh	40.1		14.2			17.8
Approach LOS	D		B			B

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		45.0				45.0		15.0
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		39.0				39.0		9.0
Max Q Clear Time (g_c+I1), s		17.1				40.2		9.2
Green Ext Time (p_c), s		8.5				0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	21.4
HCM 2010 LOS	C

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	408	251	149	187	147	231
Number	3	18	2	12	1	6
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1712	1712	1759	1900	1727	1727
Adj Flow Rate, veh/h	453	279	166	208	163	257
Adj No. of Lanes	1	1	2	0	1	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	11	11	8	8	10	10
Cap, veh/h	538	480	889	795	554	1745
Arrive On Green	0.33	0.33	0.53	0.53	0.53	0.53
Sat Flow, veh/h	1630	1455	1759	1495	931	3368
Grp Volume(v), veh/h	453	279	166	208	163	257
Grp Sat Flow(s),veh/h/ln	1630	1455	1671	1495	931	1641
Q Serve(g_s), s	14.4	8.9	2.9	4.2	6.4	2.2
Cycle Q Clear(g_c), s	14.4	8.9	2.9	4.2	10.6	2.2
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	538	480	889	795	554	1745
V/C Ratio(X)	0.84	0.58	0.19	0.26	0.29	0.15
Avail Cap(c_a), veh/h	790	705	889	795	554	1745
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.98	0.98	1.00	1.00
Uniform Delay (d), s/veh	17.3	15.5	6.8	7.1	10.0	6.6
Incr Delay (d2), s/veh	5.5	1.1	0.5	0.8	1.3	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.2	3.7	1.4	1.9	1.8	1.0
LnGrp Delay(d),s/veh	22.8	16.6	7.2	7.9	11.3	6.8
LnGrp LOS	C	B	A	A	B	A
Approach Vol, veh/h	732		374			420
Approach Delay, s/veh	20.4		7.6			8.6
Approach LOS	C		A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2				6		8
Phs Duration (G+Y+Rc), s		35.6				35.6		24.4
Change Period (Y+Rc), s		6.0				6.0		6.0
Max Green Setting (Gmax), s		21.0				21.0		27.0
Max Q Clear Time (g_c+I1), s		6.2				12.6		16.4
Green Ext Time (p_c), s		4.2				3.1		2.0

Intersection Summary	
HCM 2010 Ctrl Delay	14.0
HCM 2010 LOS	B

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	331	22	33	301	155	178
Number	7	14	5	2	6	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1638	1638	1827	1827	1727	1900
Adj Flow Rate, veh/h	368	24	37	334	172	198
Adj No. of Lanes	2	1	1	2	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	16	16	4	4	10	10
Cap, veh/h	559	257	915	2796	1322	1183
Arrive On Green	0.18	0.18	0.81	0.81	0.81	0.81
Sat Flow, veh/h	3026	1392	989	3563	1727	1468
Grp Volume(v), veh/h	368	24	37	334	172	198
Grp Sat Flow(s),veh/h/ln	1513	1392	989	1736	1641	1468
Q Serve(g_s), s	5.5	0.7	0.4	1.0	1.1	1.5
Cycle Q Clear(g_c), s	5.5	0.7	1.9	1.0	1.1	1.5
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	559	257	915	2796	1322	1183
V/C Ratio(X)	0.66	0.09	0.04	0.12	0.13	0.17
Avail Cap(c_a), veh/h	1998	919	915	2796	1322	1183
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.34	0.34	1.00	1.00	0.87	0.87
Uniform Delay (d), s/veh	18.3	16.4	1.3	1.0	1.0	1.1
Incr Delay (d2), s/veh	0.4	0.1	0.1	0.1	0.2	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.3	0.1	0.5	0.5	0.6
LnGrp Delay(d),s/veh	18.8	16.4	1.4	1.1	1.2	1.3
LnGrp LOS	B	B	A	A	A	A
Approach Vol, veh/h	392			371	370	
Approach Delay, s/veh	18.6			1.1	1.3	
Approach LOS	B			A	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		45.0		15.0		45.0		
Change Period (Y+Rc), s		6.0		6.0		6.0		
Max Green Setting (Gmax), s		16.0		32.0		16.0		
Max Q Clear Time (g_c+I1), s		3.9		7.5		3.5		
Green Ext Time (p_c), s		3.6		1.4		3.7		

Intersection Summary	
HCM 2010 Ctrl Delay	7.2
HCM 2010 LOS	A

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	177	23	22	159	304	335
Number	7	14	5	2	6	16
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1667	1667	1845	1845	1759	1900
Adj Flow Rate, veh/h	197	26	24	177	338	372
Adj No. of Lanes	2	1	1	2	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	14	14	3	3	8	8
Cap, veh/h	545	251	601	2864	1366	1222
Arrive On Green	0.18	0.18	0.82	0.82	0.27	0.27
Sat Flow, veh/h	3079	1417	729	3597	1759	1495
Grp Volume(v), veh/h	197	26	24	177	338	372
Grp Sat Flow(s),veh/h/ln	1540	1417	729	1752	1671	1495
Q Serve(g_s), s	2.7	0.7	0.6	0.5	7.6	9.6
Cycle Q Clear(g_c), s	2.7	0.7	10.2	0.5	7.6	9.6
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	545	251	601	2864	1366	1222
V/C Ratio(X)	0.36	0.10	0.04	0.06	0.25	0.30
Avail Cap(c_a), veh/h	2041	939	601	2864	1366	1222
HCM Platoon Ratio	1.00	1.00	1.00	1.00	0.33	0.33
Upstream Filter(I)	0.56	0.56	1.00	1.00	0.81	0.81
Uniform Delay (d), s/veh	17.5	16.7	3.6	0.8	6.0	6.7
Incr Delay (d2), s/veh	0.2	0.1	0.1	0.0	0.4	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.3	0.1	0.2	3.7	4.1
LnGrp Delay(d),s/veh	17.7	16.8	3.7	0.9	6.4	7.2
LnGrp LOS	B	B	A	A	A	A
Approach Vol, veh/h	223			201	710	
Approach Delay, s/veh	17.6			1.2	6.8	
Approach LOS	B			A	A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		45.5		14.5		45.5		
Change Period (Y+Rc), s		6.0		6.0		6.0		
Max Green Setting (Gmax), s		16.0		32.0		16.0		
Max Q Clear Time (g_c+I1), s		12.2		4.7		11.6		
Green Ext Time (p_c), s		2.0		0.7		2.2		

Intersection Summary	
HCM 2010 Ctrl Delay	7.9
HCM 2010 LOS	A

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	0	12	334	36	141
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	4	4
Mvmt Flow	0	0	13	371	40	157

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	252	40	40	0	-	0
Stage 1	40	-	-	-	-	-
Stage 2	212	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.12	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.218	-	-	-
Pot Cap-1 Maneuver	726	1031	1570	-	-	-
Stage 1	982	-	-	-	-	-
Stage 2	804	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	719	1031	1570	-	-	-
Mov Cap-2 Maneuver	719	-	-	-	-	-
Stage 1	982	-	-	-	-	-
Stage 2	796	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0	0.3	
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1570	-	-	-	-
HCM Lane V/C Ratio	0.008	-	-	-	-
HCM Control Delay (s)	7.3	0	0	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	0	0	13	181	16	311
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	3	3
Mvmt Flow	0	0	14	201	18	346

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	147	18	18	0	-	0
Stage 1	18	-	-	-	-	-
Stage 2	129	-	-	-	-	-
Critical Hdwy	6.63	6.23	4.12	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	2.218	-	-	-
Pot Cap-1 Maneuver	838	1060	1599	-	-	-
Stage 1	1004	-	-	-	-	-
Stage 2	884	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	830	1060	1599	-	-	-
Mov Cap-2 Maneuver	830	-	-	-	-	-
Stage 1	1004	-	-	-	-	-
Stage 2	875	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	0	0.5	
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1599	-	-	-	-
HCM Lane V/C Ratio	0.009	-	-	-	-
HCM Control Delay (s)	7.3	0	0	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	9.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	326	4	4	4	0	6	0	14	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	362	4	4	4	0	7	0	16	4

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	65	64	36	67	62	18	36	0	0
Stage 1	44	44	-	18	18	-	-	-	-
Stage 2	21	20	-	49	44	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-
Pot Cap-1 Maneuver	929	827	1037	926	829	1061	1575	-	-
Stage 1	970	858	-	1001	880	-	-	-	-
Stage 2	998	879	-	964	858	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	921	825	1037	916	827	1061	1575	-	-
Mov Cap-2 Maneuver	921	825	-	916	827	-	-	-	-
Stage 1	970	856	-	1001	880	-	-	-	-
Stage 2	992	879	-	952	856	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	11.5	8.6	
HCM LOS	B	A	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1575	-	-	921	998	1596	-	-
HCM Lane V/C Ratio	-	-	-	0.403	0.011	0.003	-	-
HCM Control Delay (s)	0	-	-	11.5	8.6	7.3	-	-
HCM Lane LOS	A	-	-	B	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	2	0	0	-	-

Intersection	
Int Delay, s/veh	

Movement	SBL	SBT	SBR
Vol, veh/h	4	32	0
Conflicting Peds, #/hr	0	0	0
Sign Control	Free	Free	Free
RT Channelized	-	-	None
Storage Length	0	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	90	90	90
Heavy Vehicles, %	2	2	2
Mvmt Flow	4	36	0

Major/Minor	Major2		
Conflicting Flow All	20	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.12	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.218	-	-
Pot Cap-1 Maneuver	1596	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	1596	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	SB
HCM Control Delay, s	
HCM LOS	

Minor Lane/Major Mvmt

Intersection	
Int Delay, s/veh	8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	167	4	4	4	0	6	0	21	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	3	3	3	2	2	2	2	2	2
Mvmt Flow	186	4	4	4	0	7	0	23	4

Major/Minor	Minor2			Minor1			Major1		
Conflicting Flow All	51	50	13	53	48	26	13	0	0
Stage 1	22	22	-	26	26	-	-	-	-
Stage 2	29	28	-	27	22	-	-	-	-
Critical Hdwy	7.13	6.53	6.23	7.12	6.52	6.22	4.12	-	-
Critical Hdwy Stg 1	6.13	5.53	-	6.12	5.52	-	-	-	-
Critical Hdwy Stg 2	6.13	5.53	-	6.12	5.52	-	-	-	-
Follow-up Hdwy	3.527	4.027	3.327	3.518	4.018	3.318	2.218	-	-
Pot Cap-1 Maneuver	946	840	1064	946	844	1050	1606	-	-
Stage 1	994	875	-	992	874	-	-	-	-
Stage 2	985	870	-	990	877	-	-	-	-
Platoon blocked, %								-	-
Mov Cap-1 Maneuver	938	838	1064	936	842	1050	1606	-	-
Mov Cap-2 Maneuver	938	838	-	936	842	-	-	-	-
Stage 1	994	873	-	992	874	-	-	-	-
Stage 2	979	870	-	978	875	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	9.8	8.6	
HCM LOS	A	A	

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1606	-	-	938	1001	1585	-	-
HCM Lane V/C Ratio	-	-	-	0.207	0.011	0.003	-	-
HCM Control Delay (s)	0	-	-	9.8	8.6	7.3	-	-
HCM Lane LOS	A	-	-	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	1	0	0	-	-

Intersection			
Int Delay, s/veh			

Movement	SBL	SBT	SBR
Vol, veh/h	4	12	0
Conflicting Peds, #/hr	0	0	0
Sign Control	Free	Free	Free
RT Channelized	-	-	None
Storage Length	0	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	90	90	90
Heavy Vehicles, %	2	2	2
Mvmt Flow	4	13	0

Major/Minor	Major2		
Conflicting Flow All	28	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.12	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.218	-	-
Pot Cap-1 Maneuver	1585	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %		-	-
Mov Cap-1 Maneuver	1585	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	SB
HCM Control Delay, s	
HCM LOS	

Minor Lane/Major Mvmt

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Cosgrove NB
Agency or Company	Atkins	Junction	7010 - Off to I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 125	V_D = veh/h
	Freeway Volume, V_F: 3128	
	Ramp Volume, V_R: 881	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3128	0.90	Level	12	0	0.943	1.00	3684
Ramp	881	0.90	Level	17	0	0.922	1.00	1062
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.619 using Equation (Exhibit 13-7)

V_{12} = 2685 pc/h

V_3 or V_{av34} 999 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3684	Exhibit 13-8	6750	No
$V_{FO} = V_F - V_R$	2622	Exhibit 13-8	6750	No
V_R	1062	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2685	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 26.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.394 (Exhibit 13-12)

S_R= 49.9 mph (Exhibit 13-12)

S_0= 60.3 mph (Exhibit 13-12)

S = 52.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Cosgrove NB
Agency or Company	Atkins	Junction	7010 - Off to I-26 EB
Date Performed	3/20/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	125	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2048	V_D =	veh/h
		Ramp Volume, V_R	478		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2048	0.90	Level	9	0	0.957	1.00	2378
Ramp	478	0.90	Level	27	0	0.881	1.00	603
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.673 using Equation (Exhibit 13-7)

V_{12} = 1797 pc/h

V_3 or V_{av34} 581 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2378	Exhibit 13-8	6750	No
$V_{FO} = V_F - V_R$	1775	Exhibit 13-8	6750	No
V_R	603	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1797	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 18.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.352 (Exhibit 13-12)

S_R= 50.4 mph (Exhibit 13-12)

S_0= 60.3 mph (Exhibit 13-12)

S = 52.5 mph (Exhibit 13-13)

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	Cosgrove NB
Weaving Segment Location	7020-I-26 EB On to I-26 WB Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	450ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1373	0.90	10	0	1.5	1.2	0.952	1.00	1602
V_{RF}	308	0.90	10	0	1.5	1.2	0.952	1.00	359
V_{FR}	874	0.90	19	0	1.5	1.2	0.913	1.00	1063
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	1602							V =	3024
V_W	1422								
VR	0.470								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1422 lc/h
Interchange density, ID	0.2 int/mi	Weaving lane changes, LC_W	1510 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1510 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	14

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3024 pc/h	Weaving intensity factor, W	0.587
Weaving segment capacity, c_w	4861 veh/h	Weaving segment speed, S	32.4 mph
Weaving segment v/c ratio	0.592	Average weaving speed, S_W	33.9 mph
Weaving segment density, D	23.4 pc/mi/ln	Average non-weaving speed, S_{NW}	31.1 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	7481 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	Cosgrove NB
Weaving Segment Location	7020-I-26 EB On to I-26 WB Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	450ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	770	0.90	8	0	1.5	1.2	0.962	1.00	890
V_{RF}	158	0.90	13	0	1.5	1.2	0.939	1.00	187
V_{FR}	800	0.90	18	0	1.5	1.2	0.917	1.00	969
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	890							V =	2046
V_W	1156								
VR	0.565								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1156 lc/h
Interchange density, ID	0.2 int/mi	Weaving lane changes, LC_W	1244 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1244 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	8

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2046 pc/h	Weaving intensity factor, W	0.504
Weaving segment capacity, c_w	4084 veh/h	Weaving segment speed, S	34.6 mph
Weaving segment v/c ratio	0.482	Average weaving speed, S_W	34.9 mph
Weaving segment density, D	14.8 pc/mi/ln	Average non-weaving speed, S_{NW}	34.2 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	8596 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Cosgrove NB
Agency or Company	Atkins	Junction	7030 - NB On from I-26 WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 200	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1681	
	Ramp Volume, V_R: 432	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1681	0.90	Level	10	0	0.952	1.00	1961
Ramp	432	0.90	Level	13	0	0.939	1.00	511
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.583 using Equation (Exhibit 13-6)

V_{12} = 1143 pc/h

V_3 or V_{av34} 818 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2472	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1654	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 16.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.323 (Exibit 13-11)

S_R= 50.8 mph (Exhibit 13-11)

S_0= 53.9 mph (Exhibit 13-11)

S = 51.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Cosgrove NB
Agency or Company	Atkins	Junction	7030 - NB On from I-26 WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 200	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 928	
	Ramp Volume, V_R: 394	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	928	0.90	Level	8	0	0.962	1.00	1072
Ramp	394	0.90	Level	13	0	0.939	1.00	466
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.583 using Equation (Exhibit 13-6)

V_{12} = 625 pc/h

V_3 or V_{av34} 447 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1538	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1091	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.315 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= 55.0 mph (Exhibit 13-11)

S = 52.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Cosgrove SB
Agency or Company	Atkins	Junction	7040 - Off to I-26 WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	225	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	1156	V_D =	veh/h
		Ramp Volume, V_R	184		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1156	0.90	Level	5	0	0.976	1.00	1317
Ramp	184	0.90	Level	24	0	0.893	1.00	229
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1317 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1317	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	1088	Exhibit 13-8	4500	No
V_R	229	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1317	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 13.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.319 (Exhibit 13-12)

S_R= 50.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Cosgrove SB
Agency or Company	Atkins	Junction	7040 - Off to I-26 WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	225
Freeway Volume, V_F	2006
Ramp Volume, V_R	373
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2006	0.90	Level	4	0	0.980	1.00	2273
Ramp	373	0.90	Level	10	0	0.952	1.00	435
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 2273 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2273	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	1838	Exhibit 13-8	4500	No
V_R	435	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2273	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 21.8 (pc/mi/ln)
LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.337 (Exhibit 13-12)
S_R= 50.6 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 50.6 mph (Exhibit 13-13)

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	Cosgrove SB
Weaving Segment Location	7050-I-26 WB On to I-26 EB Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	475ft
Freeway free-flow speed, FFS	45 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	536	0.90	10	0	1.5	1.2	0.952	1.00	625
V_{RF}	399	0.90	28	0	1.5	1.2	0.877	1.00	505
V_{FR}	436	0.90	10	0	1.5	1.2	0.952	1.00	509
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	625							V =	1639
V_W	1014								
VR	0.619								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1014 lc/h
Interchange density, ID	0.2 int/mi	Weaving lane changes, LC_W	1068 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1068 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	6

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1639 pc/h	Weaving intensity factor, W	0.428
Weaving segment capacity, c_w	3695 veh/h	Weaving segment speed, S	35.6 mph
Weaving segment v/c ratio	0.422	Average weaving speed, S_W	36.0 mph
Weaving segment density, D	15.3 pc/mi/ln	Average non-weaving speed, S_{NW}	35.1 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	9246 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	Cosgrove SB
Weaving Segment Location	7050-I-26 WB On to I-26 EB Off
Analysis Year	2038 Build - River Center Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	C-D Roadway/ Multilane Highways
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	475ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	45 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1193	0.90	8	0	1.5	1.2	0.962	1.00	1379
V_{RF}	891	0.90	11	0	1.5	1.2	0.948	1.00	1044
V_{FR}	440	0.90	8	0	1.5	1.2	0.962	1.00	508
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	1379							V =	2931
V_W	1552								
VR	0.530								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1552 lc/h
Interchange density, ID	0.2 int/mi	Weaving lane changes, LC_W	1606 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1606 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	13

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2931 pc/h	Weaving intensity factor, W	0.591
Weaving segment capacity, c_w	4358 veh/h	Weaving segment speed, S	31.5 mph
Weaving segment v/c ratio	0.647	Average weaving speed, S_W	33.9 mph
Weaving segment density, D	31.1 pc/mi/ln	Average non-weaving speed, S_{NW}	29.1 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	8173 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	Cosgrove SB
Analysis Year	2038 Build-River Center Site	Junction	From I-26 EB
Analysis Time Period:	AM Peak	Segment ID	7060
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	45	45	45
Volume, V (veh/h)	935	1,807	872
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	12%	12%	12%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.94	0.94	0.94
Demand Flow Rate, v_p (pc/h/ln)	551	709	1,027
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	2,100
v/c ratio	0.26	0.34	0.49
Density, D_{MD} (pc/mi/ln)	9.6	12.4	18.0
LOS	A	B	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	Cosgrove SB
Analysis Year	2038 Build-River Center Site	Junction	From I-26 EB
Analysis Time Period:	PM Peak	Segment ID	7060
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	45	45	45
Volume, V (veh/h)	2,084	3,337	1,253
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	9%	9%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.96	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,210	1,292	1,441
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	2,100
v/c ratio	0.58	0.62	0.69
Density, D_{MD} (pc/mi/ln)	21.2	22.6	25.2
LOS	C	C	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Montague NB
Agency or Company	Atkins	Junction	8010 - Off to I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	350	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2248	V_D =	veh/h
		Ramp Volume, V_R	719		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2248	0.90	Level	10	0	0.952	1.00	2623
Ramp	719	0.90	Level	8	0	0.962	1.00	831
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2623 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2623	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	1792	Exhibit 13-8	4500	No
V_R	831	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2623	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.373 (Exhibit 13-12)

S_R= 50.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Montague NB
Agency or Company	Atkins	Junction	8010 - Off to I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	350
Freeway Volume, V_F	2573
Ramp Volume, V_R	779
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2573	0.90	Level	8	0	0.962	1.00	2973
Ramp	779	0.90	Level	7	0	0.966	1.00	896
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 2973 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2973	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	2077	Exhibit 13-8	4500	No
V_R	896	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2973	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 26.7 (pc/mi/ln)
LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.379 (Exhibit 13-12)
S_R= 50.1 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 50.1 mph (Exhibit 13-13)

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	Montague NB
Analysis Year	2038 Build-River Center Site	Junction	From I-26 EB
Analysis Time Period:	AM Peak	Segment ID	8020
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	45	45	25
Volume, V (veh/h)	1,529	2,045	516
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	10%	7%	6%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.95	0.97	0.97
Demand Flow Rate, v_p (pc/h/ln)	892	784	591
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	1,900
v/c ratio	0.42	0.37	0.31
Density, D_{MD} (pc/mi/ln)	15.6	13.7	10.3
LOS	B	B	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	Montague NB
Analysis Year	2038 Build-River Center Site	Junction	From I-26 EB
Analysis Time Period:	PM Peak	Segment ID	8020
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	45	45	25
Volume, V (veh/h)	1,794	2,080	286
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	8%	6%	9%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.97	0.96
Demand Flow Rate, v_p (pc/h/ln)	1,037	793	332
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	1,900
v/c ratio	0.49	0.38	0.17
Density, D_{MD} (pc/mi/ln)	18.1	13.9	5.8
LOS	B	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	Montague SB
Analysis Year	2038 Build-River Center Site	Junction	Off to I-26 EB
Analysis Time Period:	AM Peak	Segment ID	8030
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	45	45	25
Volume, V (veh/h)	2,105	1,683	422
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	7%	10%	9%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.97	0.95	0.96
Demand Flow Rate, v_p (pc/h/ln)	807	982	490
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	1,900
v/c ratio	0.38	0.47	0.26
Density, D_{MD} (pc/mi/ln)	14.1	17.2	8.6
LOS	B	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	Montague SB
Analysis Year	2038 Build-River Center Site	Junction	Off to I-26 EB
Analysis Time Period:	PM Peak	Segment ID	8030
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	45	45	25
Volume, V (veh/h)	2,492	1,957	535
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	6%	8%	6%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.97	0.96	0.97
Demand Flow Rate, v_p (pc/h/ln)	951	1,131	612
Capacity Flow Rate, c (pc/h/ln)	2,100	2,100	1,900
v/c ratio	0.45	0.54	0.32
Density, D_{MD} (pc/mi/ln)	16.6	19.8	10.7
LOS	B	B	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Montague SB
Agency or Company	Atkins	Junction	8040 - On from I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 550	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1683	
	Ramp Volume, V_R: 492	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1683	0.90	Level	10	0	0.952	1.00	1964
Ramp	492	0.90	Level	15	0	0.930	1.00	588
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1964 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2552	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2552	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 21.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.322 (Exibit 13-11)

S_R= 50.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	Montague SB
Agency or Company	Atkins	Junction	8040 - On from I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build - River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 550	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1957	
	Ramp Volume, V_R: 296	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1957	0.90	Level	8	0	0.962	1.00	2261
Ramp	296	0.90	Level	8	0	0.962	1.00	342
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2261 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2603	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2603	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.324 (Exibit 13-11)

