APPENDIX II

No Build Alternative LOS Worksheets

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Appendix A

Intersection Analysis

Appendix A Includes:

A1. Year 2020 No Build Alternative Intersection LOS Worksheets

A2. Year 2040 No Build Alternative Intersection LOS Worksheets

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Appendix A1

Year 2020 No Build Alternative
Intersection Level of Service (LOS) Worksheets

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Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1298	1460	76	773	406	321
v/c Ratio	0.51	0.72	0.05	0.45	0.27	0.44
Control Delay	23.0	28.7	0.1	17.9	15.3	18.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.0	28.7	0.1	17.9	15.3	18.8
Queue Length 50th (ft)	175	256	0	158	76	132
Queue Length 95th (ft)	190	291	0	229	122	237
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2877	2293	1611	1717	1500	727
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.64	0.05	0.45	0.27	0.44

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1173	60	0	1387	0	0	0	72	734	81	610
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.88	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6361			5085				1611	3433	2988	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6361			5085				1611	3433	2988	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1235	63	0	1460	0	0	0	76	773	85	642
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	7	7
Lane Group Flow (vph)	0	1290	0	0	1460	0	0	0	76	773	400	315
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		39.7			39.7				100.0	50.0	50.0	50.0
Effective Green, g (s)		39.7			39.7				100.0	50.0	50.0	50.0
Actuated g/C Ratio		0.40			0.40				1.00	0.50	0.50	0.50
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2525			2019				1611	1717	1494	721
v/s Ratio Prot		0.20			c0.29					c0.23	0.13	
v/s Ratio Perm									0.05			0.22
v/c Ratio		0.51			0.72				0.05	0.45	0.27	0.44
Uniform Delay, d1		22.8			25.5				0.0	16.1	14.4	16.0
Progression Factor		1.00			1.06				1.00	1.00	1.00	1.00
Incremental Delay, d2		0.3			1.4				0.1	0.9	0.4	1.9
Delay (s)		23.2			28.4				0.1	17.0	14.9	17.9
Level of Service		C			C				A	B	B	B
Approach Delay (s)		23.2			28.4			0.1			16.6	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	22.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	1825	1232	818	625	491
v/c Ratio	0.49	0.60	0.65	0.55	0.52
Control Delay	15.6	6.5	5.2	30.0	28.3
Queue Delay	0.0	0.5	2.1	0.0	0.0
Total Delay	15.6	7.0	7.3	30.0	28.3
Queue Length 50th (ft)	230	113	109	169	136
Queue Length 95th (ft)	247	141	m140	225	193
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3755	2074	1266	1133	937
Starvation Cap Reductn	0	403	294	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.49	0.74	0.84	0.55	0.52

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1734	0	0	1170	777	594	0	466	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1825	0	0	1232	818	625	0	491	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	347	0	0	18	0	0	0
Lane Group Flow (vph)	0	1825	0	0	1232	471	625	0	473	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		57.6			57.6	57.6	33.0		33.0			
Effective Green, g (s)		57.6			57.6	57.6	33.0		33.0			
Actuated g/C Ratio		0.58			0.58	0.58	0.33		0.33			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3691			2038	912	1133		920			
v/s Ratio Prot		0.28			c0.35							
v/s Ratio Perm						0.30	c0.18		0.17			
v/c Ratio		0.49			0.60	0.52	0.55		0.51			
Uniform Delay, d1		12.6			13.8	12.8	27.4		27.0			
Progression Factor		1.21			0.40	3.82	1.00		1.00			
Incremental Delay, d2		0.2			0.6	0.7	1.9		2.1			
Delay (s)		15.4			6.0	49.6	29.4		29.1			
Level of Service		B			A	D	C		C			
Approach Delay (s)		15.4			23.4			29.2			0.0	
Approach LOS		B			C			C			A	

Intersection Summary			
HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	558	1272	6	1263	196	196	148	282	272
v/c Ratio	0.85	0.46	0.05	0.75	0.84	0.30	0.49	0.73	0.61
Control Delay	46.8	9.1	44.3	33.6	73.0	34.6	49.3	24.4	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.8	9.1	44.3	33.6	73.0	34.6	49.3	24.4	11.1
Queue Length 50th (ft)	192	71	4	256	124	55	46	51	0
Queue Length 95th (ft)	#271	283	17	335	#245	84	78	141	73
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	656	2771	124	1687	235	787	309	443	494
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.46	0.05	0.75	0.83	0.25	0.48	0.64	0.55

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	530	1131	77	6	1155	45	186	174	12	141	48	478
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.99		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5037		1770	5057		1770	3504		3433	1552	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5037		1770	5057		1770	3504		3433	1552	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	558	1191	81	6	1216	47	196	183	13	148	51	503
RTOR Reduction (vph)	0	6	0	0	4	0	0	6	0	0	172	234
Lane Group Flow (vph)	558	1266	0	6	1259	0	196	190	0	148	110	38
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	23.0	51.0		1.4	29.4		13.2	18.2		8.8	13.8	13.8
Effective Green, g (s)	23.0	51.0		1.4	29.4		13.2	18.2		8.8	13.8	13.8
Actuated g/C Ratio	0.23	0.51		0.01	0.29		0.13	0.18		0.09	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	790	2569		25	1487		234	638		302	214	208
v/s Ratio Prot	c0.16	0.25		0.00	c0.25		c0.11	c0.05		0.04	c0.07	
v/s Ratio Perm												0.02
v/c Ratio	0.71	0.49		0.24	0.85		0.84	0.30		0.49	0.52	0.18
Uniform Delay, d1	35.4	16.0		48.8	33.2		42.4	35.4		43.5	40.0	38.1
Progression Factor	0.88	0.58		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.7	0.6		6.7	6.1		23.0	0.4		1.7	2.8	0.6
Delay (s)	33.8	9.9		55.5	39.3		65.4	35.7		45.2	42.8	38.7
Level of Service	C	A		E	D		E	D		D	D	D
Approach Delay (s)		17.2			39.4			50.5			41.7	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM Average Control Delay	31.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1296	1382	773	846
v/c Ratio	0.41	0.64	0.77	0.53
Control Delay	11.2	14.8	37.8	1.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	11.2	14.8	37.8	1.3
Queue Length 50th (ft)	143	267	232	0
Queue Length 95th (ft)	213	412	268	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3123	2174	1710	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	142	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.43	0.64	0.45	0.53

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1231	1313	0	734	804
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1296	1382	0	773	846
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1296	1382	0	773	846
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		61.4	61.4		29.1	100.0
Effective Green, g (s)		61.4	61.4		29.1	100.0
Actuated g/C Ratio		0.61	0.61		0.29	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3122	2173		999	1583
v/s Ratio Prot		0.25	c0.39		c0.23	
v/s Ratio Perm						0.53
v/c Ratio		0.42	0.64		0.77	0.53
Uniform Delay, d1		10.0	12.2		32.4	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.4	1.3		3.6	1.3
Delay (s)		10.4	13.6		36.1	1.3
Level of Service		B	B		D	A
Approach Delay (s)		10.4	13.6		17.9	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	14.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	1907	561	266	1403
v/c Ratio	0.75	0.47	0.79	0.40
Control Delay	14.3	5.5	55.8	0.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.3	5.5	55.8	0.3
Queue Length 50th (ft)	524	99	161	0
Queue Length 95th (ft)	632	134	246	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2539	1199	389	3539
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.75	0.47	0.68	0.40

Intersection Summary

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1812	533	253	1333	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1907	561	266	1403	0	0
RTOR Reduction (vph)	0	64	0	0	0	0
Lane Group Flow (vph)	1907	497	266	1403	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	71.7	71.7	19.0	100.0		
Effective Green, g (s)	71.7	71.7	19.0	100.0		
Actuated g/C Ratio	0.72	0.72	0.19	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2537	1135	336	3539		
v/s Ratio Prot	c0.54		c0.15	0.40		
v/s Ratio Perm		0.31				
v/c Ratio	0.75	0.44	0.79	0.40		
Uniform Delay, d1	8.7	5.8	38.6	0.0		
Progression Factor	1.29	1.13	1.00	1.00		
Incremental Delay, d2	2.0	1.2	12.0	0.3		
Delay (s)	13.2	7.8	50.6	0.3		
Level of Service	B	A	D	A		
Approach Delay (s)	12.0			8.3	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	10.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	71.9%	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)	0	0	349	0	0	571	0	615	796	0	769	574
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	367	0	0	601	0	647	838	0	809	604
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.94	0.94		0.94	0.94	0.94				0.94		
vC, conflicting volume	1025	1457	270	917	1457	216	809			647		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	803	1262	270	688	1262	0	809			401		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	50	100	100	41	100			100		
cM capacity (veh/h)	106	158	728	155	158	1019	812			1085		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	367	601	259	259	409	559	324	324	363	403
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	367	601	0	0	279	559	0	0	201	403
cSH	728	1019	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.50	0.59	0.15	0.15	0.24	0.33	0.19	0.19	0.21	0.24
Queue Length 95th (ft)	72	100	0	0	0	0	0	0	0	0
Control Delay (s)	14.9	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	B								
Approach Delay (s)	14.9	13.5	0.0				0.0			
Approach LOS	B	B								

Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	59.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	638	0	1331	806	332
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	672	0	1401	848	349
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.89					
vC, conflicting volume	1199	283	848			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	595	283	848			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	6	100			
cM capacity (veh/h)	387	714	785			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	672	350	350	350	350	339	339	286	233
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	672	0	0	0	0	0	0	116	233
cSH	714	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.94	0.21	0.21	0.21	0.21	0.20	0.20	0.17	0.14
Queue Length 95th (ft)	336	0	0	0	0	0	0	0	0
Control Delay (s)	44.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	E								
Approach Delay (s)	44.7	0.0				0.0			
Approach LOS	E								

Intersection Summary			
Average Delay	9.2		
Intersection Capacity Utilization	64.2%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	112	765	135	72	1046	222	260	1181	89	1411
v/c Ratio	0.62	0.51	0.18	0.45	0.82	0.44	0.76	0.56	0.20	0.82
Control Delay	57.9	28.1	11.9	51.0	36.8	9.0	55.2	24.9	35.9	28.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.9	28.1	11.9	51.0	36.8	9.0	55.2	24.9	35.9	28.5
Queue Length 50th (ft)	32	136	32	21	215	13	75	163	22	238
Queue Length 95th (ft)	#69	176	68	42	270	81	#135	181	47	296
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	180	1499	743	160	1312	513	340	2531	450	1807
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.51	0.18	0.45	0.80	0.43	0.76	0.47	0.20	0.78

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	106	727	128	68	970	235	247	943	179	85	916	425
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4789	1362	3433	6255		3433	4844	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4789	1362	3433	6255		3433	4844	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	112	765	135	72	1021	247	260	993	188	89	964	447
RTOR Reduction (vph)	0	0	25	0	3	144	0	41	0	0	94	0
Lane Group Flow (vph)	112	765	110	72	1043	78	260	1140	0	89	1317	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	5.8	25.9	34.6	3.2	23.3	23.3	8.7	29.3		10.2	30.8	
Effective Green, g (s)	5.8	25.9	34.6	3.2	23.3	23.3	8.7	29.3		10.2	30.8	
Actuated g/C Ratio	0.06	0.29	0.38	0.04	0.26	0.26	0.10	0.32		0.11	0.34	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	221	1460	702	122	1237	352	331	2032		388	1654	
v/s Ratio Prot	0.03	c0.15	0.02	0.02	c0.22		c0.08	0.18		0.03	c0.27	
v/s Ratio Perm			0.05			0.06						
v/c Ratio	0.51	0.52	0.16	0.59	0.84	0.22	0.79	0.56		0.23	0.80	
Uniform Delay, d1	40.8	27.0	18.2	42.9	31.7	26.3	39.8	25.1		36.4	26.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.8	0.3	0.1	7.4	5.4	0.3	11.6	0.4		0.3	2.8	
Delay (s)	42.6	27.3	18.3	50.3	37.1	26.6	51.4	25.5		36.7	29.6	
Level of Service	D	C	B	D	D	C	D	C		D	C	
Approach Delay (s)		27.8			36.1			30.2			30.0	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM Average Control Delay	31.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	90.2	Sum of lost time (s)	16.2
Intersection Capacity Utilization	76.1%	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 (veh/h)	0	575	426	0	779	0	0	0	0	0	0	518
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	605	448	0	820	0	0	0	0	0	0	545
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.89			0.89	0.89	0.89	0.89	0.89	
vC, conflicting volume	820			1054			1103	1649	426	1022	1874	273
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	820			633			688	1302	0	597	1553	273
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	25
cM capacity (veh/h)	805			843			73	142	966	344	100	724

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	242	242	569	273	273	273	545
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	448	0	0	0	545
cSH	1700	1700	1700	1700	1700	1700	724
Volume to Capacity	0.14	0.14	0.33	0.16	0.16	0.16	0.75
Queue Length 95th (ft)	0	0	0	0	0	0	174
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	23.5
Lane LOS							C
Approach Delay (s)	0.0			0.0			23.5
Approach LOS							C

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	54	177	210	203	6	1413	419	1322
v/c Ratio	0.38	0.50	0.51	0.48	0.04	0.55	0.31	0.48
Control Delay	23.5	24.6	12.1	11.2	11.7	8.5	0.3	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	24.6	12.1	11.2	11.7	8.5	0.3	11.0
Queue Length 50th (ft)	8	60	25	22	1	82	0	110
Queue Length 95th (ft)	37	97	70	63	m2	m146	m0	185
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	142	532	554	568	162	2587	1362	2758
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.33	0.38	0.36	0.04	0.55	0.31	0.48

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	0	30	187	2	371	6	944	796	0	1248	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.92		1.00	0.87	0.85	1.00	0.96	0.85		1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1680		1681	1461	1504	1770	4592	1362		5081	
Flt Permitted		0.98		0.95	1.00	1.00	0.16	1.00	1.00		1.00	
Satd. Flow (perm)		1680		1681	1461	1504	298	4592	1362		5081	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	22	0	32	197	2	391	6	994	838	0	1314	8
RTOR Reduction (vph)	0	31	0	0	106	106	0	100	0	0	1	0
Lane Group Flow (vph)	0	23	0	177	104	97	6	1313	419	0	1321	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		2.4		12.6	12.6	12.6	31.0	31.0	60.0		31.0	
Effective Green, g (s)		2.4		12.6	12.6	12.6	31.0	31.0	60.0		31.0	
Actuated g/C Ratio		0.04		0.21	0.21	0.21	0.52	0.52	1.00		0.52	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		67		353	307	316	154	2373	1362		2625	
v/s Ratio Prot		0.01		c0.11	0.07			c0.29			0.26	
v/s Ratio Perm						0.06	0.02		c0.31			
v/c Ratio		0.35		0.50	0.34	0.31	0.04	0.55	0.31		0.50	
Uniform Delay, d1		28.0		20.9	20.2	20.0	7.2	9.8	0.0		9.5	
Progression Factor		1.00		1.00	1.00	1.00	1.05	0.90	1.00		1.00	
Incremental Delay, d2		3.1		1.1	0.7	0.6	0.3	0.6	0.3		0.7	
Delay (s)		31.2		22.0	20.8	20.6	7.8	9.4	0.3		10.2	
Level of Service		C		C	C	C	A	A	A		B	
Approach Delay (s)		31.2			21.1			7.4			10.2	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	10.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	54.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	111	772	202	2404	231	1067	68	986
v/c Ratio	1.08	0.73	0.37	1.05	1.05	0.71	0.76	0.89
Control Delay	164.1	45.7	23.2	48.9	114.0	26.0	95.9	50.5
Queue Delay	0.0	0.0	0.0	14.7	0.0	1.2	0.0	0.0
Total Delay	164.1	45.7	23.2	63.5	114.0	27.2	95.9	50.5
Queue Length 50th (ft)	~96	193	71	~712	~201	286	0	197
Queue Length 95th (ft)	#215	227	m127	#811	#366	298	#142	#276
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	103	1585	546	2283	221	1494	89	1110
Starvation Cap Reductn	0	0	0	74	0	214	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.08	0.49	0.37	1.09	1.05	0.83	0.76	0.89

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	592	142	192	1772	512	219	1001	12	65	795	142
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4938		1770	4914		1770	5076		1770	4970	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4938		1770	4914		1770	5076		1770	4970	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	111	623	149	202	1865	539	231	1054	13	68	837	149
RTOR Reduction (vph)	0	39	0	0	44	0	0	1	0	0	21	0
Lane Group Flow (vph)	111	733	0	202	2360	0	231	1066	0	68	965	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	7.0	24.7		37.0	54.7		15.0	35.3		6.0	26.3	
Effective Green, g (s)	7.0	24.7		37.0	54.7		15.0	35.3		6.0	26.3	
Actuated g/C Ratio	0.06	0.21		0.31	0.46		0.12	0.29		0.05	0.22	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	103	1016		546	2240		221	1493		89	1089	
v/s Ratio Prot	c0.06	0.15		0.11	c0.48		c0.13	0.21		0.04	c0.19	
v/s Ratio Perm												
v/c Ratio	1.08	0.72		0.37	1.05		1.05	0.71		0.76	0.89	
Uniform Delay, d1	56.5	44.4		32.4	32.6		52.5	37.8		56.3	45.4	
Progression Factor	1.00	1.00		0.65	0.53		0.91	0.62		0.93	0.91	
Incremental Delay, d2	111.2	2.6		0.2	30.8		67.0	2.4		29.0	9.8	
Delay (s)	167.7	47.0		21.2	48.1		114.7	25.9		81.5	51.3	
Level of Service	F	D		C	D		F	C		F	D	
Approach Delay (s)		62.2			46.0			41.7			53.2	
Approach LOS		E			D			D			D	

Intersection Summary			
HCM Average Control Delay	48.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	96.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	318	1053	306	162	600	14	963	228	1093
v/c Ratio	0.69	0.75	0.57	0.70	0.71	0.09	0.58	0.27	0.47
Control Delay	47.8	38.6	15.7	66.2	26.9	23.5	26.7	3.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Total Delay	47.8	38.6	15.7	66.2	26.9	23.5	26.8	3.7	5.2
Queue Length 50th (ft)	218	200	82	134	106	6	290	0	54
Queue Length 95th (ft)	323	247	115	207	133	22	394	49	m72
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	518	1545	575	295	1017	162	1650	860	2319
Starvation Cap Reductn	0	0	0	0	0	0	0	0	338
Spillback Cap Reductn	0	0	0	0	0	0	79	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.68	0.53	0.55	0.59	0.09	0.61	0.27	0.55

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	302	837	454	154	570	0	13	915	217	0	576	463
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4688	1362	1770	5085		1770	3539	1583		4745	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.19	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4688	1362	1770	5085		349	3539	1583		4745	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	318	881	478	162	600	0	14	963	228	0	606	487
RTOR Reduction (vph)	0	23	138	0	0	0	0	0	122	0	107	0
Lane Group Flow (vph)	318	1030	168	162	600	0	14	963	106	0	986	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	31.1	35.3	35.3	15.8	20.0		55.9	55.9	55.9		55.9	
Effective Green, g (s)	31.1	35.3	35.3	15.8	20.0		55.9	55.9	55.9		55.9	
Actuated g/C Ratio	0.26	0.29	0.29	0.13	0.17		0.47	0.47	0.47		0.47	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	459	1379	401	233	848		163	1649	737		2210	
v/s Ratio Prot	c0.18	c0.22		0.09	0.12			c0.27			0.21	
v/s Ratio Perm			0.12				0.04		0.07			
v/c Ratio	0.69	0.75	0.42	0.70	0.71		0.09	0.58	0.14		0.45	
Uniform Delay, d1	40.1	38.3	34.1	49.8	47.2		17.8	23.5	18.4		21.6	
Progression Factor	1.01	0.95	0.97	1.08	0.49		1.00	1.00	1.00		0.25	
Incremental Delay, d2	4.1	2.1	0.6	7.1	2.2		1.0	1.5	0.4		0.4	
Delay (s)	44.5	38.6	33.9	60.8	25.2		18.9	25.0	18.8		5.7	
Level of Service	D	D	C	E	C		B	C	B		A	
Approach Delay (s)		38.9			32.8			23.8			5.7	
Approach LOS		D			C			C			A	

Intersection Summary			
HCM Average Control Delay	26.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	64.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	187	1059	0	0	1209
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	197	1115	0	0	1273
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked						
vC, conflicting volume	1539	372			1115	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1539	372			1115	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	69			100	
cM capacity (veh/h)	106	626			622	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	197	372	372	372	424	424	424
Volume Left	0	0	0	0	0	0	0
Volume Right	197	0	0	0	0	0	0
cSH	626	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.31	0.22	0.22	0.22	0.25	0.25	0.25
Queue Length 95th (ft)	34	0	0	0	0	0	0
Control Delay (s)	13.4	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B						
Approach Delay (s)	13.4	0.0			0.0		
Approach LOS	B						

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	38.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1158	933	758
v/c Ratio	0.42	0.34	0.70
Control Delay	9.4	4.0	20.5
Queue Delay	0.0	0.0	0.0
Total Delay	9.4	4.0	20.5
Queue Length 50th (ft)	82	49	115
Queue Length 95th (ft)	135	95	144
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2770	2770	1491
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.42	0.34	0.51

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1100	886	0	634	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3399	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3399	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1158	933	0	667	91
RTOR Reduction (vph)	0	0	0	0	22	0
Lane Group Flow (vph)	0	1158	933	0	736	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		32.7	32.7		18.8	
Effective Green, g (s)		32.7	32.7		18.8	
Actuated g/C Ratio		0.55	0.55		0.31	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2771	2771		1065	
v/s Ratio Prot		c0.23	0.18		c0.22	
v/s Ratio Perm						
v/c Ratio		0.42	0.34		0.69	
Uniform Delay, d1		8.0	7.6		18.1	
Progression Factor		1.00	0.46		1.00	
Incremental Delay, d2		0.5	0.3		2.0	
Delay (s)		8.5	3.8		20.0	
Level of Service		A	A		C	
Approach Delay (s)		8.5	3.8		20.0	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	10.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	79	661	340	2454	101	555	457	96	789
v/c Ratio	0.77	0.42	0.62	0.86	0.11	0.58	0.60	0.70	0.57
Control Delay	104.1	7.1	41.5	26.2	3.8	53.2	21.6	67.0	34.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	104.1	7.1	41.5	26.2	3.8	53.2	21.6	67.0	34.0
Queue Length 50th (ft)	65	35	225	561	5	166	163	67	165
Queue Length 95th (ft)	m#144	41	328	634	30	227	226	#156	210
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	103	1589	546	2860	928	958	762	138	1384
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.42	0.62	0.86	0.11	0.58	0.60	0.70	0.57

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	628	0	323	2331	96	0	527	434	91	478	272
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4809	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.27	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	510	4809	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	79	661	0	340	2454	101	0	555	457	96	503	286
RTOR Reduction (vph)	0	0	0	0	0	37	0	0	333	0	81	0
Lane Group Flow (vph)	79	661	0	340	2454	64	0	555	124	96	708	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	7.0	37.5		37.0	67.5	67.5		32.5	32.5	32.5	32.5	
Effective Green, g (s)	7.0	37.5		37.0	67.5	67.5		32.5	32.5	32.5	32.5	
Actuated g/C Ratio	0.06	0.31		0.31	0.56	0.56		0.27	0.27	0.27	0.27	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	103	1589		546	2860	890		958	429	138	1302	
v/s Ratio Prot	0.04	0.13		c0.19	c0.48			0.16			0.15	
v/s Ratio Perm						0.04			0.08	c0.19		
v/c Ratio	0.77	0.42		0.62	0.86	0.07		0.58	0.29	0.70	0.54	
Uniform Delay, d1	55.7	32.6		35.5	22.2	12.0		37.8	34.6	39.3	37.4	
Progression Factor	1.21	0.20		1.00	1.00	1.00		1.34	5.65	1.00	1.00	
Incremental Delay, d2	25.5	0.7		2.2	3.6	0.2		2.1	1.4	25.2	1.6	
Delay (s)	92.7	7.1		37.7	25.8	12.1		52.8	197.0	64.5	39.0	
Level of Service	F	A		D	C	B		D	F	E	D	
Approach Delay (s)		16.2			26.7			117.9			41.8	
Approach LOS		B			C			F			D	

Intersection Summary			
HCM Average Control Delay	44.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	137	1602	156	2842	431	198	61	100	879	219
v/c Ratio	1.33	0.89	0.88	1.40	1.54	0.19	0.12	0.59	1.06	0.49
Control Delay	243.9	43.1	96.1	213.6	294.8	32.8	8.7	65.6	94.0	23.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	243.9	43.1	96.1	213.6	294.8	32.8	8.7	65.6	94.0	23.9
Queue Length 50th (ft)	~138	420	121	~1086	~469	60	0	75	~395	73
Queue Length 95th (ft)	#268	488	#247	#1175	#670	94	33	132	#524	151
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	103	1807	177	2030	280	1046	511	207	826	451
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.33	0.89	0.88	1.40	1.54	0.19	0.12	0.48	1.06	0.49