S_R= 50.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	PAR NB
Analysis Year	2038 Build-River Center Site	Junction	Merge from 26 EB & WB
Analysis Time Period:	AM Peak	Segment ID	9010
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	313	945	632
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	41%	41%	41%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.83	0.83	0.83
Demand Flow Rate, v_p (pc/h/ln)	419	633	846
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	0.19	0.29	0.38
Density, D_{MD} (pc/mi/ln)	7.3	11.1	14.8
LOS	A	B	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	PAR NB
Analysis Year	2038 Build-River Center Site	Junction	Merge from 26 EB & WB
Analysis Time Period:	PM Peak	Segment ID	9010
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	108	427	319
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	36%	36%	36%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.85	0.85	0.85
Demand Flow Rate, v_p (pc/h/ln)	142	280	418
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	0.06	0.13	0.19
Density, D_{MD} (pc/mi/ln)	2.5	4.9	7.3
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	PAR NB
Agency or Company	Atkins	Junction	9020 - Off to Local Access Rd
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build-River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	950	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	945	V_D =	veh/h
		Ramp Volume, V_R	334		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	945	0.90	Level	41	0	0.830	1.00	1265
Ramp	334	0.90	Level	2	0	0.990	1.00	375
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1265 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1265	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	890	Exhibit 13-8	4500	No
V_R	375	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1265	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 6.6 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.332 (Exhibit 13-12)

S_R= 50.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.7 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	PAR NB
Agency or Company	Atkins	Junction	9020 - Off to Local Access Rd
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build-River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	950	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	427	V_D =	veh/h
		Ramp Volume, V_R	175		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	427	0.90	Level	36	0	0.847	1.00	560
Ramp	175	0.90	Level	3	0	0.985	1.00	197
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 560 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	560	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	363	Exhibit 13-8	4500	No
V_R	197	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	560	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 0.5 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.316 (Exhibit 13-12)

S_R= 50.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 50.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	PAR SB
Agency or Company	Atkins	Junction	9030 - On from Local Access Rd
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2038 Build-River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 276	
	Ramp Volume, V_R: 153	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	276	0.90	Level	61	0	0.766	1.00	400
Ramp	153	0.90	Level	10	0	0.952	1.00	179
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 400 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	579	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	579	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 3.6 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.238 (Exibit 13-11)

S_R= 51.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	PAR SB
Agency or Company	Atkins	Junction	9030 - On from Local Access Rd
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2038 Build-River Center Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 585	
	Ramp Volume, V_R: 324	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	585	0.90	Level	56	0	0.781	1.00	832
Ramp	324	0.90	Level	4	0	0.980	1.00	367
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 832 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1199	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1199	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 8.4 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.244 (Exibit 13-11)

S_R= 51.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	PAR SB
Analysis Year	2038 Build-River Center Site	Junction	Split to 26 EB & WB
Analysis Time Period:	AM Peak	Segment ID	9040
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	1	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	429	328	101
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	41%	41%	41%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.83	0.83	0.83
Demand Flow Rate, v_p (pc/h/ln)	287	439	135
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	0.13	0.20	0.06
Density, D_{MD} (pc/mi/ln)	5.0	7.7	2.4
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	PAR SB
Analysis Year	2038 Build-River Center Site	Junction	Split to 26 EB & WB
Analysis Time Period:	PM Peak	Segment ID	9040
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	1	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	909	625	284
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	36%	36%	36%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.85	0.85	0.85
Demand Flow Rate, v_p (pc/h/ln)	596	819	372
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	0.27	0.37	0.17
Density, D_{MD} (pc/mi/ln)	10.4	14.3	6.5
LOS	B	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

Arterial Level of Service: NB #1

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Driveway	II	40	28.5	10.4	38.9	0.26	23.9	C
Carolina Ave	II	35	43.3	4.5	47.8	0.41	31.1	B
Reynolds Ave	II	35	44.7	8.2	52.9	0.43	29.2	B
ICTF Truck Dwy	II	40	30.5	18.0	48.5	0.30	22.2	C
McMillan Ave	II	40	15.4	10.5	25.9	0.13	18.6	D
Total	II		162.4	51.6	214.0	1.53	25.8	C

Arterial Level of Service: SB #1

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Cosgrove Ave	II	40	15.4	35.7	51.1	0.13	9.4	F
Reynolds Ave	II	40	30.5	24.6	55.1	0.30	19.6	D
Carolina Ave	II	35	44.7	7.6	52.3	0.43	29.6	B
Burton Ln	II	40	39.6	20.8	60.4	0.41	24.6	C
Stromboli Ave	II	40	28.5	10.5	39.0	0.26	23.9	C
Total	II		158.7	99.2	257.9	1.53	21.4	D

Arterial Level of Service: NB #1

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Driveway	II	40	28.5	14.5	43.0	0.26	21.7	D
Carolina Ave	II	35	43.3	10.1	53.4	0.41	27.8	C
Reynolds Ave	II	35	44.7	22.5	67.2	0.43	23.0	C
ICTF Truck Dwy	II	40	30.5	51.6	82.1	0.30	13.1	E
McMillan Ave	II	40	15.4	22.0	37.4	0.13	12.9	F
Total	II		162.4	120.7	283.1	1.53	19.5	D

Arterial Level of Service: SB #1

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Cosgrove Ave	II	40	15.4	20.1	35.5	0.13	13.5	E
Reynolds Ave	II	40	30.5	10.2	40.7	0.30	26.5	C
Carolina Ave	II	35	44.7	5.4	50.1	0.43	30.9	B
Burton Ln	II	40	39.6	10.5	50.1	0.41	29.7	B
Stromboli Ave	II	40	28.5	15.3	43.8	0.26	21.3	D
Total	II		158.7	61.5	220.2	1.53	25.1	C

Arterial Level of Service: NB #2

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Burton Ln	III	34	35.4	7.8	43.2	0.29	24.6	B
Reynolds Ave	III	35	50.6	11.3	61.9	0.42	24.5	B
Cosgrove Ave	III	35	27.9	23.7	51.6	0.23	16.2	D
Dorchester Rd	III	35	18.7	7.4	26.1	0.15	20.2	C
McMillan Ave	III	35	24.5	9.0	33.5	0.20	21.9	C
Total	III		157.1	59.2	216.3	1.30	21.6	C

Arterial Level of Service: SB #2

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Dorchester Rd	II	35	25.5	5.7	31.2	0.20	23.6	C
Cosgrove Ave	II	35	18.3	28.5	46.8	0.15	11.2	F
Reynolds Ave	II	35	27.6	2.5	30.1	0.23	27.8	C
Burton Ln	II	35	44.6	10.0	54.6	0.43	28.3	B
Stromboli Ave	II	37	32.4	4.2	36.6	0.29	29.0	B
Total	II		148.4	50.9	199.3	1.31	23.6	C

Arterial Level of Service: NB #2

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Burton Ln	III	34	35.4	12.8	48.2	0.29	22.0	C
Reynolds Ave	III	35	50.6	15.1	65.7	0.42	23.1	C
Cosgrove Ave	III	35	27.9	32.4	60.3	0.23	13.9	E
Dorchester Rd	III	35	18.7	3.7	22.4	0.15	23.5	C
McMillan Ave	III	35	24.5	18.8	43.3	0.20	17.0	D
Total	III		157.1	82.8	239.9	1.30	19.5	C

Arterial Level of Service: SB #2

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Dorchester Rd	II	35	25.5	6.0	31.5	0.20	23.3	C
Cosgrove Ave	II	35	18.3	57.2	75.5	0.15	7.0	F
Reynolds Ave	II	35	27.6	6.2	33.8	0.23	24.7	C
Burton Ln	II	35	44.6	10.7	55.3	0.43	27.9	C
Stromboli Ave	II	37	32.4	3.8	36.2	0.29	29.3	B
Total	II		148.4	83.9	232.3	1.31	20.2	D

Intersection: 10: Rivers Ave SB & I-526 WB Ramps

Movement	WB	WB	SB	SB	SB	SB
Directions Served	T	T	T	T	T	R
Maximum Queue (ft)	109	108	196	147	112	16
Average Queue (ft)	51	51	106	57	43	1
95th Queue (ft)	90	92	171	117	90	16
Link Distance (ft)	136	136	1224	1224	1224	
Upstream Blk Time (%)	0	0				
Queuing Penalty (veh)	0	0				
Storage Bay Dist (ft)						325
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 11: Rivers Ave NB/Rivers Ave & I-526 WB Ramps

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 20: Rivers Ave NB & I-526 EB Ramps

Movement	EB	EB	NB	NB	NB	NB
Directions Served	T	T	T	T	T	R
Maximum Queue (ft)	149	153	137	118	121	59
Average Queue (ft)	64	77	53	44	50	3
95th Queue (ft)	119	127	103	91	98	27
Link Distance (ft)	157	157	1619	1619	1619	
Upstream Blk Time (%)	0	0				
Queuing Penalty (veh)	0	0				
Storage Bay Dist (ft)						350
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 21: Rivers Ave SB & I-526 EB Ramps

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 30: Rivers Ave SB & Mall Dr

Movement	EB	EB	NB	SB	SB	SB	SB
Directions Served	T	R	L	T	T	T	R
Maximum Queue (ft)	248	148	110	298	276	235	208
Average Queue (ft)	111	30	44	131	116	97	66
95th Queue (ft)	195	86	90	240	222	198	137
Link Distance (ft)	1458		122	2788	2788	2788	
Upstream Blk Time (%)			1				
Queuing Penalty (veh)			0				
Storage Bay Dist (ft)		125					140
Storage Blk Time (%)	7					3	0
Queuing Penalty (veh)	4					12	2

Intersection: 31: Rivers Ave NB & Mall Dr Left

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 32: Rivers Ave NB & Rivers Ave NB Left

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 33: Rivers Ave SB

Movement	SB	SB	SB
Directions Served	T	T	T
Maximum Queue (ft)	5	21	11
Average Queue (ft)	0	1	0
95th Queue (ft)	5	11	12
Link Distance (ft)	122	122	122
Upstream Blk Time (%)			0
Queuing Penalty (veh)			0
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 40: Rivers Ave NB & WB Montague Ramps

Movement	WB	WB	NB	NB	NB	SB
Directions Served	T	R	T	T	TR	L
Maximum Queue (ft)	59	165	49	72	92	149
Average Queue (ft)	17	72	5	11	23	92
95th Queue (ft)	47	129	27	41	65	154
Link Distance (ft)	470		346	346	346	76
Upstream Blk Time (%)						16
Queuing Penalty (veh)						23
Storage Bay Dist (ft)		380				
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 41: Rivers Ave SB & WB Montague Ramps

Movement	
Directions Served	
Maximum Queue (ft)	
Average Queue (ft)	
95th Queue (ft)	
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 42: Rivers Ave NB

Movement	EB
Directions Served	R
Maximum Queue (ft)	98
Average Queue (ft)	11
95th Queue (ft)	54
Link Distance (ft)	109
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 43: Rivers Ave SB & Montague Ramp Left

Movement	
Directions Served	
Maximum Queue (ft)	
Average Queue (ft)	
95th Queue (ft)	
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 50: Rivers Ave NB & Morningside Dr

Movement	WB	WB	NB	NB	NB	NB	SB
Directions Served	T	R	T	T	T	R	L
Maximum Queue (ft)	310	70	147	166	185	76	126
Average Queue (ft)	169	25	49	59	75	16	77
95th Queue (ft)	267	56	111	130	155	52	132
Link Distance (ft)	701		666	666	666		61
Upstream Blk Time (%)							27
Queuing Penalty (veh)							34
Storage Bay Dist (ft)		425				120	
Storage Blk Time (%)	0				2		
Queuing Penalty (veh)	0				2		

Intersection: 51: Rivers Ave SB & Morningside Dr

Movement	SB	SB	SB
Directions Served	L	T	T
Maximum Queue (ft)	33	4	5
Average Queue (ft)	2	0	0
95th Queue (ft)	20	4	5
Link Distance (ft)	186	186	186
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 52: Rivers Ave NB

Movement	EB
Directions Served	R
Maximum Queue (ft)	116
Average Queue (ft)	17
95th Queue (ft)	71
Link Distance (ft)	60
Upstream Blk Time (%)	2
Queuing Penalty (veh)	3
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 53: Rivers Ave SB & Morningside Dr Left

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 55: Rivers Ave/Rivers Ave SB & Rivers Ave NB

Movement	SB	SB	SB
Directions Served	T	T	T
Maximum Queue (ft)	3	24	24
Average Queue (ft)	0	1	2
95th Queue (ft)	3	14	15
Link Distance (ft)	560	560	560
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 60: Rivers Ave & Piggly Wiggly Dr

Movement	EB	EB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	L	L	T	T	T	T	T	T	R
Maximum Queue (ft)	42	132	77	73	70	92	140	158	139	67
Average Queue (ft)	4	55	27	13	13	27	35	52	39	17
95th Queue (ft)	22	105	65	46	49	72	102	128	105	50
Link Distance (ft)		468		2162	2162	2162	716	716	716	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	75		125							425
Storage Blk Time (%)	0	16								
Queuing Penalty (veh)	0	8								

Intersection: 70: Rivers Ave & Meeting St/Durant Ave

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	TR	L	T	R	LT	T	TR	L	T	T	R
Maximum Queue (ft)	145	176	197	197	96	189	189	271	174	185	206	85
Average Queue (ft)	55	58	110	81	31	90	96	139	74	67	82	28
95th Queue (ft)	112	129	183	164	66	161	170	250	140	153	166	67
Link Distance (ft)		460		552		673	673			2162	2162	2162
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	50		125		150			300	725			
Storage Blk Time (%)	21	11	9	3				0				
Queuing Penalty (veh)	20	10	25	9				0				

Intersection: 80: Rivers Ave & Helm Ave

Movement	EB	WB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	TR
Maximum Queue (ft)	61	147	40	191	222	50	226	222
Average Queue (ft)	19	57	7	84	107	11	103	120
95th Queue (ft)	46	118	25	159	181	34	190	200
Link Distance (ft)	737	713		3153	3153		2604	2604
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)			225			200		
Storage Blk Time (%)				0			0	
Queuing Penalty (veh)				0			0	

Intersection: 90: Rivers Ave #2/Rivers Ave & McMillan Ave

Movement	EB	EB	WB	WB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	LT	TR	LT	R	L	T	T	R	L	T	T	R
Maximum Queue (ft)	116	50	245	70	4	144	158	128	143	206	254	98
Average Queue (ft)	29	6	117	14	0	53	63	44	48	83	111	15
95th Queue (ft)	80	28	215	44	3	113	127	92	111	172	210	62
Link Distance (ft)	1091	1091	1517	1517		981	981			3153	3153	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)					200			200	200			200
Storage Blk Time (%)						0	0	0	0	0	1	
Queuing Penalty (veh)						0	0	0	0	0	0	

Intersection: 100: Rivers Ave #2 & Dorchester Rd

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	L	T	T	T	T	R
Maximum Queue (ft)	397	200	164	119	164	165	176	51
Average Queue (ft)	166	92	73	43	71	56	58	15
95th Queue (ft)	312	200	137	100	140	123	130	42
Link Distance (ft)	1350			656	656	981	981	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		100	185					200
Storage Blk Time (%)	24	3	0				0	
Queuing Penalty (veh)	36	5	0				0	

Intersection: 110: Rivers Ave #2 & Cosgrove Ave

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	TR	L	T	T
Maximum Queue (ft)	367	460	504	102	237	272	183	219	238	141	290	257
Average Queue (ft)	194	211	230	35	131	159	78	107	126	43	138	117
95th Queue (ft)	344	433	453	78	209	242	149	184	205	104	240	208
Link Distance (ft)		3181	3181		1400	1400		1140	1140		656	656
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	450			165			200			200		
Storage Blk Time (%)	0	1			4		0	0			2	9
Queuing Penalty (veh)	0	5			1		0	1			2	27

Intersection: 110: Rivers Ave #2 & Cosgrove Ave

Movement	SB
Directions Served	R
Maximum Queue (ft)	195
Average Queue (ft)	48
95th Queue (ft)	133
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	125
Storage Blk Time (%)	0
Queuing Penalty (veh)	1

Intersection: 120: Rivers Ave #2 & Reynolds Ave

Movement	EB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	T	R
Maximum Queue (ft)	228	249	60	142	166	94	209	174	61
Average Queue (ft)	97	102	19	61	64	31	65	45	6
95th Queue (ft)	192	194	49	122	131	69	159	127	34
Link Distance (ft)	666	1494		1257	1257		1140	1140	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)			200			200			50
Storage Blk Time (%)							0	5	0
Queuing Penalty (veh)							0	2	0

Intersection: 123: Bend

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	121	218
Average Queue (ft)	4	8
95th Queue (ft)	73	104
Link Distance (ft)	422	422
Upstream Blk Time (%)	0	0
Queuing Penalty (veh)	0	0
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 130: Rivers Ave/Rivers Ave #2 & Carner Ave #2

Movement	WB	NB	NB	SB	SB
Directions Served	R	T	TR	L	T
Maximum Queue (ft)	164	20	55	308	81
Average Queue (ft)	80	1	15	155	4
95th Queue (ft)	130	8	47	282	72
Link Distance (ft)	2094	773	773		1257
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)				250	
Storage Blk Time (%)				2	
Queuing Penalty (veh)				5	

Intersection: 140: Carner Ave #2 & Burton Ln

Movement	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LTR	LT	R	L	T	R	L	TR
Maximum Queue (ft)	89	84	51	40	169	53	110	231
Average Queue (ft)	34	31	15	6	67	6	34	112
95th Queue (ft)	69	66	41	27	132	32	76	197
Link Distance (ft)	572	1428			222			2094
Upstream Blk Time (%)					0			
Queuing Penalty (veh)					0			
Storage Bay Dist (ft)			190	120		50	170	
Storage Blk Time (%)					11	0	0	1
Queuing Penalty (veh)					2	0	0	1

Intersection: 150: Carner Ave/Carner Ave #2 & Stromboli Ave

Movement	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	45	72	87	37	57	94	106
Average Queue (ft)	8	25	27	4	16	24	27
95th Queue (ft)	31	58	70	21	46	67	81
Link Distance (ft)	1754	1754	1034	1034		671	671
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)					250		
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 160: Spruill Ave & Montague Ave

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	123	396	172	241	145	330	70	171
Average Queue (ft)	19	214	87	67	64	142	22	76
95th Queue (ft)	80	361	148	155	126	277	57	140
Link Distance (ft)		450		1923		680		573
Upstream Blk Time (%)		0				0		
Queuing Penalty (veh)		0				0		
Storage Bay Dist (ft)	125		75		275		90	
Storage Blk Time (%)		22	17	5		1	0	7
Queuing Penalty (veh)		5	33	11		1	0	2

Intersection: 170: Spruill Ave #1/Spruill Ave & McMillan Ave

Movement	EB	EB	EB	WB	WB	WB	B6	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	T	TR	T	L	T	R	L	T
Maximum Queue (ft)	199	88	264	288	90	120	838	337	395	156	257	812
Average Queue (ft)	96	16	112	215	23	28	318	175	153	44	73	285
95th Queue (ft)	180	72	218	348	62	84	975	349	389	158	223	742
Link Distance (ft)		1517	1517	210	210	210	1380		598	598		1558
Upstream Blk Time (%)				59		0	0		2	0		1
Queuing Penalty (veh)				46		0	0		8	1		0
Storage Bay Dist (ft)	225							310			275	
Storage Blk Time (%)	1	0						8	0			11
Queuing Penalty (veh)	0	0						40	0			31

Intersection: 170: Spruill Ave #1/Spruill Ave & McMillan Ave

Movement	SB
Directions Served	R
Maximum Queue (ft)	278
Average Queue (ft)	68
95th Queue (ft)	231
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	200
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 180: Spruill Ave #1 & Cosgrove Ave/ICTF Truck Dwy

Movement	EB	EB	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	L	T	R	L	TR	L	TR	L	T	R
Maximum Queue (ft)	275	324	942	760	78	309	294	462	154	588	380
Average Queue (ft)	229	231	432	190	13	124	134	169	16	329	109
95th Queue (ft)	322	397	1056	675	54	255	272	387	88	525	358
Link Distance (ft)			1400	1400		554		1488		598	
Upstream Blk Time (%)			1	0						0	
Queuing Penalty (veh)			6	1						3	
Storage Bay Dist (ft)	225	225			300		260		140		280
Storage Blk Time (%)	38	17	6			1	7	2		27	0
Queuing Penalty (veh)	56	24	28			0	22	2		96	0

Intersection: 190: Spruill Ave #1 & Reynolds Ave

Movement	EB	WB	WB	NB	NB	SB	SB
Directions Served	LTR	L	TR	L	TR	L	TR
Maximum Queue (ft)	204	29	70	175	250	30	436
Average Queue (ft)	98	4	25	68	93	3	197
95th Queue (ft)	176	19	58	141	203	17	377
Link Distance (ft)	1494		716		2143		1488
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		200		185		180	
Storage Blk Time (%)				0	1		7
Queuing Penalty (veh)				1	1		1

Intersection: 200: Spruill Ave #1 & Carolina Ave

Movement	WB	NB	NB	SB
Directions Served	L	T	R	T
Maximum Queue (ft)	86	231	146	292
Average Queue (ft)	36	69	8	111
95th Queue (ft)	71	179	62	247
Link Distance (ft)	573	2106		2143
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			50	
Storage Blk Time (%)		6		
Queuing Penalty (veh)		6		

Intersection: 210: Spruill Ave #1 & Burton Ln/Driveway

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	L	TR	LTR	L	TR	L	TR
Maximum Queue (ft)	63	124	45	142	254	65	399
Average Queue (ft)	21	50	8	54	108	4	189
95th Queue (ft)	52	93	31	114	212	35	355
Link Distance (ft)		1428	473		1287		2106
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)	250			150		170	
Storage Blk Time (%)				1	2		7
Queuing Penalty (veh)				4	2		0

Intersection: 220: Spruill Ave/Spruill Ave #1 & Stromboli Ave

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	93	31	42	64	38	156	46	245	335	540
Average Queue (ft)	35	4	6	11	4	66	5	109	198	167
95th Queue (ft)	75	22	27	40	22	127	24	200	340	443
Link Distance (ft)		1754	1754		1625	1625		518		1287
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	250			250			250		250	
Storage Blk Time (%)								0	12	0
Queuing Penalty (veh)								0	58	1

Intersection: 230: St Johns Ave & ICTF Employee Dwy

Movement	WB	SB
Directions Served	LR	LT
Maximum Queue (ft)	51	64
Average Queue (ft)	23	9
95th Queue (ft)	47	38
Link Distance (ft)	1054	1099
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 250: Hobson Ave & McMillan Ave

Movement	EB	EB	WB	NB	SB
Directions Served	LT	R	LTR	LT	LT
Maximum Queue (ft)	74	88	35	53	10
Average Queue (ft)	36	52	12	19	0
95th Queue (ft)	60	75	36	48	5
Link Distance (ft)	324	324	721	578	583
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 260: Noisette Blvd & Turnbull Ave

Movement	WB	WB	NB	NB	SB
Directions Served	L	R	T	R	LT
Maximum Queue (ft)	28	61	93	36	233
Average Queue (ft)	10	29	50	14	118
95th Queue (ft)	31	47	78	39	192
Link Distance (ft)	316		1294	1294	2524
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)		75			
Storage Blk Time (%)		0			
Queuing Penalty (veh)		0			

Intersection: 270: Noisette Blvd & Avenue B

Movement	WB	NB	B127	SB
Directions Served	LR	TR	T	LT
Maximum Queue (ft)	326	1023	426	130
Average Queue (ft)	144	423	109	20
95th Queue (ft)	433	1226	599	81
Link Distance (ft)	564	1116	2524	593
Upstream Blk Time (%)	4	17		
Queuing Penalty (veh)	0	55		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 280: Virginia Ave & Avenue B

Movement	WB	WB	NB	SB
Directions Served	L	R	TR	L
Maximum Queue (ft)	609	200	66	364
Average Queue (ft)	420	107	17	138
95th Queue (ft)	793	271	49	270
Link Distance (ft)	593		466	1266
Upstream Blk Time (%)	35			
Queuing Penalty (veh)	115			
Storage Bay Dist (ft)		100		
Storage Blk Time (%)	77			
Queuing Penalty (veh)	177			

Intersection: 290: Virginia Ave & Montague Ave

Movement	EB	NB	SB	SB
Directions Served	LR	L	T	TR
Maximum Queue (ft)	523	104	2	27
Average Queue (ft)	231	37	0	1
95th Queue (ft)	493	79	2	11
Link Distance (ft)	1923		394	394
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)		150		
Storage Blk Time (%)		0		
Queuing Penalty (veh)		0		

Intersection: 300: Virginia Ave & I-526 EB Off-Ramp

Movement	EB	EB	NB	SB
Directions Served	L	R	T	T
Maximum Queue (ft)	449	1123	8	2
Average Queue (ft)	368	623	0	0
95th Queue (ft)	565	1529	8	2
Link Distance (ft)		1232	1357	593
Upstream Blk Time (%)		31		
Queuing Penalty (veh)		0		
Storage Bay Dist (ft)	350			
Storage Blk Time (%)	60	0		
Queuing Penalty (veh)	159	0		

Intersection: 310: Virginia Ave & I-526 WB On-Ramp

Movement	NB	SB	SB
Directions Served	L	T	R
Maximum Queue (ft)	76	2	18
Average Queue (ft)	24	0	1
95th Queue (ft)	61	2	10
Link Distance (ft)		492	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	225		325
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 320: Rhett Ave & I-526 EB Ramps

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	LR	L	T	T	T	T	R
Maximum Queue (ft)	375	693	250	705	666	200	635	742
Average Queue (ft)	369	645	208	405	315	59	95	395
95th Queue (ft)	396	741	306	858	776	157	367	651
Link Distance (ft)		639		684	684	803	803	803
Upstream Blk Time (%)		68		27	3	0	0	0
Queuing Penalty (veh)		0		0	0	0	2	0
Storage Bay Dist (ft)	275		150					
Storage Blk Time (%)	57	86	63	1				
Queuing Penalty (veh)	177	201	194	3				

Intersection: 330: Rhett Ave & I-526 WB Ramps

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	LR	L	T	T	T	T	R
Maximum Queue (ft)	575	796	224	235	254	639	668	425
Average Queue (ft)	566	759	107	94	133	468	621	361
95th Queue (ft)	618	838	200	191	224	707	720	582
Link Distance (ft)		735		803	803	612	612	
Upstream Blk Time (%)		52				3	27	
Queuing Penalty (veh)		0				0	0	
Storage Bay Dist (ft)	475		270					325
Storage Blk Time (%)	12	63	0	0			29	0
Queuing Penalty (veh)	71	180	2	0			184	0

Intersection: 340: Morningside Dr/Piedmont Ave & Montague Ave

Movement	EB	EB	EB	B38	B39	B39	WB	WB	WB	WB	NB	NB
Directions Served	L	T	TR	T	T	T	L	T	T	R	LT	R
Maximum Queue (ft)	132	292	319	2	88	257	74	187	179	156	201	148
Average Queue (ft)	32	127	149	0	4	10	27	101	87	72	59	17
95th Queue (ft)	84	244	274	2	74	128	62	161	153	132	132	90
Link Distance (ft)		370	370	1986	538	538		724	724		701	
Upstream Blk Time (%)		0				0						
Queuing Penalty (veh)		0				0						
Storage Bay Dist (ft)	150						175			150		50
Storage Blk Time (%)	0	4						0	0	0	15	0
Queuing Penalty (veh)	0	2						0	1	1	19	0

Intersection: 340: Morningside Dr/Piedmont Ave & Montague Ave

Movement	SB	SB
Directions Served	L	TR
Maximum Queue (ft)	50	88
Average Queue (ft)	13	34
95th Queue (ft)	41	65
Link Distance (ft)		459
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	135	
Storage Blk Time (%)		0
Queuing Penalty (veh)		0

Intersection: 350: Montague Ave & Mall Dr/Goer Dr

Movement	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	TR	L	L	T	T	TR	L	T
Maximum Queue (ft)	53	79	169	152	70	270	307	426	430	375	85	269
Average Queue (ft)	18	22	67	67	18	140	167	171	197	123	20	160
95th Queue (ft)	46	57	134	125	53	233	266	335	360	280	57	244
Link Distance (ft)		415	415		476			516	516	516		538
Upstream Blk Time (%)								0	0	0		
Queuing Penalty (veh)								0	0	0		
Storage Bay Dist (ft)	185			170		275	275				175	
Storage Blk Time (%)				0	0	0	0	1				5
Queuing Penalty (veh)				0	0	1	2	5				1

Intersection: 350: Montague Ave & Mall Dr/Goer Dr

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	287	296
Average Queue (ft)	178	172
95th Queue (ft)	272	267
Link Distance (ft)	538	538
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 360: Montague Ave & I-26 WB Ramps

Movement	WB	WB	WB	NB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	L	R	L	L	T	T	T	T	T	T	R
Maximum Queue (ft)	383	475	286	166	190	422	439	262	367	384	382	40
Average Queue (ft)	211	271	53	77	100	240	210	136	210	229	214	1
95th Queue (ft)	335	403	183	143	164	363	341	237	345	364	357	24
Link Distance (ft)		573				845	845	845	516	516	516	
Upstream Blk Time (%)		0							0	0	0	
Queuing Penalty (veh)		0							0	0	0	
Storage Bay Dist (ft)	375		375	550	550							350
Storage Blk Time (%)	0	1									1	
Queuing Penalty (veh)	0	7									1	

Intersection: 370: Montague Ave & I-26 EB Ramps

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	43	121
Average Queue (ft)	3	6
95th Queue (ft)	49	87
Link Distance (ft)	845	845
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 380: Dorchester Rd & Meeting St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	L	TR	L	T	R	LT	TR
Maximum Queue (ft)	132	144	107	93	217	308	130	136	117
Average Queue (ft)	60	64	49	20	104	116	48	59	53
95th Queue (ft)	109	110	93	56	189	224	98	108	102
Link Distance (ft)	457			469		1842	1842	1350	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)		100	125		125				125
Storage Blk Time (%)	2	1	0	0	4	5		0	0
Queuing Penalty (veh)	7	1	0	0	12	14		0	0

Intersection: 390: I-26 WB Ramps & Dorchester Rd

Movement	EB	EB	EB	WB	WB	NB	NB	NB
Directions Served	L	T	T	T	TR	L	L	R
Maximum Queue (ft)	153	216	191	237	260	287	325	10
Average Queue (ft)	67	125	96	121	140	131	195	0
95th Queue (ft)	131	193	168	199	220	262	295	11
Link Distance (ft)	304	304	304	1842	1842			561
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)						530	530	
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 400: I-26 EB Ramps & Dorchester Rd

Movement	EB	EB	EB	WB	WB	WB	SB	SB
Directions Served	T	T	R	L	T	T	L	R
Maximum Queue (ft)	451	403	359	110	232	252	395	242
Average Queue (ft)	256	195	42	37	132	149	193	19
95th Queue (ft)	387	347	212	86	209	231	326	120
Link Distance (ft)	560	560		304	304	304	445	
Upstream Blk Time (%)	0	0			0	0	0	
Queuing Penalty (veh)	0	0			0	0	0	
Storage Bay Dist (ft)			425					300
Storage Blk Time (%)		0	1				2	
Queuing Penalty (veh)		0	2				5	

Intersection: 410: Cosgrove Ave & Azalea Dr

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	TR	L	T	T	R	L
Maximum Queue (ft)	226	342	272	201	243	173	108	349	478	476	162	229
Average Queue (ft)	138	129	82	84	117	53	22	227	199	197	50	42
95th Queue (ft)	228	280	213	167	212	127	72	356	365	354	119	148
Link Distance (ft)		892	892			767			661	661	661	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	130			400	230		600	250				200
Storage Blk Time (%)	20	4	0		2	0		8	1			
Queuing Penalty (veh)	26	8	0		3	0		54	7			

Intersection: 410: Cosgrove Ave & Azalea Dr

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	561	600	300
Average Queue (ft)	269	337	122
95th Queue (ft)	527	601	339
Link Distance (ft)	3181	3181	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			200
Storage Blk Time (%)	20	40	
Queuing Penalty (veh)	8	44	

Intersection: 421: Cosgrove Ave & I-26 WB Ramps

Movement	WB	NB	NB
Directions Served	R	T	T
Maximum Queue (ft)	136	4	5
Average Queue (ft)	9	0	0
95th Queue (ft)	85	4	5
Link Distance (ft)	473	950	950
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 422: Cosgrove Ave & I-26 EB Ramps

Movement	NB	NB	NB	SB	SB
Directions Served	T	T	TR	T	R
Maximum Queue (ft)	921	941	944	6	6
Average Queue (ft)	374	913	921	0	0
95th Queue (ft)	1086	937	942	7	7
Link Distance (ft)	882	882	882	950	950
Upstream Blk Time (%)	1	39	73		
Queuing Penalty (veh)	0	0	0		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 450: Local Access Rd & Hobson Ave

Movement	WB	WB	NB	SB
Directions Served	L	R	TR	L
Maximum Queue (ft)	98	67	4	38
Average Queue (ft)	37	20	0	10
95th Queue (ft)	81	58	3	34
Link Distance (ft)	928		1166	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)		200		250
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 460: Magrath Darby Blvd & US 17

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	NB	SB
Directions Served	L	T	T	T	R	L	T	T	R	R	R
Maximum Queue (ft)	405	604	574	531	180	179	1258	1318	624	194	102
Average Queue (ft)	150	252	217	179	22	53	461	512	25	91	38
95th Queue (ft)	346	594	563	497	141	129	1121	1213	249	163	81
Link Distance (ft)		1105	1105	1105			1292	1292	1292	516	538
Upstream Blk Time (%)		0	0	0			0	0			
Queuing Penalty (veh)		0	0	0			0	1			
Storage Bay Dist (ft)	375				175	205					
Storage Blk Time (%)	1	6		5			4				
Queuing Penalty (veh)	8	9		8			3				

Intersection: 470: Houston Northcutt Blvd/Mathis Ferry Rd & US 17

Movement	EB	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	WB
Directions Served	L	L	T	T	T	R	L	L	T	T	T	R
Maximum Queue (ft)	464	515	1176	1195	1170	315	276	450	1652	1741	1663	230
Average Queue (ft)	391	436	753	737	661	204	161	337	983	1033	964	87
95th Queue (ft)	552	611	1414	1397	1282	416	256	570	1684	1720	1681	257
Link Distance (ft)			1292	1292	1292				4040	4040	4040	
Upstream Blk Time (%)			3	1	1							
Queuing Penalty (veh)			27	12	6							
Storage Bay Dist (ft)	415	415				215	350	350				130
Storage Blk Time (%)	24	41	4		24	0	0	0	41		39	
Queuing Penalty (veh)	181	315	18		81	1	0	1	143		54	

Intersection: 470: Houston Northcutt Blvd/Mathis Ferry Rd & US 17

Movement	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	T	T	R	L	T	T	R
Maximum Queue (ft)	214	310	261	236	311	484	460	310
Average Queue (ft)	156	175	124	107	105	338	308	116
95th Queue (ft)	231	285	222	200	339	574	557	370
Link Distance (ft)		543	543	543	536	536	536	
Upstream Blk Time (%)					3	12	11	
Queuing Penalty (veh)					0	0	0	
Storage Bay Dist (ft)	115							300
Storage Blk Time (%)	32	25					31	
Queuing Penalty (veh)	42	44					28	

Intersection: 480: Shelmore Blvd & US 17

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB
Directions Served	L	T	T	T	R	L	T	T	T	R	L	T
Maximum Queue (ft)	468	888	886	542	259	499	657	684	711	300	258	252
Average Queue (ft)	330	277	270	237	41	202	449	477	495	207	206	193
95th Queue (ft)	525	823	796	531	179	404	607	644	669	414	292	314
Link Distance (ft)		4040	4040	4040			2558	2558	2558		231	231
Upstream Blk Time (%)		0	0								41	26
Queuing Penalty (veh)		0	0								0	0
Storage Bay Dist (ft)	400				210	400				200		
Storage Blk Time (%)	23	0		7		0	14		36			59
Queuing Penalty (veh)	165	1		12		1	30		106			110

Intersection: 480: Shelmore Blvd & US 17

Movement	NB	SB	SB	SB	SB
Directions Served	R	L	L	T	R
Maximum Queue (ft)	190	175	348	361	223
Average Queue (ft)	117	146	230	290	90
95th Queue (ft)	250	218	360	422	193
Link Distance (ft)			333	333	333
Upstream Blk Time (%)			12	34	
Queuing Penalty (veh)			0	0	
Storage Bay Dist (ft)	90	75			
Storage Blk Time (%)	11	56	83		
Queuing Penalty (veh)	21	57	84		

Intersection: 490: Dragoon Dr & US 17

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB
Directions Served	T	T	T	R	L	T	T	T	L	R
Maximum Queue (ft)	378	379	402	300	151	513	983	531	133	151
Average Queue (ft)	207	218	232	60	74	110	138	143	57	67
95th Queue (ft)	347	353	370	227	127	345	470	386	115	128
Link Distance (ft)	2558	2558	2558			1813	1813	1813		228
Upstream Blk Time (%)							0			
Queuing Penalty (veh)							0			
Storage Bay Dist (ft)				200	200				125	
Storage Blk Time (%)			9		0	0			1	1
Queuing Penalty (veh)			11		1	0			2	1

Intersection: 500: Anna Knapp Blvd & US 17

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB
Directions Served	L	T	T	T	R	L	T	T	T	R	L	LT
Maximum Queue (ft)	431	535	574	566	275	470	1522	1517	1518	300	211	194
Average Queue (ft)	277	228	249	245	63	290	1361	1343	1341	228	120	117
95th Queue (ft)	426	530	525	467	229	568	1807	1798	1807	423	195	189
Link Distance (ft)		1813	1813	1813			1466	1466	1466		325	325
Upstream Blk Time (%)							27	20	30			
Queuing Penalty (veh)							0	0	0			
Storage Bay Dist (ft)	365				175	370				200		
Storage Blk Time (%)	8	1		15		0	38		40	0		
Queuing Penalty (veh)	56	2		19		0	75		164	0		

Intersection: 500: Anna Knapp Blvd & US 17

Movement	NB	NB	SB	SB	SB	SB
Directions Served	T	R	L	LT	T	R
Maximum Queue (ft)	199	200	175	302	255	231
Average Queue (ft)	44	93	167	267	154	101
95th Queue (ft)	149	166	190	310	255	192
Link Distance (ft)	325			260	260	260
Upstream Blk Time (%)				56	0	0
Queuing Penalty (veh)				0	0	0
Storage Bay Dist (ft)		140	75			
Storage Blk Time (%)	1	4	74	92		
Queuing Penalty (veh)	1	2	131	114		

Intersection: 510: Local Access Rd & Bainbridge Ave

Movement	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	R	T	TR	L	T	T
Maximum Queue (ft)	222	99	67	161	184	59	74
Average Queue (ft)	112	48	20	55	73	12	20
95th Queue (ft)	188	82	54	114	138	42	57
Link Distance (ft)	829	829	1376	1376		1166	1166
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)					250		
Storage Blk Time (%)					0		
Queuing Penalty (veh)					0		

Intersection: 520: Local Access Rd & Stromboli Ave

Movement	EB	EB	EB	NB	NB	NB	SB	SB
Directions Served	L	L	R	L	T	T	T	TR
Maximum Queue (ft)	154	196	55	59	75	98	64	131
Average Queue (ft)	70	108	14	18	28	39	12	53
95th Queue (ft)	134	169	43	49	63	79	42	98
Link Distance (ft)		1625	1625		1444	1444	1376	1376
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200			200				
Storage Blk Time (%)	0	0						
Queuing Penalty (veh)	0	0						

Intersection: 530: Local Access Rd & PAR SB Ramp

Movement	NB	SB
Directions Served	LT	R
Maximum Queue (ft)	29	2
Average Queue (ft)	1	0
95th Queue (ft)	11	2
Link Distance (ft)	222	1444
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 540: PAR NB Ramp/Tidewater Rd & Local Access Rd

Movement	EB	WB	SB
Directions Served	LTR	LTR	L
Maximum Queue (ft)	109	27	6
Average Queue (ft)	55	7	0
95th Queue (ft)	86	25	4
Link Distance (ft)	616	871	222
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 4639

Intersection: 10: Rivers Ave SB & I-526 WB Ramps

Movement	WB	WB	SB	SB	SB
Directions Served	T	T	T	T	T
Maximum Queue (ft)	132	132	188	117	77
Average Queue (ft)	59	62	93	38	26
95th Queue (ft)	106	107	157	83	62
Link Distance (ft)	136	136	1224	1224	1224
Upstream Blk Time (%)	0	0			
Queuing Penalty (veh)	0	0			
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 11: Rivers Ave NB/Rivers Ave & I-526 WB Ramps

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 20: Rivers Ave NB & I-526 EB Ramps

Movement	EB	EB	NB	NB	NB	NB	B27
Directions Served	T	T	T	T	T	R	T
Maximum Queue (ft)	146	162	155	150	168	83	64
Average Queue (ft)	72	84	69	68	77	9	2
95th Queue (ft)	124	136	132	130	142	49	66
Link Distance (ft)	157	157	1619	1619	1619		751
Upstream Blk Time (%)	0	0					
Queuing Penalty (veh)	0	0					
Storage Bay Dist (ft)						350	
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 21: Rivers Ave SB & I-526 EB Ramps

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 30: Rivers Ave SB & Mall Dr

Movement	EB	EB	NB	SB	SB	SB	SB
Directions Served	T	R	L	T	T	T	R
Maximum Queue (ft)	406	225	138	252	225	202	128
Average Queue (ft)	220	57	55	143	121	94	47
95th Queue (ft)	344	184	111	225	197	173	96
Link Distance (ft)	1458		122	2788	2788	2788	
Upstream Blk Time (%)			1				
Queuing Penalty (veh)			1				
Storage Bay Dist (ft)		125					140
Storage Blk Time (%)	30					2	0
Queuing Penalty (veh)	19					5	0

Intersection: 31: Rivers Ave NB & Mall Dr Left

Movement	NB
Directions Served	T
Maximum Queue (ft)	2
Average Queue (ft)	0
95th Queue (ft)	2
Link Distance (ft)	338
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 32: Rivers Ave NB & Rivers Ave NB Left

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 33: Rivers Ave SB

Movement	WB	SB	SB
Directions Served	R	T	T
Maximum Queue (ft)	2	5	2
Average Queue (ft)	0	0	0
95th Queue (ft)	3	5	2
Link Distance (ft)	73	122	122
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 40: Rivers Ave NB & WB Montague Ramps

Movement	WB	WB	NB	NB	NB	SB
Directions Served	T	R	T	T	TR	L
Maximum Queue (ft)	33	311	230	242	261	133
Average Queue (ft)	3	128	39	56	70	49
95th Queue (ft)	18	238	130	141	161	111
Link Distance (ft)	470		346	346	346	76
Upstream Blk Time (%)					0	5
Queuing Penalty (veh)					0	4
Storage Bay Dist (ft)		380				
Storage Blk Time (%)		0				
Queuing Penalty (veh)		0				

Intersection: 41: Rivers Ave SB & WB Montague Ramps

Movement			
Directions Served			
Maximum Queue (ft)			
Average Queue (ft)			
95th Queue (ft)			
Link Distance (ft)			
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 42: Rivers Ave NB

Movement	EB	NB	NB
Directions Served	R	T	T
Maximum Queue (ft)	32	2	2
Average Queue (ft)	1	0	0
95th Queue (ft)	18	2	2
Link Distance (ft)	109	76	76
Upstream Blk Time (%)	0		
Queuing Penalty (veh)	0		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 43: Rivers Ave SB & Montague Ramp Left

Movement			
Directions Served			
Maximum Queue (ft)			
Average Queue (ft)			
95th Queue (ft)			
Link Distance (ft)			
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 50: Rivers Ave NB & Morningside Dr

Movement	WB	WB	NB	NB	NB	NB	SB
Directions Served	T	R	T	T	T	R	L
Maximum Queue (ft)	250	93	220	237	301	220	125
Average Queue (ft)	135	34	95	117	146	56	68
95th Queue (ft)	226	74	183	207	253	154	125
Link Distance (ft)	701		666	666	666		61
Upstream Blk Time (%)							22
Queuing Penalty (veh)							22
Storage Bay Dist (ft)		425				120	
Storage Blk Time (%)					13	0	
Queuing Penalty (veh)					21	0	

Intersection: 51: Rivers Ave SB & Morningside Dr

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 52: Rivers Ave NB

Movement	EB	NB	NB
Directions Served	R	T	T
Maximum Queue (ft)	80	7	3
Average Queue (ft)	9	0	0
95th Queue (ft)	47	8	0
Link Distance (ft)	60	61	61
Upstream Blk Time (%)	1		
Queuing Penalty (veh)	1		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 53: Rivers Ave SB & Morningside Dr Left

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 55: Rivers Ave/Rivers Ave SB & Rivers Ave NB

Movement	SB	SB	SB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	56	61	16	17
Average Queue (ft)	2	2	1	1
95th Queue (ft)	57	57	11	9
Link Distance (ft)	560	560	560	560
Upstream Blk Time (%)		0		
Queuing Penalty (veh)		0		
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 60: Rivers Ave & Piggly Wiggly Dr

Movement	EB	EB	EB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	L	R	L	T	T	T	T	T	T	R
Maximum Queue (ft)	174	309	135	69	111	134	152	149	172	146	71
Average Queue (ft)	37	132	18	22	38	50	72	58	78	64	30
95th Queue (ft)	128	238	99	56	92	111	140	129	153	133	63
Link Distance (ft)		468			2162	2162	2162	716	716	716	
Upstream Blk Time (%)		0									
Queuing Penalty (veh)		0									
Storage Bay Dist (ft)	75		50	125							425
Storage Blk Time (%)	1	42			0						
Queuing Penalty (veh)	1	67			0						

Intersection: 70: Rivers Ave & Meeting St/Durant Ave

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	TR	L	T	R	LT	T	TR	L	T	T	R
Maximum Queue (ft)	150	276	188	158	101	273	294	324	175	242	255	108
Average Queue (ft)	98	125	95	54	35	147	159	199	73	116	131	41
95th Queue (ft)	162	227	162	127	73	250	264	307	141	204	218	84
Link Distance (ft)		460		552		673	673			2162	2162	2162
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	50		125		150			300	725			
Storage Blk Time (%)	39	26	7	1	0		0	1				
Queuing Penalty (veh)	65	42	16	3	0		1	3				

Intersection: 80: Rivers Ave & Helm Ave

Movement	EB	WB	NB	NB	NB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	TR
Maximum Queue (ft)	52	128	41	252	264	59	184	211
Average Queue (ft)	16	47	11	111	142	15	73	90
95th Queue (ft)	41	93	32	208	235	44	151	174
Link Distance (ft)	737	713		3153	3153		2604	2604
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)			225			200		
Storage Blk Time (%)				0			0	
Queuing Penalty (veh)				0			0	

Intersection: 90: Rivers Ave #2/Rivers Ave & McMillan Ave

Movement	EB	EB	WB	WB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	LT	TR	LT	R	L	T	T	R	L	T	T	R
Maximum Queue (ft)	104	64	334	305	38	262	264	109	174	188	218	60
Average Queue (ft)	27	6	166	122	5	142	155	40	52	55	95	13
95th Queue (ft)	77	34	289	246	22	235	246	82	128	139	187	39
Link Distance (ft)	1091	1091	1517	1517		981	981			3153	3153	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)					200			200	200			200
Storage Blk Time (%)						3	4		0	0	1	
Queuing Penalty (veh)						1	7		0	0	0	

Intersection: 100: Rivers Ave #2 & Dorchester Rd

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	L	T	T	T	T	R
Maximum Queue (ft)	241	177	219	130	117	124	152	74
Average Queue (ft)	109	54	95	24	42	48	61	28
95th Queue (ft)	192	120	173	75	89	101	121	61
Link Distance (ft)	1350			658	658	981	981	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		100	185					200
Storage Blk Time (%)	11	0	1	0			0	
Queuing Penalty (veh)	13	0	7	0			0	