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	130	1392	130	148	2643	57	409	188	58	95	835	208
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5020		1770	5069		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5020		1770	5069		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	137	1465	137	156	2782	60	431	198	61	100	879	219
RTOR Reduction (vph)	0	9	0	0	2	0	0	0	43	0	0	82
Lane Group Flow (vph)	137	1593	0	156	2840	0	431	198	18	100	879	137
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	7.0	43.0		12.0	48.0		19.0	35.5	35.5	11.5	28.0	28.0
Effective Green, g (s)	7.0	43.0		12.0	48.0		19.0	35.5	35.5	11.5	28.0	28.0
Actuated g/C Ratio	0.06	0.36		0.10	0.40		0.16	0.30	0.30	0.10	0.23	0.23
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	103	1799		177	2028		280	1047	468	170	826	369
v/s Ratio Prot	c0.08	0.32		0.09	c0.56		c0.24	0.06		0.06	c0.25	
v/s Ratio Perm									0.01			0.09
v/c Ratio	1.33	0.89		0.88	1.40		1.54	0.19	0.04	0.59	1.06	0.37
Uniform Delay, d1	56.5	36.2		53.3	36.0		50.5	31.5	30.1	52.0	46.0	38.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	200.7	5.6		36.3	183.3		259.8	0.1	0.0	5.1	49.8	0.6
Delay (s)	257.2	41.8		89.6	219.3		310.3	31.6	30.1	57.1	95.8	39.2
Level of Service	F	D		F	F		F	C	C	E	F	D
Approach Delay (s)		58.8			212.5			205.6			82.2	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM Average Control Delay	147.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.33		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	120.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	160	0	583	0	0	708	472	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	168	0	614	0	0	745	497	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.76		0.76						0.76	0.76
vC, conflicting volume	1856	307	1242			614			1221	1359
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1966	307	1162			614			1134	1315
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	76	100			100			100	100
cM capacity (veh/h)	47	689	455			962			91	120

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	168	307	307	745	497
Volume Left	0	0	0	0	0
Volume Right	168	0	0	0	497
cSH	689	1700	1700	1700	1700
Volume to Capacity	0.24	0.18	0.18	0.44	0.29
Queue Length 95th (ft)	24	0	0	0	0
Control Delay (s)	11.9	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	11.9	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	59.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	777	0	0	0	0	0	0	620	81	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	818	0	0	0	0	0	0	653	85	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked												
vC, conflicting volume	1391	1391	85	2208	1391	0	85			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1391	1391	85	2208	1391	0	85			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	16	100	100	100	100			60		
cM capacity (veh/h)	82	85	974	3	85	1085	1511			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	818	653	85
Volume Left	0	653	0
Volume Right	818	0	0
cSH	974	1623	1700
Volume to Capacity	0.84	0.40	0.05
Queue Length 95th (ft)	258	50	0
Control Delay (s)	24.6	8.7	0.0
Lane LOS	C	A	
Approach Delay (s)	24.6	7.7	
Approach LOS	C		

Intersection Summary			
Average Delay	16.6		
Intersection Capacity Utilization	59.0%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	553	177	115	907	204	1143
v/c Ratio	0.92	0.28	0.69	0.48	0.22	0.61
Control Delay	45.8	8.4	35.2	10.2	2.0	13.2
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.1
Total Delay	45.8	8.4	35.2	10.3	2.0	13.4
Queue Length 50th (ft)	221	19	24	120	6	169
Queue Length 95th (ft)	#401	60	m#90	m171	m16	230
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	620	639	167	1883	938	1882
Starvation Cap Reductn	0	0	0	254	0	0
Spillback Cap Reductn	0	0	0	0	0	114
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.28	0.69	0.56	0.22	0.65

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	525	24	144	109	862	194	0	1082	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.87		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1623		1770	3539	1583		3537	
Flt Permitted				0.95	1.00		0.17	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1623		315	3539	1583		3537	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	553	25	152	115	907	204	0	1139	4
RTOR Reduction (vph)	0	0	0	0	72	0	0	0	95	0	0	0
Lane Group Flow (vph)	0	0	0	553	105	0	115	907	109	0	1143	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				23.7	23.7		37.3	37.3	37.3		37.3	
Effective Green, g (s)				23.7	23.7		37.3	37.3	37.3		37.3	
Actuated g/C Ratio				0.34	0.34		0.53	0.53	0.53		0.53	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				599	550		168	1886	844		1885	
v/s Ratio Prot				c0.31	0.06			0.26			0.32	
v/s Ratio Perm							c0.37		0.07			
v/c Ratio				0.92	0.19		0.68	0.48	0.13		0.61	
Uniform Delay, d1				22.3	16.4		12.0	10.3	8.2		11.3	
Progression Factor				1.00	1.00		0.93	0.88	0.99		1.00	
Incremental Delay, d2				20.0	0.2		17.6	0.8	0.3		1.5	
Delay (s)				42.2	16.5		28.7	9.8	8.4		12.7	
Level of Service				D	B		C	A	A		B	
Approach Delay (s)		0.0			36.0			11.3			12.7	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM Average Control Delay	17.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	445	357	840	1736
v/c Ratio	0.86	0.75	0.40	0.83
Control Delay	41.5	32.4	2.5	10.9
Queue Delay	0.0	0.0	0.0	0.3
Total Delay	41.5	32.4	2.5	11.1
Queue Length 50th (ft)	174	127	23	188
Queue Length 95th (ft)	#318	#228	m39	m216
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	556	509	2101	2101
Starvation Cap Reductn	0	0	0	7
Spillback Cap Reductn	0	0	0	58
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.80	0.70	0.40	0.85

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	423	339	0	798	1649	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	445	357	0	840	1736	0
RTOR Reduction (vph)	0	12	0	0	0	0
Lane Group Flow (vph)	445	345	0	840	1736	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	20.4	20.4		41.6	41.6	
Effective Green, g (s)	20.4	20.4		41.6	41.6	
Actuated g/C Ratio	0.29	0.29		0.59	0.59	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	516	461		2103	2103	
v/s Ratio Prot				0.24	c0.49	
v/s Ratio Perm	c0.25	0.22				
v/c Ratio	0.86	0.75		0.40	0.83	
Uniform Delay, d1	23.5	22.5		7.6	11.3	
Progression Factor	1.00	1.00		0.25	0.62	
Incremental Delay, d2	13.9	6.5		0.5	2.8	
Delay (s)	37.3	29.0		2.4	9.8	
Level of Service	D	C		A	A	
Approach Delay (s)	33.6			2.4	9.8	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	13.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	209	343	123	38	272	81	160	479	103	178	1484	435
v/c Ratio	0.91	0.44	0.28	0.19	0.35	0.20	0.90	0.35	0.15	0.47	0.83	0.48
Control Delay	69.8	25.3	6.7	24.8	24.2	7.3	82.0	16.0	4.0	24.2	11.0	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.3
Total Delay	69.8	25.3	6.7	24.8	24.2	7.3	82.0	16.0	4.0	24.2	12.5	2.9
Queue Length 50th (ft)	87	66	0	13	51	0	70	75	0	78	87	7
Queue Length 95th (ft)	#205	103	38	38	83	31	#174	110	27	m89	233	m22
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	237	809	457	201	809	424	177	1388	684	379	1793	901
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	152	111
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.42	0.27	0.19	0.34	0.19	0.90	0.35	0.15	0.47	0.90	0.55

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	199	326	117	36	258	77	152	455	98	169	1410	413
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.56	1.00	1.00	0.47	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1039	3539	1583	880	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	209	343	123	38	272	81	160	479	103	178	1484	435
RTOR Reduction (vph)	0	0	96	0	0	63	0	0	63	0	0	99
Lane Group Flow (vph)	209	343	27	38	272	18	160	479	40	178	1484	336
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	15.5	15.5	15.5	15.5	15.5	15.5	7.0	27.5	27.5	15.0	35.5	35.5
Effective Green, g (s)	15.5	15.5	15.5	15.5	15.5	15.5	7.0	27.5	27.5	15.0	35.5	35.5
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.22	0.22	0.10	0.39	0.39	0.21	0.51	0.51
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	230	784	351	195	784	351	177	1390	622	379	1795	803
v/s Ratio Prot		0.10			0.08		c0.09	0.14		0.10	c0.42	
v/s Ratio Perm	c0.20		0.02	0.04		0.01			0.03			0.21
v/c Ratio	0.91	0.44	0.08	0.19	0.35	0.05	0.90	0.34	0.07	0.47	0.83	0.42
Uniform Delay, d1	26.6	23.5	21.6	22.2	23.0	21.5	31.2	14.9	13.2	24.0	14.6	10.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.52	0.25
Incremental Delay, d2	35.2	0.4	0.1	0.5	0.3	0.1	41.2	0.7	0.2	0.5	2.6	0.9
Delay (s)	61.8	23.9	21.7	22.7	23.2	21.5	72.3	15.6	13.4	21.8	10.2	3.7
Level of Service	E	C	C	C	C	C	E	B	B	C	B	A
Approach Delay (s)		35.2			22.8			27.5			9.9	
Approach LOS		D			C			C			A	

Intersection Summary			
HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	67	453	0	401	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	71	477	0	422	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			547		282	35
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			547		282	35
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1018		685	1030

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	47	182	318	211	211
Volume Left	0	0	0	0	0
Volume Right	0	159	318	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.03	0.11	0.19	0.12	0.12
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	22.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	73	1091	1525	267
v/c Ratio	0.37	0.31	0.51	0.19
Control Delay	25.4	0.2	3.3	0.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	25.4	0.2	3.3	0.7
Queue Length 50th (ft)	26	0	93	0
Queue Length 95th (ft)	53	0	131	12
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	207	3539	2991	1379
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.35	0.31	0.51	0.19

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	69	1036	1449	254
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	73	1091	1525	267
RTOR Reduction (vph)	0	0	0	0	0	57
Lane Group Flow (vph)	0	0	73	1091	1525	210
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			4.2	60.0	47.3	47.3
Effective Green, g (s)			4.2	60.0	47.3	47.3
Actuated g/C Ratio			0.07	1.00	0.79	0.79
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			124	3539	2790	1248
v/s Ratio Prot			0.04	c0.31	c0.43	
v/s Ratio Perm						0.13
v/c Ratio			0.59	0.31	0.55	0.17
Uniform Delay, d1			27.1	0.0	2.4	1.6
Progression Factor			0.81	1.00	1.00	1.00
Incremental Delay, d2			6.8	0.2	0.8	0.3
Delay (s)			28.6	0.2	3.1	1.8
Level of Service			C	A	A	A
Approach Delay (s)	0.0			2.0	2.9	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	2.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	4.5
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	166	269	0	961	1452	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	175	283	0	1012	1528	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.87	0.81	0.81			
vC, conflicting volume	2034	764	1528			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1285	249	1189			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	54	100			
cM capacity (veh/h)	136	610	474			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	116	341	506	506	764	764
Volume Left	116	58	0	0	0	0
Volume Right	0	283	0	0	0	0
cSH	136	383	1700	1700	1700	1700
Volume to Capacity	0.86	0.89	0.30	0.30	0.45	0.45
Queue Length 95th (ft)	137	225	0	0	0	0
Control Delay (s)	104.8	56.0	0.0	0.0	0.0	0.0
Lane LOS	F	F				
Approach Delay (s)	68.4		0.0		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	10.5		
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	123	119	35	84	160	865	8	1151	493
v/c Ratio	0.52	0.19	0.15	0.13	0.45	0.35	0.02	0.53	0.45
Control Delay	29.2	7.0	20.4	13.6	14.4	6.1	1.8	8.5	2.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.2	7.0	20.4	13.6	14.4	6.1	1.8	8.5	2.7
Queue Length 50th (ft)	41	3	11	8	16	54	0	70	5
Queue Length 95th (ft)	77	19	29	22	42	153	m1	233	20
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	348	898	336	915	354	2495	434	2166	1100
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.13	0.10	0.09	0.45	0.35	0.02	0.53	0.45

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	117	19	94	33	50	29	152	815	7	8	1093	468
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.88		1.00	0.94		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3098		1770	3343		1770	3535		1770	3539	1583
Flt Permitted	0.70	1.00		0.68	1.00		0.18	1.00		0.29	1.00	1.00
Satd. Flow (perm)	1303	3098		1260	3343		328	3535		541	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	123	20	99	35	53	31	160	858	7	8	1151	493
RTOR Reduction (vph)	0	83	0	0	26	0	0	1	0	0	0	158
Lane Group Flow (vph)	123	36	0	35	58	0	160	864	0	8	1151	335
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	9.7	9.7		9.7	9.7		42.3	37.5		32.7	31.9	31.9
Effective Green, g (s)	9.7	9.7		9.7	9.7		42.3	37.5		32.7	31.9	31.9
Actuated g/C Ratio	0.16	0.16		0.16	0.16		0.70	0.62		0.55	0.53	0.53
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	211	501		204	540		385	2209		311	1882	842
v/s Ratio Prot		0.01			0.02		c0.04	c0.24		0.00	c0.33	
v/s Ratio Perm	c0.09			0.03			0.25			0.01		0.21
v/c Ratio	0.58	0.07		0.17	0.11		0.42	0.39		0.03	0.61	0.40
Uniform Delay, d1	23.3	21.3		21.7	21.5		10.0	5.6		8.1	9.8	8.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.37	0.77	0.42
Incremental Delay, d2	4.1	0.1		0.4	0.1		0.7	0.5		0.0	1.4	1.3
Delay (s)	27.3	21.4		22.1	21.5		10.7	6.1		3.0	8.9	4.8
Level of Service	C	C		C	C		B	A		A	A	A
Approach Delay (s)		24.4			21.7			6.8			7.7	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	9.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	565	258	567	80	94	821
v/c Ratio	0.67	0.44	0.36	0.11	0.39	0.38
Control Delay	24.4	5.5	9.6	1.8	28.1	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.4	5.5	9.6	1.8	28.1	6.9
Queue Length 50th (ft)	92	0	75	0	31	71
Queue Length 95th (ft)	137	47	98	14	68	103
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	937	619	1628	772	260	2188
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.42	0.35	0.10	0.36	0.38

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	537	245	539	76	89	780
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	565	258	567	80	94	821
RTOR Reduction (vph)	0	194	0	46	0	0
Lane Group Flow (vph)	565	64	567	34	94	821
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	14.8	14.8	25.7	25.7	7.0	36.7
Effective Green, g (s)	14.8	14.8	25.7	25.7	7.0	36.7
Actuated g/C Ratio	0.25	0.25	0.43	0.43	0.12	0.61
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	847	390	1516	678	207	2165
v/s Ratio Prot	c0.16		0.16		0.05	c0.23
v/s Ratio Perm		0.04		0.02		
v/c Ratio	0.67	0.16	0.37	0.05	0.45	0.38
Uniform Delay, d1	20.4	17.7	11.7	10.0	24.7	5.9
Progression Factor	1.00	1.00	0.70	0.51	1.00	1.00
Incremental Delay, d2	2.0	0.2	0.7	0.1	1.6	0.5
Delay (s)	22.4	17.9	8.9	5.2	26.3	6.4
Level of Service	C	B	A	A	C	A
Approach Delay (s)	21.0		8.5			8.4
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	45.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	33	65	643	1281	197	1180
v/c Ratio	0.16	0.42	0.24	0.93	1.11	0.37
Control Delay	54.7	21.3	5.1	19.3	146.5	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.7	21.3	5.1	19.3	146.5	1.0
Queue Length 50th (ft)	12	0	72	332	~178	28
Queue Length 95th (ft)	29	44	104	#1069	#331	46
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	629	343	2665	1376	177	3163
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.19	0.24	0.93	1.11	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	31	62	611	1217	187	1121
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	33	65	643	1281	197	1180
RTOR Reduction (vph)	0	62	0	188	0	0
Lane Group Flow (vph)	33	3	643	1093	197	1180
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	5.9	5.9	89.6	89.6	12.0	105.6
Effective Green, g (s)	5.9	5.9	89.6	89.6	12.0	105.6
Actuated g/C Ratio	0.05	0.05	0.75	0.75	0.10	0.88
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	169	78	2642	1182	177	3114
v/s Ratio Prot	c0.01		0.18		c0.11	0.33
v/s Ratio Perm		0.00		c0.69		
v/c Ratio	0.20	0.04	0.24	0.92	1.11	0.38
Uniform Delay, d1	54.8	54.4	4.7	12.4	54.0	1.3
Progression Factor	1.00	1.00	1.00	1.00	0.99	0.52
Incremental Delay, d2	0.6	0.2	0.2	13.4	97.7	0.3
Delay (s)	55.3	54.6	4.9	25.8	151.0	1.0
Level of Service	E	D	A	C	F	A
Approach Delay (s)	54.8		18.8			22.5
Approach LOS	D		B			C

Intersection Summary			
HCM Average Control Delay	21.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	92.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	133	148	681	59	37	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	140	156	717	62	39	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	826	748			717	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	826	748			717	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	57	62			96	
cM capacity (veh/h)	327	412			884	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	140	156	779	39	0
Volume Left	140	0	0	39	0
Volume Right	0	156	62	0	0
cSH	327	412	1700	884	1700
Volume to Capacity	0.43	0.38	0.46	0.04	0.00
Queue Length 95th (ft)	52	43	0	3	0
Control Delay (s)	24.0	18.9	0.0	9.3	0.0
Lane LOS	C	C		A	
Approach Delay (s)	21.3		0.0	9.3	
Approach LOS	C				

Intersection Summary			
Average Delay	6.0		
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2364	1524	506	125	1110	467	657
v/c Ratio	1.02	0.94	0.46	0.51	0.96	0.72	0.47
Control Delay	60.0	41.4	4.0	42.4	61.9	56.8	40.4
Queue Delay	527.0	306.4	4.6	0.0	0.0	0.0	0.0
Total Delay	587.0	347.8	8.6	42.4	61.9	56.8	40.4
Queue Length 50th (ft)	~774	712	66	106	364	192	168
Queue Length 95th (ft)	#867	m693	m45	172	#449	253	209
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2308	1620	1090	246	1151	647	1404
Starvation Cap Reductn	0	717	498	0	0	0	0
Spillback Cap Reductn	1237	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	2.21	1.69	0.85	0.51	0.96	0.72	0.47

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2085	161	0	1448	481	119	1030	25	444	623	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5031			3539	1583	1770	5067		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5031			3539	1583	1770	5067		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2195	169	0	1524	506	125	1084	26	467	656	1
RTOR Reduction (vph)	0	7	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	2357	0	0	1524	506	125	1108	0	467	657	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		59.5			59.5	84.0	18.1	29.5		24.5	35.9	
Effective Green, g (s)		59.5			59.5	84.0	18.1	29.5		24.5	35.9	
Actuated g/C Ratio		0.46			0.46	0.65	0.14	0.23		0.19	0.28	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2303			1620	1090	246	1150		647	1404	
v/s Ratio Prot		c0.47			0.43	0.09	0.07	c0.22		c0.14	0.13	
v/s Ratio Perm						0.23						
v/c Ratio		1.02			0.94	0.46	0.51	0.96		0.72	0.47	
Uniform Delay, d1		35.2			33.6	11.6	51.8	49.7		49.5	39.1	
Progression Factor		1.00			1.09	0.38	0.69	0.89		1.00	1.00	
Incremental Delay, d2		25.0			4.1	0.1	6.4	17.5		4.0	1.1	
Delay (s)		60.3			40.7	4.5	42.0	61.6		53.5	40.2	
Level of Service		E			D	A	D	E		D	D	
Approach Delay (s)		60.3			31.7			59.6			45.8	
Approach LOS		E			C			E			D	

Intersection Summary			
HCM Average Control Delay	49.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	416	2256	34	2077	749	146	245	441	367
v/c Ratio	1.05	0.74	0.39	1.06	1.03	0.48	0.98	0.48	0.54
Control Delay	80.7	34.6	86.9	87.8	104.7	37.2	110.8	43.1	7.0
Queue Delay	131.0	198.5	0.0	327.3	0.0	0.6	649.2	0.0	0.5
Total Delay	211.7	233.1	86.9	415.1	104.7	37.8	760.0	43.1	7.4
Queue Length 50th (ft)	~393	617	28	~682	~251	53	108	166	0
Queue Length 95th (ft)	m#419	m620	m39	#775	#342	120	#195	220	80
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	396	3055	91	1964	724	304	251	912	680
Starvation Cap Reductn	91	1488	0	4	0	0	0	0	0
Spillback Cap Reductn	0	545	0	805	0	31	251	0	80
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.36	1.44	0.37	1.79	1.03	0.53	245.00	0.48	0.61

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	395	2130	13	32	1618	355	0	712	139	233	419	349
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5081		1770	4948			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5081		1770	4948			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	416	2242	14	34	1703	374	0	749	146	245	441	367
RTOR Reduction (vph)	0	0	0	0	27	0	0	0	79	0	0	272
Lane Group Flow (vph)	416	2256	0	34	2050	0	0	749	67	245	441	95
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	29.1	76.0		4.0	50.9			18.5	18.5	9.5	33.5	33.5
Effective Green, g (s)	29.1	76.0		4.0	50.9			18.5	18.5	9.5	33.5	33.5
Actuated g/C Ratio	0.22	0.58		0.03	0.39			0.14	0.14	0.07	0.26	0.26
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	396	2970		54	1937			724	225	251	912	408
v/s Ratio Prot	c0.24	0.44		0.02	c0.41			c0.15		c0.07	0.12	
v/s Ratio Perm									0.04			0.06
v/c Ratio	1.05	0.76		0.63	1.06			1.03	0.30	0.98	0.48	0.23
Uniform Delay, d1	50.5	20.2		62.3	39.6			55.8	49.9	60.1	40.9	38.1
Progression Factor	0.83	1.73		1.30	1.48			1.21	1.56	1.00	1.00	1.00
Incremental Delay, d2	39.2	0.6		14.3	34.8			40.5	2.9	51.0	1.8	1.3
Delay (s)	81.3	35.5		95.5	93.1			108.2	80.6	111.1	42.7	39.4
Level of Service	F	D		F	F			F	F	F	D	D
Approach Delay (s)		42.7			93.2			103.7			57.5	
Approach LOS		D			F			F			E	

Intersection Summary			
HCM Average Control Delay	68.9	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	99.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	35	735	46	1139	457	72	460	164	322	12
v/c Ratio	0.29	0.35	0.20	0.54	0.50	0.17	0.56	0.48	0.30	0.03
Control Delay	37.1	30.9	27.4	30.2	4.2	41.1	45.5	79.8	73.2	50.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.1	30.9	27.4	30.2	4.2	41.1	45.5	79.8	73.2	50.1
Queue Length 50th (ft)	27	204	25	263	0	49	175	170	111	4
Queue Length 95th (ft)	m53	m236	56	309	64	92	232	m258	148	m17
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	122	2088	235	2093	920	415	823	345	1063	368
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.35	0.20	0.54	0.50	0.17	0.56	0.48	0.30	0.03

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	33	684	14	44	1082	434	68	373	64	312	150	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5070		1770	5085	1583	1770	3462		1522	4687	1583
Flt Permitted	0.16	1.00		0.31	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	297	5070		572	5085	1583	1770	3462		1522	4687	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	35	720	15	46	1139	457	72	393	67	328	158	12
RTOR Reduction (vph)	0	2	0	0	0	269	0	11	0	0	0	9
Lane Group Flow (vph)	35	733	0	46	1139	188	72	449	0	164	322	3
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	53.5	53.5		53.5	53.5	53.5	30.5	30.5		29.5	29.5	29.5
Effective Green, g (s)	53.5	53.5		53.5	53.5	53.5	30.5	30.5		29.5	29.5	29.5
Actuated g/C Ratio	0.41	0.41		0.41	0.41	0.41	0.23	0.23		0.23	0.23	0.23
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	122	2087		235	2093	651	415	812		345	1064	359
v/s Ratio Prot		0.14			c0.22		0.04	c0.13		c0.11	0.07	
v/s Ratio Perm	0.12			0.08		0.12						0.00
v/c Ratio	0.29	0.35		0.20	0.54	0.29	0.17	0.55		0.48	0.30	0.01
Uniform Delay, d1	25.5	26.3		24.5	29.0	25.5	39.7	43.8		43.5	41.7	38.9
Progression Factor	1.16	1.16		1.00	1.00	1.00	1.00	1.00		1.71	1.73	2.73
Incremental Delay, d2	4.8	0.4		1.9	1.0	1.1	0.9	2.7		4.2	0.7	0.0
Delay (s)	34.5	30.9		26.3	30.0	26.7	40.6	46.5		78.5	72.8	106.4
Level of Service	C	C		C	C	C	D	D		E	E	F
Approach Delay (s)		31.1			29.0			45.7			75.5	
Approach LOS		C			C			D			E	

Intersection Summary			
HCM Average Control Delay	38.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	102	2474	37	124	2391	88	87	158	45	17	33
v/c Ratio	0.68	0.78	0.04	0.73	0.75	0.64	0.47	0.54	0.25	0.06	0.12
Control Delay	79.0	41.1	15.6	52.6	0.5	76.6	63.1	15.1	47.7	45.0	15.2
Queue Delay	0.0	30.2	0.0	0.0	0.3	10.8	0.0	0.0	0.0	0.0	0.3
Total Delay	79.0	71.3	15.6	52.6	0.8	87.4	63.1	15.1	47.7	45.0	15.4
Queue Length 50th (ft)	76	775	14	111	12	72	70	0	32	12	0
Queue Length 95th (ft)	m109	m826	m23	m107	m12	128	123	66	67	34	30
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	165	3187	1000	185	3186	171	229	307	183	344	319
Starvation Cap Reductn	0	854	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	254	57	0	0	0	0	101
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	1.06	0.04	0.67	0.82	0.77	0.38	0.51	0.25	0.05	0.15