Intersection: 110: Rivers Ave #2 & Cosgrove Ave

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	TR	L	T	T
Maximum Queue (ft)	513	430	209	264	746	758	300	620	519	236	339	393
Average Queue (ft)	307	124	81	70	488	514	255	312	256	59	181	170
95th Queue (ft)	494	298	176	231	775	799	345	581	424	161	319	343
Link Distance (ft)		3181	3181		1391	1391		1140	1140		658	658
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	450			165			200			200		
Storage Blk Time (%)	5	0			63		35	9		0	13	23
Queuing Penalty (veh)	10	0			22		107	28		0	8	74

Intersection: 110: Rivers Ave #2 & Cosgrove Ave

Movement	SB
Directions Served	R
Maximum Queue (ft)	218
Average Queue (ft)	108
95th Queue (ft)	224
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	125
Storage Blk Time (%)	2
Queuing Penalty (veh)	5

Intersection: 120: Rivers Ave #2 & Reynolds Ave

Movement	EB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	LTR	LTR	L	T	TR	L	T	T	R
Maximum Queue (ft)	230	262	117	244	226	127	101	64	36
Average Queue (ft)	116	137	35	123	108	48	27	15	5
95th Queue (ft)	206	232	85	219	202	99	76	51	24
Link Distance (ft)	666	1494		1257	1257		1140	1140	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)			200			200			50
Storage Blk Time (%)				2			0	2	0
Queuing Penalty (veh)				1			0	1	0

Intersection: 130: Rivers Ave/Rivers Ave #2 & Carner Ave #2

Movement	WB	NB	NB	SB	SB
Directions Served	R	T	TR	L	T
Maximum Queue (ft)	348	37	66	314	151
Average Queue (ft)	134	3	19	149	14
95th Queue (ft)	263	18	54	273	151
Link Distance (ft)	2094	773	773		1257
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)				250	
Storage Blk Time (%)				4	
Queuing Penalty (veh)				4	

Intersection: 140: Carner Ave #2 & Burton Ln

Movement	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LTR	LT	R	L	T	R	L	TR
Maximum Queue (ft)	77	143	114	37	200	139	82	166
Average Queue (ft)	29	55	39	4	100	18	27	70
95th Queue (ft)	61	115	85	22	173	69	65	138
Link Distance (ft)	572	1388			222			2094
Upstream Blk Time (%)					0			
Queuing Penalty (veh)					1			
Storage Bay Dist (ft)			190	120		50	170	
Storage Blk Time (%)		0	0		19	0		0
Queuing Penalty (veh)		0	0		7	1		0

Intersection: 150: Carner Ave/Carner Ave #2 & Stromboli Ave

Movement	WB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	L	R	T	TR	L	T	T
Maximum Queue (ft)	3	41	46	96	30	35	60	71
Average Queue (ft)	0	5	8	17	2	4	8	6
95th Queue (ft)	3	25	33	65	13	21	35	37
Link Distance (ft)		1754	1754	1034	1034		671	671
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	300					250		
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 160: Spruill Ave & Montague Ave

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	L	TR	L	TR	L	TR	L	TR
Maximum Queue (ft)	48	191	111	142	195	186	39	74
Average Queue (ft)	12	78	50	58	86	81	10	30
95th Queue (ft)	39	144	92	114	152	153	34	66
Link Distance (ft)		450		1923		680		573
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	125		75		275		90	
Storage Blk Time (%)		2	2	4		0		0
Queuing Penalty (veh)		0	4	5		0		0

Intersection: 170: Spruill Ave #1/Spruill Ave & McMillan Ave

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	T	R
Maximum Queue (ft)	156	117	127	238	229	228	410	670	62	285	142
Average Queue (ft)	70	46	45	211	104	127	194	484	12	120	28
95th Queue (ft)	148	96	101	275	189	212	455	723	40	219	89
Link Distance (ft)		1517	1517	220	220	220		652		774	
Upstream Blk Time (%)				40	0	0		1			
Queuing Penalty (veh)				105	1	1		12			
Storage Bay Dist (ft)	225						310		275		200
Storage Blk Time (%)	0							26		1	
Queuing Penalty (veh)	0							45		1	

Intersection: 180: Spruill Ave #1 & Cosgrove Ave

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	T	R
Maximum Queue (ft)	325	832	310	21	59	32	360	1402	34	265	287
Average Queue (ft)	292	395	47	3	14	2	278	1003	6	121	59
95th Queue (ft)	387	972	183	12	42	17	488	1602	25	229	209
Link Distance (ft)		1391	1391		1117	1117		1405		652	
Upstream Blk Time (%)								1			
Queuing Penalty (veh)								8			
Storage Bay Dist (ft)	225			30			260		140		280
Storage Blk Time (%)	54			0	4		0	57		4	1
Queuing Penalty (veh)	17			0	1		1	96		23	3

Intersection: 190: Spruill Ave #1 & Reynolds Ave

Movement	EB	WB	WB	NB	NB	SB	SB
Directions Served	LTR	L	TR	L	TR	L	TR
Maximum Queue (ft)	182	27	89	263	743	48	243
Average Queue (ft)	85	4	33	89	263	13	86
95th Queue (ft)	160	20	71	228	658	40	194
Link Distance (ft)	1494		716		2143		1405
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		200		185		180	
Storage Blk Time (%)				0	14		1
Queuing Penalty (veh)				0	17		0

Intersection: 200: Spruill Ave #1 & Carolina Ave

Movement	WB	NB	NB	SB
Directions Served	L	T	R	T
Maximum Queue (ft)	98	273	134	158
Average Queue (ft)	41	111	13	51
95th Queue (ft)	81	229	82	128
Link Distance (ft)	573	2062		2143
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			50	
Storage Blk Time (%)		12		
Queuing Penalty (veh)		10		

Intersection: 210: Spruill Ave #1 & Burton Ln/Viaduct Rd

Movement	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	L	T	R	L	TR	L	TR
Maximum Queue (ft)	65	72	226	622	191	208	428	214	379
Average Queue (ft)	15	16	98	101	96	25	196	79	132
95th Queue (ft)	47	51	186	378	164	98	357	179	408
Link Distance (ft)		1388		1596			1278		2062
Upstream Blk Time (%)				0					
Queuing Penalty (veh)				1					
Storage Bay Dist (ft)	250		340		250	150		170	
Storage Blk Time (%)				0	0		14	6	2
Queuing Penalty (veh)				0	0		4	24	2

Intersection: 220: Spruill Ave/Spruill Ave #1 & Stromboli Ave

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	TR	L	TR
Maximum Queue (ft)	41	33	50	44	14	58	46	217	63	215
Average Queue (ft)	9	2	9	14	0	16	8	94	18	103
95th Queue (ft)	32	16	35	38	6	41	30	179	49	188
Link Distance (ft)		1754	1754		1627	1627		518		1278
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	250			250			250		250	
Storage Blk Time (%)								0		0
Queuing Penalty (veh)								0		0

Intersection: 230: McMillan Ave & St Johns Ave

Movement	EB	EB	WB	WB	SB
Directions Served	LT	T	T	TR	LR
Maximum Queue (ft)	133	26	267	218	527
Average Queue (ft)	59	1	87	29	342
95th Queue (ft)	111	12	232	134	680
Link Distance (ft)	220	220	1999	1999	517
Upstream Blk Time (%)					45
Queuing Penalty (veh)					0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 240: Noisette Blvd & McMillan Ave

Movement	EB	EB	WB	WB	NB	SB	SB
Directions Served	LT	TR	LT	TR	LTR	LT	R
Maximum Queue (ft)	105	16	18	2	40	106	126
Average Queue (ft)	39	0	1	0	13	41	70
95th Queue (ft)	79	8	9	2	39	81	107
Link Distance (ft)	1999	1999	324	324	535	1291	1291
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)							
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 250: Hobson Ave & McMillan Ave

Movement	EB	EB	WB	NB	SB	SB
Directions Served	LT	R	LTR	LT	LT	TR
Maximum Queue (ft)	52	71	42	73	24	19
Average Queue (ft)	23	38	11	19	1	1
95th Queue (ft)	48	61	36	54	11	10
Link Distance (ft)	324	324	721	578	583	583
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 260: Noisette Blvd & Turnbull Ave

Movement	EB	WB	WB	NB	NB	SB
Directions Served	LTR	LT	R	LT	R	LTR
Maximum Queue (ft)	120	29	71	146	52	112
Average Queue (ft)	57	11	33	73	12	59
95th Queue (ft)	94	33	56	118	38	95
Link Distance (ft)	550	315		1291	1291	2516
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)			75			
Storage Blk Time (%)			0			
Queuing Penalty (veh)			0			

Intersection: 270: Noisette Blvd & Avenue B

Movement	WB	NB	SB
Directions Served	LR	TR	LT
Maximum Queue (ft)	98	1	62
Average Queue (ft)	44	0	10
95th Queue (ft)	77	1	41
Link Distance (ft)	564	1116	593
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 280: Virginia Ave & Avenue B

Movement	WB	NB	SB
Directions Served	L	TR	L
Maximum Queue (ft)	62	21	71
Average Queue (ft)	23	1	24
95th Queue (ft)	47	12	57
Link Distance (ft)	593	466	1266
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)	0		
Queuing Penalty (veh)	0		

Intersection: 290: Virginia Ave & Montague Ave

Movement	EB	NB	SB
Directions Served	LR	L	TR
Maximum Queue (ft)	117	79	11
Average Queue (ft)	53	27	0
95th Queue (ft)	93	61	6
Link Distance (ft)	1923		394
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		150	
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 300: Virginia Ave & I-526 EB Off-Ramp

Movement	EB	EB	NB	NB
Directions Served	L	R	T	T
Maximum Queue (ft)	303	421	272	200
Average Queue (ft)	116	135	65	45
95th Queue (ft)	322	618	378	316
Link Distance (ft)		1232	1357	1357
Upstream Blk Time (%)		3		
Queuing Penalty (veh)		0		
Storage Bay Dist (ft)	350			
Storage Blk Time (%)	10	0		
Queuing Penalty (veh)	9	0		

Intersection: 310: Virginia Ave & I-526 WB On-Ramp

Movement	NB	NB	NB	SB	SB
Directions Served	L	T	T	T	R
Maximum Queue (ft)	324	564	464	7	129
Average Queue (ft)	205	178	128	0	40
95th Queue (ft)	371	602	497	5	95
Link Distance (ft)		593	593	492	
Upstream Blk Time (%)		7	1		
Queuing Penalty (veh)		25	3		
Storage Bay Dist (ft)	225				325
Storage Blk Time (%)	32	0			
Queuing Penalty (veh)	62	0			

Intersection: 320: Rhett Ave & I-526 EB Ramps

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	LR	L	T	T	T	T	R
Maximum Queue (ft)	375	618	250	557	495	176	252	591
Average Queue (ft)	310	413	160	222	160	92	95	238
95th Queue (ft)	423	615	272	456	386	152	191	457
Link Distance (ft)		639		684	684	803	803	803
Upstream Blk Time (%)		4		0	0		0	
Queuing Penalty (veh)		0		0	0		0	
Storage Bay Dist (ft)	275		150					
Storage Blk Time (%)	5	37	31	6				
Queuing Penalty (veh)	22	113	140	11				

Intersection: 330: Rhett Ave & I-526 WB Ramps

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	LR	L	T	T	T	T	R
Maximum Queue (ft)	575	786	144	272	282	629	652	425
Average Queue (ft)	541	705	51	150	158	350	456	279
95th Queue (ft)	643	877	106	237	245	621	728	546
Link Distance (ft)		735		803	803	612	612	
Upstream Blk Time (%)		27				1	11	
Queuing Penalty (veh)		0				0	0	
Storage Bay Dist (ft)	475		270					325
Storage Blk Time (%)	3	43	0	0			21	2
Queuing Penalty (veh)	20	174	0	0			112	11

Intersection: 340: Morningside Dr/Piedmont Ave & Montague Ave

Movement	EB	EB	EB	B38	B39	B39	B39	WB	WB	WB	WB	NB
Directions Served	L	T	TR	T	T	T		L	T	T	R	LT
Maximum Queue (ft)	203	305	357	5	293	428	54	124	171	180	193	267
Average Queue (ft)	72	148	171	0	14	25	0	48	94	81	91	115
95th Queue (ft)	152	274	315	5	150	210	0	102	148	148	163	216
Link Distance (ft)		370	370	1986	538	538	538		724	724		701
Upstream Blk Time (%)		0	0		0	0	0					
Queuing Penalty (veh)		0	2		0	0	0					
Storage Bay Dist (ft)	150							175			150	
Storage Blk Time (%)	2	6						0	0	0	1	33
Queuing Penalty (veh)	9	6						1	0	1	5	44

Intersection: 340: Morningside Dr/Piedmont Ave & Montague Ave

Movement	NB	SB	SB
Directions Served	R	L	TR
Maximum Queue (ft)	150	55	77
Average Queue (ft)	35	17	29
95th Queue (ft)	138	47	60
Link Distance (ft)			459
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	50	135	
Storage Blk Time (%)	0		0
Queuing Penalty (veh)	0		0

Intersection: 350: Montague Ave & Mall Dr/Goer Dr

Movement	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	TR	L	L	T	T	TR	L	T
Maximum Queue (ft)	159	441	458	269	415	193	348	476	510	498	96	268
Average Queue (ft)	44	315	396	178	88	76	122	253	277	207	21	159
95th Queue (ft)	104	621	537	288	287	142	260	427	452	406	62	243
Link Distance (ft)		415	415		476			516	516	516		538
Upstream Blk Time (%)		39	72		0			0	0	0		
Queuing Penalty (veh)		0	0		0			1	1	1		
Storage Bay Dist (ft)	185			170		275	275				175	
Storage Blk Time (%)				13	0		0	7				5
Queuing Penalty (veh)				8	0		0	18				1

Intersection: 350: Montague Ave & Mall Dr/Goer Dr

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	283	301
Average Queue (ft)	173	172
95th Queue (ft)	257	269
Link Distance (ft)	538	538
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		0
Queuing Penalty (veh)		0

Intersection: 360: Montague Ave & I-26 WB Ramps

Movement	WB	WB	WB	NB	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	L	R	L	L	T	T	T	T	T	T	R
Maximum Queue (ft)	473	623	475	386	403	288	259	209	471	478	490	383
Average Queue (ft)	357	458	191	225	245	173	161	107	295	313	319	36
95th Queue (ft)	515	668	557	343	363	251	237	190	436	437	459	195
Link Distance (ft)		573				845	845	845	516	516	516	
Upstream Blk Time (%)		10							0	0	0	
Queuing Penalty (veh)		0							0	0	2	
Storage Bay Dist (ft)	375		375	550	550							350
Storage Blk Time (%)	3	23									4	
Queuing Penalty (veh)	23	151									10	

Intersection: 370: Montague Ave & I-26 EB Ramps

Movement	B123	B123	SB	SB	SB
Directions Served	T	T	T	T	R
Maximum Queue (ft)	38	38	32	38	2
Average Queue (ft)	3	1	0	1	0
95th Queue (ft)	56	39	4	27	2
Link Distance (ft)	369	369	845	845	845
Upstream Blk Time (%)	0	0			
Queuing Penalty (veh)	0	0			
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 380: Dorchester Rd & Meeting St

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB
Directions Served	LT	R	L	TR	L	T	R	LT	TR
Maximum Queue (ft)	145	179	157	142	210	219	112	184	174
Average Queue (ft)	57	82	77	42	104	96	40	97	89
95th Queue (ft)	107	140	133	102	178	181	82	161	149
Link Distance (ft)	457			469		1842	1842	1350	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)		100	125		125				125
Storage Blk Time (%)	2	5	2	0	5	3		3	2
Queuing Penalty (veh)	7	4	2	1	13	9		6	4

Intersection: 390: I-26 WB Ramps & Dorchester Rd

Movement	EB	EB	EB	WB	WB	NB	NB
Directions Served	L	T	T	T	TR	L	L
Maximum Queue (ft)	306	156	140	389	417	342	387
Average Queue (ft)	179	82	46	216	247	171	227
95th Queue (ft)	289	135	103	333	368	300	336
Link Distance (ft)	304	304	304	1842	1842		
Upstream Blk Time (%)	1						
Queuing Penalty (veh)	2						
Storage Bay Dist (ft)						530	530
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 400: I-26 EB Ramps & Dorchester Rd

Movement	EB	EB	EB	WB	WB	WB	SB	SB
Directions Served	T	T	R	L	T	T	L	R
Maximum Queue (ft)	510	420	210	166	220	245	247	141
Average Queue (ft)	312	237	12	61	149	160	115	13
95th Queue (ft)	461	393	100	130	213	234	208	77
Link Distance (ft)	560	560		304	304	304	445	
Upstream Blk Time (%)	0	0						
Queuing Penalty (veh)	0	0						
Storage Bay Dist (ft)			425					300
Storage Blk Time (%)		0					0	
Queuing Penalty (veh)		0					0	

Intersection: 410: Cosgrove Ave & Azalea Dr

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	TR	L	T	T	R	L
Maximum Queue (ft)	216	843	914	500	330	822	700	347	487	435	192	175
Average Queue (ft)	117	313	588	443	306	614	523	218	178	138	35	24
95th Queue (ft)	216	877	1244	607	398	1019	934	354	391	306	129	120
Link Distance (ft)		892	892			767			661	661	661	
Upstream Blk Time (%)		2	45			38			0		0	
Queuing Penalty (veh)		0	0			0			0		0	
Storage Bay Dist (ft)	130			400	230		600	250				200
Storage Blk Time (%)	27	4	0	60	80	0	1	12	0			
Queuing Penalty (veh)	21	4	0	46	298	0	6	50	1			

Intersection: 410: Cosgrove Ave & Azalea Dr

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	535	564	300
Average Queue (ft)	299	344	124
95th Queue (ft)	543	590	344
Link Distance (ft)	3181	3181	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			200
Storage Blk Time (%)	20	30	0
Queuing Penalty (veh)	6	44	0

Intersection: 421: Cosgrove Ave & I-26 WB Ramps

Movement	WB
Directions Served	R
Maximum Queue (ft)	38
Average Queue (ft)	2
95th Queue (ft)	31
Link Distance (ft)	473
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 422: Cosgrove Ave & I-26 EB Ramps

Movement	NB	NB	NB	SB	SB
Directions Served	T	T	TR	T	R
Maximum Queue (ft)	710	928	940	142	131
Average Queue (ft)	110	427	508	7	5
95th Queue (ft)	580	1155	1203	116	93
Link Distance (ft)	882	882	882	950	950
Upstream Blk Time (%)	0	14	29		
Queuing Penalty (veh)	0	0	0		
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 430: Bainbridge Ave & Viaduct Rd Ramp

Movement	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	TR	L	LR
Maximum Queue (ft)	56	7	8	16	136	167
Average Queue (ft)	18	0	0	1	50	77
95th Queue (ft)	48	4	6	8	105	141
Link Distance (ft)		789	1095	1095	625	625
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	200					
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 440: Viaduct Rd & Viaduct Rd Ramp

Movement	EB	B6	B6
Directions Served	R	T	
Maximum Queue (ft)	225	157	6
Average Queue (ft)	44	14	0
95th Queue (ft)	176	86	6
Link Distance (ft)	145	601	601
Upstream Blk Time (%)	3		
Queuing Penalty (veh)	19		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 450: Viaduct Rd & Hobson Ave

Movement	EB	WB	NB
Directions Served	R	LT	L
Maximum Queue (ft)	80	119	62
Average Queue (ft)	9	58	5
95th Queue (ft)	47	97	29
Link Distance (ft)	379	472	347
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 460: Magrath Darby Blvd & US 17

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	NB	SB
Directions Served	L	T	T	T	R	L	T	T	R	R	R
Maximum Queue (ft)	402	896	841	840	247	304	1327	1313	765	290	123
Average Queue (ft)	184	444	412	373	66	85	529	591	46	145	45
95th Queue (ft)	424	1094	1060	1001	256	220	1268	1327	411	252	94
Link Distance (ft)		1105	1105	1105			1292	1292	1292	516	538
Upstream Blk Time (%)		6	2	3			0	0	0		
Queuing Penalty (veh)		0	0	0			1	2	0		
Storage Bay Dist (ft)	375				175	205					
Storage Blk Time (%)		12		14		0	8				
Queuing Penalty (veh)		14		22		0	6				

Intersection: 470: Houston Northcutt Blvd/Mathis Ferry Rd & US 17

Movement	EB	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	WB
Directions Served	L	L	T	T	T	R	L	L	T	T	T	R
Maximum Queue (ft)	448	515	1257	1254	1266	315	398	450	2341	2145	2117	230
Average Queue (ft)	357	430	857	868	866	194	329	415	1202	1226	1156	78
95th Queue (ft)	536	622	1505	1499	1494	425	476	537	2240	2230	2203	243
Link Distance (ft)			1292	1292	1292				4040	4040	4040	
Upstream Blk Time (%)			1	1	1							
Queuing Penalty (veh)			11	8	8							
Storage Bay Dist (ft)	415	415				215	350	350				130
Storage Blk Time (%)	18	30	16		33		32	50	30		25	
Queuing Penalty (veh)	156	263	70		106		228	357	93		34	

Intersection: 470: Houston Northcutt Blvd/Mathis Ferry Rd & US 17

Movement	NB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	T	T	R	L	T	T	R
Maximum Queue (ft)	214	432	355	432	274	324	286	245
Average Queue (ft)	178	240	162	237	127	209	172	104
95th Queue (ft)	248	449	344	384	249	377	355	236
Link Distance (ft)		543	543	543	536	536	536	
Upstream Blk Time (%)		1	0	0	0	3	2	
Queuing Penalty (veh)		0	0	0	0	0	0	
Storage Bay Dist (ft)	115							300
Storage Blk Time (%)	49	19					8	
Queuing Penalty (veh)	66	43					14	

Intersection: 480: Shelmore Blvd & US 17

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB
Directions Served	L	T	T	T	R	L	T	T	T	R	L	T
Maximum Queue (ft)	480	1270	1992	921	310	488	762	764	748	300	256	254
Average Queue (ft)	311	404	460	434	131	357	472	467	447	155	230	151
95th Queue (ft)	477	940	1192	811	364	570	845	823	765	379	294	299
Link Distance (ft)		4040	4040	4040			2558	2558	2558		231	231
Upstream Blk Time (%)		0	0								74	19
Queuing Penalty (veh)		0	0								0	0
Storage Bay Dist (ft)	400				210	400				200		
Storage Blk Time (%)	5	6		35		30	6		32			48
Queuing Penalty (veh)	43	20		43		228	12		59			129

Intersection: 480: Shelmore Blvd & US 17

Movement	NB	SB	SB	SB	SB
Directions Served	R	L	L	T	R
Maximum Queue (ft)	190	175	358	349	249
Average Queue (ft)	97	160	298	255	77
95th Queue (ft)	229	204	415	428	204
Link Distance (ft)			333	333	333
Upstream Blk Time (%)			43	32	1
Queuing Penalty (veh)			0	0	0
Storage Bay Dist (ft)	90	75			
Storage Blk Time (%)	17	76	91		
Queuing Penalty (veh)	30	87	103		

Intersection: 490: Dragoon Dr & US 17

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB
Directions Served	T	T	T	R	L	T	T	T	L	R
Maximum Queue (ft)	207	435	450	54	227	406	1176	878	189	240
Average Queue (ft)	86	137	136	10	117	121	181	167	86	127
95th Queue (ft)	177	458	374	37	203	318	643	515	170	232
Link Distance (ft)	2558	2558	2558			1813	1813	1813		228
Upstream Blk Time (%)						0	0	0	0	3
Queuing Penalty (veh)						0	0	0	0	0
Storage Bay Dist (ft)				200	200				125	
Storage Blk Time (%)			2		1	0			10	17
Queuing Penalty (veh)			2		11	0			15	13

Intersection: 500: Anna Knapp Blvd & US 17

Movement	EB	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB
Directions Served	L	T	T	T	R	L	T	T	T	R	L	LT
Maximum Queue (ft)	406	517	549	544	275	470	1196	1160	1150	300	180	186
Average Queue (ft)	250	295	328	352	94	376	726	685	630	173	92	104
95th Queue (ft)	398	461	484	508	292	572	1244	1195	1131	402	159	168
Link Distance (ft)		1813	1813	1813			1466	1466	1466		325	325
Upstream Blk Time (%)							1	1	1			
Queuing Penalty (veh)							0	0	0			
Storage Bay Dist (ft)	365				175	370				200		
Storage Blk Time (%)	4	2		33		22	26		33			
Queuing Penalty (veh)	44	5		43		176	52		89			

Intersection: 500: Anna Knapp Blvd & US 17

Movement	NB	NB	SB	SB	SB	SB
Directions Served	T	R	L	LT	T	R
Maximum Queue (ft)	250	226	175	304	265	200
Average Queue (ft)	61	127	171	278	165	76
95th Queue (ft)	200	213	183	290	265	157
Link Distance (ft)	325			260	260	260
Upstream Blk Time (%)				90	4	0
Queuing Penalty (veh)				0	0	0
Storage Bay Dist (ft)		140	75			
Storage Blk Time (%)	3	10	75	92		
Queuing Penalty (veh)	6	5	194	159		

Intersection: 510: Local Access Rd & Bainbridge Ave

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	TR	L	T	TR	L	T
Maximum Queue (ft)	37	126	121	110	153	198	188	115	16	39	26	24
Average Queue (ft)	5	57	62	49	69	103	97	42	1	8	2	1
95th Queue (ft)	23	101	107	87	128	168	160	88	8	26	13	12
Link Distance (ft)		1095	1095			754	754		1254	1254		641
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	150			150	150			250			250	
Storage Blk Time (%)		0	0	0	0	1						
Queuing Penalty (veh)		0	0	0	1	1						

Intersection: 510: Local Access Rd & Bainbridge Ave

Movement	SB
Directions Served	TR
Maximum Queue (ft)	33
Average Queue (ft)	7
95th Queue (ft)	27
Link Distance (ft)	641
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 520: Local Access Rd & Stromboli Ave

Movement	EB	EB	EB	NB	NB	NB	SB	SB
Directions Served	L	L	R	L	T	T	T	TR
Maximum Queue (ft)	80	42	33	36	55	35	27	67
Average Queue (ft)	25	11	5	4	13	4	2	22
95th Queue (ft)	59	35	24	22	42	20	16	58
Link Distance (ft)		1627	1627		1431	1431	1254	1254
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200			200				
Storage Blk Time (%)								
Queuing Penalty (veh)								

Intersection: 530: Local Access Rd & PAR SB Ramp

Movement	SB
Directions Served	TR
Maximum Queue (ft)	12
Average Queue (ft)	0
95th Queue (ft)	9
Link Distance (ft)	1431
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 540: PAR NB Ramp/Tidewater Rd & Local Access Rd

Movement	EB	WB	SB
Directions Served	LTR	LTR	L
Maximum Queue (ft)	60	30	3
Average Queue (ft)	35	7	0
95th Queue (ft)	54	25	3
Link Distance (ft)	616	871	222
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 5551

Appendix E

Traffic Analysis Worksheets

2018 Opening Year

Build Proposed Project Alternatives 1 - 4

Appendix E

Traffic Analysis Worksheets

2018 Opening Year

Build Proposed Project Alternatives 1 - 4

Interstate 26

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1010-EB Off to C-D
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	4	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	400	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	8417	V_D =	veh/h
		Ramp Volume, V_R	1025		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	55.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	8417	0.90	Level	15	0	0.930	1.00	10054
Ramp	1025	0.90	Level	7	0	0.966	1.00	1179
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 5048 pc/h

V_3 or V_{av34} 2503 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	10054	Exhibit 13-8	9200	Yes
$V_{FO} = V_F - V_R$	8875	Exhibit 13-8	9200	No
V_R	1179	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	5048	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 44.1 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.274 (Exhibit 13-12)

S_R= 55.1 mph (Exhibit 13-12)

S_0= 60.0 mph (Exhibit 13-12)

S = 57.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1010-EB Off to C-D
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	4	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	400	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	5600	V_D =	veh/h
		Ramp Volume, V_R	542		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	55.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5600	0.90	Level	11	0	0.948	1.00	6564
Ramp	542	0.90	Level	11	0	0.948	1.00	635
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.436 using Equation (Exhibit 13-7)

V_{12} = 3220 pc/h

V_3 or V_{av34} 1672 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6564	Exhibit 13-8	9200	No
$V_{FO} = V_F - V_R$	5929	Exhibit 13-8	9200	No
V_R	635	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3220	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 28.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.225 (Exhibit 13-12)

S_R= 55.9 mph (Exhibit 13-12)

S_0= 63.2 mph (Exhibit 13-12)

S = 59.4 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1015-Avai/Rem CD Off to CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*7392*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*15*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2207*	pc/h/ln
S	*53.3*	mph
D = v_p / S	*41.4*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1015-Avai/Rem CD Off to CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5058*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1489*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*24.8*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	EB Off to Aviation Ave
Analysis Time Period:	AM Peak	Segment ID	1020
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	1,025	463	562
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	7%	7%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.97	0.97	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,179	532	646
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.54	0.24	0.31
Density, D_{MD} (pc/mi/ln)	20.6	9.3	11.3
LOS	C	A	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	EB Off to Aviation Ave
Analysis Time Period:	PM Peak	Segment ID	1020
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	542	303	239
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	11%	9%	15%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.95	0.96	0.93
Demand Flow Rate, v_p (pc/h/ln)	635	352	285
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.29	0.16	0.14
Density, D_{MD} (pc/mi/ln)	11.1	6.2	5.0
LOS	B	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1025 - Avia Off to Avia WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*926*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*532*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*9.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4843

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1025 - Avia Off to Avia WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*606*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*352*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*6.4*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4844

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB Aviation EB On Loop
Analysis Time Period:	AM Peak	Segment ID	1030
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	25
Volume, V (veh/h)	463	759	296
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	7%	5%	3%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.97	0.98	0.99
Demand Flow Rate, v_p (pc/h/ln)	532	864	334
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	1,900
v/c ratio	0.24	0.39	0.18
Density, D_{MD} (pc/mi/ln)	9.3	15.1	5.8
LOS	A	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB Aviation EB On Loop
Analysis Time Period:	PM Peak	Segment ID	1030
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	25
Volume, V (veh/h)	303	774	471
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	9%	4%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.98	0.99
Demand Flow Rate, v_p (pc/h/ln)	352	877	529
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	1,900
v/c ratio	0.16	0.40	0.28
Density, D_{MD} (pc/mi/ln)	6.2	15.3	9.3
LOS	A	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 EB - Aviation-Remount C-D
Weaving Segment Location	1040-EB Aviation to Remount
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	535ft
Freeway free-flow speed, FFS	55 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	296	0.90	3	0	1.5	1.2	0.985	1.00	334
V_{RF}	197	0.90	7	0	1.5	1.2	0.966	1.00	227
V_{FR}	463	0.90	7	0	1.5	1.2	0.966	1.00	532
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	334							V =	1093
V_W	759								
VR	0.694								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	759 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	797 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	797 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	14

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1093 pc/h	Weaving intensity factor, W	0.310
Weaving segment capacity, c_w	2979 veh/h	Weaving segment speed, S	46.0 mph
Weaving segment v/c ratio	0.361	Average weaving speed, S_W	45.5 mph
Weaving segment density, D	11.9 pc/mi/ln	Average non-weaving speed, S_{NW}	46.9 mph
Level of Service, LOS	A	Maximum weaving length, L_{MAX}	10186 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25//2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 EB - Aviation-Remount C-D
Weaving Segment Location	1040-EB Aviation to Remount
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	535ft
Freeway free-flow speed, FFS	55 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	471	0.90	2	0	1.5	1.2	0.990	1.00	529
V_{RF}	351	0.90	3	0	1.5	1.2	0.985	1.00	396
V_{FR}	303	0.90	9	0	1.5	1.2	0.957	1.00	352
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	529							V =	1277
V_W	748								
VR	0.586								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	748 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	786 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	14 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	800 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	23

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1277 pc/h	Weaving intensity factor, W	0.310
Weaving segment capacity, c_w	3196 veh/h	Weaving segment speed, S	45.9 mph
Weaving segment v/c ratio	0.396	Average weaving speed, S_W	45.5 mph
Weaving segment density, D	13.9 pc/mi/ln	Average non-weaving speed, S_{NW}	46.5 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	8846 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1045-Remount Off to Remount On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*986*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*561*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*10.2*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1045-Remount Off to Remount On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1644*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*922*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*16.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	Remount EB On Loop
Analysis Time Period:	AM Peak	Segment ID	1050
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	25
Volume, V (veh/h)	493	832	339
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	5%	4%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.98	0.99
Demand Flow Rate, v_p (pc/h/ln)	561	943	380
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	1,900
v/c ratio	0.26	0.43	0.20
Density, D_{MD} (pc/mi/ln)	9.8	16.5	6.7
LOS	A	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	Remount EB On Loop
Analysis Time Period:	PM Peak	Segment ID	1050
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	25
Volume, V (veh/h)	822	1,212	390
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	2%	2%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.99
Demand Flow Rate, v_p (pc/h/ln)	922	1,360	438
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	1,900
v/c ratio	0.42	0.62	0.23
Density, D_{MD} (pc/mi/ln)	16.1	23.8	7.7
LOS	B	C	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1060-Avi-Rem C-D to 526 C-D
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	5	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1850ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4186	0.90	13	0	1.5	1.2	0.939	1.00	4953
V_{RF}	471	0.90	13	0	1.5	1.2	0.939	1.00	557
V_{FR}	3206	0.90	33	0	1.5	1.2	0.858	1.00	4150
V_{RR}	361	0.90	33	0	1.5	1.2	0.858	1.00	467
V_{NW}	5420							V =	10127
V_W	4707								
VR	0.465								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	2 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	602

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	10127 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	4848 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.961	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	7418 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1060-Avi-Rem C-D to 526 C-D
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	5	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1850ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2733	0.90	10	0	1.5	1.2	0.952	1.00	3189
V_{RF}	655	0.90	10	0	1.5	1.2	0.952	1.00	764
V_{FR}	2325	0.90	35	0	1.5	1.2	0.851	1.00	3035
V_{RR}	557	0.90	35	0	1.5	1.2	0.851	1.00	727
V_{NW}	3916							V =	7715
V_W	3799								
VR	0.492								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	2 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	393

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	7715 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	4642 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.583	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	7738 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1065 - I-526 CD Off to CD On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4657*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1837*	pc/h/ln
S	*59.0*	mph
D = v_p / S	*31.1*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1065 - I-526 CD Off to CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3388*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*10*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1318*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*22.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4856

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	EB Off to I-526 WB
Analysis Time Period:	AM Peak	Segment ID	1070
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	3,567	1,355	2,212
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	33%	53%	20%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.86	0.79	0.91
Demand Flow Rate, v_p (pc/h/ln)	2,309	1,905	2,704
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	1.05	0.87	1.29
Density, D_{MD} (pc/mi/ln)	40.4	33.3	47.3
LOS	F	D	F

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	EB Off to I-526 WB
Analysis Time Period:	PM Peak	Segment ID	1070
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	2,882	1,108	1,774
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	35%	56%	22%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.85	0.78	0.90
Demand Flow Rate, v_p (pc/h/ln)	1,881	1,576	2,188
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.86	0.72	1.04
Density, D_{MD} (pc/mi/ln)	32.9	27.6	38.3
LOS	D	C	F

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1075-I526 WB Off to I526 WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2710*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*53*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.791*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1905*	pc/h/ln
S	*54.7*	mph
D = v_p / S	*34.8*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1075-I526 WB Off to I526 WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2216*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*56*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.781*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1576*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*28.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4860

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	3/20/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 EB C-D
Weaving Segment Location	1080 - I-526 WB to I-526 EB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	C-D Roadway/ Multilane Highways
Weaving number of lanes, N	2	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	620ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{RF}	538	0.90	8	0	1.5	1.2	0.962	1.00	622
V_{FR}	1355	0.90	53	0	1.5	1.2	0.791	1.00	1905
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	0							V =	2527
V_W	2527								
VR	1.000								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2527 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	2400 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.053	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	14232 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 EB C-D
Weaving Segment Location	1080 - I-526 WB to I-526 EB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	C-D Roadway/ Multilane Highways
Weaving number of lanes, N	2	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	620ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{RF}	474	0.90	8	0	1.5	1.2	0.962	1.00	548
V_{FR}	1108	0.90	56	0	1.5	1.2	0.781	1.00	1576
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	0							V =	2124
V_W	2124								
VR	1.000								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	2124 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	2169 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2169 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2124 pc/h	Weaving intensity factor, W	0.607
Weaving segment capacity, c_w	2400 veh/h	Weaving segment speed, S	39.9 mph
Weaving segment v/c ratio	0.885	Average weaving speed, S_W	39.9 mph
Weaving segment density, D	26.6 pc/mi/ln	Average non-weaving speed, S_{NW}	34.6 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	14232 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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F-4862

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1085-I526 EB Off to I526 EB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1076*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*622*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*11.3*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4863

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB C-D*
Agency or Company	*Atkins*	From/To	*1085-I526 EB Off to I526 EB On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*948*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*548*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*10.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4864

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB
Analysis Year	2018 Build - Proposed Site	Junction	I-526 EB Ramp Split
Analysis Time Period:	AM Peak	Segment ID	1088
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	2,099	1,800	299
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	11%	13%	3%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.95	0.94	0.99
Demand Flow Rate, v_p (pc/h/ln)	1,230	1,065	337
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	0.56	0.48	0.15
Density, D_{MD} (pc/mi/ln)	21.5	18.6	5.9
LOS	C	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	I-26 EB
Analysis Year	2018 Build - Proposed Site	Junction	I-526 EB Ramp Split
Analysis Time Period:	PM Peak	Segment ID	1088
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	2,426	2,082	344
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	9%	10%	3%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.95	0.99
Demand Flow Rate, v_p (pc/h/ln)	1,408	1,215	388
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	0.64	0.55	0.18
Density, D_{MD} (pc/mi/ln)	24.6	21.3	6.8
LOS	C	C	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	I-526 EB On
Analysis Time Period:	AM Peak	Segment ID	1090
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	538	837	299
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	8%	7%	3%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.97	0.99
Demand Flow Rate, v_p (pc/h/ln)	622	963	337
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.28	0.44	0.16
Density, D_{MD} (pc/mi/ln)	10.9	16.9	5.9
LOS	B	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB C-D
Analysis Year	2018 Build - Proposed Site	Junction	I-526 EB On
Analysis Time Period:	PM Peak	Segment ID	1090
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	474	818	344
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	8%	6%	3%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.97	0.99
Demand Flow Rate, v_p (pc/h/ln)	548	936	388
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.25	0.43	0.18
Density, D_{MD} (pc/mi/ln)	9.6	16.4	6.8
LOS	A	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1100 - I-526 CD to Montague SB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1550ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	4110	0.90	4	0	1.5	1.2	0.980	1.00	4658
V_{RF}	739	0.90	7	0	1.5	1.2	0.966	1.00	850
V_{FR}	547	0.90	13	0	1.5	1.2	0.939	1.00	647
V_{RR}	98	0.90	13	0	1.5	1.2	0.939	1.00	116
V_{NW}	4774							V =	6271
V_W	1497								
VR	0.239								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1497 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1850 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1053 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2903 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	592

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6271 pc/h	Weaving intensity factor, W	0.371
Weaving segment capacity, c_w	8004 veh/h	Weaving segment speed, S	43.0 mph
Weaving segment v/c ratio	0.768	Average weaving speed, S_W	47.8 mph
Weaving segment density, D	36.4 pc/mi/ln	Average non-weaving speed, S_{NW}	41.7 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	4936 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	3/20/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1100 - I-526 CD to Montague SB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1550ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2600	0.90	3	0	1.5	1.2	0.985	1.00	2932
V_{RF}	628	0.90	6	0	1.5	1.2	0.971	1.00	719
V_{FR}	788	0.90	7	0	1.5	1.2	0.966	1.00	906
V_{RR}	190	0.90	7	0	1.5	1.2	0.966	1.00	219
V_{NW}	3151							V =	4776
V_W	1625								
VR	0.340								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1625 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1978 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	719 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2697 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	391

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4776 pc/h	Weaving intensity factor, W	0.350
Weaving segment capacity, c_w	6950 veh/h	Weaving segment speed, S	44.4 mph
Weaving segment v/c ratio	0.677	Average weaving speed, S_W	48.3 mph
Weaving segment density, D	26.9 pc/mi/ln	Average non-weaving speed, S_{NW}	42.6 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	6020 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1105-Mont SB Off to Mont SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4849*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1832*	pc/h/ln
S	*59.0*	mph
D = v_p / S	*31.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1105-Mont SB Off to Mont SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3228*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1213*	pc/h/ln	Design LOS	
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*20.2*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1110 - Montague SB to Mont. NB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	470ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	4400	0.90	4	0	1.5	1.2	0.980	1.00	4987
V_{RF}	371	0.90	8	0	1.5	1.2	0.962	1.00	429
V_{FR}	449	0.90	6	0	1.5	1.2	0.971	1.00	514
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	4987							V =	5930
V_W	943								
VR	0.159								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	943 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1085 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	512 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1597 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	234

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5930 pc/h	Weaving intensity factor, W	0.593
Weaving segment capacity, c_w	7925 veh/h	Weaving segment speed, S	45.6 mph
Weaving segment v/c ratio	0.734	Average weaving speed, S_W	43.2 mph
Weaving segment density, D	32.5 pc/mi/ln	Average non-weaving speed, S_{NW}	46.1 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	4122 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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F-4873

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1110 - Montague SB to Mont. NB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	470ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2981	0.90	3	0	1.5	1.2	0.985	1.00	3362
V_{RF}	468	0.90	6	0	1.5	1.2	0.971	1.00	536
V_{FR}	247	0.90	9	0	1.5	1.2	0.957	1.00	287
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	3362							V =	4185
V_W	823								
VR	0.197								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	823 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	965 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	177 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1142 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	158

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4185 pc/h	Weaving intensity factor, W	0.455
Weaving segment capacity, c_w	7850 veh/h	Weaving segment speed, S	48.4 mph
Weaving segment v/c ratio	0.525	Average weaving speed, S_W	45.9 mph
Weaving segment density, D	21.6 pc/mi/ln	Average non-weaving speed, S_{NW}	49.1 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	4502 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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F-4874

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1115-Mont NB Off to Mont NB On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4771*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1802*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.3*	mph	S	mph
D = v_p / S	*30.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1115-Mont NB Off to Mont NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3449*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1297*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*21.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4876

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1120 - EB On from Montague NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 850	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4771	
	Ramp Volume, V_R: 552	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4771	0.90	Level	4	0	0.980	1.00	5407
Ramp	552	0.90	Level	5	0	0.976	1.00	629
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.601 using Equation (Exhibit 13-6)

V_{12} = 3251 pc/h

V_3 or V_{av34} 2156 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6036	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3880	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.433 (Exibit 13-11)

S_R= 52.2 mph (Exhibit 13-11)

S_0= 54.0 mph (Exhibit 13-11)

S = 52.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1120 - EB On from Montague NB
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 850	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3449	
	Ramp Volume, V_R: 597	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3449	0.90	Level	3	0	0.985	1.00	3890
Ramp	597	0.90	Level	4	0	0.980	1.00	677
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.601 using Equation (Exhibit 13-6)

V_{12} = 2339 pc/h

V_3 or V_{av34} 1551 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4567	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3016	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.4 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.324 (Exibit 13-11)

S_R= 54.2 mph (Exhibit 13-11)

S_0= 56.2 mph (Exhibit 13-11)

S = 54.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1130 - Montague to Dorchester*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5323*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2001*	pc/h/ln
S	*57.1*	mph
D = v_p / S	*35.1*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1130 - Montague to Dorchester*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4046*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1521*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*25.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1140-EB Off to Dorchester Rd
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	380	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	5323	V_D =	veh/h
		Ramp Volume, V_R	576		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5323	0.90	Level	3	0	0.985	1.00	6003
Ramp	576	0.90	Level	11	0	0.948	1.00	675
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.579 using Equation (Exhibit 13-7)

V_{12} = 3759 pc/h

V_3 or V_{av34} 2244 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6003	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	5328	Exhibit 13-8	6900	No
V_R	675	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3759	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 33.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.359 (Exhibit 13-12)

S_R= 53.5 mph (Exhibit 13-12)

S_0= 61.0 mph (Exhibit 13-12)

S = 56.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1140-EB Off to Dorchester Rd
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	380	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	4046	V_D =	veh/h
		Ramp Volume, V_R	383		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4046	0.90	Level	3	0	0.985	1.00	4563
Ramp	383	0.90	Level	15	0	0.930	1.00	457
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.625 using Equation (Exhibit 13-7)

V_{12} = 3023 pc/h

V_3 or V_{av34} 1540 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4563	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	4106	Exhibit 13-8	6900	No
V_R	457	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3023	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 26.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.339 (Exhibit 13-12)

S_R= 53.9 mph (Exhibit 13-12)

S_0= 63.7 mph (Exhibit 13-12)

S = 56.9 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1145-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4747*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1793*	pc/h/ln
S	*59.3*	mph
D = v_p / S	*30.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1145-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3663*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1377*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*23.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1150 - EB On from Dorchester
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☑ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☐ No ☑ Off
L_{up} = ft	Acceleration Lane Length, L_A: 560	L_{down} = 2100 ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = 807 veh/h
	Freeway Volume, V_F: 4747	
	Ramp Volume, V_R: 631	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4747	0.90	Level	4	0	0.980	1.00	5380
Ramp	631	0.90	Level	10	0	0.952	1.00	736
UpStream								
DownStream	807	0.90	Level	11	0	0.948	1.00	946

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 5580.46 (Equation 13-6 or 13-7)

P_{FM} = 0.667 using Equation (Exhibit 13-6)

V_{12} = 3589 pc/h

V_3 or V_{av34} 1791 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6116	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4325	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 35.4 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

M_S = 0.565 (Exibit 13-11)

S_R= 49.8 mph (Exhibit 13-11)

S_0= 55.4 mph (Exhibit 13-11)

S = 51.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1150 - EB On from Dorchester
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A	560	☐ No	☑ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	2100 ft
V_u =	veh/h	Freeway Volume, V_F	3663	V_D =	1170 veh/h
		Ramp Volume, V_R	490		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3663	0.90	Level	3	0	0.985	1.00	4131
Ramp	490	0.90	Level	12	0	0.943	1.00	577
UpStream								
DownStream	1170	0.90	Level	7	0	0.966	1.00	1345

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 7934.17 (Equation 13-6 or 13-7)

P_{FM} = 0.717 using Equation (Exhibit 13-6)

V_{12} = 2962 pc/h

V_3 or V_{av34} 1169 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4708	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3539	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.405 (Exibit 13-11)

S_R= 52.7 mph (Exhibit 13-11)

S_0= 57.6 mph (Exhibit 13-11)

S = 53.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1160-EB Off to Cosgrove SB
Date Performed	3/20/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 2100 ft

V_u = 631 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	200
Freeway Volume, V_F	5378
Ramp Volume, V_R	807
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5378	0.90	Level	4	0	0.980	1.00	6095
Ramp	807	0.90	Level	11	0	0.948	1.00	946
UpStream	631	0.90	Level	10	0	0.952	1.00	736
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 5283.98 (Equation 13-12 or 13-13)

P_{FD} = 0.564 using Equation (Exhibit 13-7)

V_{12} = 3851 pc/h

V_3 or V_{av34} 2244 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6095	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	5149	Exhibit 13-8	6900	No
V_R	946	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3851	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 35.6 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.383 (Exhibit 13-12)

S_R= 53.1 mph (Exhibit 13-12)

S_0= 61.0 mph (Exhibit 13-12)

S = 55.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1160-EB Off to Cosgrove SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 2100 ft