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	97	2350	35	118	1891	380	84	83	150	43	16	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	4958		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.75	1.00	1.00	0.51	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4958		1390	1863	1583	959	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	102	2474	37	124	1991	400	88	87	158	45	17	33
RTOR Reduction (vph)	0	0	8	0	21	0	0	0	143	0	0	28
Lane Group Flow (vph)	102	2474	29	124	2370	0	88	87	15	45	17	5
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	11.0	80.8	80.8	12.5	82.3		12.8	12.8	12.5	20.2	20.2	20.2
Effective Green, g (s)	11.0	80.8	80.8	12.5	82.3		12.8	12.8	12.5	20.2	20.2	20.2
Actuated g/C Ratio	0.08	0.62	0.62	0.10	0.63		0.10	0.10	0.10	0.16	0.16	0.16
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	150	3161	984	170	3139		137	183	152	170	289	246
v/s Ratio Prot	0.06	c0.49		c0.07	0.48			0.05	0.01	c0.01	0.01	
v/s Ratio Perm			0.02				c0.06			0.03		0.00
v/c Ratio	0.68	0.78	0.03	0.73	0.75		0.64	0.48	0.10	0.26	0.06	0.02
Uniform Delay, d1	57.8	18.1	9.5	57.1	16.8		56.4	55.4	53.6	47.7	46.8	46.5
Progression Factor	1.11	2.08	2.50	0.87	0.02		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.9	1.3	0.0	1.4	0.2		9.9	1.9	0.3	0.8	0.1	0.0
Delay (s)	72.1	39.1	23.7	51.4	0.5		66.3	57.4	53.9	48.5	46.9	46.6
Level of Service	E	D	C	D	A		E	E	D	D	D	D
Approach Delay (s)		40.1			3.0			58.1			47.5	
Approach LOS		D			A			E			D	

Intersection Summary			
HCM Average Control Delay	24.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	77.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	106	2474	3089	143
v/c Ratio	0.41	0.74	1.06	0.27
Control Delay	30.0	9.8	48.2	31.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	30.0	9.8	48.2	31.5
Queue Length 50th (ft)	74	173	~1024	32
Queue Length 95th (ft)	m88	313	m#360	67
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	456	3344	2919	521
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.23	0.74	1.06	0.27

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	101	2350	2411	523	80	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.97		0.94	
Flt Protected	0.95	1.00	1.00		0.97	
Satd. Flow (prot)	1770	5085	4949		3293	
Flt Permitted	0.95	1.00	1.00		0.97	
Satd. Flow (perm)	1770	5085	4949		3293	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	106	2474	2538	551	84	59
RTOR Reduction (vph)	0	0	26	0	51	0
Lane Group Flow (vph)	106	2474	3063	0	92	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	18.9	85.5	76.0		18.6	
Effective Green, g (s)	18.9	85.5	76.0		18.6	
Actuated g/C Ratio	0.15	0.66	0.58		0.14	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	257	3344	2893		471	
v/s Ratio Prot	c0.06	c0.49	c0.62		c0.03	
v/s Ratio Perm						
v/c Ratio	0.41	0.74	1.06		0.20	
Uniform Delay, d1	50.5	14.8	27.0		49.1	
Progression Factor	0.54	0.59	0.75		1.00	
Incremental Delay, d2	0.7	1.0	27.4		0.9	
Delay (s)	27.9	9.7	47.6		50.0	
Level of Service	C	A	D		D	
Approach Delay (s)		10.4	47.6		50.0	
Approach LOS		B	D		D	

Intersection Summary			
HCM Average Control Delay	31.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	141	2345	64	42	3435	167	46	110
v/c Ratio	0.99	0.66	0.06	0.39	1.03	1.03	0.27	0.37
Control Delay	97.4	1.1	0.1	69.1	48.2	132.9	55.1	17.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	97.4	1.1	0.1	69.1	48.2	132.9	55.1	17.1
Queue Length 50th (ft)	114	17	0	35	~1137	~149	35	12
Queue Length 95th (ft)	m#207	21	m0	74	#1210	#298	76	68
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	143	3534	1120	123	3320	162	173	300
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.99	0.66	0.06	0.34	1.03	1.03	0.27	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	134	2228	61	40	3069	194	113	35	10	44	15	89
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.64		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1191		1287	1624	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	141	2345	64	42	3231	204	119	37	11	46	16	94
RTOR Reduction (vph)	0	0	20	0	6	0	0	2	0	0	81	0
Lane Group Flow (vph)	141	2345	44	42	3429	0	0	165	0	46	29	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	11.6	89.3	89.3	6.7	84.4			17.5		17.5	17.5	
Effective Green, g (s)	11.6	89.3	89.3	6.7	84.4			17.5		17.5	17.5	
Actuated g/C Ratio	0.09	0.69	0.69	0.05	0.65			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	158	3493	1087	91	3272			160		173	219	
v/s Ratio Prot	c0.08	0.46		0.02	c0.68						0.02	
v/s Ratio Perm			0.03					c0.14		0.04		
v/c Ratio	0.89	0.67	0.04	0.46	1.05			1.03		0.27	0.13	
Uniform Delay, d1	58.6	11.8	6.6	59.9	22.8			56.2		50.5	49.6	
Progression Factor	0.60	0.03	0.00	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	31.7	0.7	0.0	3.7	30.2			80.1		0.8	0.3	
Delay (s)	66.6	1.1	0.0	63.6	53.0			136.4		51.3	49.8	
Level of Service	E	A	A	E	D			F		D	D	
Approach Delay (s)		4.7			53.2			136.4			50.3	
Approach LOS		A			D			F			D	

Intersection Summary			
HCM Average Control Delay	35.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	100.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	17	1118	72	1250	62	164	471	58	123	87
v/c Ratio	0.12	0.72	0.29	0.71	0.15	0.26	0.74	0.14	0.20	0.16
Control Delay	17.0	19.0	11.1	15.0	15.7	16.4	20.0	15.7	15.8	10.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.0	19.0	11.1	15.0	15.7	16.4	20.0	15.7	15.8	10.7
Queue Length 50th (ft)	4	183	11	168	18	49	112	17	36	15
Queue Length 95th (ft)	20	318	36	309	42	89	213	40	69	42
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	168	1895	251	2316	704	1038	951	677	1038	897
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.59	0.29	0.54	0.09	0.16	0.50	0.09	0.12	0.10

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	1006	56	68	1175	12	59	156	447	55	117	83
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3511		1770	3534		1770	1863	1583	1770	1863	1583
Flt Permitted	0.17	1.00		0.14	1.00		0.68	1.00	1.00	0.65	1.00	1.00
Satd. Flow (perm)	311	3511		259	3534		1263	1863	1583	1217	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	17	1059	59	72	1237	13	62	164	471	58	123	87
RTOR Reduction (vph)	0	5	0	0	1	0	0	0	104	0	0	23
Lane Group Flow (vph)	17	1113	0	72	1249	0	62	164	367	58	123	64
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	25.8	25.8		30.8	30.8		19.7	19.7	19.7	19.7	19.7	19.7
Effective Green, g (s)	25.8	25.8		30.8	30.8		19.7	19.7	19.7	19.7	19.7	19.7
Actuated g/C Ratio	0.43	0.43		0.52	0.52		0.33	0.33	0.33	0.33	0.33	0.33
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	135	1522		185	1829		418	617	524	403	617	524
v/s Ratio Prot		0.32		0.01	c0.35			0.09			0.07	
v/s Ratio Perm	0.05			0.19			0.05		c0.23	0.05		0.04
v/c Ratio	0.13	0.73		0.39	0.68		0.15	0.27	0.70	0.14	0.20	0.12
Uniform Delay, d1	10.1	14.0		9.2	10.7		14.0	14.6	17.3	14.0	14.3	13.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	1.8		1.4	1.1		0.2	0.2	4.1	0.2	0.2	0.1
Delay (s)	10.5	15.8		10.6	11.8		14.2	14.8	21.4	14.1	14.4	14.0
Level of Service	B	B		B	B		B	B	C	B	B	B
Approach Delay (s)		15.7			11.7			19.2			14.2	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	59.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	2006	1447	539	1020	519	234
v/c Ratio	0.75	0.67	0.33	0.61	0.33	0.33
Control Delay	28.3	30.5	0.6	23.2	18.1	18.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.3	30.5	0.6	23.2	18.1	18.7
Queue Length 50th (ft)	327	298	0	272	120	105
Queue Length 95th (ft)	371	343	0	341	163	171
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2780	2224	1611	1660	1551	703
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.65	0.33	0.61	0.33	0.33

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1735	171	0	1375	0	0	0	512	969	304	411
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.94	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6322			5085				1611	3433	3195	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6322			5085				1611	3433	3195	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1826	180	0	1447	0	0	0	539	1020	320	433
RTOR Reduction (vph)	0	15	0	0	0	0	0	0	0	0	6	6
Lane Group Flow (vph)	0	1991	0	0	1447	0	0	0	539	1020	513	228
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		46.5			46.5				110.0	53.2	53.2	53.2
Effective Green, g (s)		46.5			46.5				110.0	53.2	53.2	53.2
Actuated g/C Ratio		0.42			0.42				1.00	0.48	0.48	0.48
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2672			2150				1611	1660	1545	697
v/s Ratio Prot		c0.31			0.28					c0.30	0.16	
v/s Ratio Perm									0.33			0.16
v/c Ratio		0.75			0.67				0.33	0.61	0.33	0.33
Uniform Delay, d1		26.8			25.6				0.0	20.9	17.5	17.4
Progression Factor		1.00			1.14				1.00	1.00	1.00	1.00
Incremental Delay, d2		1.4			0.9				0.6	1.7	0.6	1.2
Delay (s)		28.2			30.0				0.6	22.6	18.0	18.7
Level of Service		C			C				A	C	B	B
Approach Delay (s)		28.2			30.0			0.6			20.7	
Approach LOS		C			C			A			C	

Intersection Summary			
HCM Average Control Delay	23.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	64.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	3134	1185	769	714	279
v/c Ratio	0.81	0.55	0.61	0.67	0.32
Control Delay	18.1	4.7	4.0	36.9	30.4
Queue Delay	0.1	0.5	1.6	0.0	0.0
Total Delay	18.2	5.2	5.6	36.9	30.4
Queue Length 50th (ft)	484	76	79	225	85
Queue Length 95th (ft)	517	113	m114	291	125
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3880	2143	1262	1061	862
Starvation Cap Reductn	129	483	308	0	0
Spillback Cap Reductn	67	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.84	0.71	0.81	0.67	0.32

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2977	0	0	1126	731	678	0	265	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	3134	0	0	1185	769	714	0	279	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	303	0	0	1	0	0	0
Lane Group Flow (vph)	0	3134	0	0	1185	466	714	0	278	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		66.6			66.6	66.6	34.0		34.0			
Effective Green, g (s)		66.6			66.6	66.6	34.0		34.0			
Actuated g/C Ratio		0.61			0.61	0.61	0.31		0.31			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3880			2143	958	1061		861			
v/s Ratio Prot		c0.49			0.33							
v/s Ratio Perm						0.29	c0.21		0.10			
v/c Ratio		0.81			0.55	0.49	0.67		0.32			
Uniform Delay, d1		16.8			12.9	12.1	33.1		29.2			
Progression Factor		0.97			0.31	3.23	1.00		1.00			
Incremental Delay, d2		1.2			0.3	0.5	3.4		1.0			
Delay (s)		17.5			4.3	39.7	36.6		30.2			
Level of Service		B			A	D	D		C			
Approach Delay (s)		17.5			18.2			34.8			0.0	
Approach LOS		B			B			C			A	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	70.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	812	2056	6	1244	197	96	149	304	295
v/c Ratio	0.93	0.73	0.05	0.87	0.83	0.29	0.24	0.80	0.64
Control Delay	40.9	8.0	49.7	44.9	74.6	44.8	39.2	33.6	11.7
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.9	8.2	49.7	44.9	74.6	44.8	39.2	33.6	11.7
Queue Length 50th (ft)	304	95	4	309	138	31	45	78	0
Queue Length 95th (ft)	#406	543	18	#397	#271	57	76	#205	83
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	877	2826	113	1436	238	706	617	413	493
Starvation Cap Reductn	0	180	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.78	0.05	0.87	0.83	0.14	0.24	0.74	0.60

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	771	1748	205	6	1060	122	187	84	8	142	49	520
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.98		1.00	0.98		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5005		1770	5007		1770	3495		3433	1550	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5005		1770	5007		1770	3495		3433	1550	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	812	1840	216	6	1116	128	197	88	8	149	52	547
RTOR Reduction (vph)	0	11	0	0	13	0	0	7	0	0	164	254
Lane Group Flow (vph)	812	2045	0	6	1231	0	197	89	0	149	140	41
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	32.0	57.9		1.4	27.3		14.9	10.3		19.8	15.2	15.2
Effective Green, g (s)	32.0	57.9		1.4	27.3		14.9	10.3		19.8	15.2	15.2
Actuated g/C Ratio	0.29	0.53		0.01	0.25		0.14	0.09		0.18	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	999	2634		23	1243		240	327		618	214	208
v/s Ratio Prot	0.24	c0.41		0.00	c0.25		c0.11	0.03		c0.04	c0.09	
v/s Ratio Perm												0.03
v/c Ratio	0.81	0.78		0.26	0.99		0.82	0.27		0.24	0.66	0.20
Uniform Delay, d1	36.2	20.9		53.8	41.2		46.3	46.4		38.7	44.9	42.0
Progression Factor	0.70	0.35		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.4	1.4		8.1	23.4		20.5	0.6		0.3	7.8	0.6
Delay (s)	28.8	8.7		61.9	64.6		66.7	47.0		38.9	52.7	42.6
Level of Service	C	A		E	E		E	D		D	D	D
Approach Delay (s)		14.4			64.6			60.3			46.0	
Approach LOS		B			E			E			D	

Intersection Summary			
HCM Average Control Delay	33.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	20.6
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1877	1304	671	848
v/c Ratio	0.62	0.62	0.71	0.54
Control Delay	11.2	11.7	27.1	1.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	11.2	11.7	27.1	1.3
Queue Length 50th (ft)	170	170	134	0
Queue Length 95th (ft)	268	288	165	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3004	2091	1609	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	14	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.62	0.62	0.42	0.54

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1783	1239	0	637	806
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1877	1304	0	671	848
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1877	1304	0	671	848
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		41.4	41.4		19.1	70.0
Effective Green, g (s)		41.4	41.4		19.1	70.0
Actuated g/C Ratio		0.59	0.59		0.27	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3007	2093		937	1583
v/s Ratio Prot		c0.37	0.37		c0.20	
v/s Ratio Perm						0.54
v/c Ratio		0.62	0.62		0.72	0.54
Uniform Delay, d1		9.3	9.3		23.0	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		1.0	1.3		2.5	1.3
Delay (s)		10.3	10.6		25.5	1.3
Level of Service		B	B		C	A
Approach Delay (s)		10.3	10.6		12.0	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	10.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2041	969	179	1279
v/c Ratio	0.78	0.80	0.79	0.36
Control Delay	8.8	11.1	56.6	0.3
Queue Delay	0.2	0.1	0.0	0.0
Total Delay	8.9	11.2	56.6	0.3
Queue Length 50th (ft)	301	244	76	0
Queue Length 95th (ft)	441	449	#174	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2618	1217	228	3539
Starvation Cap Reductn	95	8	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.81	0.80	0.79	0.36

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1939	921	170	1215	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2041	969	179	1279	0	0
RTOR Reduction (vph)	0	46	0	0	0	0
Lane Group Flow (vph)	2041	923	179	1279	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	51.8	51.8	8.9	70.0		
Effective Green, g (s)	51.8	51.8	8.9	70.0		
Actuated g/C Ratio	0.74	0.74	0.13	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2619	1171	225	3539		
v/s Ratio Prot	0.58		c0.10	0.36		
v/s Ratio Perm		c0.58				
v/c Ratio	0.78	0.79	0.80	0.36		
Uniform Delay, d1	5.6	5.7	29.7	0.0		
Progression Factor	1.11	1.11	1.00	1.00		
Incremental Delay, d2	2.1	4.9	17.4	0.3		
Delay (s)	8.3	11.2	47.1	0.3		
Level of Service	A	B	D	A		
Approach Delay (s)	9.2			6.0	0.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	8.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	74.2%	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 (veh/h)	0	0	326	0	0	570	0	848	611	0	729	342
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	343	0	0	600	0	893	643	0	767	360
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.89	0.89		0.89	0.89	0.89				0.89		
vC, conflicting volume	1065	1660	256	1148	1660	298	767			893		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	639	1308	256	733	1308	0	767			446		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	54	100	100	38	100			100		
cM capacity (veh/h)	121	141	743	148	141	965	842			988		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	343	600	357	357	393	429	307	307	273	240
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	343	600	0	0	214	429	0	0	120	240
cSH	743	965	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.46	0.62	0.21	0.21	0.23	0.25	0.18	0.18	0.16	0.14
Queue Length 95th (ft)	61	112	0	0	0	0	0	0	0	0
Control Delay (s)	13.9	14.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	B								
Approach Delay (s)	13.9	14.7	0.0				0.0			
Approach LOS	B	B								

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	715	0	1331	582	370
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	753	0	1401	613	389
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.87					
vC, conflicting volume	963	204	613			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	229	204	613			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	6	100			
cM capacity (veh/h)	645	803	963			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	753	350	350	350	350	245	245	252	260
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	753	0	0	0	0	0	0	130	260
cSH	803	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.94	0.21	0.21	0.21	0.21	0.14	0.14	0.15	0.15
Queue Length 95th (ft)	349	0	0	0	0	0	0	0	0
Control Delay (s)	41.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	E								
Approach Delay (s)	41.2	0.0				0.0			
Approach LOS	E								

Intersection Summary			
Average Delay	9.8		
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	164	1954	311	216	905	236	212	1076	151	1103
v/c Ratio	0.54	0.98	0.36	0.89	0.51	0.36	0.62	0.71	0.42	0.91
Control Delay	54.6	49.8	15.4	86.4	27.8	4.8	55.3	39.9	50.6	51.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.6	49.8	15.4	86.4	27.8	4.8	55.3	39.9	50.6	51.6
Queue Length 50th (ft)	57	495	116	79	191	0	74	196	52	274
Queue Length 95th (ft)	93	#619	177	#151	236	60	113	229	87	#357
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	328	1989	872	243	1791	656	372	1681	359	1222
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.98	0.36	0.89	0.51	0.36	0.57	0.64	0.42	0.90

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	156	1856	295	205	835	249	201	897	125	143	931	117
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4785	1362	3433	6290		3433	5000	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4785	1362	3433	6290		3433	5000	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	164	1954	311	216	879	262	212	944	132	151	980	123
RTOR Reduction (vph)	0	0	4	0	3	148	0	24	0	0	14	0
Lane Group Flow (vph)	164	1954	307	216	902	88	212	1052	0	151	1089	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	9.6	42.6	53.5	7.7	40.7	40.7	10.9	25.6		11.4	26.1	
Effective Green, g (s)	9.6	42.6	53.5	7.7	40.7	40.7	10.9	25.6		11.4	26.1	
Actuated g/C Ratio	0.09	0.39	0.49	0.07	0.37	0.37	0.10	0.24		0.10	0.24	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	303	1989	856	243	1788	509	344	1479		359	1198	
v/s Ratio Prot	0.05	c0.38	0.04	c0.06	0.19		0.06	c0.17		0.04	c0.22	
v/s Ratio Perm			0.16			0.06						
v/c Ratio	0.54	0.98	0.36	0.89	0.50	0.17	0.62	0.71		0.42	0.91	
Uniform Delay, d1	47.5	32.8	17.1	50.2	26.3	22.8	47.0	38.3		45.7	40.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.0	16.1	0.3	29.9	0.2	0.2	3.3	1.6		0.8	10.1	
Delay (s)	49.5	48.9	17.4	80.1	26.5	23.0	50.3	39.9		46.5	50.3	
Level of Service	D	D	B	F	C	C	D	D		D	D	
Approach Delay (s)		44.9			34.5			41.6			49.9	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	43.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	108.9	Sum of lost time (s)	16.2
Intersection Capacity Utilization	86.0%	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)	0	1562	611	0	710	0	0	0	0	0	0	691
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	1644	643	0	747	0	0	0	0	0	0	727
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.63			0.63	0.63	0.63	0.63	0.63	
vC, conflicting volume	747			2287			2215	2713	870	1295	3035	249
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	747			993			878	1668	0	0	2178	249
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	3
cM capacity (veh/h)	857			437			5	60	684	645	29	751

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	658	658	972	249	249	249	727
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	643	0	0	0	727
cSH	1700	1700	1700	1700	1700	1700	751
Volume to Capacity	0.39	0.39	0.57	0.15	0.15	0.15	0.97
Queue Length 95th (ft)	0	0	0	0	0	0	378
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	49.0
Lane LOS							E
Approach Delay (s)	0.0			0.0			49.0
Approach LOS							E

Intersection Summary			
Average Delay	9.5		
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	43	168	218	208	20	1693	483	1523
v/c Ratio	0.37	0.63	0.69	0.66	0.12	0.51	0.35	0.44
Control Delay	43.2	52.4	36.8	34.4	2.2	1.5	0.3	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.2	52.4	36.8	34.4	2.2	1.5	0.3	9.5
Queue Length 50th (ft)	18	118	96	85	1	42	0	177
Queue Length 95th (ft)	55	175	171	155	m2	m41	m0	267
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	125	428	448	448	173	3288	1362	3500
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.39	0.49	0.46	0.12	0.51	0.35	0.44

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	0	16	178	40	347	19	1508	560	0	1425	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.95		1.00	0.89	0.85	1.00	0.99	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1712		1681	1505	1504	1770	4761	1362		5074	
Flt Permitted		0.97		0.95	1.00	1.00	0.13	1.00	1.00		1.00	
Satd. Flow (perm)		1712		1681	1505	1504	251	4761	1362		5074	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	26	0	17	187	42	365	20	1587	589	0	1500	23
RTOR Reduction (vph)	0	16	0	0	73	73	0	5	0	0	1	0
Lane Group Flow (vph)	0	27	0	168	145	135	20	1688	483	0	1522	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		4.2		17.6	17.6	17.6	74.2	74.2	110.0		74.2	
Effective Green, g (s)		4.2		17.6	17.6	17.6	74.2	74.2	110.0		74.2	
Actuated g/C Ratio		0.04		0.16	0.16	0.16	0.67	0.67	1.00		0.67	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		65		269	241	241	169	3212	1362		3423	
v/s Ratio Prot		0.02		c0.10	0.10			c0.35			0.30	
v/s Ratio Perm						0.09	0.08		c0.35			
v/c Ratio		0.41		0.62	0.60	0.56	0.12	0.53	0.35		0.44	
Uniform Delay, d1		51.7		43.1	42.9	42.6	6.3	9.0	0.0		8.3	
Progression Factor		1.00		1.00	1.00	1.00	0.16	0.13	1.00		1.00	
Incremental Delay, d2		4.2		4.5	4.2	2.8	0.6	0.3	0.3		0.4	
Delay (s)		55.9		47.6	47.1	45.4	1.6	1.4	0.3		8.7	
Level of Service		E		D	D	D	A	A	A		A	
Approach Delay (s)		55.9			46.7			1.1			8.7	
Approach LOS		E			D			A			A	

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	277	1965	145	1062	180	1899	45	1362
v/c Ratio	0.89	1.11	1.28	0.88	0.93	0.91	0.70	0.83
Control Delay	74.5	92.5	207.5	53.3	47.0	13.3	92.3	31.7
Queue Delay	0.0	10.9	0.0	0.0	0.0	47.1	0.0	0.0
Total Delay	74.5	103.4	207.5	53.3	47.0	60.5	92.3	31.7
Queue Length 50th (ft)	194	~574	~135	283	138	322	32	330
Queue Length 95th (ft)	#351	#672	#267	#332	m130	m276	m#96	216
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	312	1767	113	1226	193	2082	64	1633
Starvation Cap Reductn	0	0	0	0	0	361	0	0
Spillback Cap Reductn	0	39	0	0	0	16	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	1.14	1.28	0.87	0.93	1.10	0.70	0.83

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	263	1489	378	138	810	199	171	1779	25	43	1216	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4931		1770	4935		1770	5075		1770	5039	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4931		1770	4935		1770	5075		1770	5039	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	277	1567	398	145	853	209	180	1873	26	45	1280	82
RTOR Reduction (vph)	0	40	0	0	38	0	0	1	0	0	7	0
Lane Group Flow (vph)	277	1925	0	145	1024	0	180	1898	0	45	1355	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	19.4	38.5		7.0	26.1		12.8	44.3		3.2	34.7	
Effective Green, g (s)	19.4	38.5		7.0	26.1		12.8	44.3		3.2	34.7	
Actuated g/C Ratio	0.18	0.35		0.06	0.24		0.12	0.40		0.03	0.32	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	312	1726		113	1171		206	2044		51	1590	
v/s Ratio Prot	0.16	c0.39		c0.08	0.21		c0.10	c0.37		0.03	0.27	
v/s Ratio Perm												
v/c Ratio	0.89	1.12		1.28	0.87		0.87	0.93		0.88	0.85	
Uniform Delay, d1	44.2	35.8		51.5	40.4		47.8	31.3		53.2	35.3	
Progression Factor	1.00	1.00		0.79	1.18		0.72	0.37		0.84	0.78	
Incremental Delay, d2	24.8	60.5		171.3	6.2		4.0	1.0		79.0	5.5	
Delay (s)	69.0	96.2		212.0	54.0		38.6	12.6		123.9	33.0	
Level of Service	E	F		F	D		D	B		F	C	
Approach Delay (s)		92.8			73.0			14.8			35.9	
Approach LOS		F			E			B			D	