V_u = 490 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	200
Freeway Volume, V_F	4153
Ramp Volume, V_R	1170
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4153	0.90	Level	3	0	0.985	1.00	4684
Ramp	1170	0.90	Level	7	0	0.966	1.00	1345
UpStream	490	0.90	Level	12	0	0.943	1.00	577
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 7541.30 (Equation 13-12 or 13-13)

P_{FD} = 0.581 using Equation (Exhibit 13-7)

V_{12} = 3285 pc/h

V_3 or V_{av34} 1399 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4684	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	3339	Exhibit 13-8	6900	No
V_R	1345	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3285	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.419 (Exhibit 13-12)

S_R= 52.5 mph (Exhibit 13-12)

S_0= 64.3 mph (Exhibit 13-12)

S = 55.5 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1165-Cosg SB Off to Cosg SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4571*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*4*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1727*	pc/h/ln
S	*59.7*	mph
D = v_p / S	*28.9*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1165-Cosg SB Off to Cosg SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2983*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1121*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*18.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1170 - Cosgrove SB to Cos. NB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	600ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4273	0.90	4	0	1.5	1.2	0.980	1.00	4843
V_{RF}	414	0.90	2	0	1.5	1.2	0.990	1.00	465
V_{FR}	298	0.90	8	0	1.5	1.2	0.962	1.00	344
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	4843							V =	5652
V_W	809								
VR	0.143								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	809 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	997 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	552 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1549 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	291

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5652 pc/h	Weaving intensity factor, W	0.478
Weaving segment capacity, c_w	8012 veh/h	Weaving segment speed, S	47.1 mph
Weaving segment v/c ratio	0.692	Average weaving speed, S_W	45.5 mph
Weaving segment density, D	30.0 pc/mi/ln	Average non-weaving speed, S_{NW}	47.4 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	3963 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 EB
Weaving Segment Location	1170 - Cosgrove SB to Cos. NB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	600ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2845	0.90	3	0	1.5	1.2	0.985	1.00	3209
V_{RF}	412	0.90	2	0	1.5	1.2	0.990	1.00	462
V_{FR}	138	0.90	14	0	1.5	1.2	0.935	1.00	164
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	3209							V =	3835
V_W	626								
VR	0.163								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	626 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	814 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	216 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1030 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	193

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3835 pc/h	Weaving intensity factor, W	0.346
Weaving segment capacity, c_w	7988 veh/h	Weaving segment speed, S	50.5 mph
Weaving segment v/c ratio	0.473	Average weaving speed, S_W	48.4 mph
Weaving segment density, D	19.0 pc/mi/ln	Average non-weaving speed, S_{NW}	50.9 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	4164 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1175-Cosg NB Off to Cosg NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4687*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*4*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1771*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.5*	mph	S	mph
D = v_p / S	*29.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1175-Cosg NB Off to Cosg NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3257*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1224*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*20.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1180 - EB On from Cosgrove NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A	440	☑ No ☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	veh/h	Freeway Volume, V_F	4687	V_D = veh/h
		Ramp Volume, V_R	826	
		Freeway Free-Flow Speed, S_{FF}	60.0	
		Ramp Free-Flow Speed, S_{FR}	45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4687	0.90	Level	4	0	0.980	1.00	5312
Ramp	826	0.90	Level	12	0	0.943	1.00	973
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.590 using Equation (Exhibit 13-6)

V_{12} = 3133 pc/h

V_3 or V_{av34} 2179 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6285	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4106	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 34.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.518 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= 54.0 mph (Exhibit 13-11)

S = 51.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1180 - EB On from Cosgrove NB
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 440	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3257	
	Ramp Volume, V_R: 444	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3257	0.90	Level	3	0	0.985	1.00	3673
Ramp	444	0.90	Level	19	0	0.913	1.00	540
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.590 using Equation (Exhibit 13-6)

V_{12} = 2166 pc/h

V_3 or V_{av34} 1507 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4213	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2706	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.340 (Exibit 13-11)

S_R= 53.9 mph (Exhibit 13-11)

S_0= 56.4 mph (Exhibit 13-11)

S = 54.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1190 - Cosgrove to US-52*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5513*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2072*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*56.0*	mph	S	mph
D = v_p / S	*37.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1190 - Cosgrove to US-52*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3701*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1391*	pc/h/ln	Design LOS	
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*23.2*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1200-EB Off to US-52 & PAR
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	340	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	5513	V_D =	veh/h
		Ramp Volume, V_R	397		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5513	0.90	Level	3	0	0.985	1.00	6217
Ramp	397	0.90	Level	24	0	0.893	1.00	494
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.582 using Equation (Exhibit 13-7)

V_{12} = 3824 pc/h

V_3 or V_{av34} 2393 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	6217	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	5723	Exhibit 13-8	6900	No
V_R	494	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3824	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.342 (Exhibit 13-12)

S_R= 53.8 mph (Exhibit 13-12)

S_0= 60.4 mph (Exhibit 13-12)

S = 56.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1200-EB Off to US-52
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 340	V_D = veh/h
	Freeway Volume, V_F: 3701	
	Ramp Volume, V_R: 339	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3701	0.90	Level	3	0	0.985	1.00	4174
Ramp	339	0.90	Level	20	0	0.909	1.00	414
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.637 using Equation (Exhibit 13-7)

V_{12} = 2808 pc/h

V_3 or V_{av34} 1366 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4174	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	3760	Exhibit 13-8	6900	No
V_R	414	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2808	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.335 (Exhibit 13-12)

S_R= 54.0 mph (Exhibit 13-12)

S_0= 64.4 mph (Exhibit 13-12)

S = 57.0 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1205 - PAR Off to PAR On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5116*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1942*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*57.9*	mph	S	mph
D = v_p / S	*33.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4901

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1205 - PAR Off to PAR On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3362*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1270*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.0*	mph	S	mph
D = v_p / S	*21.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4902

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	EB US-52 & PAR Off Ramp
Analysis Year	2018 Build - Proposed Site	Junction	US-52 & PAR EB Ramp Split
Analysis Time Period:	AM Peak	Segment ID	1208
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	45	55	45
Volume, V (veh/h)	397	264	133
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	24%	28%	18%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.89	0.88	0.92
Demand Flow Rate, v_p (pc/h/ln)	494	334	161
Capacity Flow Rate, c (pc/h/ln)	2,100	2,200	2,100
v/c ratio	0.24	0.15	0.08
Density, D_{MD} (pc/mi/ln)	8.6	5.8	2.8
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	EB US-52 & PAR Off Ramp
Analysis Year	2018 Build - Proposed Site	Junction	US-52 & PAR EB Ramp Split
Analysis Time Period:	PM Peak	Segment ID	1208
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	45	55	45
Volume, V (veh/h)	339	297	42
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	20%	21%	17%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.91	0.90	0.92
Demand Flow Rate, v_p (pc/h/ln)	414	365	51
Capacity Flow Rate, c (pc/h/ln)	2,100	2,200	2,100
v/c ratio	0.20	0.17	0.02
Density, D_{MD} (pc/mi/ln)	7.2	6.4	0.9
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1210 - EB On from PAR
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 5116	
	Ramp Volume, V_R: 118	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 55.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5116	0.90	Level	5	0	0.976	1.00	5827
Ramp	118	0.90	Level	18	0	0.917	1.00	143
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.605 using Equation (Exhibit 13-6)

V_{12} = 3528 pc/h

V_3 or V_{av34} 2299 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5970	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3671	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.364 (Exibit 13-11)

S_R= 53.4 mph (Exhibit 13-11)

S_0= 53.5 mph (Exhibit 13-11)

S = 53.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1210 - EB On from PAR
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1000	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3362	
	Ramp Volume, V_R: 232	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 55.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3362	0.90	Level	4	0	0.980	1.00	3810
Ramp	232	0.90	Level	16	0	0.926	1.00	278
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.605 using Equation (Exhibit 13-6)

V_{12} = 2307 pc/h

V_3 or V_{av34} 1503 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4088	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2585	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 19.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.263 (Exibit 13-11)

S_R= 55.3 mph (Exhibit 13-11)

S_0= 56.4 mph (Exhibit 13-11)

S = 55.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1220 - PAR to Heriot*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5234*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1987*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*57.3*	mph	S	mph
D = v_p / S	*34.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1220 - PAR to Heriot*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3594*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1358*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.0*	mph	S	mph
D = v_p / S	*22.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4908

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1230-EB Off to Heriot St
Date Performed	3/20/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	200
Freeway Volume, V_F	5234
Ramp Volume, V_R	635
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 1400 ft

V_D = 754 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5234	0.90	Level	5	0	0.976	1.00	5961
Ramp	635	0.90	Level	3	0	0.985	1.00	716
UpStream								
DownStream	754	0.90	Level	8	0	0.962	1.00	871

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 1254.34 (Equation 13-12 or 13-13)

P_{FD} = 0.578 using Equation (Exhibit 13-7)

V_{12} = 3748 pc/h

V_3 or V_{av34} 2213 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5961	Exhibit 13-8	6750	No
$V_{FO} = V_F - V_R$	5245	Exhibit 13-8	6750	No
V_R	716	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3748	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.362 (Exhibit 13-12)

S_R= 50.3 mph (Exhibit 13-12)

S_0= 55.6 mph (Exhibit 13-12)

S = 52.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1230-EB Off to Heriot St
Date Performed	3/20/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	200
Freeway Volume, V_F	3594
Ramp Volume, V_R	449
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{down} = 1400 ft

V_D = 344 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3594	0.90	Level	4	0	0.980	1.00	4073
Ramp	449	0.90	Level	4	0	0.980	1.00	509
UpStream								
DownStream	344	0.90	Level	15	0	0.930	1.00	411

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 494.35 (Equation 13-12 or 13-13)

P_{FD} = 0.635 using Equation (Exhibit 13-7)

V_{12} = 2771 pc/h

V_3 or V_{av34} 1302 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4073	Exhibit 13-8	6750	No
$V_{FO} = V_F - V_R$	3564	Exhibit 13-8	6750	No
V_R	509	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2771	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 26.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.344 (Exhibit 13-12)

S_R= 50.5 mph (Exhibit 13-12)

S_0= 59.2 mph (Exhibit 13-12)

S = 53.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1240-EB Off to Mt. Pleasant St
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	175	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	4599	V_D =	veh/h
		Ramp Volume, V_R	754		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4599	0.90	Level	5	0	0.976	1.00	5238
Ramp	754	0.90	Level	8	0	0.962	1.00	871
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.589 using Equation (Exhibit 13-7)

V_{12} = 3443 pc/h

V_3 or V_{av34} 1795 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5238	Exhibit 13-8	6750	No
$V_{FO} = V_F - V_R$	4367	Exhibit 13-8	6750	No
V_R	871	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3443	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.376 (Exhibit 13-12)

S_R= 50.1 mph (Exhibit 13-12)

S_0= 57.2 mph (Exhibit 13-12)

S = 52.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 EB
Agency or Company	Atkins	Junction	1240-EB Off to Mt. Pleasant St
Date Performed	3/20/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	175	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3145	V_D =	veh/h
		Ramp Volume, V_R	344		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3145	0.90	Level	4	0	0.980	1.00	3564
Ramp	344	0.90	Level	15	0	0.930	1.00	411
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.652 using Equation (Exhibit 13-7)

V_{12} = 2467 pc/h

V_3 or V_{av34} 1097 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3564	Exhibit 13-8	6750	No
$V_{FO} = V_F - V_R$	3153	Exhibit 13-8	6750	No
V_R	411	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2467	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.9 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.335 (Exhibit 13-12)

S_R= 50.6 mph (Exhibit 13-12)

S_0= 60.0 mph (Exhibit 13-12)

S = 53.2 mph (Exhibit 13-13)

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FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB
Analysis Year	2018 Build - Proposed Site	Junction	EB Off to US-17 NB
Analysis Time Period:	AM Peak	Segment ID	1250
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	3,845	2,512	1,333
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	5%	4%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.98	0.98
Demand Flow Rate, v_p (pc/h/ln)	1,453	1,430	1,511
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.65	0.64	0.69
Density, D_{MD} (pc/mi/ln)	25.4	25.0	26.4
LOS	C	C	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB
Analysis Year	2018 Build - Proposed Site	Junction	EB Off to US-17 NB
Analysis Time Period:	PM Peak	Segment ID	1250
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	2,801	2,087	714
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	4%	7%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.98	0.97
Demand Flow Rate, v_p (pc/h/ln)	1,053	1,183	821
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.47	0.53	0.37
Density, D_{MD} (pc/mi/ln)	18.4	20.7	14.4
LOS	B	C	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1260 - US17 NB to Cypress St*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2512*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1430*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*26.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1260 - US17 NB to Cypress St*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2087*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1183*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*21.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB
Analysis Year	2018 Build - Proposed Site	Junction	EB On from Cypress St
Analysis Time Period:	AM Peak	Segment ID	1270
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	2,512	2,585	73
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	5%	4%	23%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.98	0.90
Demand Flow Rate, v_p (pc/h/ln)	1,430	977	90
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,100
v/c ratio	0.64	0.43	0.04
Density, D_{MD} (pc/mi/ln)	25.0	17.1	1.6
LOS	C	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 EB
Analysis Year	2018 Build - Proposed Site	Junction	EB On from Cypress St
Analysis Time Period:	PM Peak	Segment ID	1270
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	2,087	2,210	123
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	3%	11%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.99	0.95
Demand Flow Rate, v_p (pc/h/ln)	1,183	831	144
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,100
v/c ratio	0.53	0.37	0.07
Density, D_{MD} (pc/mi/ln)	20.7	14.5	2.5
LOS	C	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1280 - East Of Cypress*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2585*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*4*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*977*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*17.8*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 EB*
Agency or Company	*Atkins*	From/To	*1280 - East Of Cypress*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2210*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*831*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*15.1*	pc/mi/ln	S	mph
LOS	*B*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4920

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	WB Off to US-17 NB
Analysis Time Period:	AM Peak	Segment ID	2010
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	4	3	2
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	3,434	1,443	1,991
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	4%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.98	0.99
Demand Flow Rate, v_p (pc/h/ln)	968	545	1,117
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.43	0.24	0.51
Density, D_{MD} (pc/mi/ln)	16.9	9.5	19.5
LOS	B	A	B

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	WB Off to US-17 NB
Analysis Time Period:	PM Peak	Segment ID	2010
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	4	3	2
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	4,126	1,977	2,149
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.99
Demand Flow Rate, v_p (pc/h/ln)	1,163	743	1,206
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.52	0.33	0.55
Density, D_{MD} (pc/mi/ln)	20.4	13.0	21.1
LOS	C	B	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$

HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$

HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$

HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	WB Off to Romney St
Analysis Time Period:	AM Peak	Segment ID	2020
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	1,443	1,223	220
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	4%	5%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.98	0.98
Demand Flow Rate, v_p (pc/h/ln)	545	693	251
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,100
v/c ratio	0.24	0.31	0.12
Density, D_{MD} (pc/mi/ln)	9.5	12.1	4.4
LOS	A	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	WB Off to Romney St
Analysis Time Period:	PM Peak	Segment ID	2020
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	3	2	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	1,977	1,833	144
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	6%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.97
Demand Flow Rate, v_p (pc/h/ln)	743	1,034	165
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,100
v/c ratio	0.33	0.46	0.08
Density, D_{MD} (pc/mi/ln)	13.0	18.1	2.9
LOS	B	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2025- Romney Off to US17 SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1223*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*4*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*693*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*12.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2025- Romney Off to US17 SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1833*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1034*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*18.8*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	WB On from US-17 SB
Analysis Time Period:	AM Peak	Segment ID	2030
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	1,223	2,411	1,188
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	4%	5%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.98	0.98
Demand Flow Rate, v_p (pc/h/ln)	693	911	1,353
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.31	0.40	0.62
Density, D_{MD} (pc/mi/ln)	12.1	15.9	23.7
LOS	B	B	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	WB On from US-17 SB
Analysis Time Period:	PM Peak	Segment ID	2030
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	2	3	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	1,833	3,024	1,191
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	4%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.98
Demand Flow Rate, v_p (pc/h/ln)	1,034	1,137	1,350
Capacity Flow Rate, c (pc/h/ln)	2,250	2,250	2,200
v/c ratio	0.46	0.51	0.61
Density, D_{MD} (pc/mi/ln)	18.1	19.9	23.6
LOS	B	B	C

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2040 - WB On from Meeting
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 600	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2411	
	Ramp Volume, V_R: 378	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2411	0.90	Level	4	0	0.980	1.00	2732
Ramp	378	0.90	Level	7	0	0.966	1.00	435
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 1624 pc/h

V_3 or V_{av34} 1108 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3167	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2059	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 17.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.298 (Exibit 13-11)

S_R= 51.1 mph (Exhibit 13-11)

S_0= 52.8 mph (Exhibit 13-11)

S = 51.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2040 - WB On from Meeting
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 600	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3024	
	Ramp Volume, V_R: 750	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3024	0.90	Level	3	0	0.985	1.00	3410
Ramp	750	0.90	Level	3	0	0.985	1.00	846
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 2027 pc/h

V_3 or V_{av34} 1383 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4256	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2873	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.336 (Exibit 13-11)

S_R= 50.6 mph (Exhibit 13-11)

S_0= 51.8 mph (Exhibit 13-11)

S = 51.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2050 - Meeting to Mt Pleasant*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2789*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1054*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*19.2*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2050 - Meeting to Mt Pleasant*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3774*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*4*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1426*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*25.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2060 - WB On from Mt Pleasant
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A	275	☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2789	V_D =	veh/h
		Ramp Volume, V_R	306		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2789	0.90	Level	4	0	0.980	1.00	3161
Ramp	306	0.90	Level	5	0	0.976	1.00	349
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.585 using Equation (Exhibit 13-6)

V_{12} = 1850 pc/h

V_3 or V_{av34} 1311 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3510	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2199	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 20.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.331 (Exibit 13-11)

S_R= 50.7 mph (Exhibit 13-11)

S_0= 52.1 mph (Exhibit 13-11)

S = 51.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2060 - WB On from Mt Pleasant
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 275	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3774	
	Ramp Volume, V_R: 730	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3774	0.90	Level	3	0	0.985	1.00	4256
Ramp	730	0.90	Level	2	0	0.990	1.00	819
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.585 using Equation (Exhibit 13-6)

V_{12} = 2491 pc/h

V_3 or V_{av34} 1765 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5075	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3310	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.403 (Exibit 13-11)

S_R= 49.8 mph (Exhibit 13-11)

S_0= 50.4 mph (Exhibit 13-11)

S = 50.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2070 - WB On from Heriot
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1165	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3095	
	Ramp Volume, V_R: 251	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3095	0.90	Level	5	0	0.976	1.00	3525
Ramp	251	0.90	Level	20	0	0.909	1.00	307
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.610 using Equation (Exhibit 13-6)

V_{12} = 2151 pc/h

V_3 or V_{av34} 1374 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3832	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2458	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 17.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.262 (Exibit 13-11)

S_R= 51.6 mph (Exhibit 13-11)

S_0= 51.9 mph (Exhibit 13-11)

S = 51.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2070 - WB On from Heriot
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1165	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4504	
	Ramp Volume, V_R: 420	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4504	0.90	Level	4	0	0.980	1.00	5105
Ramp	420	0.90	Level	10	0	0.952	1.00	490
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.610 using Equation (Exhibit 13-6)

V_{12} = 3115 pc/h

V_3 or V_{av34} 1990 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5595	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3605	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 26.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.360 (Exibit 13-11)

S_R= 50.3 mph (Exhibit 13-11)

S_0= 49.6 mph (Exhibit 13-11)

S = 50.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2080 - Heriot to PAR*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3346*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*5*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1270*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*21.2*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2080 - Heriot to PAR*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4924*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1860*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*58.8*	mph	S	mph
D = v_p / S	*31.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4938

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2090-WB Off to PAR
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	3346
Ramp Volume, V_R	238
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3346	0.90	Level	5	0	0.976	1.00	3811
Ramp	238	0.90	Level	18	0	0.917	1.00	288
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 0.651 using Equation (Exhibit 13-7)
V_{12} = 2583 pc/h
V_3 or V_{av34} 1228 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3811	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	3523	Exhibit 13-8	6900	No
V_R	288	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2583	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.4 (pc/mi/ln)
LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.324 (Exhibit 13-12)
S_R= 54.2 mph (Exhibit 13-12)
S_0= 64.9 mph (Exhibit 13-12)
S = 57.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2090-WB Off to PAR
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	340
Freeway Volume, V_F	4924
Ramp Volume, V_R	125
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4924	0.90	Level	4	0	0.980	1.00	5581
Ramp	125	0.90	Level	16	0	0.926	1.00	150
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 0.614 using Equation (Exhibit 13-7)
V_{12} = 3482 pc/h
V_3 or V_{av34} 2099 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5581	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	5431	Exhibit 13-8	6900	No
V_R	150	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3482	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.1 (pc/mi/ln)
LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.312 (Exhibit 13-12)
S_R= 54.4 mph (Exhibit 13-12)
S_0= 61.5 mph (Exhibit 13-12)
S = 56.9 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2100 - PAR Off to PAR On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3108*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1180*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.0*	mph	S	mph
D = v_p / S	*19.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2100 - PAR Off to PAR On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4799*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1813*	pc/h/ln	Design LOS		
S	*59.2*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
D = v_p / S	*30.6*	pc/mi/ln	S		mph
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4942

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	WB US-52 & PAR Off Ramp
Analysis Year	2018 Build - Proposed Site	Junction	US-52 & PAR WB Ramp Merge
Analysis Time Period:	AM Peak	Segment ID	2105
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	469	512	43
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	8%	19%	9%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.96	0.91	0.96
Demand Flow Rate, v_p (pc/h/ln)	542	623	50
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.25	0.28	0.02
Density, D_{MD} (pc/mi/ln)	9.5	10.9	0.9
LOS	A	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	3/20/2014	Freeway/Direction	WB US-52 & PAR Off Ramp
Analysis Year	2018 Build - Proposed Site	Junction	US-52 & PAR WB Ramp Merge
Analysis Time Period:	PM Peak	Segment ID	2105
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	167	262	95
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	19%	18%	17%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.91	0.92	0.92
Demand Flow Rate, v_p (pc/h/ln)	203	317	115
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.09	0.14	0.05
Density, D_{MD} (pc/mi/ln)	3.6	5.5	2.0
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2110 - WB On from US-52 & PAR
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 180	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3108	
	Ramp Volume, V_R: 512	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3108	0.90	Level	5	0	0.976	1.00	3540
Ramp	512	0.90	Level	9	0	0.957	1.00	594
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.583 using Equation (Exhibit 13-6)

V_{12} = 2062 pc/h

V_3 or V_{av34} 1478 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4134	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2656	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 24.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.360 (Exibit 13-11)

S_R= 53.5 mph (Exhibit 13-11)

S_0= 56.5 mph (Exhibit 13-11)

S = 54.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2110 - WB On from US-52 & PAR
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 180	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4799	
	Ramp Volume, V_R: 262	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4799	0.90	Level	4	0	0.980	1.00	5439
Ramp	262	0.90	Level	18	0	0.917	1.00	317
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.583 using Equation (Exhibit 13-6)

V_{12} = 3168 pc/h

V_3 or V_{av34} 2271 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5756	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3485	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 31.4 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.432 (Exibit 13-11)

S_R= 52.2 mph (Exhibit 13-11)

S_0= 53.6 mph (Exhibit 13-11)

S = 52.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2120 - US-52 to Cosgrove*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3620*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1361*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.0*	mph	S	mph
D = v_p / S	*22.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2120 - US-52 to Cosgrove*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5061*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1903*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*58.3*	mph	S	mph
D = v_p / S	*32.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2130-WB Off to Cosgrove NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	525	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3620	V_D =	veh/h
		Ramp Volume, V_R	378		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3620	0.90	Level	3	0	0.985	1.00	4083
Ramp	378	0.90	Level	10	0	0.952	1.00	441
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.638 using Equation (Exhibit 13-7)

V_{12} = 2763 pc/h

V_3 or V_{av34} 1320 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4083	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	3642	Exhibit 13-8	6900	No
V_R	441	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2763	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.338 (Exhibit 13-12)

S_R= 53.9 mph (Exhibit 13-12)