Intersection Summary			
HCM Average Control Delay	54.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	97.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	428	1165	304	281	655	23	1731	533	1826
v/c Ratio	0.99	0.92	0.78	0.97	0.70	0.34	1.08	0.57	0.80
Control Delay	78.0	48.9	44.5	72.7	20.5	36.3	76.0	8.4	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	96.4	0.0	0.2
Total Delay	78.0	48.9	44.5	72.7	20.5	36.3	172.4	8.4	8.1
Queue Length 50th (ft)	311	252	165	207	106	10	~718	61	116
Queue Length 95th (ft)	#539	#411	#351	m#255	m104	39	#857	161	m155
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	432	1265	392	290	1109	68	1609	930	2278
Starvation Cap Reductn	0	0	0	0	0	0	0	0	56
Spillback Cap Reductn	0	0	0	0	0	0	273	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.99	0.92	0.78	0.97	0.59	0.34	1.30	0.57	0.82

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	407	1074	321	267	617	6	22	1644	506	0	1251	484
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4785	1362	1770	5078		1770	3539	1583		4873	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.08	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4785	1362	1770	5078		149	3539	1583		4873	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	428	1131	338	281	649	6	23	1731	533	0	1317	509
RTOR Reduction (vph)	0	3	33	0	1	0	0	0	211	0	63	0
Lane Group Flow (vph)	428	1162	271	281	654	0	23	1731	322	0	1763	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	26.8	29.0	29.0	18.0	20.2		50.0	50.0	50.0		50.0	
Effective Green, g (s)	26.8	29.0	29.0	18.0	20.2		50.0	50.0	50.0		50.0	
Actuated g/C Ratio	0.24	0.26	0.26	0.16	0.18		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	431	1262	359	290	933		68	1609	720		2215	
v/s Ratio Prot	c0.24	c0.24		0.16	0.13			c0.49			0.36	
v/s Ratio Perm			0.20				0.15		0.20			
v/c Ratio	0.99	0.92	0.75	0.97	0.70		0.34	1.08	0.45		0.80	
Uniform Delay, d1	41.5	39.4	37.2	45.7	42.1		19.3	30.0	20.5		25.6	
Progression Factor	0.85	0.93	0.95	0.77	0.42		1.00	1.00	1.00		0.28	
Incremental Delay, d2	40.1	10.5	8.3	33.8	1.5		13.0	45.9	2.0		1.1	
Delay (s)	75.5	47.3	43.7	69.0	19.4		32.3	75.9	22.6		8.3	
Level of Service	E	D	D	E	B		C	E	C		A	
Approach Delay (s)		53.1			34.3			63.0			8.3	
Approach LOS		D			C			E			A	

Intersection Summary			
HCM Average Control Delay	42.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	474	1784	0	0	1817
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	499	1878	0	0	1913
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked	0.74					
vC, conflicting volume	2515	626			1878	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1811	626			1878	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	52	427			316	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	499	626	626	626	638	638	638
Volume Left	0	0	0	0	0	0	0
Volume Right	499	0	0	0	0	0	0
cSH	427	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.17	0.37	0.37	0.37	0.38	0.38	0.38
Queue Length 95th (ft)	472	0	0	0	0	0	0
Control Delay (s)	128.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F						
Approach Delay (s)	128.0	0.0			0.0		
Approach LOS	F						

Intersection Summary			
Average Delay	14.9		
Intersection Capacity Utilization	70.5%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1243	1006	654
v/c Ratio	0.36	0.29	0.78
Control Delay	8.3	8.9	43.9
Queue Delay	0.0	0.0	0.0
Total Delay	8.3	8.9	43.9
Queue Length 50th (ft)	121	84	216
Queue Length 95th (ft)	180	254	259
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	3454	3454	1369
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.36	0.29	0.48

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1181	956	0	528	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3388	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3388	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1243	1006	0	556	98
RTOR Reduction (vph)	0	0	0	0	17	0
Lane Group Flow (vph)	0	1243	1006	0	637	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		74.7	74.7		26.8	
Effective Green, g (s)		74.7	74.7		26.8	
Actuated g/C Ratio		0.68	0.68		0.24	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		3453	3453		825	
v/s Ratio Prot		c0.24	0.20		c0.19	
v/s Ratio Perm						
v/c Ratio		0.36	0.29		0.77	
Uniform Delay, d1		7.5	7.1		38.8	
Progression Factor		1.00	1.15		1.00	
Incremental Delay, d2		0.3	0.2		4.5	
Delay (s)		7.8	8.3		43.3	
Level of Service		A	A		D	
Approach Delay (s)		7.8	8.3		43.3	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	175	1436	441	1143	222	802	671	148	622
v/c Ratio	0.78	0.96	1.25	0.61	0.34	0.59	0.75	0.95	0.32
Control Delay	37.8	14.7	170.2	30.2	15.0	9.9	11.3	97.2	21.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
Total Delay	37.8	14.7	170.2	30.2	15.0	9.9	11.8	97.2	21.8
Queue Length 50th (ft)	89	330	~389	242	58	77	94	100	99
Queue Length 95th (ft)	m79	m234	#586	290	121	m95	m112	#233	131
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	241	1502	354	1874	648	1367	900	155	1944
Starvation Cap Reductn	0	0	0	0	0	0	44	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.96	1.25	0.61	0.34	0.59	0.78	0.95	0.32

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	166	1364	0	419	1086	211	0	762	637	141	477	114
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4938	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.22	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	402	4938	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	175	1436	0	441	1143	222	0	802	671	148	502	120
RTOR Reduction (vph)	0	0	0	0	0	65	0	0	288	0	36	0
Lane Group Flow (vph)	175	1436	0	441	1143	157	0	802	383	148	586	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	14.0	32.5		22.0	40.5	40.5		42.5	42.5	42.5	42.5	
Effective Green, g (s)	14.0	32.5		22.0	40.5	40.5		42.5	42.5	42.5	42.5	
Actuated g/C Ratio	0.13	0.30		0.20	0.37	0.37		0.39	0.39	0.39	0.39	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	225	1502		354	1872	583		1367	612	155	1908	
v/s Ratio Prot	0.10	c0.28		c0.25	0.22			0.23			0.12	
v/s Ratio Perm						0.10			0.24	c0.37		
v/c Ratio	0.78	0.96		1.25	0.61	0.27		0.59	0.63	0.95	0.31	
Uniform Delay, d1	46.5	38.0		44.0	28.3	24.4		26.8	27.3	32.8	23.5	
Progression Factor	0.74	0.29		1.00	1.00	1.00		0.33	0.96	1.00	1.00	
Incremental Delay, d2	1.6	2.1		132.2	1.5	1.1		1.0	2.7	61.2	0.4	
Delay (s)	36.0	13.0		176.2	29.8	25.5		9.8	28.9	94.0	23.9	
Level of Service	D	B		F	C	C		A	C	F	C	
Approach Delay (s)		15.5			65.0			18.5			37.4	
Approach LOS		B			E			B			D	

Intersection Summary			
HCM Average Control Delay	35.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	93.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	155	1755	114	1345	228	303	20	40	581	141
v/c Ratio	0.79	0.93	0.88	0.79	0.89	0.25	0.04	0.37	0.74	0.31
Control Delay	70.8	39.0	100.6	33.4	76.0	23.9	9.8	54.7	41.2	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	70.8	39.0	100.6	33.4	76.0	23.9	9.8	54.7	41.2	8.9
Queue Length 50th (ft)	95	372	72	276	141	73	0	24	175	6
Queue Length 95th (ft)	#204	#502	#180	345	#287	108	17	59	234	53
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	202	1885	129	1700	258	1246	570	110	919	506
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.93	0.88	0.79	0.88	0.24	0.04	0.36	0.63	0.28

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	147	1374	294	108	1198	80	217	288	19	38	552	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	4951		1770	5038		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	4951		1770	5038		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	155	1446	309	114	1261	84	228	303	20	40	581	141
RTOR Reduction (vph)	0	33	0	0	7	0	0	0	13	0	0	98
Lane Group Flow (vph)	155	1722	0	114	1338	0	228	303	7	40	581	43
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	10.7	36.1		7.0	32.4		14.0	33.5	33.5	3.5	23.0	23.0
Effective Green, g (s)	10.7	36.1		7.0	32.4		14.0	33.5	33.5	3.5	23.0	23.0
Actuated g/C Ratio	0.11	0.37		0.07	0.33		0.14	0.34	0.34	0.04	0.23	0.23
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	193	1822		126	1664		253	1209	541	63	830	371
v/s Ratio Prot	c0.09	c0.35		0.06	0.27		c0.13	0.09		0.02	c0.16	
v/s Ratio Perm									0.00			0.03
v/c Ratio	0.80	0.95		0.90	0.80		0.90	0.25	0.01	0.63	0.70	0.12
Uniform Delay, d1	42.7	30.0		45.2	30.0		41.4	23.3	21.4	46.7	34.4	29.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.9	10.7		51.7	2.9		31.8	0.1	0.0	19.1	2.6	0.1
Delay (s)	63.6	40.8		96.9	32.9		73.2	23.4	21.4	65.7	37.0	29.7
Level of Service	E	D		F	C		E	C	C	E	D	C
Approach Delay (s)		42.6			37.9			43.9			37.1	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	40.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	98.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	229	0	278	0	0	706	315	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	241	0	293	0	0	743	332	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.84		0.84						0.84	0.84
vC, conflicting volume	1367	146	1075			293			1131	1036
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1341	146	991			293			1058	944
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	72	100			100			100	100
cM capacity (veh/h)	126	874	579			1266			108	218

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	241	146	146	743	332
Volume Left	0	0	0	0	0
Volume Right	241	0	0	0	332
cSH	874	1700	1700	1700	1700
Volume to Capacity	0.28	0.09	0.09	0.44	0.20
Queue Length 95th (ft)	28	0	0	0	0
Control Delay (s)	10.7	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	10.7	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	68.3%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	704	0	0	0	0	0	0	351	342	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	741	0	0	0	0	0	0	369	360	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked	0.94	0.94	0.94	0.94	0.94		0.94					
vC, conflicting volume	1099	1099	360	1840	1099	0	360			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1074	1074	290	1861	1074	0	290			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	0	0	100	100	100			77		
cM capacity (veh/h)	153	160	706	0	160	1085	1198			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	741	369	360
Volume Left	0	369	0
Volume Right	741	0	0
cSH	706	1623	1700
Volume to Capacity	1.05	0.23	0.21
Queue Length 95th (ft)	476	22	0
Control Delay (s)	71.7	7.9	0.0
Lane LOS	F	A	
Approach Delay (s)	71.7	4.0	
Approach LOS	F		

Intersection Summary			
Average Delay	38.1		
Intersection Capacity Utilization	68.3%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	459	379	153	779	341	773
v/c Ratio	0.80	0.62	0.49	0.42	0.34	0.42
Control Delay	30.2	15.4	12.8	6.9	1.3	10.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.2	15.4	12.8	6.9	1.3	10.0
Queue Length 50th (ft)	140	65	24	50	3	88
Queue Length 95th (ft)	#266	141	m64	65	9	127
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	634	657	310	1861	995	1859
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.58	0.49	0.42	0.34	0.42

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	436	10	350	145	740	324	0	727	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.85		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1591		1770	3539	1583		3534	
Flt Permitted				0.95	1.00		0.32	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1591		588	3539	1583		3534	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	459	11	368	153	779	341	0	765	8
RTOR Reduction (vph)	0	0	0	0	91	0	0	0	161	0	1	0
Lane Group Flow (vph)	0	0	0	459	288	0	153	779	180	0	772	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				19.4	19.4		31.6	31.6	31.6		31.6	
Effective Green, g (s)				19.4	19.4		31.6	31.6	31.6		31.6	
Actuated g/C Ratio				0.32	0.32		0.53	0.53	0.53		0.53	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				572	514		310	1864	834		1861	
v/s Ratio Prot				c0.26	0.18			0.22			0.22	
v/s Ratio Perm							c0.26		0.11			
v/c Ratio				0.80	0.56		0.49	0.42	0.22		0.41	
Uniform Delay, d1				18.5	16.8		9.1	8.6	7.6		8.6	
Progression Factor				1.00	1.00		0.70	0.67	0.39		1.00	
Incremental Delay, d2				8.0	1.3		4.6	0.6	0.5		0.7	
Delay (s)				26.5	18.1		11.0	6.4	3.4		9.3	
Level of Service				C	B		B	A	A		A	
Approach Delay (s)		0.0			22.7			6.1			9.3	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	11.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	431	407	1041	1174
v/c Ratio	0.76	0.76	0.54	0.61
Control Delay	27.1	25.7	3.2	7.7
Queue Delay	0.0	0.0	0.0	0.1
Total Delay	27.1	25.7	3.3	7.7
Queue Length 50th (ft)	133	112	41	120
Queue Length 95th (ft)	209	190	65	150
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	679	633	1933	1933
Starvation Cap Reductn	0	0	26	62
Spillback Cap Reductn	0	1	0	80
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.63	0.64	0.55	0.63

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	409	387	0	989	1115	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	431	407	0	1041	1174	0
RTOR Reduction (vph)	0	29	0	0	0	0
Lane Group Flow (vph)	431	378	0	1041	1174	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	19.2	19.2		32.8	32.8	
Effective Green, g (s)	19.2	19.2		32.8	32.8	
Actuated g/C Ratio	0.32	0.32		0.55	0.55	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	566	507		1935	1935	
v/s Ratio Prot				0.29	c0.33	
v/s Ratio Perm	c0.24	0.24				
v/c Ratio	0.76	0.75		0.54	0.61	
Uniform Delay, d1	18.3	18.2		8.7	9.2	
Progression Factor	1.00	1.00		0.24	0.62	
Incremental Delay, d2	6.0	5.9		0.9	1.2	
Delay (s)	24.3	24.1		3.0	7.0	
Level of Service	C	C		A	A	
Approach Delay (s)	24.2			3.0	7.0	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	203	538	345	119	338	89	198	792	486	199	1217	254
v/c Ratio	0.84	0.60	0.54	0.78	0.38	0.19	0.82	0.54	0.68	0.84	0.84	0.33
Control Delay	52.2	22.7	6.7	57.9	19.6	5.9	56.0	15.3	17.6	50.1	17.6	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.2	22.7	6.7	57.9	19.6	5.9	56.0	15.3	17.6	50.1	17.6	2.3
Queue Length 50th (ft)	68	88	6	39	52	0	71	112	110	73	173	3
Queue Length 95th (ft)	#171	132	61	#118	83	28	#172	160	211	m#161	#323	m10
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	256	944	660	160	944	487	240	1464	713	236	1456	763
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.57	0.52	0.74	0.36	0.18	0.82	0.54	0.68	0.84	0.84	0.33

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	193	511	328	113	321	85	188	752	462	189	1156	241
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.52	1.00	1.00	0.32	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	960	3539	1583	600	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	203	538	345	119	338	89	198	792	486	199	1217	254
RTOR Reduction (vph)	0	0	242	0	0	66	0	0	59	0	0	112
Lane Group Flow (vph)	203	538	103	119	338	23	198	792	427	199	1217	142
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	15.2	15.2	15.2	15.2	15.2	15.2	8.1	24.8	24.8	8.0	24.7	24.7
Effective Green, g (s)	15.2	15.2	15.2	15.2	15.2	15.2	8.1	24.8	24.8	8.0	24.7	24.7
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25	0.25	0.13	0.41	0.41	0.13	0.41	0.41
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	243	897	401	152	897	401	239	1463	654	236	1457	652
v/s Ratio Prot		0.15			0.10		c0.11	0.22		0.11	c0.34	
v/s Ratio Perm	c0.21		0.07	0.20		0.01			0.27			0.09
v/c Ratio	0.84	0.60	0.26	0.78	0.38	0.06	0.83	0.54	0.65	0.84	0.84	0.22
Uniform Delay, d1	21.2	19.7	17.9	20.9	18.5	17.0	25.3	13.3	14.1	25.4	15.8	11.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.72	0.32
Incremental Delay, d2	21.3	1.1	0.3	22.6	0.3	0.1	20.5	1.4	5.0	19.5	4.8	0.6
Delay (s)	42.5	20.8	18.2	43.5	18.8	17.0	45.7	14.7	19.2	39.9	16.2	4.3
Level of Service	D	C	B	D	B	B	D	B	B	D	B	A
Approach Delay (s)		24.0			23.9			20.4			17.2	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM Average Control Delay	20.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	194	688	0	441	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	204	724	0	464	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			928		436	102
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			928		436	102
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			732		548	933

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	136	309	483	232	232
Volume Left	0	0	0	0	0
Volume Right	0	241	483	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.08	0.18	0.28	0.14	0.14
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	31.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	197	1671	1083	144
v/c Ratio	0.39	0.47	0.52	0.15
Control Delay	17.4	0.4	9.5	2.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	17.4	0.4	9.5	2.2
Queue Length 50th (ft)	72	0	128	4
Queue Length 95th (ft)	m78	0	174	23
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	506	3539	2098	988
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.39	0.47	0.52	0.15

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	187	1587	1029	137
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	197	1671	1083	144
RTOR Reduction (vph)	0	0	0	0	0	49
Lane Group Flow (vph)	0	0	197	1671	1083	95
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			20.0	70.0	41.5	41.5
Effective Green, g (s)			20.0	70.0	41.5	41.5
Actuated g/C Ratio			0.29	1.00	0.59	0.59
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			506	3539	2098	938
v/s Ratio Prot			0.11	c0.47	0.31	
v/s Ratio Perm						0.06
v/c Ratio			0.39	0.47	0.52	0.10
Uniform Delay, d1			20.1	0.0	8.4	6.2
Progression Factor			0.76	1.00	1.00	1.00
Incremental Delay, d2			0.4	0.4	0.9	0.2
Delay (s)			15.7	0.4	9.3	6.4
Level of Service			B	A	A	A
Approach Delay (s)	0.0			2.0	8.9	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	165	159	0	1708	1046	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	174	167	0	1798	1101	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.75	0.81	0.81			
vC, conflicting volume	2000	551	1101			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	561	0	670			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	50	81	100			
cM capacity (veh/h)	344	884	747			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	116	225	899	899	551	551
Volume Left	116	58	0	0	0	0
Volume Right	0	167	0	0	0	0
cSH	344	630	1700	1700	1700	1700
Volume to Capacity	0.34	0.36	0.53	0.53	0.32	0.32
Queue Length 95th (ft)	36	40	0	0	0	0
Control Delay (s)	20.7	13.9	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	16.2		0.0		0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	266	159	23	70	176	1530	18	952	188
v/c Ratio	0.84	0.19	0.08	0.09	0.45	0.69	0.08	0.56	0.23
Control Delay	50.3	7.1	20.7	11.4	9.1	12.1	4.1	8.0	1.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.3	7.1	20.7	11.4	9.1	12.1	4.1	8.0	1.5
Queue Length 50th (ft)	107	5	8	5	27	197	1	137	1
Queue Length 95th (ft)	#222	26	24	20	50	372	m2	193	6
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	340	895	312	863	408	2203	220	1686	823
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.18	0.07	0.08	0.43	0.69	0.08	0.56	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	253	31	120	22	29	37	167	1418	35	17	904	179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.88		1.00	0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3119		1770	3243		1770	3526		1770	3539	1583
Flt Permitted	0.71	1.00		0.65	1.00		0.19	1.00		0.12	1.00	1.00
Satd. Flow (perm)	1321	3119		1213	3243		347	3526		224	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	266	33	126	23	31	39	176	1493	37	18	952	188
RTOR Reduction (vph)	0	96	0	0	30	0	0	2	0	0	0	69
Lane Group Flow (vph)	266	63	0	23	40	0	176	1528	0	18	952	119
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	16.7	16.7		16.7	16.7		45.3	40.5		34.1	33.3	33.3
Effective Green, g (s)	16.7	16.7		16.7	16.7		45.3	40.5		34.1	33.3	33.3
Actuated g/C Ratio	0.24	0.24		0.24	0.24		0.65	0.58		0.49	0.48	0.48
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	315	744		289	774		387	2040		127	1684	753
v/s Ratio Prot		0.02			0.01		c0.05	c0.43		0.00	0.27	
v/s Ratio Perm	c0.20			0.02			0.24			0.07		0.08
v/c Ratio	0.84	0.08		0.08	0.05		0.45	0.75		0.14	0.57	0.16
Uniform Delay, d1	25.4	20.7		20.7	20.5		6.9	11.0		10.5	13.2	10.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.61	0.48	0.21
Incremental Delay, d2	18.3	0.0		0.1	0.0		0.9	2.6		0.5	1.3	0.4
Delay (s)	43.7	20.8		20.8	20.6		7.8	13.5		6.9	7.6	2.6
Level of Service	D	C		C	C		A	B		A	A	A
Approach Delay (s)		35.1			20.6			12.9			6.8	
Approach LOS		D			C			B			A	

Intersection Summary			
HCM Average Control Delay	13.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	1206	357	1005	100	121	1113
v/c Ratio	0.88	0.46	0.72	0.15	0.71	0.60
Control Delay	39.3	8.6	25.6	5.7	71.0	20.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.3	8.6	25.6	5.7	71.0	20.3
Queue Length 50th (ft)	387	44	195	7	84	287
Queue Length 95th (ft)	479	117	238	m20	#169	357
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1436	810	1390	663	179	1857
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.44	0.72	0.15	0.68	0.60

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	1146	339	955	95	115	1057
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1206	357	1005	100	121	1113
RTOR Reduction (vph)	0	153	0	42	0	0
Lane Group Flow (vph)	1206	204	1005	58	121	1113
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	43.8	43.8	43.1	43.1	10.6	57.7
Effective Green, g (s)	43.8	43.8	43.1	43.1	10.6	57.7
Actuated g/C Ratio	0.40	0.40	0.39	0.39	0.10	0.52
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1367	630	1387	620	171	1856
v/s Ratio Prot	c0.35		c0.28		c0.07	0.31
v/s Ratio Perm		0.13		0.04		
v/c Ratio	0.88	0.32	0.72	0.09	0.71	0.60
Uniform Delay, d1	30.7	22.9	28.4	21.1	48.2	18.1
Progression Factor	1.00	1.00	0.77	0.58	1.00	1.00
Incremental Delay, d2	7.0	0.3	3.0	0.3	12.6	1.4
Delay (s)	37.7	23.2	24.8	12.4	60.8	19.6
Level of Service	D	C	C	B	E	B
Approach Delay (s)	34.4		23.7			23.6
Approach LOS	C		C			C

Intersection Summary			
HCM Average Control Delay	28.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	227	367	826	1240	251	2072
v/c Ratio	0.53	0.76	0.37	0.98	1.12	0.73
Control Delay	48.8	18.4	10.8	31.7	125.8	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.8	18.4	10.8	31.7	125.8	4.2
Queue Length 50th (ft)	79	27	130	434	~207	76
Queue Length 95th (ft)	108	119	211	#970	m#318	324
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	687	577	2244	1262	225	2823
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.64	0.37	0.98	1.12	0.73

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	216	349	785	1178	238	1968
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	227	367	826	1240	251	2072
RTOR Reduction (vph)	0	285	0	258	0	0
Lane Group Flow (vph)	227	82	826	982	251	2072
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	13.7	13.7	69.8	69.8	14.0	87.8
Effective Green, g (s)	13.7	13.7	69.8	69.8	14.0	87.8
Actuated g/C Ratio	0.12	0.12	0.63	0.63	0.13	0.80
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	428	197	2246	1004	225	2825
v/s Ratio Prot	c0.07		0.23		c0.14	0.59
v/s Ratio Perm		0.05		c0.62		
v/c Ratio	0.53	0.42	0.37	0.98	1.12	0.73
Uniform Delay, d1	45.1	44.5	9.6	19.4	48.0	5.4
Progression Factor	1.00	1.00	1.00	1.00	0.91	0.46
Incremental Delay, d2	1.3	1.4	0.5	23.6	84.2	1.2
Delay (s)	46.4	45.9	10.0	43.0	127.8	3.7
Level of Service	D	D	B	D	F	A
Approach Delay (s)	46.1		29.8			17.1
Approach LOS	D		C			B

Intersection Summary			
HCM Average Control Delay	25.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	93.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	49	102	1388	152	74	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	52	107	1461	160	78	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	1697	1541			1461	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1697	1541			1461	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	39	24			83	
cM capacity (veh/h)	85	142			462	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	52	107	1621	78	0
Volume Left	52	0	0	78	0
Volume Right	0	107	160	0	0
cSH	85	142	1700	462	1700
Volume to Capacity	0.61	0.76	0.95	0.17	0.00
Queue Length 95th (ft)	70	114	0	15	0
Control Delay (s)	99.1	83.7	0.0	14.4	0.0
Lane LOS	F	F		B	
Approach Delay (s)	88.7		0.0	14.4	
Approach LOS	F				