S_0= 64.6 mph (Exhibit 13-12)

S = 57.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2130-WB Off to Cosgrove NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	525	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	5061	V_D =	veh/h
		Ramp Volume, V_R	345		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5061	0.90	Level	3	0	0.985	1.00	5708
Ramp	345	0.90	Level	9	0	0.957	1.00	401
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.599 using Equation (Exhibit 13-7)

V_{12} = 3579 pc/h

V_3 or V_{av34} 2129 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5708	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	5307	Exhibit 13-8	6900	No
V_R	401	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3579	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.334 (Exhibit 13-12)

S_R= 54.0 mph (Exhibit 13-12)

S_0= 61.4 mph (Exhibit 13-12)

S = 56.5 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2135-Cosg NB Off to Cosg NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3242*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1225*	pc/h/ln	Design LOS	
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*20.4*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2135-Cosg NB Off to Cosg NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4716*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1773*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.5*	mph	S	mph
D = v_p / S	*29.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4952

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 WB
Weaving Segment Location	2140 - Cosgrove NB to Cos. SB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	560ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2889	0.90	4	0	1.5	1.2	0.980	1.00	3274
V_{RF}	864	0.90	19	0	1.5	1.2	0.913	1.00	1051
V_{FR}	353	0.90	22	0	1.5	1.2	0.901	1.00	435
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	3274							V =	4760
V_W	1486								
VR	0.312								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1486 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1661 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	208 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1869 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	183

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4760 pc/h	Weaving intensity factor, W	0.585
Weaving segment capacity, c_w	7475 veh/h	Weaving segment speed, S	43.5 mph
Weaving segment v/c ratio	0.624	Average weaving speed, S_W	43.4 mph
Weaving segment density, D	27.3 pc/mi/ln	Average non-weaving speed, S_{NW}	43.6 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5715 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 WB
Weaving Segment Location	2140 - Cosgrove NB to Cos. SB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	560ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3895	0.90	3	0	1.5	1.2	0.985	1.00	4393
V_{RF}	780	0.90	18	0	1.5	1.2	0.917	1.00	945
V_{FR}	821	0.90	8	0	1.5	1.2	0.962	1.00	949
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	4393							V =	6287
V_W	1894								
VR	0.301								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1894 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	2069 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	438 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2507 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	246

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6287 pc/h	Weaving intensity factor, W	0.737
Weaving segment capacity, c_w	7547 veh/h	Weaving segment speed, S	39.4 mph
Weaving segment v/c ratio	0.821	Average weaving speed, S_W	40.9 mph
Weaving segment density, D	39.9 pc/mi/ln	Average non-weaving speed, S_{NW}	38.8 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5597 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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F-4954

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2145-Cosg SB Off to Cosg SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3753*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*4*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1418*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.0*	mph	S	mph
D = v_p / S	*23.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2145-Cosg SB Off to Cosg SB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4675*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1757*	pc/h/ln
S	*59.6*	mph
D = v_p / S	*29.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2150 - WB On from Cosgrove SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☑ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☐ No ☑ Off
L_{up} = ft	Acceleration Lane Length, L_A: 425	L_{down} = 2390 ft
V_u = veh/h	Deceleration Lane Length L_D	V_D = 347 veh/h
	Freeway Volume, V_F: 3753	
	Ramp Volume, V_R: 157	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3753	0.90	Level	4	0	0.980	1.00	4253
Ramp	157	0.90	Level	21	0	0.905	1.00	193
UpStream								
DownStream	347	0.90	Level	19	0	0.913	1.00	422

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 2721.26 (Equation 13-6 or 13-7)

P_{FM} = 0.595 using Equation (Exhibit 13-6)

V_{12} = 2531 pc/h

V_3 or V_{av34} 1722 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4446	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2724	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 24.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.342 (Exibit 13-11)

S_R= 53.8 mph (Exhibit 13-11)

S_0= 55.6 mph (Exhibit 13-11)

S = 54.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2150 - WB On from Cosgrove SB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A	425	☐ No	☑ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	2390 ft
V_u =	veh/h	Freeway Volume, V_F	4675	V_D =	409 veh/h
		Ramp Volume, V_R	339		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4675	0.90	Level	3	0	0.985	1.00	5272
Ramp	339	0.90	Level	8	0	0.962	1.00	392
UpStream								
DownStream	409	0.90	Level	14	0	0.935	1.00	486

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 3133.97 (Equation 13-6 or 13-7)

P_{FM} = 0.602 using Equation (Exhibit 13-6)

V_{12} = 3174 pc/h

V_3 or V_{av34} 2098 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5664	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3566	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.4 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.421 (Exibit 13-11)

S_R= 52.4 mph (Exhibit 13-11)

S_0= 54.2 mph (Exhibit 13-11)

S = 53.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2160-WB Off to Dorchester
Date Performed	3/20/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 2390 ft

V_u = 157 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	425
Freeway Volume, V_F	3910
Ramp Volume, V_R	347
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3910	0.90	Level	4	0	0.980	1.00	4431
Ramp	347	0.90	Level	19	0	0.913	1.00	422
UpStream	157	0.90	Level	21	0	0.905	1.00	193
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 1370.34 (Equation 13-12 or 13-13)

P_{FD} = 0.630 using Equation (Exhibit 13-7)

V_{12} = 2947 pc/h

V_3 or V_{av34} 1484 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4431	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	4009	Exhibit 13-8	6900	No
V_R	422	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2947	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.336 (Exhibit 13-12)

S_R= 54.0 mph (Exhibit 13-12)

S_0= 63.9 mph (Exhibit 13-12)

S = 56.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2160-WB Off to Dorchester
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 2390 ft

V_u = 339 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	425
Freeway Volume, V_F	5014
Ramp Volume, V_R	409
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5014	0.90	Level	3	0	0.985	1.00	5655
Ramp	409	0.90	Level	14	0	0.935	1.00	486
UpStream	339	0.90	Level	8	0	0.962	1.00	392
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = 2388.37 (Equation 13-12 or 13-13)

P_{FD} = 0.596 using Equation (Exhibit 13-7)

V_{12} = 3568 pc/h

V_3 or V_{av34} 2087 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5655	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	5169	Exhibit 13-8	6900	No
V_R	486	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3568	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.342 (Exhibit 13-12)

S_R= 53.8 mph (Exhibit 13-12)

S_0= 61.6 mph (Exhibit 13-12)

S = 56.5 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2165-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3563*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1346*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*22.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2165-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4605*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1731*	pc/h/ln
S	*59.7*	mph
D = v_p / S	*29.0*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2170 - WB On from Dorchester
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 600	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3563	
	Ramp Volume, V_R: 248	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3563	0.90	Level	4	0	0.980	1.00	4038
Ramp	248	0.90	Level	25	0	0.889	1.00	310
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 2400 pc/h

V_3 or V_{av34} 1638 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4348	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2710	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.326 (Exibit 13-11)

S_R= 54.1 mph (Exhibit 13-11)

S_0= 55.9 mph (Exhibit 13-11)

S = 54.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2170 - WB On from Dorchester
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 600	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 4605	
	Ramp Volume, V_R: 581	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4605	0.90	Level	3	0	0.985	1.00	5193
Ramp	581	0.90	Level	9	0	0.957	1.00	675
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 3086 pc/h

V_3 or V_{av34} 2107 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5868	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3761	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.435 (Exibit 13-11)

S_R= 52.2 mph (Exhibit 13-11)

S_0= 54.2 mph (Exhibit 13-11)

S = 52.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2180 - Dorchester to Montague*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3811*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1433*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*23.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2180 - Dorchester to Montague*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5186*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1950*	pc/h/ln
S	*57.8*	mph
D = v_p / S	*33.8*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2190-WB Off to Montague
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	240	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3811	V_D =	veh/h
		Ramp Volume, V_R	1004		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3811	0.90	Level	3	0	0.985	1.00	4298
Ramp	1004	0.90	Level	10	0	0.952	1.00	1171
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.599 using Equation (Exhibit 13-7)

V_{12} = 3043 pc/h

V_3 or V_{av34} 1255 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4298	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	3127	Exhibit 13-8	6900	No
V_R	1171	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3043	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 28.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.403 (Exhibit 13-12)

S_R= 52.7 mph (Exhibit 13-12)

S_0= 64.8 mph (Exhibit 13-12)

S = 55.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2190-WB Off to Montague
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	240
Freeway Volume, V_F	5186
Ramp Volume, V_R	1017
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5186	0.90	Level	3	0	0.985	1.00	5849
Ramp	1017	0.90	Level	8	0	0.962	1.00	1175
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.560 using Equation (Exhibit 13-7)

V_{12} = 3791 pc/h

V_3 or V_{av34} 2058 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5849	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	4674	Exhibit 13-8	6900	No
V_R	1175	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3791	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.404 (Exhibit 13-12)

S_R= 52.7 mph (Exhibit 13-12)

S_0= 61.7 mph (Exhibit 13-12)

S = 55.6 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2195-Montagu Off to Montagu On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2807*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*4*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1060*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*17.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2195-Montagu Off to Montagu On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4169*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*3*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*	
			Up/Down %		

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1567*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*26.1*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 WB
Weaving Segment Location	2200 - Montague to I-526 EB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1920ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2379	0.90	4	0	1.5	1.2	0.980	1.00	2696
V_{RF}	344	0.90	22	0	1.5	1.2	0.901	1.00	424
V_{FR}	428	0.90	9	0	1.5	1.2	0.957	1.00	497
V_{RR}	62	0.90	22	0	1.5	1.2	0.901	1.00	76
V_{NW}	2772							V =	3693
V_W	921								
VR	0.249								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	921 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1323 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	841 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2164 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	426

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3693 pc/h	Weaving intensity factor, W	0.248
Weaving segment capacity, c_w	8082 veh/h	Weaving segment speed, S	49.4 mph
Weaving segment v/c ratio	0.448	Average weaving speed, S_W	51.0 mph
Weaving segment density, D	18.7 pc/mi/ln	Average non-weaving speed, S_{NW}	48.9 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	5047 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 WB
Weaving Segment Location	2200 - Montague to I-526 EB
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1920ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3821	0.90	3	0	1.5	1.2	0.985	1.00	4309
V_{RF}	1028	0.90	7	0	1.5	1.2	0.966	1.00	1182
V_{FR}	348	0.90	8	0	1.5	1.2	0.962	1.00	402
V_{RR}	93	0.90	8	0	1.5	1.2	0.962	1.00	107
V_{NW}	4416							V =	6000
V_W	1584								
VR	0.264								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1584 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1986 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1180 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3166 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	678

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6000 pc/h	Weaving intensity factor, W	0.335
Weaving segment capacity, c_w	8075 veh/h	Weaving segment speed, S	43.1 mph
Weaving segment v/c ratio	0.732	Average weaving speed, S_W	48.7 mph
Weaving segment density, D	34.8 pc/mi/ln	Average non-weaving speed, S_{NW}	41.4 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	5201 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2210-WB Off to I-526 WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	830	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2723	V_D =	veh/h
		Ramp Volume, V_R	275		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2723	0.90	Level	13	0	0.939	1.00	3222
Ramp	275	0.90	Level	7	0	0.966	1.00	316
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.665 using Equation (Exhibit 13-7)

V_{12} = 2248 pc/h

V_3 or V_{av34} 974 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3222	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	2906	Exhibit 13-8	6900	No
V_R	316	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2248	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 16.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.586 (Exhibit 13-12)

S_R= 49.4 mph (Exhibit 13-12)

S_0= 65.8 mph (Exhibit 13-12)

S = 53.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-26 WB
Agency or Company	Atkins	Junction	2210-WB Off to I-526 WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	830	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	4849	V_D =	veh/h
		Ramp Volume, V_R	338		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4849	0.90	Level	10	0	0.952	1.00	5657
Ramp	338	0.90	Level	5	0	0.976	1.00	385
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.601 using Equation (Exhibit 13-7)

V_{12} = 3553 pc/h

V_3 or V_{av34} 2104 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	5657	Exhibit 13-8	6900	No
$V_{FO} = V_F - V_R$	5272	Exhibit 13-8	6900	No
V_R	385	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3553	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.593 (Exhibit 13-12)

S_R= 49.3 mph (Exhibit 13-12)

S_0= 61.5 mph (Exhibit 13-12)

S = 53.3 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2215- I-526 WB Off to EB&WB On*
Date Performed	*4/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2448*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*13*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*966*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.0*	mph	S	mph
D = v_p / S	*16.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-4975

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2215- I-526 WB Off to EB&WB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4511*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1754*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*59.6*	mph	S	mph
D = v_p / S	*29.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	On from 526 WB & EB
Analysis Time Period:	AM Peak	Segment ID	2218
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	1,800	3,133	1,333
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	13%	30%	54%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.94	0.87	0.79
Demand Flow Rate, v_p (pc/h/ln)	2,130	2,002	1,881
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	0.97	0.91	0.86
Density, D_{MD} (pc/mi/ln)	37.3	35.0	32.9
LOS	E	D	D

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	On from 526 WB & EB
Analysis Time Period:	PM Peak	Segment ID	2218
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	2	1
Free-Flow Speed, FFS (mph)	55	55	55
Volume, V (veh/h)	2,082	3,687	1,605
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	10%	22%	39%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.95	0.90	0.84
Demand Flow Rate, v_p (pc/h/ln)	2,429	2,274	2,131
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,200
v/c ratio	1.10	1.03	0.97
Density, D_{MD} (pc/mi/ln)	42.5	39.8	37.3
LOS	F	F	E

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 WB
Weaving Segment Location	2220 - 526 to Rem/Aviation C-D
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	5	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	2285ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1906	0.90	13	0	1.5	1.2	0.939	1.00	2255
V_{RF}	2440	0.90	30	0	1.5	1.2	0.870	1.00	3118
V_{FR}	542	0.90	13	0	1.5	1.2	0.939	1.00	641
V_{RR}	693	0.90	30	0	1.5	1.2	0.870	1.00	886
V_{NW}	3141							V =	6900
V_W	3759								
VR	0.545								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	0 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	484

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6900 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	6032 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.074	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	6789 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 WB
Weaving Segment Location	2220 - 526 to Rem/Aviation C-D
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	5	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	2285ft	Freeway maximum capacity, C_{IFL}	2300
Freeway free-flow speed, FFS	60 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3999	0.90	10	0	1.5	1.2	0.952	1.00	4666
V_{RF}	3269	0.90	22	0	1.5	1.2	0.901	1.00	4032
V_{FR}	512	0.90	10	0	1.5	1.2	0.952	1.00	597
V_{RR}	418	0.90	22	0	1.5	1.2	0.901	1.00	516
V_{NW}	5182							V =	9811
V_W	4629								
VR	0.472								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	0 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	9811 pc/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	7065 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.323	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	5933 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2225- Rem/Avia CD Off to CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4346*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1298*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*60.0*	mph	S	mph
D = v_p / S	*21.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB*
Agency or Company	*Atkins*	From/To	*2225- Rem/Avia CD Off to CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*7268*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2140*	pc/h/ln
S	*54.7*	mph
D = v_p / S	*39.1*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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F-4982

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB Off to Remount
Analysis Time Period:	AM Peak	Segment ID	2230
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	1,235	765	470
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.99
Demand Flow Rate, v_p (pc/h/ln)	696	863	527
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.32	0.39	0.25
Density, D_{MD} (pc/mi/ln)	12.2	15.1	9.2
LOS	B	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB Off to Remount
Analysis Time Period:	PM Peak	Segment ID	2230
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	2	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	930	499	431
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	4%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.98	0.99
Demand Flow Rate, v_p (pc/h/ln)	524	566	484
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.24	0.26	0.23
Density, D_{MD} (pc/mi/ln)	9.2	9.9	8.5
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB C-D*
Agency or Company	*Atkins*	From/To	*2235-Remount Off to Remount On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1530*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*3*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.985*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*863*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*15.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB C-D*
Agency or Company	*Atkins*	From/To	*2235-Remount Off to Remount On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*998*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*566*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*10.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-26 WB C-D
Weaving Segment Location	2240 - Remount to Aviation
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	750ft
Freeway free-flow speed, FFS	55 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{RF}	250	0.90	18	0	1.5	1.2	0.917	1.00	303
V_{FR}	765	0.90	3	0	1.5	1.2	0.985	1.00	863
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	0							V =	1166
V_W	1166								
VR	1.000								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1166 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1219 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	21 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1240 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1166 pc/h	Weaving intensity factor, W	0.336
Weaving segment capacity, c_w	2400 veh/h	Weaving segment speed, S	44.9 mph
Weaving segment v/c ratio	0.486	Average weaving speed, S_W	44.9 mph
Weaving segment density, D	13.0 pc/mi/ln	Average non-weaving speed, S_{NW}	43.8 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	14232 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-26 WB C-D
Weaving Segment Location	2240 - Remount to Aviation
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	750ft
Freeway free-flow speed, FFS	55 mph
Segment type	C-D Roadway/ Multilane Highways
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{RF}	910	0.90	4	0	1.5	1.2	0.980	1.00	1031
V_{FR}	499	0.90	4	0	1.5	1.2	0.980	1.00	566
V_{RR}	0	0.90	0	0	1.5	1.2	1.000	1.00	0
V_{NW}	0							V =	1597
V_W	1597								
VR	1.000								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1597 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1650 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	21 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1671 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	0

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1597 pc/h	Weaving intensity factor, W	0.425
Weaving segment capacity, c_w	2400 veh/h	Weaving segment speed, S	43.1 mph
Weaving segment v/c ratio	0.665	Average weaving speed, S_W	43.1 mph
Weaving segment density, D	18.5 pc/mi/ln	Average non-weaving speed, S_{NW}	39.7 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	14232 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB C-D*
Agency or Company	*Atkins*	From/To	*2245 - Avia Off to Avia EB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*250*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*18*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*151*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*2.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-26 WB C-D*
Agency or Company	*Atkins*	From/To	*2245 - Avia Off to Avia EB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1820*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*4*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.980*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1031*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*18.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB On from Aviation EB
Analysis Time Period:	AM Peak	Segment ID	2250
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	25
Volume, V (veh/h)	250	270	20
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	18%	18%	25%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.92	0.92	0.89
Demand Flow Rate, v_p (pc/h/ln)	303	327	25
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	1,900
v/c ratio	0.14	0.15	0.01
Density, D_{MD} (pc/mi/ln)	5.3	5.7	0.4
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB On from Aviation EB
Analysis Time Period:	PM Peak	Segment ID	2250
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	25
Volume, V (veh/h)	910	1,294	384
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	4%	3%	2%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.98	0.99	0.99
Demand Flow Rate, v_p (pc/h/ln)	1,031	1,459	431
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	1,900
v/c ratio	0.47	0.66	0.23
Density, D_{MD} (pc/mi/ln)	18.0	25.5	7.5
LOS	B	C	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB On from Aviation WB
Analysis Time Period:	AM Peak	Segment ID	2260
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	270	365	95
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	18%	19%	20%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.92	0.91	0.91
Demand Flow Rate, v_p (pc/h/ln)	327	444	116
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.15	0.20	0.06
Density, D_{MD} (pc/mi/ln)	5.7	7.8	2.0
LOS	A	A	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

RAMP ADD OR DROP LANE ANALYSIS (MAINLINE <55 MPH)

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB C-D
Analysis Year	2018 Build - Proposed Site	Junction	WB On from Aviation WB
Analysis Time Period:	PM Peak	Segment ID	2260
Project Description:	Navy Base ICTF		

Inputs

	Mainline Upstream Ramp	Mainline Downstream Ramp	Ramp
Number of Lanes, N	1	1	1
Free-Flow Speed, FFS (mph)	55	55	45
Volume, V (veh/h)	1,294	1,779	485
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	3%	3%	3%
%RVs, P_R	0%	0%	0%

Performance Measures

	Upstream of Off-Ramp	Downstream of Off-Ramp	Off-Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.99	0.99	0.99
Demand Flow Rate, v_p (pc/h/ln)	1,459	2,006	547
Capacity Flow Rate, c (pc/h/ln)	2,200	2,200	2,100
v/c ratio	0.66	0.91	0.26
Density, D_{MD} (pc/mi/ln)	25.5	35.1	9.6
LOS	C	E	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	From Rem/Aviation C-D
Analysis Time Period:	AM Peak	Segment ID	2270
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	4	5	1
Free-Flow Speed, FFS (mph)	60	60	55
Volume, V (veh/h)	4,346	4,711	365
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	15%	15%	19%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.93	0.93	0.91
Demand Flow Rate, v_p (pc/h/ln)	1,298	1,125	444
Capacity Flow Rate, c (pc/h/ln)	2,300	2,300	2,200
v/c ratio	0.56	0.49	0.20
Density, D_{MD} (pc/mi/ln)	22.7	19.7	7.8
LOS	C	B	A

Formulas and Reference Material

$$f_{HV} = \frac{1}{1+P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

FREEWAY RAMP ADD OR DROP LANE ANALYSIS

ATKINS

General Information

Date Performed:	7/25/2014	Freeway/Direction	I-26 WB
Analysis Year	2018 Build - Proposed Site	Junction	From Rem/Aviation C-D
Analysis Time Period:	PM Peak	Segment ID	2270
Project Description:	Navy Base ICTF		

Inputs

	Freeway Upstream of Ramp	Freeway Downstream of Ramp	Ramp
Number of Lanes, N	4	5	1
Free-Flow Speed, FFS (mph)	60	60	55
Volume, V (veh/h)	7,268	9,047	1,779
Driver Population, f_P	1	1	1
General Terrain	Level	Level	Level
Peak Hour Factor, PHF	0.90	0.90	0.90
%Trucks and Buses, P_T	12%	11%	3%
%RVs, P_R	0%	0%	0%

Performance Measures

	Freeway Upstream Ramp	Freeway Downstream Ramp	Ramp
Heavy Vehicle Adjustment Factor, f_{HV}	0.94	0.95	0.99
Demand Flow Rate, v_p (pc/h/ln)	2,140	2,121	2,006
Capacity Flow Rate, c (pc/h/ln)	2,300	2,300	2,200
v/c ratio	0.93	0.92	0.91
Density, D_{MD} (pc/mi/ln)	37.5	37.1	35.1
LOS	E	E	E

Formulas and Reference Material

$$f_{HV} = \frac{1}{1 + P_T(E_T-1)+P_R(E_R-1)}$$ HCM 2010, Equation 11-3

$$V_p = \frac{V}{PHF*N*f_{HV}*f_P}$$ HCM 2010, Equation 11-2

$$D_{MD} = \frac{0.0175*v_f}{N}$$ HCM 2010, Equation 13-26

Basic Freeway Segments Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
75	2,400
70	2,400
65	2,350
60	2,300
55	2,250

Source: HCM 2010, Exhibit 11-17

Ramp Roadways Max Service Flow Rates

FFS (mi/h)	Capacity (pc/h/ln)
> 50	2,200
>40-50	2,100
>30-40	2,000
≥20-30	1,900
<20	1,800

Source: HCM 2010, Exhibit 13-10

Diverge LOS Thresholds

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	v/c > 1

Source: HCM 2010, Exhibit 13-2

Appendix E

Traffic Analysis Worksheets

2018 Opening Year

Build Proposed Project Alternatives 1 - 4

Interstate 526

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3010-EB Off to PaulCantrell EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	340	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2665	V_D =	veh/h
		Ramp Volume, V_R	28		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2665	0.90	Level	3	0	0.985	1.00	3006
Ramp	28	0.90	Level	36	0	0.847	1.00	37
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3006 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3006	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2969	Exhibit 13-8	4600	No
V_R	37	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3006	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.301 (Exhibit 13-12)

S_R= 54.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3010-EB Off to PaulCantrell EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	340	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2549	V_D =	veh/h
		Ramp Volume, V_R	55		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2549	0.90	Level	3	0	0.985	1.00	2875
Ramp	55	0.90	Level	15	0	0.930	1.00	66
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2875 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2875	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2809	Exhibit 13-8	4600	No
V_R	66	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2875	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.9 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.304 (Exhibit 13-12)