Intersection Summary			
Average Delay	8.2		
Intersection Capacity Utilization	95.3%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2056	1589	500	195	1003	605	1051
v/c Ratio	0.90	0.99	0.45	0.86	0.93	0.90	0.74
Control Delay	36.4	21.6	1.6	77.3	50.4	64.9	42.8
Queue Delay	15.1	31.1	0.9	0.0	8.8	0.0	0.0
Total Delay	51.5	52.8	2.5	77.3	59.2	64.9	42.8
Queue Length 50th (ft)	522	133	20	155	282	238	270
Queue Length 95th (ft)	597	m#728	m17	#292	#367	#338	324
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2290	1607	1102	226	1079	672	1428
Starvation Cap Reductn	0	138	327	0	0	0	0
Spillback Cap Reductn	278	0	0	0	71	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.02	1.08	0.65	0.86	1.00	0.90	0.74

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1791	162	0	1510	475	185	925	28	575	997	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5022			3539	1583	1770	5063		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5022			3539	1583	1770	5063		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1885	171	0	1589	500	195	974	29	605	1049	2
RTOR Reduction (vph)	0	9	0	0	0	1	0	2	0	0	0	0
Lane Group Flow (vph)	0	2047	0	0	1589	499	195	1001	0	605	1051	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		54.5			54.5	78.0	15.3	25.5		23.5	33.7	
Effective Green, g (s)		54.5			54.5	78.0	15.3	25.5		23.5	33.7	
Actuated g/C Ratio		0.45			0.45	0.65	0.13	0.21		0.20	0.28	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2281			1607	1102	226	1076		672	1428	
v/s Ratio Prot		0.41			c0.45	0.09	0.11	c0.20		c0.18	0.21	
v/s Ratio Perm						0.23						
v/c Ratio		0.90			0.99	0.45	0.86	0.93		0.90	0.74	
Uniform Delay, d1		30.2			32.4	10.4	51.3	46.4		47.1	39.1	
Progression Factor		1.00			0.26	0.14	0.87	0.76		1.00	1.00	
Incremental Delay, d2		5.1			10.8	0.1	31.6	14.5		15.2	3.4	
Delay (s)		35.3			19.4	1.5	76.2	49.9		62.3	42.5	
Level of Service		D			B	A	E	D		E	D	
Approach Delay (s)		35.3			15.1			54.2			49.7	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM Average Control Delay	35.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	395	2125	42	1726	665	102	369	745	552
v/c Ratio	0.99	0.77	0.55	0.99	0.97	0.36	0.95	0.72	0.76
Control Delay	70.8	9.1	83.3	66.7	77.4	22.0	87.5	42.5	19.4
Queue Delay	71.0	3.7	0.0	9.2	0.0	0.0	0.0	0.0	0.1
Total Delay	141.8	12.9	83.3	76.0	77.4	22.0	87.5	42.5	19.5
Queue Length 50th (ft)	328	280	29	418	178	9	148	271	126
Queue Length 95th (ft)	m#400	312	m#71	#591	m#255	m47	#243	343	277
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	397	2756	77	1736	686	283	389	1041	730
Starvation Cap Reductn	65	535	0	0	0	0	0	0	0
Spillback Cap Reductn	0	176	0	56	0	2	0	0	4
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.19	0.96	0.55	1.03	0.97	0.36	0.95	0.72	0.76

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	375	1993	26	40	1485	155	0	632	97	351	708	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	395	2098	27	42	1563	163	0	665	102	369	745	552
RTOR Reduction (vph)	0	1	0	0	11	0	0	0	69	0	0	264
Lane Group Flow (vph)	395	2124	0	42	1715	0	0	665	33	369	745	288
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	28.0	64.0		4.2	40.2			16.2	16.2	13.6	35.3	35.3
Effective Green, g (s)	28.0	64.0		4.2	40.2			16.2	16.2	13.6	35.3	35.3
Actuated g/C Ratio	0.23	0.53		0.04	0.34			0.13	0.13	0.11	0.29	0.29
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	413	2707		62	1679			686	214	389	1041	466
v/s Ratio Prot	c0.22	0.42		0.02	c0.34			c0.13		c0.11	0.21	
v/s Ratio Perm									0.02			0.18
v/c Ratio	0.96	0.78		0.68	1.02			0.97	0.15	0.95	0.72	0.62
Uniform Delay, d1	45.4	22.5		57.2	39.9			51.7	45.8	52.9	37.9	36.5
Progression Factor	0.90	0.37		1.08	1.24			1.03	1.25	1.00	1.00	1.00
Incremental Delay, d2	18.8	1.0		22.9	26.3			24.3	1.2	34.4	4.2	6.0
Delay (s)	59.6	9.3		84.4	75.7			77.4	58.3	87.2	42.1	42.6
Level of Service	E	A		F	E			E	E	F	D	D
Approach Delay (s)		17.2			75.9			74.8			52.2	
Approach LOS		B			E			E			D	

Intersection Summary			
HCM Average Control Delay	47.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	93.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	175	857	84	1085	393	45	251	157	491	39
v/c Ratio	0.74	0.29	0.26	0.37	0.36	0.31	0.87	0.52	0.52	0.12
Control Delay	37.7	1.1	15.2	13.8	2.1	58.1	81.3	33.9	30.6	18.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.7	1.1	15.2	13.8	2.1	58.1	81.3	33.9	30.6	18.3
Queue Length 50th (ft)	62	12	30	155	0	33	101	150	156	23
Queue Length 95th (ft)	m100	m13	64	185	41	73	#177	m212	199	m36
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	238	2917	319	2954	1084	145	290	304	951	337
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.74	0.29	0.26	0.37	0.36	0.31	0.87	0.52	0.52	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	166	724	90	80	1031	373	43	225	13	249	367	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	5001		1770	5085	1583	1770	3510		1522	4755	1583
Flt Permitted	0.22	1.00		0.29	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	409	5001		549	5085	1583	1770	3510		1522	4755	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	175	762	95	84	1085	393	45	237	14	262	386	39
RTOR Reduction (vph)	0	13	0	0	0	165	0	4	0	0	0	21
Lane Group Flow (vph)	175	844	0	84	1085	228	45	247	0	157	491	18
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	69.7	69.7		69.7	69.7	69.7	9.8	9.8		24.0	24.0	24.0
Effective Green, g (s)	69.7	69.7		69.7	69.7	69.7	9.8	9.8		24.0	24.0	24.0
Actuated g/C Ratio	0.58	0.58		0.58	0.58	0.58	0.08	0.08		0.20	0.20	0.20
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	238	2905		319	2954	919	145	287		304	951	317
v/s Ratio Prot		0.17			0.21		0.03	c0.07		0.10	c0.10	
v/s Ratio Perm	c0.43			0.15		0.14						0.01
v/c Ratio	0.74	0.29		0.26	0.37	0.25	0.31	0.86		0.52	0.52	0.06
Uniform Delay, d1	18.4	12.7		12.4	13.4	12.3	51.9	54.4		42.8	42.8	38.8
Progression Factor	1.21	0.08		1.00	1.00	1.00	1.00	1.00		0.68	0.68	0.89
Incremental Delay, d2	12.0	0.2		2.0	0.4	0.6	5.5	27.2		4.3	1.4	0.2
Delay (s)	34.2	1.2		14.5	13.8	13.0	57.4	81.6		33.4	30.5	34.9
Level of Service	C	A		B	B	B	E	F		C	C	C
Approach Delay (s)		6.8			13.6			78.0			31.4	
Approach LOS		A			B			E			C	

Intersection Summary			
HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	25	2422	106	283	1744	55	13	129	255	85	64
v/c Ratio	0.28	0.90	0.12	0.97	0.51	0.57	0.09	0.41	1.06	0.27	0.20
Control Delay	82.3	13.9	2.2	61.9	7.6	76.1	52.6	28.0	120.0	43.6	11.1
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	82.3	14.1	2.2	61.9	7.6	76.1	52.6	28.0	120.0	43.6	11.1
Queue Length 50th (ft)	21	142	4	193	110	41	10	45	183	56	0
Queue Length 95th (ft)	m28	m#461	m6	m#264	139	#88	30	106	#364	103	38
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	90	2678	861	291	3442	109	155	313	240	373	368
Starvation Cap Reductn	0	29	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.91	0.12	0.97	0.51	0.50	0.08	0.41	1.06	0.23	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	24	2301	101	269	1620	37	52	12	123	242	81	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5068		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.70	1.00	1.00	0.49	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1307	1863	1583	918	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	25	2422	106	283	1705	39	55	13	129	255	85	64
RTOR Reduction (vph)	0	0	30	0	2	0	0	0	52	0	0	52
Lane Group Flow (vph)	25	2422	76	283	1742	0	55	13	77	255	85	12
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	3.7	59.9	59.9	21.9	78.1		7.7	7.7	21.9	21.7	21.7	21.7
Effective Green, g (s)	3.7	59.9	59.9	21.9	78.1		7.7	7.7	21.9	21.7	21.7	21.7
Actuated g/C Ratio	0.03	0.50	0.50	0.18	0.65		0.06	0.06	0.18	0.18	0.18	0.18
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	55	2538	790	323	3298		84	120	289	237	337	286
v/s Ratio Prot	0.01	c0.48		c0.16	0.34			0.01	0.05	c0.09	0.05	
v/s Ratio Perm			0.05				0.04			c0.10		0.01
v/c Ratio	0.45	0.95	0.10	0.88	0.53		0.65	0.11	0.27	1.08	0.25	0.04
Uniform Delay, d1	57.2	28.7	15.8	47.7	11.1		54.9	52.9	42.2	48.2	42.2	40.6
Progression Factor	1.40	0.35	0.26	0.62	0.67		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.6	6.7	0.1	11.1	0.3		16.9	0.4	0.5	80.1	0.4	0.1
Delay (s)	83.6	16.9	4.3	40.6	7.7		71.7	53.3	42.7	128.2	42.6	40.6
Level of Service	F	B	A	D	A		E	D	D	F	D	D
Approach Delay (s)		17.0			12.3			51.5			96.3	
Approach LOS		B			B			D			F	

Intersection Summary			
HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	93.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	34	2797	2242	464
v/c Ratio	0.21	1.02	0.90	0.45
Control Delay	36.2	24.6	19.6	36.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	36.2	24.6	19.6	36.5
Queue Length 50th (ft)	3	~854	601	156
Queue Length 95th (ft)	m3	m#897	#729	213
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	413	2754	2491	1035
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.08	1.02	0.90	0.45

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	32	2657	1957	173	413	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.99		0.99	
Flt Protected	0.95	1.00	1.00		0.96	
Satd. Flow (prot)	1770	5085	5023		3420	
Flt Permitted	0.95	1.00	1.00		0.96	
Satd. Flow (perm)	1770	5085	5023		3420	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	34	2797	2060	182	435	29
RTOR Reduction (vph)	0	0	9	0	3	0
Lane Group Flow (vph)	34	2797	2233	0	461	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	6.9	62.8	54.9		36.2	
Effective Green, g (s)	6.9	62.8	54.9		36.2	
Actuated g/C Ratio	0.06	0.52	0.46		0.30	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	102	2661	2298		1032	
v/s Ratio Prot	c0.02	c0.55	0.44		c0.13	
v/s Ratio Perm						
v/c Ratio	0.33	1.05	0.97		0.45	
Uniform Delay, d1	54.3	28.6	31.8		33.8	
Progression Factor	1.32	0.25	0.52		1.00	
Incremental Delay, d2	0.8	28.0	10.3		1.4	
Delay (s)	72.3	35.3	26.7		35.2	
Level of Service	E	D	C		D	
Approach Delay (s)		35.7	26.7		35.2	
Approach LOS		D	C		D	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	124	3086	20	66	2296	74	119	199
v/c Ratio	0.64	0.88	0.02	0.76	0.72	0.68	0.73	0.59
Control Delay	41.4	5.2	0.5	102.7	16.6	72.6	76.5	21.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.4	5.2	0.5	102.7	16.6	72.6	76.5	21.3
Queue Length 50th (ft)	91	119	0	52	409	47	90	31
Queue Length 95th (ft)	m99	m118	m0	#131	464	#125	#183	108
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	195	3513	1099	87	3191	109	163	336
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.88	0.02	0.76	0.72	0.68	0.73	0.59

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	118	2932	19	63	2113	68	27	26	18	113	34	155
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5061			1765		1770	1634	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.45		0.71	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5061			805		1329	1634	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	124	3086	20	66	2224	72	28	27	19	119	36	163
RTOR Reduction (vph)	0	0	6	0	3	0	0	11	0	0	136	0
Lane Group Flow (vph)	124	3086	14	66	2293	0	0	63	0	119	63	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	13.2	82.9	82.9	5.9	75.6			14.7		14.7	14.7	
Effective Green, g (s)	13.2	82.9	82.9	5.9	75.6			14.7		14.7	14.7	
Actuated g/C Ratio	0.11	0.69	0.69	0.05	0.63			0.12		0.12	0.12	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	195	3513	1094	87	3188			99		163	200	
v/s Ratio Prot	0.07	c0.61		0.04	c0.45						0.04	
v/s Ratio Perm			0.01					0.08		c0.09		
v/c Ratio	0.64	0.88	0.01	0.76	0.72			0.64		0.73	0.31	
Uniform Delay, d1	51.1	14.6	5.8	56.3	15.0			50.1		50.7	48.1	
Progression Factor	0.69	0.26	0.19	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	2.3	1.2	0.0	30.9	1.4			27.7		15.4	0.9	
Delay (s)	37.6	5.0	1.1	87.2	16.5			77.9		66.2	49.0	
Level of Service	D	A	A	F	B			E		E	D	
Approach Delay (s)		6.3			18.4			77.9			55.4	
Approach LOS		A			B			E			E	

Intersection Summary			
HCM Average Control Delay	14.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	94.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	26	1520	233	1112	76	248	315	27	293	19
v/c Ratio	0.11	0.89	0.74	0.49	0.54	0.59	0.64	0.15	0.70	0.05
Control Delay	14.0	26.2	27.6	8.0	39.4	31.0	17.5	24.2	35.0	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.0	26.2	27.6	8.0	39.4	31.0	17.5	24.2	35.0	10.2
Queue Length 50th (ft)	6	312	45	115	30	101	54	10	122	0
Queue Length 95th (ft)	24	#549	#161	202	73	169	132	30	201	15
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	233	1717	351	2365	202	598	628	253	598	521
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.89	0.66	0.47	0.38	0.41	0.50	0.11	0.49	0.04

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	1341	103	221	1029	28	72	236	299	26	278	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3501		1770	3525		1770	1863	1583	1770	1863	1583
Flt Permitted	0.26	1.00		0.10	1.00		0.34	1.00	1.00	0.42	1.00	1.00
Satd. Flow (perm)	477	3501		195	3525		627	1863	1583	787	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	26	1412	108	233	1083	29	76	248	315	27	293	19
RTOR Reduction (vph)	0	6	0	0	2	0	0	0	136	0	0	15
Lane Group Flow (vph)	26	1514	0	233	1110	0	76	248	179	27	293	4
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	35.3	35.3		46.8	46.8		16.3	16.3	16.3	16.3	16.3	16.3
Effective Green, g (s)	35.3	35.3		46.8	46.8		16.3	16.3	16.3	16.3	16.3	16.3
Actuated g/C Ratio	0.49	0.49		0.65	0.65		0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	234	1714		312	2288		142	421	358	178	421	358
v/s Ratio Prot		c0.43		c0.09	0.31			0.13			c0.16	
v/s Ratio Perm	0.05			0.40			0.12		0.11	0.03		0.00
v/c Ratio	0.11	0.88		0.75	0.49		0.54	0.59	0.50	0.15	0.70	0.01
Uniform Delay, d1	9.9	16.5		15.5	6.5		24.6	24.9	24.3	22.4	25.6	21.7
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	5.8		9.4	0.2		3.8	2.1	1.1	0.4	4.9	0.0
Delay (s)	10.1	22.3		24.8	6.6		28.4	27.0	25.4	22.8	30.6	21.7
Level of Service	B	C		C	A		C	C	C	C	C	C
Approach Delay (s)		22.1			9.8			26.4			29.5	
Approach LOS		C			A			C			C	

Intersection Summary			
HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	72.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Appendix A2

Year 2040 No Build Alternative
Intersection Level of Service (LOS) Worksheets

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Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1403	1578	82	835	440	347
v/c Ratio	0.53	0.75	0.05	0.51	0.30	0.50
Control Delay	22.2	28.2	0.1	19.8	16.8	21.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.2	28.2	0.1	19.8	16.8	21.2
Queue Length 50th (ft)	185	276	0	184	90	158
Queue Length 95th (ft)	208	330	0	252	134	263
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2877	2293	1611	1652	1444	698
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.69	0.05	0.51	0.30	0.50

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1268	65	0	1499	0	0	0	78	793	88	659
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.88	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6361			5085				1611	3433	2989	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6361			5085				1611	3433	2989	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1335	68	0	1578	0	0	0	82	835	93	694
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	5	5
Lane Group Flow (vph)	0	1395	0	0	1578	0	0	0	82	835	435	342
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		41.6			41.6				100.0	48.1	48.1	48.1
Effective Green, g (s)		41.6			41.6				100.0	48.1	48.1	48.1
Actuated g/C Ratio		0.42			0.42				1.00	0.48	0.48	0.48
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2646			2115				1611	1651	1438	693
v/s Ratio Prot		0.22			c0.31					c0.24	0.15	
v/s Ratio Perm									0.05			0.24
v/c Ratio		0.53			0.75				0.05	0.51	0.30	0.49
Uniform Delay, d1		21.8			24.7				0.0	17.8	15.8	17.7
Progression Factor		1.00			1.07				1.00	1.00	1.00	1.00
Incremental Delay, d2		0.4			1.4				0.1	1.1	0.5	2.5
Delay (s)		22.2			27.9				0.1	18.9	16.3	20.2
Level of Service		C			C				A	B	B	C
Approach Delay (s)		22.2			27.9			0.1			18.5	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	22.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	1974	1332	884	676	531
v/c Ratio	0.53	0.64	0.68	0.62	0.59
Control Delay	15.4	6.5	5.9	31.7	30.6
Queue Delay	0.0	0.8	3.4	0.0	0.0
Total Delay	15.4	7.3	9.3	31.7	30.6
Queue Length 50th (ft)	247	124	138	186	153
Queue Length 95th (ft)	271	m151	m173	246	214
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3755	2074	1294	1099	905
Starvation Cap Reductn	0	399	307	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.53	0.80	0.90	0.62	0.59

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1875	0	0	1265	840	642	0	504	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1974	0	0	1332	884	676	0	531	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	366	0	0	13	0	0	0
Lane Group Flow (vph)	0	1974	0	0	1332	518	676	0	518	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		58.6			58.6	58.6	32.0		32.0			
Effective Green, g (s)		58.6			58.6	58.6	32.0		32.0			
Actuated g/C Ratio		0.59			0.59	0.59	0.32		0.32			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3755			2074	928	1099		892			
v/s Ratio Prot		0.31			c0.38							
v/s Ratio Perm						0.33	c0.20		0.19			
v/c Ratio		0.53			0.64	0.56	0.62		0.58			
Uniform Delay, d1		12.4			13.7	12.7	28.8		28.4			
Progression Factor		1.20			0.39	4.55	1.00		1.00			
Incremental Delay, d2		0.2			0.6	0.8	2.6		2.8			
Delay (s)		15.1			6.0	58.7	31.4		31.2			
Level of Service		B			A	E	C		C			
Approach Delay (s)		15.1			27.0			31.3			0.0	
Approach LOS		B			C			C			A	

Intersection Summary			
HCM Average Control Delay	23.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	603	1374	6	1367	212	212	160	305	294
v/c Ratio	0.92	0.50	0.05	0.83	0.90	0.32	0.53	0.77	0.63
Control Delay	53.2	9.5	44.5	37.3	82.2	34.3	50.3	27.7	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.2	9.5	44.5	37.3	82.2	34.3	50.3	27.7	10.8
Queue Length 50th (ft)	209	79	4	297	135	58	51	64	0
Queue Length 95th (ft)	#303	312	17	#402	#270	90	84	164	76
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	656	2730	124	1644	235	787	309	443	512
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.92	0.50	0.05	0.83	0.90	0.27	0.52	0.69	0.57

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	573	1223	83	6	1249	49	201	188	13	152	52	517
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.99		1.00	0.99		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5037		1770	5056		1770	3504		3433	1552	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5037		1770	5056		1770	3504		3433	1552	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	603	1287	87	6	1315	52	212	198	14	160	55	544
RTOR Reduction (vph)	0	6	0	0	4	0	0	6	0	0	171	251
Lane Group Flow (vph)	603	1368	0	6	1363	0	212	206	0	160	134	43
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	23.1	50.1		1.4	28.4		13.3	19.1		8.8	14.6	14.6
Effective Green, g (s)	23.1	50.1		1.4	28.4		13.3	19.1		8.8	14.6	14.6
Actuated g/C Ratio	0.23	0.50		0.01	0.28		0.13	0.19		0.09	0.15	0.15
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	793	2524		25	1436		235	669		302	227	220
v/s Ratio Prot	c0.18	0.27		0.00	c0.27		c0.12	c0.06		0.05	c0.09	
v/s Ratio Perm												0.03
v/c Ratio	0.76	0.54		0.24	0.95		0.90	0.31		0.53	0.59	0.20
Uniform Delay, d1	35.9	17.1		48.8	35.1		42.7	34.8		43.6	39.9	37.5
Progression Factor	0.86	0.57		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.9	0.7		6.7	14.3		34.2	0.4		2.2	4.8	0.6
Delay (s)	34.8	10.4		55.5	49.4		76.9	35.1		45.8	44.7	38.1
Level of Service	C	B		E	D		E	D		D	D	D
Approach Delay (s)		17.9			49.5			56.0			42.4	
Approach LOS		B			D			E			D	

Intersection Summary			
HCM Average Control Delay	35.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	83.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	1401	1494	835	915
v/c Ratio	0.46	0.71	0.78	0.58
Control Delay	12.7	17.6	36.6	1.5
Queue Delay	0.1	0.0	0.0	0.0
Total Delay	12.8	17.6	36.6	1.5
Queue Length 50th (ft)	169	325	249	0
Queue Length 95th (ft)	247	495	283	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	3022	2103	1710	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	351	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.52	0.71	0.49	0.58

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1331	1419	0	793	869
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1401	1494	0	835	915
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1401	1494	0	835	915
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		59.4	59.4		31.1	100.0
Effective Green, g (s)		59.4	59.4		31.1	100.0
Actuated g/C Ratio		0.59	0.59		0.31	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		3020	2102		1068	1583
v/s Ratio Prot		0.28	c0.42		c0.24	
v/s Ratio Perm						0.58
v/c Ratio		0.46	0.71		0.78	0.58
Uniform Delay, d1		11.4	14.3		31.4	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.5	1.9		3.7	1.5
Delay (s)		11.9	16.2		35.0	1.5
Level of Service		B	B		D	A
Approach Delay (s)		11.9	16.2		17.5	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	69.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2062	606	288	1517
v/c Ratio	0.82	0.51	0.82	0.43
Control Delay	16.5	6.1	57.7	0.4
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	16.5	6.2	57.7	0.4
Queue Length 50th (ft)	608	116	173	0
Queue Length 95th (ft)	716	151	#287	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2509	1179	389	3539
Starvation Cap Reductn	0	70	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.82	0.55	0.74	0.43

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1959	576	274	1441	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2062	606	288	1517	0	0
RTOR Reduction (vph)	0	57	0	0	0	0
Lane Group Flow (vph)	2062	549	288	1517	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	70.9	70.9	19.8	100.0		
Effective Green, g (s)	70.9	70.9	19.8	100.0		
Actuated g/C Ratio	0.71	0.71	0.20	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2509	1122	350	3539		
v/s Ratio Prot	c0.58		c0.16	0.43		
v/s Ratio Perm		0.35				
v/c Ratio	0.82	0.49	0.82	0.43		
Uniform Delay, d1	10.1	6.5	38.4	0.0		
Progression Factor	1.21	0.99	1.00	1.00		
Incremental Delay, d2	3.0	1.4	14.4	0.4		
Delay (s)	15.2	7.9	52.8	0.4		
Level of Service	B	A	D	A		
Approach Delay (s)	13.5			8.7	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	77.1%	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 (veh/h)	0	0	377	0	0	617	0	665	860	0	831	620
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	397	0	0	649	0	700	905	0	875	653
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.92	0.92		0.92	0.92	0.92				0.92		
vC, conflicting volume	1108	1575	292	992	1575	233	875			700		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	833	1337	292	707	1337	0	875			392		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	44	100	100	35	100			100		
cM capacity (veh/h)	85	141	705	130	141	1003	767			1076		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	397	649	280	280	442	604	350	350	392	435
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	397	649	0	0	302	604	0	0	218	435
cSH	705	1003	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.56	0.65	0.16	0.16	0.26	0.36	0.21	0.21	0.23	0.26
Queue Length 95th (ft)	88	124	0	0	0	0	0	0	0	0
Control Delay (s)	16.5	14.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	B								
Approach Delay (s)	16.5	14.9	0.0				0.0			
Approach LOS	C	B								

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	690	0	1439	871	359
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	726	0	1515	917	378
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.88					
vC, conflicting volume	1296	306	917			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	630	306	917			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	0	100			
cM capacity (veh/h)	363	690	740			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	726	379	379	379	379	367	367	309	252
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	726	0	0	0	0	0	0	126	252
cSH	690	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.05	0.22	0.22	0.22	0.22	0.22	0.22	0.18	0.15
Queue Length 95th (ft)	473	0	0	0	0	0	0	0	0
Control Delay (s)	73.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F								
Approach Delay (s)	73.0	0.0				0.0			
Approach LOS	F								