S_R= 54.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3020-EB Off to PaulCantrell WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	600	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2637	V_D =	veh/h
		Ramp Volume, V_R	174		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2637	0.90	Level	10	0	0.952	1.00	3077
Ramp	174	0.90	Level	8	0	0.962	1.00	201
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3077 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3077	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2876	Exhibit 13-8	4600	No
V_R	201	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3077	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 25.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.576 (Exhibit 13-12)

S_R= 49.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 49.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3020-EB Off to PaulCantrell WB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	600	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	2494	V_D =	veh/h
		Ramp Volume, V_R	574		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2494	0.90	Level	9	0	0.957	1.00	2896
Ramp	574	0.90	Level	2	0	0.990	1.00	644
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2896 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2896	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	2252	Exhibit 13-8	4600	No
V_R	644	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2896	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.616 (Exhibit 13-12)

S_R= 48.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.9 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3025- PaulC WB Off to PaulC On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2463*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1437*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*24.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3025- PaulC WB Off to PaulC On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1920*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1115*	pc/h/ln	Design LOS	
S	*60.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*18.6*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-5003

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3030-EB On from Paul Cantrell
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 850	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2463	
	Ramp Volume, V_R: 1635	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2463	0.90	Level	10	0	0.952	1.00	2874
Ramp	1635	0.90	Level	19	0	0.913	1.00	1989
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2874 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4863	Exhibit 13-8		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4863	Exhibit 13-8	4600:All	Yes

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 37.2 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

M_S = 0.749 (Exibit 13-11)

S_R= 46.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 46.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3030-EB On from Paul Cantrell
Date Performed	4/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 850	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1920	
	Ramp Volume, V_R: 1432	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1920	0.90	Level	9	0	0.957	1.00	2229
Ramp	1432	0.90	Level	18	0	0.917	1.00	1734
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2229 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3963	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3963	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.450 (Exibit 13-11)

S_R= 51.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 51.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3040 - Paul Cantrell to Leeds*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4098*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2391*	pc/h/ln
S	*48.6*	mph
D = v_p / S	*49.2*	pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3040 - Paul Cantrell to Leeds*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3352*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1946*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*57.8*	mph	S	mph
D = v_p / S	*33.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*D*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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F-5007

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3050-EB Off to Leeds
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	325	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	4098	V_D =	veh/h
		Ramp Volume, V_R	667		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4098	0.90	Level	10	0	0.952	1.00	4781
Ramp	667	0.90	Level	8	0	0.962	1.00	771
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4781 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4781	Exhibit 13-8	4600	Yes
$V_{FO} = V_F - V_R$	4010	Exhibit 13-8	4600	No
V_R	771	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4781	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 42.4 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.367 (Exhibit 13-12)

S_R= 53.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3050-EB Off to Leeds
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	325
Freeway Volume, V_F	3352
Ramp Volume, V_R	315
Freeway Free-Flow Speed, S_{FF}	60.0
Ramp Free-Flow Speed, S_{FR}	45.0

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3352	0.90	Level	9	0	0.957	1.00	3892
Ramp	315	0.90	Level	15	0	0.930	1.00	376
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 3892 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3892	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3516	Exhibit 13-8	4600	No
V_R	376	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3892	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 34.8 (pc/mi/ln)
LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.332 (Exhibit 13-12)
S_R= 54.0 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 54.0 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3055 - Leeds Off to Leeds On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3431*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2001*	pc/h/ln
S	*57.1*	mph
D = v_p / S	*35.1*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3055 - Leeds Off to Leeds On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3037*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1763*	pc/h/ln
S	*59.5*	mph
D = v_p / S	*29.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3060 - Leeds to Dorchester
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2020ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3130	0.90	9	0	1.5	1.2	0.957	1.00	3634
V_{RF}	238	0.90	9	0	1.5	1.2	0.957	1.00	276
V_{FR}	301	0.90	12	0	1.5	1.2	0.943	1.00	355
V_{RR}	23	0.90	12	0	1.5	1.2	0.943	1.00	27
V_{NW}	3661							V =	4292
V_W	631								
VR	0.147								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	631 lc/h
Weaving lane changes, LC_W	884 lc/h
Non-weaving lane changes, LC_{NW}	1271 lc/h
Total lane changes, LC_{ALL}	2155 lc/h
Non-weaving vehicle index, I_{NW}	740

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4292 pc/h
Weaving segment capacity, c_w	6167 veh/h
Weaving segment v/c ratio	0.666
Weaving segment density, D	29.2 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.238
Weaving segment speed, S	49.0 mph
Average weaving speed, S_W	51.4 mph
Average non-weaving speed, S_{NW}	48.6 mph
Maximum weaving length, L_{MAX}	4002 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3060 - Leeds to Dorchester
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2020ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2682	0.90	7	0	1.5	1.2	0.966	1.00	3084
V_{RF}	833	0.90	7	0	1.5	1.2	0.966	1.00	958
V_{FR}	355	0.90	7	0	1.5	1.2	0.966	1.00	408
V_{RR}	111	0.90	7	0	1.5	1.2	0.966	1.00	128
V_{NW}	3212							V =	4578
V_W	1366								
VR	0.298								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1366 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1619 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1179 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2798 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	649

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4578 pc/h	Weaving intensity factor, W	0.292
Weaving segment capacity, c_w	5881 veh/h	Weaving segment speed, S	44.7 mph
Weaving segment v/c ratio	0.752	Average weaving speed, S_W	49.8 mph
Weaving segment density, D	34.1 pc/mi/ln	Average non-weaving speed, S_{NW}	42.8 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	5567 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3065-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3368*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1955*	pc/h/ln
S	*57.7*	mph
D = v_p / S	*33.9*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3065-Dorches Off to Dorches On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3515*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2031*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*56.6*	mph	S	mph
D = v_p / S	*35.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3070 - Dorchester to Montague
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1515ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2713	0.90	9	0	1.5	1.2	0.957	1.00	3150
V_{RF}	524	0.90	20	0	1.5	1.2	0.909	1.00	640
V_{FR}	655	0.90	10	0	1.5	1.2	0.952	1.00	764
V_{RR}	127	0.90	20	0	1.5	1.2	0.909	1.00	155
V_{NW}	3305							V =	4709
V_W	1404								
VR	0.298								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1404 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	1600 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	924 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2524 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	401

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4709 pc/h	Weaving intensity factor, W	0.338
Weaving segment capacity, c_w	5713 veh/h	Weaving segment speed, S	44.1 mph
Weaving segment v/c ratio	0.789	Average weaving speed, S_W	48.6 mph
Weaving segment density, D	35.6 pc/mi/ln	Average non-weaving speed, S_{NW}	42.4 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5564 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3070 - Dorchester to Montague
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1515ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2672	0.90	8	0	1.5	1.2	0.962	1.00	3088
V_{RF}	746	0.90	11	0	1.5	1.2	0.948	1.00	874
V_{FR}	843	0.90	8	0	1.5	1.2	0.962	1.00	974
V_{RR}	236	0.90	11	0	1.5	1.2	0.948	1.00	277
V_{NW}	3365							V =	5213
V_W	1848								
VR	0.354								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1848 lc/h
Interchange density, ID	0.8 int/mi	Weaving lane changes, LC_W	2044 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	937 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2981 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	408

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5213 pc/h	Weaving intensity factor, W	0.386
Weaving segment capacity, c_w	5605 veh/h	Weaving segment speed, S	41.2 mph
Weaving segment v/c ratio	0.894	Average weaving speed, S_W	47.5 mph
Weaving segment density, D	42.2 pc/mi/ln	Average non-weaving speed, S_{NW}	38.4 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6176 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3080-Montague to International*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3237*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1879*	pc/h/ln
S	*58.6*	mph
D = v_p / S	*32.1*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3080-Montague to International*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3418*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1984*	pc/h/ln
S	*57.3*	mph
D = v_p / S	*34.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3090-EB Off to InternationalWB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 700	V_D = veh/h
	Freeway Volume, V_F: 3237	
	Ramp Volume, V_R: 587	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3237	0.90	Level	9	0	0.957	1.00	3759
Ramp	587	0.90	Level	8	0	0.962	1.00	678
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3759 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3759	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3081	Exhibit 13-8	4600	No
V_R	678	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3759	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.619 (Exhibit 13-12)

S_R= 48.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3090-EB Off to InternationalWB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 700	V_D = veh/h
	Freeway Volume, V_F: 3418	
	Ramp Volume, V_R: 602	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3418	0.90	Level	9	0	0.957	1.00	3969
Ramp	602	0.90	Level	7	0	0.966	1.00	692
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3969 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3969	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3277	Exhibit 13-8	4600	No
V_R	692	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3969	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.620 (Exhibit 13-12)

S_R= 48.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.8 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3095- Inter WB Off to Inter On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2650*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1546*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*25.8*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3095- Inter WB Off to Inter On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2816*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1635*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*27.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3100 - International to I-26
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2025ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1227	0.90	10	0	1.5	1.2	0.952	1.00	1432
V_{RF}	584	0.90	10	0	1.5	1.2	0.952	1.00	681
V_{FR}	1423	0.90	11	0	1.5	1.2	0.948	1.00	1668
V_{RR}	676	0.90	11	0	1.5	1.2	0.948	1.00	792
V_{NW}	2224							V =	4573
V_W	2349								
VR	0.514								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	681 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	935 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	978 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1913 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	450

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4573 pc/h	Weaving intensity factor, W	0.216
Weaving segment capacity, c_w	5469 veh/h	Weaving segment speed, S	45.3 mph
Weaving segment v/c ratio	0.796	Average weaving speed, S_W	47.9 mph
Weaving segment density, D	33.7 pc/mi/ln	Average non-weaving speed, S_{NW}	42.8 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	6421 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3100 - International to I-26
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2025ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1360	0.90	9	0	1.5	1.2	0.957	1.00	1579
V_{RF}	907	0.90	9	0	1.5	1.2	0.957	1.00	1053
V_{FR}	1456	0.90	9	0	1.5	1.2	0.957	1.00	1691
V_{RR}	970	0.90	9	0	1.5	1.2	0.957	1.00	1126
V_{NW}	2705							V =	5449
V_W	2744								
VR	0.504								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	1053 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1307 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1077 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	2384 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	548

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5449 pc/h	Weaving intensity factor, W	0.257
Weaving segment capacity, c_w	5521 veh/h	Weaving segment speed, S	42.4 mph
Weaving segment v/c ratio	0.944	Average weaving speed, S_W	46.8 mph
Weaving segment density, D	42.8 pc/mi/ln	Average non-weaving speed, S_{NW}	38.7 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6302 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3105-I-26 Off to I-26 EB CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1811*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*17*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.922*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1092*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*19.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3105-I-26 Off to I-26 EB CD On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2267*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1354*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*24.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3110-EB On from I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 625	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1811	
	Ramp Volume, V_R: 1355	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1811	0.90	Level	17	0	0.922	1.00	2183
Ramp	1355	0.90	Level	53	0	0.791	1.00	1905
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2183 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4088	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4088	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 32.6 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.522 (Exibit 13-11)

S_R= 48.2 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 48.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3110-EB On from I-26 EB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 625	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2267	
	Ramp Volume, V_R: 1108	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 25.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2267	0.90	Level	15	0	0.930	1.00	2708
Ramp	1108	0.90	Level	56	0	0.781	1.00	1576
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2708 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4284	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4284	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 34.2 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.573 (Exibit 13-11)

S_R= 47.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 47.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3120 - I-26 WB to Rivers Ave
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1615ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2956	0.90	17	0	1.5	1.2	0.922	1.00	3564
V_{RF}	458	0.90	17	0	1.5	1.2	0.922	1.00	552
V_{FR}	210	0.90	18	0	1.5	1.2	0.917	1.00	254
V_{RR}	32	0.90	18	0	1.5	1.2	0.917	1.00	39
V_{NW}	3603							V =	4409
V_W	806								
VR	0.183								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	806 lc/h
Interchange density, ID	1.2 int/mi	Weaving lane changes, LC_W	1045 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1040 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2085 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	698

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4409 pc/h	Weaving intensity factor, W	0.276
Weaving segment capacity, c_w	5641 veh/h	Weaving segment speed, S	42.9 mph
Weaving segment v/c ratio	0.720	Average weaving speed, S_W	46.3 mph
Weaving segment density, D	34.3 pc/mi/ln	Average non-weaving speed, S_{NW}	42.1 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	4361 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3120 - I-26 WB to Rivers Ave
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	1615ft	Freeway maximum capacity, C_{IFL}	2250
Freeway free-flow speed, FFS	55 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3043	0.90	15	0	1.5	1.2	0.930	1.00	3635
V_{RF}	398	0.90	15	0	1.5	1.2	0.930	1.00	475
V_{FR}	332	0.90	15	0	1.5	1.2	0.930	1.00	397
V_{RR}	43	0.90	10	0	1.5	1.2	0.952	1.00	50
V_{NW}	3685							V =	4557
V_W	872								
VR	0.191								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	872 lc/h
Interchange density, ID	1.2 int/mi	Weaving lane changes, LC_W	1111 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1057 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2168 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	714

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4557 pc/h	Weaving intensity factor, W	0.285
Weaving segment capacity, c_w	5673 veh/h	Weaving segment speed, S	42.3 mph
Weaving segment v/c ratio	0.747	Average weaving speed, S_W	46.1 mph
Weaving segment density, D	35.9 pc/mi/ln	Average non-weaving speed, S_{NW}	41.4 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	4448 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3130-EB Off to Rivers NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	800	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3414	V_D =	veh/h
		Ramp Volume, V_R	161		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3414	0.90	Level	17	0	0.922	1.00	4116
Ramp	161	0.90	Level	18	0	0.917	1.00	195
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4116 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4116	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	3921	Exhibit 13-8	4500	No
V_R	195	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4116	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.4 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.576 (Exhibit 13-12)

S_R= 47.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 47.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3130-EB Off to Rivers NB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	800	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3441	V_D =	veh/h
		Ramp Volume, V_R	332		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3441	0.90	Level	15	0	0.930	1.00	4110
Ramp	332	0.90	Level	9	0	0.957	1.00	385
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4110 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4110	Exhibit 13-8	4500	No
$V_{FO} = V_F - V_R$	3725	Exhibit 13-8	4500	No
V_R	385	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4110	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 32.4 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.593 (Exhibit 13-12)

S_R= 47.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 47.3 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3135-RiversNB Off to Rivers On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3253*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*17*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.922*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1961*	pc/h/ln
S	*54.4*	mph
D = v_p / S	*36.1*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3135-RiversNB Off to Rivers On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3109*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1857*	pc/h/ln
S	*54.9*	mph
D = v_p / S	*33.8*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3140-EB On from Rivers
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☑ No ☐ Off		☑ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h		V_D = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	825
Deceleration Lane Length L_D	
Freeway Volume, V_F	3253
Ramp Volume, V_R	511
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	45.0

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3253	0.90	Level	17	0	0.922	1.00	3922
Ramp	511	0.90	Level	2	0	0.990	1.00	573
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3922 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4495	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4495	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 35.1 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

M_S = 0.596 (Exibit 13-11)

S_R= 47.3 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 47.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3140-EB On from Rivers
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 825	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 3109	
	Ramp Volume, V_R: 461	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3109	0.90	Level	15	0	0.930	1.00	3714
Ramp	461	0.90	Level	2	0	0.990	1.00	517
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3714 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4231	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4231	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 33.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.515 (Exibit 13-11)

S_R= 48.3 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 48.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3150-Rivers to Rhett*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3764*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*15*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2248*	pc/h/ln	Design LOS	
S	*52.4*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*42.9*	pc/mi/ln	S	mph
LOS	*E*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3150-Rivers to Rhett*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3570*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*14*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2122*	pc/h/ln
S	*55.1*	mph
D = v_p / S	*38.5*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3160-EB Off to Rhett
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	225	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3764	V_D =	veh/h
		Ramp Volume, V_R	466		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3764	0.90	Level	15	0	0.930	1.00	4496
Ramp	466	0.90	Level	7	0	0.966	1.00	536
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4496 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4496	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3960	Exhibit 13-8	4600	No
V_R	536	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4496	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 40.9 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.346 (Exhibit 13-12)

S_R= 53.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3160-EB Off to Rhett
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 225	V_D = veh/h
	Freeway Volume, V_F: 3570	
	Ramp Volume, V_R: 683	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3570	0.90	Level	14	0	0.935	1.00	4244
Ramp	683	0.90	Level	4	0	0.980	1.00	774
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4244 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4244	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3470	Exhibit 13-8	4600	No
V_R	774	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4244	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 38.7 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.368 (Exhibit 13-12)

S_R= 53.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.4 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3165 - Rhett Off to Rhett On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3298*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*15*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.930*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1970*	pc/h/ln
S	*57.5*	mph
D = v_p / S	*34.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3165 - Rhett Off to Rhett On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2887*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1716*	pc/h/ln
S	*59.8*	mph
D = v_p / S	*28.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3170 - Rhett to Virginia
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1090ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2832	0.90	13	0	1.5	1.2	0.939	1.00	3351
V_{RF}	1135	0.90	13	0	1.5	1.2	0.939	1.00	1343
V_{FR}	466	0.90	13	0	1.5	1.2	0.939	1.00	551
V_{RR}	187	0.90	11	0	1.5	1.2	0.948	1.00	219
V_{NW}	3570							V =	5464
V_W	1894								
VR	0.347								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1894 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	2045 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	748 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2793 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	272

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5464 pc/h	Weaving intensity factor, W	0.475
Weaving segment capacity, c_w	5403 veh/h	Weaving segment speed, S	40.0 mph
Weaving segment v/c ratio	0.950	Average weaving speed, S_W	45.5 mph
Weaving segment density, D	45.5 pc/mi/ln	Average non-weaving speed, S_{NW}	37.6 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	6090 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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Navy Base ICTF

FREEWAY WEAVING WORKSHEET

General Information

Analyst	AJR
Agency/Company	Atkins
Date Performed	7/25/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-526 EB
Weaving Segment Location	3170 - Rhett to Virginia
Analysis Year	2018 Build - Proposed Site

Project Description *Navy Base ICTF*

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	1090ft
Freeway free-flow speed, FFS	60 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2300
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2754	0.90	13	0	1.5	1.2	0.939	1.00	3259
V_{RF}	971	0.90	13	0	1.5	1.2	0.939	1.00	1149
V_{FR}	133	0.90	34	0	1.5	1.2	0.855	1.00	173
V_{RR}	47	0.90	34	0	1.5	1.2	0.855	1.00	61
V_{NW}	3320							V =	4642
V_W	1322								
VR	0.285								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1322 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	1473 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	697 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2170 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	253

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4642 pc/h	Weaving intensity factor, W	0.389
Weaving segment capacity, c_w	5546 veh/h	Weaving segment speed, S	44.2 mph
Weaving segment v/c ratio	0.786	Average weaving speed, S_W	47.4 mph
Weaving segment density, D	35.0 pc/mi/ln	Average non-weaving speed, S_{NW}	43.1 mph
Level of Service, LOS	E	Maximum weaving length, L_{MAX}	5421 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3180-Virginia to ClementsFerry*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3967*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2325*	pc/h/ln
S	*50.5*	mph
D = v_p / S	*46.1*	pc/mi/ln
LOS	*F*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3180-Virginia to ClementsFerry*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3725*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2183*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*53.8*	mph	S	mph
D = v_p / S	*40.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*E*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3190-EB Off to ClementsFerrySB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	250	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3967	V_D =	veh/h
		Ramp Volume, V_R	457		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3967	0.90	Level	11	0	0.948	1.00	4650
Ramp	457	0.90	Level	7	0	0.966	1.00	526
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4650 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4650	Exhibit 13-8	4600	Yes
$V_{FO} = V_F - V_R$	4124	Exhibit 13-8	4600	No
V_R	526	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4650	Exhibit 13-8	4400:All	Yes

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 42.0 (pc/mi/ln)

LOS = F (Exhibit 13-2)

Speed Determination

D_s = 0.345 (Exhibit 13-12)

S_R= 53.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 53.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3190-EB Off to ClementsFerrySB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	250	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3725	V_D =	veh/h
		Ramp Volume, V_R	237		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3725	0.90	Level	11	0	0.948	1.00	4367
Ramp	237	0.90	Level	12	0	0.943	1.00	279
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4367 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4367	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	4088	Exhibit 13-8	4600	No
V_R	279	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4367	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 39.6 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

D_s = 0.323 (Exhibit 13-12)

S_R= 54.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3200-EB Off to ClementsFerryNB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	900	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3510	V_D =	veh/h
		Ramp Volume, V_R	836		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3510	0.90	Level	11	0	0.948	1.00	4115
Ramp	836	0.90	Level	22	0	0.901	1.00	1031
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4115 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4115	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3084	Exhibit 13-8	4600	No
V_R	1031	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4115	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.5 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.651 (Exhibit 13-12)

S_R= 48.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3200-EB Off to ClementsFerryNB
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	900	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3488	V_D =	veh/h
		Ramp Volume, V_R	767		
		Freeway Free-Flow Speed, S_{FF}	60.0		
		Ramp Free-Flow Speed, S_{FR}	25.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3488	0.90	Level	11	0	0.948	1.00	4089
Ramp	767	0.90	Level	20	0	0.909	1.00	937
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 4089 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	4089	Exhibit 13-8	4600	No
$V_{FO} = V_F - V_R$	3152	Exhibit 13-8	4600	No
V_R	937	Exhibit 13-10	1900	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4089	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 31.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.642 (Exhibit 13-12)

S_R= 48.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 48.4 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3205-ClemFerry NB Off to NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2674*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1567*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*26.1*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3205-ClemFerry NB Off to NB On*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2721*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1595*	pc/h/ln
S	*60.0*	mph
D = v_p / S	*26.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3210-EB On from Clements Ferry
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1025	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2674	
	Ramp Volume, V_R: 380	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2674	0.90	Level	11	0	0.948	1.00	3135
Ramp	380	0.90	Level	9	0	0.957	1.00	441
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3135 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3576	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3576	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 26.7 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.368 (Exibit 13-11)

S_R= 53.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 53.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3210-EB On from Clements Ferry
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 1025	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 2721	
	Ramp Volume, V_R: 582	
	Freeway Free-Flow Speed, S_{FF}: 60.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2721	0.90	Level	11	0	0.948	1.00	3190
Ramp	582	0.90	Level	5	0	0.976	1.00	663
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 3190 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3853	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3853	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 28.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.413 (Exibit 13-11)

S_R= 52.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 52.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3220-ClementsFerrytoRiversLand*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3054*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*60.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*60.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1773*	pc/h/ln
S	*59.5*	mph
D = v_p / S	*29.8*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*AJR*	Highway/Direction of Travel	*I-526 EB*
Agency or Company	*Atkins*	From/To	*3220-ClementsFerrytoRiversLand*
Date Performed	*7/25/2014*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2018 Build - Proposed Site*

Project Description *Navy Base ICTF*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3303*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*60.0*	mph	FFS	*60.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1908*	pc/h/ln	Design LOS	
S	*58.3*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*32.7*	pc/mi/ln	S	mph
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3230-EB Off to River Landing
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	800	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	3054	V_D =	veh/h
		Ramp Volume, V_R	757		
		Freeway Free-Flow Speed, S_{FF}	65.0		
		Ramp Free-Flow Speed, S_{FR}	45.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3054	0.90	Level	9	0	0.957	1.00	3546
Ramp	757	0.90	Level	3	0	0.985	1.00	854
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3546 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3546	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	2692	Exhibit 13-8	4700	No
V_R	854	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3546	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 27.5 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.375 (Exhibit 13-12)

S_R= 56.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 56.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	AJR	Freeway/Dir of Travel	I-526 EB
Agency or Company	Atkins	Junction	3230-EB Off to River Landing
Date Performed	7/25/2014	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2018 Build - Proposed Site

Project Description Navy Base ICTF

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D: 800	V_D = veh/h
	Freeway Volume, V_F: 3303	
	Ramp Volume, V_R: 784	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 45.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3303	0.90	Level	8	0	0.962	1.00	3817
Ramp	784	0.90	Level	2	0	0.990	1.00	880
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3817 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3817	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	2937	Exhibit 13-8	4700	No
V_R	880	Exhibit 13-10	2100	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3817	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 29.9 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.377 (Exhibit 13-12)

S_R= 56.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 56.3 mph (Exhibit 13-13)

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