Intersection Summary			
Average Delay	15.0		
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	121	827	145	78	1131	240	281	1276	97	1525
v/c Ratio	0.69	0.55	0.20	0.50	0.88	0.48	0.84	0.57	0.25	0.87
Control Delay	62.8	29.0	13.3	53.1	41.0	11.0	63.0	24.1	38.6	31.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.8	29.0	13.3	53.1	41.0	11.0	63.0	24.1	38.6	31.5
Queue Length 50th (ft)	35	149	39	22	238	26	82	174	25	268
Queue Length 95th (ft)	#76	191	77	45	#320	102	#150	188	52	331
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	176	1498	733	157	1287	502	334	2537	388	1776
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.55	0.20	0.50	0.88	0.48	0.84	0.50	0.25	0.86

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	115	786	138	74	1049	254	267	1019	193	92	990	459
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4789	1362	3433	6255		3433	4844	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4789	1362	3433	6255		3433	4844	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	121	827	145	78	1104	267	281	1073	203	97	1042	483
RTOR Reduction (vph)	0	0	19	0	3	138	0	40	0	0	93	0
Lane Group Flow (vph)	121	827	126	78	1128	102	281	1236	0	97	1432	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	5.8	26.4	35.1	3.3	23.9	23.9	8.7	31.6		8.9	31.8	
Effective Green, g (s)	5.8	26.4	35.1	3.3	23.9	23.9	8.7	31.6		8.9	31.8	
Actuated g/C Ratio	0.06	0.29	0.38	0.04	0.26	0.26	0.09	0.34		0.10	0.35	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	217	1462	698	123	1247	355	325	2153		333	1678	
v/s Ratio Prot	0.04	c0.16	0.02	0.02	c0.24		c0.08	0.20		0.03	c0.30	
v/s Ratio Perm			0.06			0.07						
v/c Ratio	0.56	0.57	0.18	0.63	0.90	0.29	0.86	0.57		0.29	0.85	
Uniform Delay, d1	41.8	27.8	18.8	43.7	32.8	27.1	41.0	24.6		38.5	27.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.1	0.5	0.1	10.2	9.4	0.4	20.5	0.4		0.5	4.4	
Delay (s)	44.8	28.3	18.9	53.9	42.3	27.6	61.5	25.0		39.0	32.3	
Level of Service	D	C	B	D	D	C	E	C		D	C	
Approach Delay (s)		28.9			40.5			31.6			32.7	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM Average Control Delay	33.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	91.8	Sum of lost time (s)	16.2
Intersection Capacity Utilization	80.5%	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 (veh/h)	0	622	460	0	842	0	0	0	0	0	0	560
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	655	484	0	886	0	0	0	0	0	0	589
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.88			0.88	0.88	0.88	0.88	0.88	
vC, conflicting volume	886			1139			1192	1783	460	1105	2025	295
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	886			667			728	1401	0	628	1678	295
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	16
cM capacity (veh/h)	760			806			43	122	951	322	83	701

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	262	262	615	295	295	295	589
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	484	0	0	0	589
cSH	1700	1700	1700	1700	1700	1700	701
Volume to Capacity	0.15	0.15	0.36	0.17	0.17	0.17	0.84
Queue Length 95th (ft)	0	0	0	0	0	0	236
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	31.1
Lane LOS							D
Approach Delay (s)	0.0			0.0			31.1
Approach LOS							D

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	58	192	226	219	6	1528	452	1429
v/c Ratio	0.40	0.53	0.55	0.52	0.04	0.60	0.33	0.52
Control Delay	24.1	25.0	14.3	13.3	12.3	9.9	0.3	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.1	25.0	14.3	13.3	12.3	9.9	0.3	11.7
Queue Length 50th (ft)	8	65	35	30	1	103	0	125
Queue Length 95th (ft)	39	106	83	75	m2	m168	m0	205
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	144	532	546	560	135	2561	1362	2727
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.36	0.41	0.39	0.04	0.60	0.33	0.52

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	0	32	202	2	401	6	1021	860	0	1349	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.92		1.00	0.87	0.85	1.00	0.96	0.85		1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1681		1681	1460	1504	1770	4592	1362		5080	
Flt Permitted		0.98		0.95	1.00	1.00	0.13	1.00	1.00		1.00	
Satd. Flow (perm)		1681		1681	1460	1504	251	4592	1362		5080	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	24	0	34	213	2	422	6	1075	905	0	1420	9
RTOR Reduction (vph)	0	33	0	0	96	96	0	100	0	0	1	0
Lane Group Flow (vph)	0	25	0	192	130	123	6	1428	452	0	1428	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		2.4		13.0	13.0	13.0	30.6	30.6	60.0		30.6	
Effective Green, g (s)		2.4		13.0	13.0	13.0	30.6	30.6	60.0		30.6	
Actuated g/C Ratio		0.04		0.22	0.22	0.22	0.51	0.51	1.00		0.51	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		67		364	316	326	128	2342	1362		2591	
v/s Ratio Prot		0.02		c0.11	0.09			c0.31			0.28	
v/s Ratio Perm						0.08	0.02		c0.33			
v/c Ratio		0.38		0.53	0.41	0.38	0.05	0.61	0.33		0.55	
Uniform Delay, d1		28.1		20.8	20.2	20.0	7.4	10.5	0.0		10.0	
Progression Factor		1.00		1.00	1.00	1.00	1.08	0.98	1.00		1.00	
Incremental Delay, d2		3.6		1.4	0.9	0.7	0.3	0.6	0.3		0.8	
Delay (s)		31.6		22.2	21.1	20.8	8.3	10.9	0.3		10.9	
Level of Service		C		C	C	C	A	B	A		B	
Approach Delay (s)		31.6			21.3			8.5			10.9	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	120	836	219	2600	249	1153	74	1066
v/c Ratio	1.17	0.74	0.42	1.14	1.13	0.77	0.83	0.96
Control Delay	188.9	44.6	27.2	86.3	133.9	25.4	105.7	59.8
Queue Delay	0.0	0.0	0.0	16.6	0.0	2.3	0.0	0.0
Total Delay	188.9	44.6	27.2	102.9	133.9	27.8	105.7	59.8
Queue Length 50th (ft)	~110	210	94	~831	~230	313	0	213
Queue Length 95th (ft)	#234	241	m139	#926	#403	311	#157	#332
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	103	1585	517	2283	221	1494	89	1110
Starvation Cap Reductn	0	0	0	73	0	214	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.53	0.42	1.18	1.13	0.90	0.83	0.96

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	114	640	154	208	1916	554	237	1082	13	70	859	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4937		1770	4914		1770	5076		1770	4969	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4937		1770	4914		1770	5076		1770	4969	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	120	674	162	219	2017	583	249	1139	14	74	904	162
RTOR Reduction (vph)	0	38	0	0	44	0	0	1	0	0	21	0
Lane Group Flow (vph)	120	798	0	219	2556	0	249	1152	0	74	1045	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	7.0	26.7		35.0	54.7		15.0	35.3		6.0	26.3	
Effective Green, g (s)	7.0	26.7		35.0	54.7		15.0	35.3		6.0	26.3	
Actuated g/C Ratio	0.06	0.22		0.29	0.46		0.12	0.29		0.05	0.22	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	103	1098		516	2240		221	1493		89	1089	
v/s Ratio Prot	c0.07	0.16		0.12	c0.52		c0.14	0.23		0.04	c0.21	
v/s Ratio Perm												
v/c Ratio	1.17	0.73		0.42	1.14		1.13	0.77		0.83	0.96	
Uniform Delay, d1	56.5	43.3		34.4	32.6		52.5	38.7		56.5	46.3	
Progression Factor	1.00	1.00		0.72	0.60		0.87	0.58		0.93	0.93	
Incremental Delay, d2	139.8	2.4		0.2	66.2		91.2	3.0		41.3	17.5	
Delay (s)	196.3	45.7		25.0	85.9		136.9	25.3		93.9	60.6	
Level of Service	F	D		C	F		F	C		F	E	
Approach Delay (s)		64.6			81.2			45.1			62.7	
Approach LOS		E			F			D			E	

Intersection Summary			
HCM Average Control Delay	67.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	103.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	343	1139	331	175	648	15	1041	247	1182
v/c Ratio	0.72	0.78	0.62	0.72	0.73	0.11	0.66	0.29	0.53
Control Delay	48.0	38.0	19.5	67.1	26.0	25.3	29.5	3.8	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.1
Total Delay	48.0	38.0	19.5	67.1	26.0	25.3	30.4	3.8	5.9
Queue Length 50th (ft)	235	222	116	144	117	7	340	0	66
Queue Length 95th (ft)	347	269	160	m218	145	24	437	51	m56
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	516	1546	557	295	1017	131	1587	846	2239
Starvation Cap Reductn	0	0	0	0	0	0	0	0	266
Spillback Cap Reductn	0	0	0	0	0	0	280	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.74	0.59	0.59	0.64	0.11	0.80	0.29	0.60

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	326	905	491	166	616	0	14	989	235	0	623	500
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	0.98	0.85	1.00	1.00		1.00	1.00	0.85		0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4688	1362	1770	5085		1770	3539	1583		4746	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.16	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4688	1362	1770	5085		293	3539	1583		4746	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	343	953	517	175	648	0	15	1041	247	0	656	526
RTOR Reduction (vph)	0	22	118	0	0	0	0	0	136	0	111	0
Lane Group Flow (vph)	343	1117	213	175	648	0	15	1041	111	0	1071	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	32.2	36.8	36.8	16.4	21.0		53.8	53.8	53.8		53.8	
Effective Green, g (s)	32.2	36.8	36.8	16.4	21.0		53.8	53.8	53.8		53.8	
Actuated g/C Ratio	0.27	0.31	0.31	0.14	0.18		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	475	1438	418	242	890		131	1587	710		2128	
v/s Ratio Prot	c0.19	c0.24		0.10	0.13			c0.29			0.23	
v/s Ratio Perm			0.16				0.05		0.07			
v/c Ratio	0.72	0.78	0.51	0.72	0.73		0.11	0.66	0.16		0.50	
Uniform Delay, d1	39.8	37.9	34.2	49.6	46.8		19.2	25.9	19.6		23.6	
Progression Factor	1.00	0.93	0.90	1.09	0.47		1.00	1.00	1.00		0.26	
Incremental Delay, d2	4.7	2.4	0.9	8.0	2.3		1.8	2.1	0.5		0.5	
Delay (s)	44.7	37.7	31.5	62.1	24.5		21.0	28.0	20.1		6.6	
Level of Service	D	D	C	E	C		C	C	C		A	
Approach Delay (s)		37.9			32.5			26.4			6.6	
Approach LOS		D			C			C			A	

Intersection Summary			
HCM Average Control Delay	26.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	202	1145	0	0	1307
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	213	1205	0	0	1376
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked						
vC, conflicting volume	1664	402			1205	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1664	402			1205	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	64			100	
cM capacity (veh/h)	88	598			575	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	213	402	402	402	459	459	459
Volume Left	0	0	0	0	0	0	0
Volume Right	213	0	0	0	0	0	0
cSH	598	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.36	0.24	0.24	0.24	0.27	0.27	0.27
Queue Length 95th (ft)	40	0	0	0	0	0	0
Control Delay (s)	14.3	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B						
Approach Delay (s)	14.3	0.0			0.0		
Approach LOS	B						

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	41.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1252	1008	819
v/c Ratio	0.47	0.38	0.72
Control Delay	10.3	4.8	20.2
Queue Delay	0.0	0.0	0.0
Total Delay	10.3	4.8	20.2
Queue Length 50th (ft)	95	64	124
Queue Length 95th (ft)	154	119	154
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	2685	2685	1491
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.47	0.38	0.55

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1189	958	0	685	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3399	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3399	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1252	1008	0	721	98
RTOR Reduction (vph)	0	0	0	0	21	0
Lane Group Flow (vph)	0	1252	1008	0	798	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		31.7	31.7		19.8	
Effective Green, g (s)		31.7	31.7		19.8	
Actuated g/C Ratio		0.53	0.53		0.33	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		2687	2687		1122	
v/s Ratio Prot		c0.25	0.20		c0.23	
v/s Ratio Perm						
v/c Ratio		0.47	0.38		0.71	
Uniform Delay, d1		8.9	8.3		17.6	
Progression Factor		1.00	0.50		1.00	
Incremental Delay, d2		0.6	0.3		2.1	
Delay (s)		9.4	4.5		19.7	
Level of Service		A	A		B	
Approach Delay (s)		9.4	4.5		19.7	
Approach LOS		A	A		B	

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	85	715	367	2653	109	600	494	103	853
v/c Ratio	0.83	0.45	0.67	0.93	0.12	0.63	0.63	0.85	0.62
Control Delay	110.9	7.1	43.4	31.1	4.9	55.3	22.3	93.0	35.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	110.9	7.1	43.4	31.1	4.9	55.3	22.3	93.0	35.3
Queue Length 50th (ft)	70	38	248	657	11	185	184	76	185
Queue Length 95th (ft)	m#155	m44	358	740	38	248	241	#185	232
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	103	1589	546	2860	923	958	789	121	1383
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.45	0.67	0.93	0.12	0.63	0.63	0.85	0.62

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	81	679	0	349	2520	104	0	570	469	98	517	294
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4809	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.24	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	448	4809	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	85	715	0	367	2653	109	0	600	494	103	544	309
RTOR Reduction (vph)	0	0	0	0	0	33	0	0	360	0	80	0
Lane Group Flow (vph)	85	715	0	367	2653	76	0	600	134	103	773	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	7.0	37.5		37.0	67.5	67.5		32.5	32.5	32.5	32.5	
Effective Green, g (s)	7.0	37.5		37.0	67.5	67.5		32.5	32.5	32.5	32.5	
Actuated g/C Ratio	0.06	0.31		0.31	0.56	0.56		0.27	0.27	0.27	0.27	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	103	1589		546	2860	890		958	429	121	1302	
v/s Ratio Prot	0.05	0.14		c0.21	c0.52			0.17			0.16	
v/s Ratio Perm						0.05			0.08	c0.23		
v/c Ratio	0.83	0.45		0.67	0.93	0.09		0.63	0.31	0.85	0.59	
Uniform Delay, d1	55.9	33.0		36.2	24.0	12.1		38.4	34.8	41.5	38.0	
Progression Factor	1.20	0.19		1.00	1.00	1.00		1.37	6.02	1.00	1.00	
Incremental Delay, d2	34.8	0.8		3.3	6.7	0.2		2.4	1.4	49.1	2.0	
Delay (s)	101.6	7.0		39.5	30.7	12.3		54.8	211.3	90.6	40.0	
Level of Service	F	A		D	C	B		D	F	F	D	
Approach Delay (s)		17.1			31.1			125.5			45.5	
Approach LOS		B			C			F			D	

Intersection Summary			
HCM Average Control Delay	48.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	147	1732	168	3072	465	214	66	108	951	237
v/c Ratio	1.43	0.96	0.95	1.51	1.66	0.21	0.13	0.62	1.15	0.53
Control Delay	279.5	51.0	109.6	262.7	345.4	33.2	8.4	67.1	123.5	26.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	279.5	51.0	109.6	262.7	345.4	33.2	8.4	67.1	123.5	26.3
Queue Length 50th (ft)	~154	473	132	~1224	~524	66	0	81	~456	86
Queue Length 95th (ft)	#288	#583	#272	#1309	#730	101	35	141	#587	170
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	103	1807	177	2030	280	1038	511	207	826	451
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.43	0.96	0.95	1.51	1.66	0.21	0.13	0.52	1.15	0.53

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	140	1505	141	160	2857	62	442	203	63	103	903	225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5020		1770	5069		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5020		1770	5069		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	147	1584	148	168	3007	65	465	214	66	108	951	237
RTOR Reduction (vph)	0	9	0	0	2	0	0	0	47	0	0	82
Lane Group Flow (vph)	147	1723	0	168	3070	0	465	214	19	108	951	155
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	7.0	43.0		12.0	48.0		19.0	35.2	35.2	11.8	28.0	28.0
Effective Green, g (s)	7.0	43.0		12.0	48.0		19.0	35.2	35.2	11.8	28.0	28.0
Actuated g/C Ratio	0.06	0.36		0.10	0.40		0.16	0.29	0.29	0.10	0.23	0.23
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	103	1799		177	2028		280	1038	464	174	826	369
v/s Ratio Prot	c0.08	0.34		0.09	c0.61		c0.26	0.06		0.06	c0.27	
v/s Ratio Perm									0.01			0.10
v/c Ratio	1.43	0.96		0.95	1.51		1.66	0.21	0.04	0.62	1.15	0.42
Uniform Delay, d1	56.5	37.6		53.7	36.0		50.5	31.9	30.3	52.0	46.0	39.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	239.2	12.6		52.3	233.8		312.7	0.1	0.0	6.7	81.9	0.8
Delay (s)	295.7	50.2		106.0	269.8		363.2	32.0	30.4	58.7	127.9	39.9
Level of Service	F	D		F	F		F	C	C	E	F	D
Approach Delay (s)		69.4			261.3			238.6			106.0	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM Average Control Delay	180.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.44		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	128.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	173	0	630	0	0	765	510	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	182	0	663	0	0	805	537	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.76		0.76						0.76	0.76
vC, conflicting volume	2005	332	1342			663			1319	1468
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	2164	332	1292			663			1262	1458
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	73	100			100			100	100
cM capacity (veh/h)	35	664	405			922			70	98

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	182	332	332	805	537
Volume Left	0	0	0	0	0
Volume Right	182	0	0	0	537
cSH	664	1700	1700	1700	1700
Volume to Capacity	0.27	0.20	0.20	0.47	0.32
Queue Length 95th (ft)	28	0	0	0	0
Control Delay (s)	12.5	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	12.5	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	840	0	0	0	0	0	0	670	88	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	884	0	0	0	0	0	0	705	93	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked												
vC, conflicting volume	1503	1503	93	2387	1503	0	93			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1503	1503	93	2387	1503	0	93			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	8	100	100	100	100			57		
cM capacity (veh/h)	66	69	965	1	69	1085	1502			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	884	705	93
Volume Left	0	705	0
Volume Right	884	0	0
cSH	965	1623	1700
Volume to Capacity	0.92	0.43	0.05
Queue Length 95th (ft)	347	57	0
Control Delay (s)	33.5	8.9	0.0
Lane LOS	D	A	
Approach Delay (s)	33.5	7.9	
Approach LOS	D		

Intersection Summary			
Average Delay	21.3		
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	598	191	124	981	221	1236
v/c Ratio	0.96	0.31	0.93	0.53	0.24	0.67
Control Delay	53.6	10.5	77.8	10.6	1.9	14.6
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.3
Total Delay	53.6	10.5	77.8	10.8	1.9	14.9
Queue Length 50th (ft)	248	30	48	137	5	190
Queue Length 95th (ft)	#447	74	m#114	m181	m16	257
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	620	626	133	1845	931	1846
Starvation Cap Reductn	0	0	0	225	0	0
Spillback Cap Reductn	0	0	0	0	0	178
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.31	0.93	0.61	0.24	0.74

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	568	26	156	118	932	210	0	1170	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.87		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1623		1770	3539	1583		3537	
Flt Permitted				0.95	1.00		0.14	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1623		255	3539	1583		3537	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	598	27	164	124	981	221	0	1232	4
RTOR Reduction (vph)	0	0	0	0	59	0	0	0	106	0	0	0
Lane Group Flow (vph)	0	0	0	598	133	0	124	981	115	0	1236	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				24.5	24.5		36.5	36.5	36.5		36.5	
Effective Green, g (s)				24.5	24.5		36.5	36.5	36.5		36.5	
Actuated g/C Ratio				0.35	0.35		0.52	0.52	0.52		0.52	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				620	568		133	1845	825		1844	
v/s Ratio Prot				c0.34	0.08			0.28			0.35	
v/s Ratio Perm							c0.49		0.07			
v/c Ratio				0.96	0.23		0.93	0.53	0.14		0.67	
Uniform Delay, d1				22.3	16.1		15.6	11.1	8.6		12.3	
Progression Factor				1.00	1.00		0.92	0.86	0.92		1.00	
Incremental Delay, d2				27.3	0.2		54.4	0.9	0.3		2.0	
Delay (s)				49.6	16.3		68.8	10.4	8.2		14.3	
Level of Service				D	B		E	B	A		B	
Approach Delay (s)		0.0			41.5			15.5			14.3	
Approach LOS		A			D			B			B	

Intersection Summary			
HCM Average Control Delay	21.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	81.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	481	385	908	1877
v/c Ratio	0.90	0.79	0.44	0.91
Control Delay	45.7	35.1	2.8	14.5
Queue Delay	0.0	0.0	0.1	1.7
Total Delay	45.7	35.1	2.9	16.2
Queue Length 50th (ft)	193	143	24	204
Queue Length 95th (ft)	#356	#274	m41	m#244
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	556	506	2064	2064
Starvation Cap Reductn	0	0	178	7
Spillback Cap Reductn	0	0	0	83
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.87	0.76	0.48	0.95

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	457	366	0	863	1783	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	481	385	0	908	1877	0
RTOR Reduction (vph)	0	8	0	0	0	0
Lane Group Flow (vph)	481	377	0	908	1877	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	21.2	21.2		40.8	40.8	
Effective Green, g (s)	21.2	21.2		40.8	40.8	
Actuated g/C Ratio	0.30	0.30		0.58	0.58	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	536	479		2063	2063	
v/s Ratio Prot				0.26	c0.53	
v/s Ratio Perm	c0.27	0.24				
v/c Ratio	0.90	0.79		0.44	0.91	
Uniform Delay, d1	23.4	22.3		8.2	13.0	
Progression Factor	1.00	1.00		0.26	0.61	
Incremental Delay, d2	17.5	8.3		0.6	5.0	
Delay (s)	40.9	30.6		2.7	12.9	
Level of Service	D	C		A	B	
Approach Delay (s)	36.3			2.7	12.9	
Approach LOS	D			A	B	

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	226	371	133	41	294	87	173	518	112	193	1604	469
v/c Ratio	1.00	0.46	0.29	0.22	0.36	0.20	0.98	0.38	0.16	0.51	0.91	0.53
Control Delay	90.6	25.4	6.5	25.4	24.3	7.1	98.6	16.5	3.9	23.6	13.9	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	0.4
Total Delay	90.6	25.4	6.5	25.4	24.3	7.1	98.6	16.5	3.9	23.6	21.7	3.9
Queue Length 50th (ft)	98	72	0	14	56	0	76	82	0	80	115	11
Queue Length 95th (ft)	#229	111	39	40	89	32	#189	119	28	m88	m#263	m27
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	227	809	464	190	809	429	177	1365	679	379	1770	879
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	153	108
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.00	0.46	0.29	0.22	0.36	0.20	0.98	0.38	0.16	0.51	0.99	0.61

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	215	352	126	39	279	83	164	492	106	183	1524	446
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.53	1.00	1.00	0.45	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	994	3539	1583	830	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	226	371	133	41	294	87	173	518	112	193	1604	469
RTOR Reduction (vph)	0	0	103	0	0	67	0	0	69	0	0	88
Lane Group Flow (vph)	226	371	30	41	294	20	173	518	43	193	1604	382
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	16.0	16.0	16.0	16.0	16.0	16.0	7.0	27.0	27.0	15.0	35.0	35.0
Effective Green, g (s)	16.0	16.0	16.0	16.0	16.0	16.0	7.0	27.0	27.0	15.0	35.0	35.0
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23	0.23	0.10	0.39	0.39	0.21	0.50	0.50
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	227	809	362	190	809	362	177	1365	611	379	1770	792
v/s Ratio Prot		0.10			0.08		c0.10	0.15		0.11	c0.45	
v/s Ratio Perm	c0.23		0.02	0.05		0.01			0.03			0.24
v/c Ratio	1.00	0.46	0.08	0.22	0.36	0.05	0.98	0.38	0.07	0.51	0.91	0.48
Uniform Delay, d1	27.0	23.3	21.2	21.9	22.7	21.1	31.4	15.5	13.6	24.3	16.0	11.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.54	0.34
Incremental Delay, d2	58.1	0.4	0.1	0.6	0.3	0.1	60.4	0.8	0.2	0.5	4.0	0.9
Delay (s)	85.1	23.7	21.3	22.5	23.0	21.2	91.8	16.3	13.8	21.4	12.6	4.9
Level of Service	F	C	C	C	C	C	F	B	B	C	B	A
Approach Delay (s)		42.3			22.6			32.2			11.8	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM Average Control Delay	22.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	84.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	72	490	0	433	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	76	516	0	456	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			592		304	38
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			592		304	38
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			980		664	1026

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	51	197	344	228	228
Volume Left	0	0	0	0	0
Volume Right	0	172	344	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.03	0.12	0.20	0.13	0.13
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	23.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	79	1179	1648	289
v/c Ratio	0.40	0.33	0.55	0.21
Control Delay	25.7	0.3	3.6	0.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	25.7	0.3	3.6	0.7
Queue Length 50th (ft)	28	0	107	0
Queue Length 95th (ft)	53	0	150	12
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	207	3539	2991	1383
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.38	0.33	0.55	0.21

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	75	1120	1566	275
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	79	1179	1648	289
RTOR Reduction (vph)	0	0	0	0	0	61
Lane Group Flow (vph)	0	0	79	1179	1648	228
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			4.2	60.0	47.3	47.3
Effective Green, g (s)			4.2	60.0	47.3	47.3
Actuated g/C Ratio			0.07	1.00	0.79	0.79
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			124	3539	2790	1248
v/s Ratio Prot			0.04	c0.33	c0.47	
v/s Ratio Perm						0.14
v/c Ratio			0.64	0.33	0.59	0.18
Uniform Delay, d1			27.2	0.0	2.5	1.6
Progression Factor			0.79	1.00	1.00	1.00
Incremental Delay, d2			9.9	0.2	0.9	0.3
Delay (s)			31.4	0.2	3.4	1.9
Level of Service			C	A	A	A
Approach Delay (s)	0.0			2.2	3.2	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	2.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	4.5
Intersection Capacity Utilization	64.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	179	291	0	1039	1570	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	188	306	0	1094	1653	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.84	0.78	0.78			
vC, conflicting volume	2199	826	1653			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1328	196	1262			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	51	100			
cM capacity (veh/h)	123	630	424			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	126	369	547	547	826	826
Volume Left	126	63	0	0	0	0
Volume Right	0	306	0	0	0	0
cSH	123	371	1700	1700	1700	1700
Volume to Capacity	1.02	0.99	0.32	0.32	0.49	0.49
Queue Length 95th (ft)	175	291	0	0	0	0
Control Delay (s)	153.7	79.5	0.0	0.0	0.0	0.0
Lane LOS	F	F				
Approach Delay (s)	98.3		0.0		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	15.0		
Intersection Capacity Utilization	64.4%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	134	128	38	90	173	935	9	1244	533
v/c Ratio	0.55	0.19	0.16	0.14	0.57	0.38	0.02	0.62	0.51
Control Delay	29.7	6.7	20.2	13.3	22.5	6.6	1.9	9.8	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.7	6.7	20.2	13.3	22.5	6.6	1.9	9.8	3.5
Queue Length 50th (ft)	44	3	12	8	18	62	1	98	6
Queue Length 95th (ft)	84	20	30	22	#88	171	m1	264	29
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	346	904	333	916	304	2473	389	1991	1038
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.14	0.11	0.10	0.57	0.38	0.02	0.62	0.51

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	20	102	36	54	31	164	881	8	9	1182	506
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.87		1.00	0.94		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3095		1770	3345		1770	3535		1770	3539	1583
Flt Permitted	0.70	1.00		0.67	1.00		0.14	1.00		0.26	1.00	1.00
Satd. Flow (perm)	1296	3095		1250	3345		254	3535		482	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	134	21	107	38	57	33	173	927	8	9	1244	533
RTOR Reduction (vph)	0	89	0	0	28	0	0	1	0	0	0	170
Lane Group Flow (vph)	134	39	0	38	63	0	173	934	0	9	1244	363
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	10.0	10.0		10.0	10.0		42.0	37.2		30.6	29.8	29.8
Effective Green, g (s)	10.0	10.0		10.0	10.0		42.0	37.2		30.6	29.8	29.8
Actuated g/C Ratio	0.17	0.17		0.17	0.17		0.70	0.62		0.51	0.50	0.50
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	216	516		208	558		385	2192		263	1758	786
v/s Ratio Prot		0.01			0.02		c0.06	c0.26		0.00	c0.35	
v/s Ratio Perm	c0.10			0.03			0.25			0.02		0.23
v/c Ratio	0.62	0.08		0.18	0.11		0.45	0.43		0.03	0.71	0.46
Uniform Delay, d1	23.2	21.1		21.5	21.2		13.7	5.9		9.8	11.7	9.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.36	0.78	0.44
Incremental Delay, d2	5.4	0.1		0.4	0.1		0.8	0.6		0.0	2.2	1.8
Delay (s)	28.7	21.2		21.9	21.3		14.5	6.5		3.6	11.3	6.2
Level of Service	C	C		C	C		B	A		A	B	A
Approach Delay (s)		25.0			21.5			7.7			9.7	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	10.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	611	279	614	86	101	887
v/c Ratio	0.70	0.46	0.40	0.12	0.43	0.42
Control Delay	24.7	5.4	9.7	1.7	29.4	7.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.7	5.4	9.7	1.7	29.4	7.4
Queue Length 50th (ft)	100	0	85	0	34	82
Queue Length 95th (ft)	149	48	102	14	74	113
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	941	637	1601	763	254	2160
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.44	0.38	0.11	0.40	0.41

Intersection Summary

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	580	265	583	82	96	843
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	611	279	614	86	101	887
RTOR Reduction (vph)	0	208	0	50	0	0
Lane Group Flow (vph)	611	71	614	36	101	887
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	15.3	15.3	25.3	25.3	6.9	36.2
Effective Green, g (s)	15.3	15.3	25.3	25.3	6.9	36.2
Actuated g/C Ratio	0.26	0.26	0.42	0.42	0.12	0.60
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	875	404	1492	667	204	2135
v/s Ratio Prot	c0.18		0.17		0.06	c0.25
v/s Ratio Perm		0.04		0.02		
v/c Ratio	0.70	0.18	0.41	0.05	0.50	0.42
Uniform Delay, d1	20.3	17.4	12.1	10.3	24.9	6.3
Progression Factor	1.00	1.00	0.69	0.53	1.00	1.00
Incremental Delay, d2	2.5	0.2	0.8	0.2	1.9	0.6
Delay (s)	22.7	17.6	9.2	5.6	26.8	6.9
Level of Service	C	B	A	A	C	A
Approach Delay (s)	21.1		8.8			8.9
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	13.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	35	71	695	1385	213	1276
v/c Ratio	0.17	0.44	0.26	1.01	1.20	0.40
Control Delay	54.8	21.0	5.2	35.5	174.0	1.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.8	21.0	5.2	35.5	174.0	1.1
Queue Length 50th (ft)	13	0	79	~800	~204	32
Queue Length 95th (ft)	29	46	114	#1244	#359	51
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	629	348	2663	1374	177	3161
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.20	0.26	1.01	1.20	0.40

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	33	67	660	1316	202	1212
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	35	71	695	1385	213	1276
RTOR Reduction (vph)	0	67	0	188	0	0
Lane Group Flow (vph)	35	4	695	1197	213	1276
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	6.0	6.0	89.5	89.5	12.0	105.5
Effective Green, g (s)	6.0	6.0	89.5	89.5	12.0	105.5
Actuated g/C Ratio	0.05	0.05	0.75	0.75	0.10	0.88
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	172	79	2640	1181	177	3111
v/s Ratio Prot	c0.01		0.20		c0.12	0.36
v/s Ratio Perm		0.00		c0.76		
v/c Ratio	0.20	0.04	0.26	1.01	1.20	0.41
Uniform Delay, d1	54.7	54.3	4.8	15.2	54.0	1.4
Progression Factor	1.00	1.00	1.00	1.00	0.98	0.49
Incremental Delay, d2	0.6	0.2	0.2	29.7	128.9	0.4
Delay (s)	55.3	54.5	5.1	44.9	181.7	1.0
Level of Service	E	D	A	D	F	A
Approach Delay (s)	54.8		31.6			26.9
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	30.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	99.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	144	160	736	64	40	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	152	168	775	67	42	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	893	808			775	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	893	808			775	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	49	56			95	
cM capacity (veh/h)	297	381			841	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	152	168	842	42	0
Volume Left	152	0	0	42	0
Volume Right	0	168	67	0	0
cSH	297	381	1700	841	1700
Volume to Capacity	0.51	0.44	0.50	0.05	0.00
Queue Length 95th (ft)	68	55	0	4	0
Control Delay (s)	29.2	21.7	0.0	9.5	0.0
Lane LOS	D	C		A	
Approach Delay (s)	25.3		0.0	9.5	
Approach LOS	D				

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	59.2%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2556	1647	547	136	1201	505	709
v/c Ratio	1.11	1.02	0.50	0.55	1.04	0.78	0.50
Control Delay	89.2	52.2	4.2	43.0	79.1	59.6	41.1
Queue Delay	624.3	357.2	6.3	0.0	0.0	0.0	0.0
Total Delay	713.5	409.5	10.5	43.0	79.1	59.6	41.1
Queue Length 50th (ft)	~899	~790	81	117	~411	210	184
Queue Length 95th (ft)	#989	m734	m50	182	#510	275	227
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2308	1620	1090	246	1152	647	1404
Starvation Cap Reductn	0	719	481	0	0	0	0
Spillback Cap Reductn	1292	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	2.52	1.83	0.90	0.55	1.04	0.78	0.50

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	2254	174	0	1565	520	129	1114	27	480	673	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5031			3539	1583	1770	5068		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5031			3539	1583	1770	5068		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2373	183	0	1647	547	136	1173	28	505	708	1
RTOR Reduction (vph)	0	7	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	2549	0	0	1647	547	136	1199	0	505	709	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		59.5			59.5	84.0	18.1	29.5		24.5	35.9	
Effective Green, g (s)		59.5			59.5	84.0	18.1	29.5		24.5	35.9	
Actuated g/C Ratio		0.46			0.46	0.65	0.14	0.23		0.19	0.28	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2303			1620	1090	246	1150		647	1404	
v/s Ratio Prot		c0.51			0.47	0.09	0.08	c0.24		c0.15	0.14	
v/s Ratio Perm						0.25						
v/c Ratio		1.11			1.02	0.50	0.55	1.04		0.78	0.50	
Uniform Delay, d1		35.2			35.2	12.0	52.2	50.2		50.2	39.6	
Progression Factor		1.00			1.06	0.39	0.67	0.88		1.00	1.00	
Incremental Delay, d2		55.2			15.1	0.1	7.3	36.3		6.1	1.3	
Delay (s)		90.5			52.6	4.8	42.5	80.4		56.3	40.9	
Level of Service		F			D	A	D	F		E	D	
Approach Delay (s)		90.5			40.6			76.5			47.3	
Approach LOS		F			D			E			D	

Intersection Summary			
HCM Average Control Delay	65.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	97.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	449	2439	37	2245	811	158	265	477	397
v/c Ratio	1.16	0.79	0.54	1.09	1.18	0.58	1.18	0.56	0.58
Control Delay	112.4	35.7	93.9	95.0	151.2	48.4	169.5	46.0	7.5
Queue Delay	138.0	266.7	0.0	368.8	0.0	1.1	579.2	0.0	0.6
Total Delay	250.4	302.4	93.9	463.8	151.2	49.5	748.8	46.0	8.1
Queue Length 50th (ft)	~460	663	30	~757	~305	79	~137	186	0
Queue Length 95th (ft)	m#435	m617	m38	#850	#397	151	#228	243	85
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	388	3088	69	2063	685	273	224	858	684
Starvation Cap Reductn	83	1556	0	22	0	0	0	0	0
Spillback Cap Reductn	0	881	0	889	0	25	224	0	79
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.47	1.59	0.54	1.91	1.18	0.64	265.00	0.56	0.66

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	427	2303	14	35	1749	384	0	770	150	252	453	377
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.97			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5081		1770	4948			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5081		1770	4948			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	449	2424	15	37	1841	404	0	811	158	265	477	397
RTOR Reduction (vph)	0	0	0	0	26	0	0	0	60	0	0	301
Lane Group Flow (vph)	449	2439	0	37	2219	0	0	811	98	265	477	96
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	28.5	77.9		4.1	53.5			17.5	17.5	8.5	31.5	31.5
Effective Green, g (s)	28.5	77.9		4.1	53.5			17.5	17.5	8.5	31.5	31.5
Actuated g/C Ratio	0.22	0.60		0.03	0.41			0.13	0.13	0.07	0.24	0.24
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	388	3045		56	2036			685	213	224	858	384
v/s Ratio Prot	c0.25	0.48		0.02	c0.45			c0.16		c0.08	0.13	
v/s Ratio Perm									0.06			0.06
v/c Ratio	1.16	0.80		0.66	1.09			1.18	0.46	1.18	0.56	0.25
Uniform Delay, d1	50.8	20.1		62.3	38.2			56.2	51.9	60.8	43.1	39.7
Progression Factor	0.83	1.78		1.27	1.45			1.21	1.37	1.00	1.00	1.00
Incremental Delay, d2	73.7	0.2		15.7	45.8			95.2	6.0	118.5	2.6	1.6
Delay (s)	115.7	35.9		94.8	101.2			163.0	77.2	179.2	45.7	41.3
Level of Service	F	D		F	F			F	E	F	D	D
Approach Delay (s)		48.3			101.1			149.0			75.2	
Approach LOS		D			F			F			E	

Intersection Summary			
HCM Average Control Delay	82.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	106.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	38	794	51	1232	494	78	497	177	349	13
v/c Ratio	0.37	0.38	0.24	0.59	0.53	0.19	0.60	0.51	0.33	0.04
Control Delay	42.3	31.4	28.8	31.1	5.3	41.3	46.7	77.9	70.8	49.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.3	31.4	28.8	31.1	5.3	41.3	46.7	77.9	70.8	49.6
Queue Length 50th (ft)	29	222	28	291	15	53	192	183	120	8
Queue Length 95th (ft)	m55	m251	62	340	91	98	252	m273	m159	m17
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	103	2088	215	2093	925	415	823	345	1063	368
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.38	0.24	0.59	0.53	0.19	0.60	0.51	0.33	0.04

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	36	739	15	48	1170	469	74	403	69	337	162	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (prot)	1770	5070		1770	5085	1583	1770	3461		1522	4686	1583
Flt Permitted	0.13	1.00		0.28	1.00	1.00	0.95	1.00		0.95	0.98	1.00
Satd. Flow (perm)	250	5070		523	5085	1583	1770	3461		1522	4686	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	38	778	16	51	1232	494	78	424	73	355	171	13
RTOR Reduction (vph)	0	2	0	0	0	273	0	11	0	0	0	9
Lane Group Flow (vph)	38	792	0	51	1232	221	78	486	0	177	349	4
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	53.5	53.5		53.5	53.5	53.5	30.5	30.5		29.5	29.5	29.5
Effective Green, g (s)	53.5	53.5		53.5	53.5	53.5	30.5	30.5		29.5	29.5	29.5
Actuated g/C Ratio	0.41	0.41		0.41	0.41	0.41	0.23	0.23		0.23	0.23	0.23
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	103	2087		215	2093	651	415	812		345	1063	359
v/s Ratio Prot		0.16			c0.24		0.04	c0.14		c0.12	0.07	
v/s Ratio Perm	0.15			0.10		0.14						0.00
v/c Ratio	0.37	0.38		0.24	0.59	0.34	0.19	0.60		0.51	0.33	0.01
Uniform Delay, d1	26.5	26.7		24.9	29.7	26.2	39.8	44.3		44.0	42.0	38.9
Progression Factor	1.17	1.16		1.00	1.00	1.00	1.00	1.00		1.64	1.66	2.58
Incremental Delay, d2	7.7	0.4		2.6	1.2	1.4	1.0	3.3		4.5	0.7	0.0
Delay (s)	38.7	31.3		27.5	30.9	27.6	40.8	47.6		76.7	70.4	100.5
Level of Service	D	C		C	C	C	D	D		E	E	F
Approach Delay (s)		31.7			29.9			46.6			73.2	
Approach LOS		C			C			D			E	

Intersection Summary			
HCM Average Control Delay	39.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	68.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	111	2675	40	135	2585	96	95	171	48	18	36
v/c Ratio	0.72	0.84	0.04	0.77	0.82	0.68	0.50	0.56	0.27	0.06	0.13
Control Delay	79.8	42.8	14.6	53.4	0.8	79.1	63.8	15.9	48.3	44.9	14.7
Queue Delay	0.0	72.8	0.0	0.0	1.4	288.2	0.0	0.0	0.0	0.0	0.8
Total Delay	79.8	115.5	14.6	53.4	2.2	367.3	63.8	15.9	48.3	44.9	15.5
Queue Length 50th (ft)	85	861	16	122	13	79	76	3	34	13	0
Queue Length 95th (ft)	m112	m884	m20	m109	m13	138	132	73	70	36	31
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	165	3167	994	185	3166	171	229	315	178	344	322
Starvation Cap Reductn	0	861	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	362	111	0	0	0	0	164
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	1.16	0.04	0.73	0.92	1.60	0.41	0.54	0.27	0.05	0.23

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	105	2541	38	128	2044	411	91	90	162	46	17	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	4958		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.75	1.00	1.00	0.49	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	4958		1389	1863	1583	918	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	111	2675	40	135	2152	433	96	95	171	48	18	36
RTOR Reduction (vph)	0	0	8	0	22	0	0	0	150	0	0	30
Lane Group Flow (vph)	111	2675	32	135	2563	0	96	95	21	48	18	6
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	11.4	80.2	80.2	12.9	81.7		13.2	13.2	12.9	20.4	20.4	20.4
Effective Green, g (s)	11.4	80.2	80.2	12.9	81.7		13.2	13.2	12.9	20.4	20.4	20.4
Actuated g/C Ratio	0.09	0.62	0.62	0.10	0.63		0.10	0.10	0.10	0.16	0.16	0.16
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	155	3137	977	176	3116		141	189	157	165	292	248
v/s Ratio Prot	0.06	c0.53		c0.08	0.52			0.05	0.01	c0.01	0.01	
v/s Ratio Perm			0.02				c0.07			0.04		0.00
v/c Ratio	0.72	0.85	0.03	0.77	0.82		0.68	0.50	0.13	0.29	0.06	0.02
Uniform Delay, d1	57.7	20.1	9.7	57.1	18.6		56.4	55.3	53.4	47.6	46.7	46.4
Progression Factor	1.13	1.96	2.24	0.88	0.03		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.4	1.8	0.0	1.9	0.2		12.7	2.1	0.4	1.0	0.1	0.0
Delay (s)	73.6	41.2	21.8	51.8	0.8		69.1	57.4	53.8	48.6	46.7	46.4
Level of Service	E	D	C	D	A		E	E	D	D	D	D
Approach Delay (s)		42.2			3.3			58.8			47.5	
Approach LOS		D			A			E			D	

Intersection Summary			
HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	115	2675	3339	156
v/c Ratio	0.43	0.80	1.14	0.31
Control Delay	31.4	12.4	87.5	32.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	31.4	12.4	87.5	32.3
Queue Length 50th (ft)	76	261	~1185	36
Queue Length 95th (ft)	m90	369	m#360	73
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	456	3344	2919	511
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.25	0.80	1.14	0.31

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	109	2541	2607	565	87	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.97		0.94	
Flt Protected	0.95	1.00	1.00		0.97	
Satd. Flow (prot)	1770	5085	4949		3294	
Flt Permitted	0.95	1.00	1.00		0.97	
Satd. Flow (perm)	1770	5085	4949		3294	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	115	2675	2744	595	92	64
RTOR Reduction (vph)	0	0	26	0	55	0
Lane Group Flow (vph)	115	2675	3313	0	101	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	19.5	85.5	76.0		18.0	
Effective Green, g (s)	19.5	85.5	76.0		18.0	
Actuated g/C Ratio	0.15	0.66	0.58		0.14	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	266	3344	2893		456	
v/s Ratio Prot	c0.06	c0.53	c0.67		c0.03	
v/s Ratio Perm						
v/c Ratio	0.43	0.80	1.15		0.22	
Uniform Delay, d1	50.2	16.1	27.0		49.8	
Progression Factor	0.58	0.68	0.78		1.00	
Incremental Delay, d2	0.6	1.2	65.7		1.1	
Delay (s)	29.6	12.2	86.8		50.9	
Level of Service	C	B	F		D	
Approach Delay (s)		12.9	86.8		50.9	
Approach LOS		B	F		D	

Intersection Summary			
HCM Average Control Delay	53.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	87.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	153	2536	69	45	3714	180	51	118
v/c Ratio	1.07	0.72	0.06	0.42	1.12	1.16	0.29	0.39
Control Delay	116.3	1.2	0.1	70.3	81.5	170.4	55.9	16.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	116.3	1.2	0.1	70.3	81.5	170.4	55.9	16.9
Queue Length 50th (ft)	~140	19	0	37	~1319	~178	39	13
Queue Length 95th (ft)	m#212	23	m0	78	#1387	#331	82	71
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	143	3532	1120	123	3320	155	173	306
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.07	0.72	0.06	0.37	1.12	1.16	0.29	0.39

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	145	2409	66	43	3318	210	122	38	11	48	16	96
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99			0.99		1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5040			1783		1770	1624	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.62		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5040			1140		1287	1624	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	153	2536	69	45	3493	221	128	40	12	51	17	101
RTOR Reduction (vph)	0	0	21	0	6	0	0	2	0	0	87	0
Lane Group Flow (vph)	153	2536	48	45	3708	0	0	178	0	51	31	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	11.6	89.2	89.2	6.8	84.4			17.5		17.5	17.5	
Effective Green, g (s)	11.6	89.2	89.2	6.8	84.4			17.5		17.5	17.5	
Actuated g/C Ratio	0.09	0.69	0.69	0.05	0.65			0.13		0.13	0.13	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	158	3489	1086	93	3272			153		173	219	
v/s Ratio Prot	c0.09	0.50		0.03	c0.74						0.02	
v/s Ratio Perm			0.03					c0.16		0.04		
v/c Ratio	0.97	0.73	0.04	0.48	1.13			1.17		0.29	0.14	
Uniform Delay, d1	59.0	12.8	6.6	59.9	22.8			56.2		50.7	49.6	
Progression Factor	0.62	0.03	0.00	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	46.0	0.8	0.0	3.9	64.4			124.0		1.0	0.3	
Delay (s)	82.5	1.2	0.0	63.8	87.2			180.3		51.6	49.9	
Level of Service	F	A	A	E	F			F		D	D	
Approach Delay (s)		5.7			86.9			180.3			50.4	
Approach LOS		A			F			F			D	

Intersection Summary			
HCM Average Control Delay	55.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	106.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	18	1209	78	1351	67	178	508	62	134	95
v/c Ratio	0.15	0.80	0.33	0.75	0.16	0.28	0.80	0.16	0.21	0.17
Control Delay	18.8	23.2	12.4	16.7	16.0	17.0	23.9	16.0	16.2	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.8	23.2	12.4	16.7	16.0	17.0	23.9	16.0	16.2	12.4
Queue Length 50th (ft)	4	222	14	210	19	53	134	18	39	20
Queue Length 95th (ft)	21	#396	38	350	44	96	248	42	74	48
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	135	1720	237	2142	632	941	874	590	941	812
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.70	0.33	0.63	0.11	0.19	0.58	0.11	0.14	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	1088	61	74	1270	13	64	169	483	59	127	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3511		1770	3534		1770	1863	1583	1770	1863	1583
Flt Permitted	0.15	1.00		0.13	1.00		0.67	1.00	1.00	0.63	1.00	1.00
Satd. Flow (perm)	275	3511		248	3534		1250	1863	1583	1167	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	18	1145	64	78	1337	14	67	178	508	62	134	95
RTOR Reduction (vph)	0	5	0	0	1	0	0	0	99	0	0	17
Lane Group Flow (vph)	18	1204	0	78	1350	0	67	178	409	62	134	78
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	27.1	27.1		33.0	33.0		21.5	21.5	21.5	21.5	21.5	21.5
Effective Green, g (s)	27.1	27.1		33.0	33.0		21.5	21.5	21.5	21.5	21.5	21.5
Actuated g/C Ratio	0.43	0.43		0.52	0.52		0.34	0.34	0.34	0.34	0.34	0.34
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	117	1498		198	1837		423	631	536	395	631	536
v/s Ratio Prot		c0.34		0.02	c0.38			0.10			0.07	
v/s Ratio Perm	0.07			0.19			0.05		c0.26	0.05		0.05
v/c Ratio	0.15	0.80		0.39	0.73		0.16	0.28	0.76	0.16	0.21	0.15
Uniform Delay, d1	11.2	15.9		10.6	11.9		14.7	15.4	18.7	14.7	15.0	14.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	3.2		1.3	1.6		0.2	0.2	6.4	0.2	0.2	0.1
Delay (s)	11.8	19.1		11.8	13.4		14.9	15.6	25.1	14.9	15.1	14.7
Level of Service	B	B		B	B		B	B	C	B	B	B
Approach Delay (s)		19.0			13.3			22.0			14.9	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	63.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues
1: Carson St & I-605 SB Off Ramps

11/30/2012

Lane Group	EBT	WBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	2170	1565	582	1103	561	252
v/c Ratio	0.79	0.71	0.36	0.68	0.37	0.37
Control Delay	29.1	30.7	0.6	25.2	19.2	19.9
Queue Delay	0.0	0.0	0.0	0.1	0.0	0.0
Total Delay	29.1	30.7	0.6	25.2	19.2	19.9
Queue Length 50th (ft)	368	340	0	305	134	117
Queue Length 95th (ft)	416	381	0	379	178	187
Internal Link Dist (ft)	550	190			1136	
Turn Bay Length (ft)				300		300
Base Capacity (vph)	2780	2224	1611	1628	1521	688
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	13	28	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.70	0.36	0.69	0.37	0.37

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1876	185	0	1487	0	0	0	553	1048	329	444
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.9			4.9				4.0	5.4	5.4	5.4
Lane Util. Factor		0.86			0.91				1.00	0.97	0.91	0.91
Frt		0.99			1.00				0.86	1.00	0.94	0.85
Flt Protected		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (prot)		6321			5085				1611	3433	3195	1441
Flt Permitted		1.00			1.00				1.00	0.95	1.00	1.00
Satd. Flow (perm)		6321			5085				1611	3433	3195	1441
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1975	195	0	1565	0	0	0	582	1103	346	467
RTOR Reduction (vph)	0	15	0	0	0	0	0	0	0	0	4	4
Lane Group Flow (vph)	0	2155	0	0	1565	0	0	0	582	1103	557	248
Turn Type									Free	Split		Perm
Protected Phases		2			6					4	4	
Permitted Phases									Free			4
Actuated Green, G (s)		47.5			47.5				110.0	52.2	52.2	52.2
Effective Green, g (s)		47.5			47.5				110.0	52.2	52.2	52.2
Actuated g/C Ratio		0.43			0.43				1.00	0.47	0.47	0.47
Clearance Time (s)		4.9			4.9					5.4	5.4	5.4
Vehicle Extension (s)		5.0			5.0					2.5	2.5	2.5
Lane Grp Cap (vph)		2730			2196				1611	1629	1516	684
v/s Ratio Prot		c0.34			0.31					c0.32	0.17	
v/s Ratio Perm									0.36			0.17
v/c Ratio		0.79			0.71				0.36	0.68	0.37	0.36
Uniform Delay, d1		26.9			25.6				0.0	22.4	18.4	18.3
Progression Factor		1.00			1.13				1.00	1.00	1.00	1.00
Incremental Delay, d2		1.8			1.1				0.6	2.3	0.7	1.5
Delay (s)		28.8			30.1				0.6	24.7	19.1	19.8
Level of Service		C			C				A	C	B	B
Approach Delay (s)		28.8			30.1			0.6			22.4	
Approach LOS		C			C			A			C	

Intersection Summary			
HCM Average Control Delay	24.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	3387	1281	832	772	302
v/c Ratio	0.87	0.60	0.65	0.73	0.35
Control Delay	20.1	4.8	4.6	38.6	30.8
Queue Delay	0.3	0.7	2.4	0.0	0.0
Total Delay	20.4	5.5	7.0	38.6	30.8
Queue Length 50th (ft)	543	85	88	249	93
Queue Length 95th (ft)	622	m115	m119	319	135
Internal Link Dist (ft)	410	90			
Turn Bay Length (ft)				300	300
Base Capacity (vph)	3880	2143	1287	1061	862
Starvation Cap Reductn	124	478	317	0	0
Spillback Cap Reductn	65	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.90	0.77	0.86	0.73	0.35

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	3218	0	0	1217	790	733	0	287	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.4			5.4	5.4	4.0		4.0			
Lane Util. Factor		0.86			0.95	1.00	0.97		0.88			
Frt		1.00			1.00	0.85	1.00		0.85			
Flt Protected		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (prot)		6408			3539	1583	3433		2787			
Flt Permitted		1.00			1.00	1.00	0.95		1.00			
Satd. Flow (perm)		6408			3539	1583	3433		2787			
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	3387	0	0	1281	832	772	0	302	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	328	0	0	1	0	0	0
Lane Group Flow (vph)	0	3387	0	0	1281	504	772	0	301	0	0	0
Turn Type						Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases						6	8		8			
Actuated Green, G (s)		66.6			66.6	66.6	34.0		34.0			
Effective Green, g (s)		66.6			66.6	66.6	34.0		34.0			
Actuated g/C Ratio		0.61			0.61	0.61	0.31		0.31			
Clearance Time (s)		5.4			5.4	5.4	4.0		4.0			
Vehicle Extension (s)		5.0			5.0	5.0	3.0		3.0			
Lane Grp Cap (vph)		3880			2143	958	1061		861			
v/s Ratio Prot		c0.53			0.36							
v/s Ratio Perm						0.32	c0.22		0.11			
v/c Ratio		0.87			0.60	0.53	0.73		0.35			
Uniform Delay, d1		18.2			13.4	12.6	33.9		29.4			
Progression Factor		0.96			0.30	3.99	1.00		1.00			
Incremental Delay, d2		2.1			0.4	0.5	4.4		1.1			
Delay (s)		19.4			4.4	50.7	38.2		30.6			
Level of Service		B			A	D	D		C			
Approach Delay (s)		19.4			22.7			36.1			0.0	
Approach LOS		B			C			D			A	

Intersection Summary			
HCM Average Control Delay	23.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	9.4
Intersection Capacity Utilization	75.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	877	2223	6	1345	213	105	162	328	320
v/c Ratio	1.00	0.80	0.05	0.96	0.88	0.31	0.25	0.85	0.65
Control Delay	51.2	8.8	49.7	56.0	81.1	45.3	39.2	39.7	11.5
Queue Delay	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.2	9.2	49.7	56.0	81.1	45.3	39.2	39.7	11.5
Queue Length 50th (ft)	330	113	4	343	152	34	50	98	0
Queue Length 95th (ft)	m#431	#663	18	#454	#299	61	82	#248	86
Internal Link Dist (ft)		311		731		382		448	
Turn Bay Length (ft)	250		80		120		140		140
Base Capacity (vph)	877	2788	113	1398	243	705	638	413	514
Starvation Cap Reductn	0	180	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.00	0.85	0.05	0.96	0.88	0.15	0.25	0.79	0.62

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	833	1890	222	6	1146	132	202	91	9	154	53	562
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Lane Util. Factor	0.97	0.91		1.00	0.91		1.00	0.95		0.97	0.95	0.95
Frt	1.00	0.98		1.00	0.98		1.00	0.99		1.00	0.88	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5005		1770	5006		1770	3494		3433	1549	1504
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5005		1770	5006		1770	3494		3433	1549	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	877	1989	234	6	1206	139	213	96	9	162	56	592
RTOR Reduction (vph)	0	12	0	0	14	0	0	7	0	0	163	274
Lane Group Flow (vph)	877	2211	0	6	1331	0	213	98	0	162	165	46
Turn Type	Prot			Prot			Prot			Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)	32.1	57.1		1.4	26.4		15.1	10.4		20.5	15.8	15.8
Effective Green, g (s)	32.1	57.1		1.4	26.4		15.1	10.4		20.5	15.8	15.8
Actuated g/C Ratio	0.29	0.52		0.01	0.24		0.14	0.09		0.19	0.14	0.14
Clearance Time (s)	4.9	5.4		4.9	5.4		4.9	5.4		4.9	5.4	5.4
Vehicle Extension (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	1002	2598		23	1201		243	330		640	222	216
v/s Ratio Prot	0.26	c0.44		0.00	c0.27		c0.12	0.03		c0.05	c0.11	
v/s Ratio Perm												0.03
v/c Ratio	0.88	0.85		0.26	1.11		0.88	0.30		0.25	0.74	0.21
Uniform Delay, d1	37.0	22.8		53.8	41.8		46.5	46.4		38.2	45.2	41.6
Progression Factor	0.67	0.31		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.0	2.0		8.1	61.1		28.5	0.7		0.3	13.5	0.7
Delay (s)	29.7	9.2		61.9	102.9		75.0	47.1		38.5	58.6	42.3
Level of Service	C	A		E	F		E	D		D	E	D
Approach Delay (s)		15.0			102.7			65.8			48.1	
Approach LOS		B			F			E			D	

Intersection Summary			
HCM Average Control Delay	43.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	20.6
Intersection Capacity Utilization	91.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	2029	1409	725	917
v/c Ratio	0.69	0.69	0.73	0.58
Control Delay	13.0	13.7	26.6	1.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	13.0	13.7	26.6	1.6
Queue Length 50th (ft)	204	202	144	0
Queue Length 95th (ft)	316	340	175	0
Internal Link Dist (ft)	898	560	1261	
Turn Bay Length (ft)			230	900
Base Capacity (vph)	2922	2033	1609	1583
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	43	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.69	0.69	0.46	0.58

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1928	1339	0	689	871
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3		4.2	4.0
Lane Util. Factor		0.91	0.95		0.97	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		5085	3539		3433	1583
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		5085	3539		3433	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2029	1409	0	725	917
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2029	1409	0	725	917
Turn Type						Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		40.2	40.2		20.3	70.0
Effective Green, g (s)		40.2	40.2		20.3	70.0
Actuated g/C Ratio		0.57	0.57		0.29	1.00
Clearance Time (s)		5.3	5.3		4.2	
Vehicle Extension (s)		5.0	5.0		2.5	
Lane Grp Cap (vph)		2920	2032		996	1583
v/s Ratio Prot		c0.40	0.40		c0.21	
v/s Ratio Perm						0.58
v/c Ratio		0.69	0.69		0.73	0.58
Uniform Delay, d1		10.6	10.5		22.4	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		1.4	1.9		2.5	1.6
Delay (s)		11.9	12.4		24.9	1.6
Level of Service		B	B		C	A
Approach Delay (s)		11.9	12.4		11.9	
Approach LOS		B	B		B	

Intersection Summary			
HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	64.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	WBL	WBT
Lane Group Flow (vph)	2206	1048	194	1383
v/c Ratio	0.84	0.87	0.85	0.39
Control Delay	10.3	15.0	64.2	0.3
Queue Delay	0.4	0.2	0.0	0.0
Total Delay	10.7	15.2	64.2	0.3
Queue Length 50th (ft)	357	303	83	0
Queue Length 95th (ft)	517	#612	#191	0
Internal Link Dist (ft)	560			522
Turn Bay Length (ft)			260	
Base Capacity (vph)	2614	1208	228	3539
Starvation Cap Reductn	92	8	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.87	0.87	0.85	0.39

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	2096	996	184	1314	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.3	5.3	4.0	5.3		
Lane Util. Factor	0.95	1.00	1.00	0.95		
Frt	1.00	0.85	1.00	1.00		
Flt Protected	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	3539	1583	1770	3539		
Flt Permitted	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	3539	1583	1770	3539		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2206	1048	194	1383	0	0
RTOR Reduction (vph)	0	39	0	0	0	0
Lane Group Flow (vph)	2206	1009	194	1383	0	0
Turn Type		Perm	Prot			
Protected Phases	2		1	6		
Permitted Phases		2				
Actuated Green, G (s)	51.7	51.7	9.0	70.0		
Effective Green, g (s)	51.7	51.7	9.0	70.0		
Actuated g/C Ratio	0.74	0.74	0.13	1.00		
Clearance Time (s)	5.3	5.3	4.0	5.3		
Vehicle Extension (s)	5.0	5.0	3.0	5.0		
Lane Grp Cap (vph)	2614	1169	228	3539		
v/s Ratio Prot	0.62		c0.11	0.39		
v/s Ratio Perm		c0.64				
v/c Ratio	0.84	0.86	0.85	0.39		
Uniform Delay, d1	6.3	6.6	29.8	0.0		
Progression Factor	1.04	1.03	1.00	1.00		
Incremental Delay, d2	3.1	7.4	25.0	0.3		
Delay (s)	9.7	14.2	54.8	0.3		
Level of Service	A	B	D	A		
Approach Delay (s)	11.1			7.0	0.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM Average Control Delay	9.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.3
Intersection Capacity Utilization	79.6%	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 (veh/h)	0	0	352	0	0	616	0	917	660	0	788	370
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	371	0	0	648	0	965	695	0	829	389
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)								1120				
pX, platoon unblocked	0.87	0.87		0.87	0.87	0.87				0.87		
vC, conflicting volume	1151	1795	276	1242	1795	322	829			965		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	664	1401	276	768	1401	0	829			451		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	49	100	100	32	100			100		
cM capacity (veh/h)	95	121	721	124	121	947	798			965		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	371	648	386	386	425	463	332	332	296	260
Volume Left	0	0	0	0	0	0	0	0	0	0
Volume Right	371	648	0	0	232	463	0	0	130	260
cSH	721	947	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.51	0.68	0.23	0.23	0.25	0.27	0.20	0.20	0.17	0.15
Queue Length 95th (ft)	74	142	0	0	0	0	0	0	0	0
Control Delay (s)	15.2	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	C								
Approach Delay (s)	15.2	16.6	0.0				0.0			
Approach LOS	C	C								

Intersection Summary				
Average Delay	4.2			
Intersection Capacity Utilization	67.4%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	773	0	1439	629	400
Sign Control	Yield			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	814	0	1515	662	421
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				640		
pX, platoon unblocked	0.86					
vC, conflicting volume	1041	221	662			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	216	221	662			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	0	100			
cM capacity (veh/h)	645	783	922			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	814	379	379	379	379	265	265	273	281
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	814	0	0	0	0	0	0	140	281
cSH	783	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.04	0.22	0.22	0.22	0.22	0.16	0.16	0.16	0.17
Queue Length 95th (ft)	487	0	0	0	0	0	0	0	0
Control Delay (s)	65.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F								
Approach Delay (s)	65.6	0.0				0.0			
Approach LOS	F								

Intersection Summary			
Average Delay	15.6		
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	178	2113	336	234	979	255	228	1163	163	1194
v/c Ratio	0.58	1.02	0.40	0.94	0.52	0.38	0.89	0.76	0.56	0.94
Control Delay	56.1	59.3	17.0	94.1	27.0	5.2	85.1	41.2	57.0	54.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.1	59.3	17.0	94.1	27.0	5.2	85.1	41.2	57.0	54.8
Queue Length 50th (ft)	62	~583	133	86	203	5	84	212	58	299
Queue Length 95th (ft)	100	#679	202	#163	249	67	#155	253	#101	#392
Internal Link Dist (ft)		578			652			1209		560
Turn Bay Length (ft)	175			150			180		150	
Base Capacity (vph)	325	2062	840	250	1866	678	256	1625	292	1269
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	1.02	0.40	0.94	0.52	0.38	0.89	0.72	0.56	0.94

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	169	2007	319	222	903	269	217	970	135	155	1007	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.86	0.97	0.86		0.97	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	4785	1362	3433	6290		3433	5000	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	4785	1362	3433	6290		3433	5000	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	178	2113	336	234	951	283	228	1021	142	163	1060	134
RTOR Reduction (vph)	0	0	3	0	2	148	0	24	0	0	14	0
Lane Group Flow (vph)	178	2113	333	234	977	107	228	1139	0	163	1180	0
Turn Type	Prot		pm+ov	Prot		Perm	Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4			8						
Actuated Green, G (s)	9.8	44.6	52.8	8.0	42.8	42.8	8.2	26.4		9.4	27.6	
Effective Green, g (s)	9.8	44.6	52.8	8.0	42.8	42.8	8.2	26.4		9.4	27.6	
Actuated g/C Ratio	0.09	0.41	0.48	0.07	0.39	0.39	0.07	0.24		0.09	0.25	
Clearance Time (s)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	306	2062	838	250	1862	530	256	1510		293	1255	
v/s Ratio Prot	0.05	c0.42	0.03	c0.07	0.20		0.07	c0.18		0.05	c0.24	
v/s Ratio Perm			0.18			0.08						
v/c Ratio	0.58	1.02	0.40	0.94	0.52	0.20	0.89	0.75		0.56	0.94	
Uniform Delay, d1	48.1	32.7	18.4	50.7	25.8	22.3	50.5	38.8		48.3	40.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.8	26.4	0.3	39.5	0.3	0.2	29.5	2.2		2.3	13.5	
Delay (s)	50.9	59.1	18.7	90.2	26.1	22.5	80.0	41.0		50.6	53.9	
Level of Service	D	E	B	F	C	C	E	D		D	D	
Approach Delay (s)		53.4			35.7			47.4			53.5	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	48.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.2
Intersection Capacity Utilization	91.6%	ICU Level of Service	F
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)	0	1689	660	0	768	0	0	0	0	0	0	747
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	1778	695	0	808	0	0	0	0	0	0	786
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		732										
pX, platoon unblocked				0.61			0.61	0.61	0.61	0.61	0.61	
vC, conflicting volume	808			2473			2395	2934	940	1401	3281	269
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	808			1176			1048	1932	0	0	2501	269
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			0	100	100	100	100	0
cM capacity (veh/h)	813			360			0	40	661	624	17	728

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SB 1
Volume Total	711	711	1050	269	269	269	786
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	695	0	0	0	786
cSH	1700	1700	1700	1700	1700	1700	728
Volume to Capacity	0.42	0.42	0.62	0.16	0.16	0.16	1.08
Queue Length 95th (ft)	0	0	0	0	0	0	529
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	80.0
Lane LOS							F
Approach Delay (s)	0.0			0.0			80.0
Approach LOS							F

Intersection Summary			
Average Delay	15.5		
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	46	182	235	225	22	1831	522	1647
v/c Ratio	0.39	0.63	0.72	0.69	0.16	0.58	0.38	0.49
Control Delay	44.0	50.6	40.4	37.9	2.6	1.7	0.3	11.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.0	50.6	40.4	37.9	2.6	1.7	0.3	11.6
Queue Length 50th (ft)	19	128	117	104	1	44	0	206
Queue Length 95th (ft)	57	185	193	173	m2	m41	m0	311
Internal Link Dist (ft)	296		624			121		607
Turn Bay Length (ft)				470	120			
Base Capacity (vph)	126	428	441	441	136	3138	1362	3340
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.43	0.53	0.51	0.16	0.58	0.38	0.49

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	0	17	192	43	375	21	1630	605	0	1541	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		5.0	5.0	5.0	5.0	5.0	4.0		5.0	
Lane Util. Factor		1.00		0.95	0.91	0.95	1.00	0.86	0.86		0.91	
Frt		0.95		1.00	0.89	0.85	1.00	0.99	0.85		1.00	
Flt Protected		0.97		0.95	1.00	1.00	0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1712		1681	1505	1504	1770	4761	1362		5074	
Flt Permitted		0.97		0.95	1.00	1.00	0.11	1.00	1.00		1.00	
Satd. Flow (perm)		1712		1681	1505	1504	206	4761	1362		5074	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	28	0	18	202	45	395	22	1716	637	0	1622	25
RTOR Reduction (vph)	0	17	0	0	65	65	0	5	0	0	1	0
Lane Group Flow (vph)	0	29	0	182	170	160	22	1826	522	0	1646	0
Turn Type	Split			Split		Perm	Perm		Free			
Protected Phases	4	4		8	8			2			6	
Permitted Phases						8	2		Free			
Actuated Green, G (s)		5.4		19.0	19.0	19.0	71.6	71.6	110.0		71.6	
Effective Green, g (s)		5.4		19.0	19.0	19.0	71.6	71.6	110.0		71.6	
Actuated g/C Ratio		0.05		0.17	0.17	0.17	0.65	0.65	1.00		0.65	
Clearance Time (s)		4.0		5.0	5.0	5.0	5.0	5.0			5.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)		84		290	260	260	134	3099	1362		3303	
v/s Ratio Prot		0.02		0.11	c0.11			c0.38			0.32	
v/s Ratio Perm						0.11	0.11		c0.38			
v/c Ratio		0.34		0.63	0.66	0.62	0.16	0.59	0.38		0.50	
Uniform Delay, d1		50.6		42.2	42.4	42.1	7.5	10.9	0.0		9.9	
Progression Factor		1.00		1.00	1.00	1.00	0.16	0.13	1.00		1.00	
Incremental Delay, d2		2.5		4.2	5.8	4.3	0.7	0.2	0.2		0.5	
Delay (s)		53.0		46.4	48.3	46.4	1.9	1.6	0.2		10.5	
Level of Service		D		D	D	D	A	A	A		B	
Approach Delay (s)		53.0			47.1			1.3			10.5	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	299	2126	157	1148	195	2052	48	1472
v/c Ratio	0.98	1.20	1.39	0.94	1.01	0.99	0.75	0.90
Control Delay	92.3	129.4	245.0	57.6	60.3	17.9	97.1	34.7
Queue Delay	0.0	21.5	0.0	0.0	0.0	80.5	0.0	0.0
Total Delay	92.3	150.8	245.0	57.6	60.3	98.4	97.1	34.7
Queue Length 50th (ft)	212	~662	~153	307	~151	~456	34	366
Queue Length 95th (ft)	#388	#760	m#274	#382	m129	m272	m#98	#258
Internal Link Dist (ft)		1129		409		285		200
Turn Bay Length (ft)	140		110		150		120	
Base Capacity (vph)	306	1767	113	1226	193	2082	64	1633
Starvation Cap Reductn	0	0	0	0	0	361	0	0
Spillback Cap Reductn	0	68	0	0	0	16	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	1.25	1.39	0.94	1.01	1.19	0.75	0.90

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	284	1610	409	149	876	215	185	1923	27	46	1315	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	0.97		1.00	0.97		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	4931		1770	4935		1770	5075		1770	5040	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	4931		1770	4935		1770	5075		1770	5040	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	299	1695	431	157	922	226	195	2024	28	48	1384	88
RTOR Reduction (vph)	0	40	0	0	38	0	0	1	0	0	6	0
Lane Group Flow (vph)	299	2086	0	157	1110	0	195	2051	0	48	1466	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	19.0	38.5		7.0	26.5		12.8	44.3		3.2	34.7	
Effective Green, g (s)	19.0	38.5		7.0	26.5		12.8	44.3		3.2	34.7	
Actuated g/C Ratio	0.17	0.35		0.06	0.24		0.12	0.40		0.03	0.32	
Clearance Time (s)	4.0	4.5		4.0	4.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	306	1726		113	1189		206	2044		51	1590	
v/s Ratio Prot	0.17	c0.42		c0.09	0.22		c0.11	c0.40		0.03	0.29	
v/s Ratio Perm												
v/c Ratio	0.98	1.21		1.39	0.93		0.95	1.00		0.94	0.92	
Uniform Delay, d1	45.3	35.8		51.5	40.9		48.3	32.9		53.3	36.3	
Progression Factor	1.00	1.00		0.77	1.17		0.72	0.37		0.81	0.75	
Incremental Delay, d2	44.7	99.5		211.5	10.7		9.1	6.8		97.2	9.4	
Delay (s)	90.0	135.2		251.3	58.4		43.8	19.0		140.4	36.7	
Level of Service	F	F		F	E		D	B		F	D	
Approach Delay (s)		129.7			81.6			21.2			39.9	
Approach LOS		F			F			C			D	

Intersection Summary			
HCM Average Control Delay	70.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	103.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	463	1259	328	304	708	25	1871	576	1974
v/c Ratio	1.11	1.00	0.85	1.05	0.73	0.37	1.16	0.62	0.87
Control Delay	110.9	63.2	54.6	89.2	20.2	38.7	110.0	10.1	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	145.0	0.0	0.4
Total Delay	110.9	63.2	54.6	89.2	20.2	38.7	255.0	10.1	8.7
Queue Length 50th (ft)	~383	320	159	~239	117	11	~826	87	130
Queue Length 95th (ft)	#599	#461	#419	m#277	m111	43	#965	202	m169
Internal Link Dist (ft)		339			174		323		285
Turn Bay Length (ft)	200			175		175			
Base Capacity (vph)	419	1265	386	290	1109	68	1609	930	2278
Starvation Cap Reductn	0	0	0	0	0	0	0	0	56
Spillback Cap Reductn	0	0	0	0	0	0	351	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.11	1.00	0.85	1.05	0.64	0.37	1.49	0.62	0.89

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	440	1161	347	289	667	6	24	1777	547	0	1352	523
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor	1.00	0.86	0.86	1.00	0.91		1.00	0.95	1.00		0.91	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)	1770	4785	1362	1770	5079		1770	3539	1583		4872	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.08	1.00	1.00		1.00	
Satd. Flow (perm)	1770	4785	1362	1770	5079		149	3539	1583		4872	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	463	1222	365	304	702	6	25	1871	576	0	1423	551
RTOR Reduction (vph)	0	3	27	0	1	0	0	0	211	0	63	0
Lane Group Flow (vph)	463	1256	301	304	707	0	25	1871	365	0	1911	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2		2			
Actuated Green, G (s)	26.0	29.0	29.0	18.0	21.0		50.0	50.0	50.0		50.0	
Effective Green, g (s)	26.0	29.0	29.0	18.0	21.0		50.0	50.0	50.0		50.0	
Actuated g/C Ratio	0.24	0.26	0.26	0.16	0.19		0.45	0.45	0.45		0.45	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	418	1262	359	290	970		68	1609	720		2215	
v/s Ratio Prot	c0.26	c0.26		0.17	0.14			c0.53			0.39	
v/s Ratio Perm			0.22				0.17		0.23			
v/c Ratio	1.11	1.00	0.84	1.05	0.73		0.37	1.16	0.51		0.86	
Uniform Delay, d1	42.0	40.4	38.3	46.0	41.8		19.6	30.0	21.3		26.9	
Progression Factor	0.88	0.98	1.01	0.77	0.42		1.00	1.00	1.00		0.30	
Incremental Delay, d2	75.0	23.1	14.7	52.5	1.5		14.6	80.5	2.5		0.5	
Delay (s)	111.8	62.6	53.4	87.8	19.2		34.3	110.5	23.8		8.6	
Level of Service	F	E	D	F	B		C	F	C		A	
Approach Delay (s)		72.2			39.8			89.6			8.6	
Approach LOS		E			D			F			A	

Intersection Summary			
HCM Average Control Delay	56.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	101.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	512	1929	0	0	1964
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	539	2031	0	0	2067
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						629
pX, platoon unblocked	0.69					
vC, conflicting volume	2720	677			2031	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1931	677			2031	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	40	395			275	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	539	677	677	677	689	689	689
Volume Left	0	0	0	0	0	0	0
Volume Right	539	0	0	0	0	0	0
cSH	395	1700	1700	1700	1700	1700	1700
Volume to Capacity	1.36	0.40	0.40	0.40	0.41	0.41	0.41
Queue Length 95th (ft)	645	0	0	0	0	0	0
Control Delay (s)	206.5	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F						
Approach Delay (s)	206.5	0.0			0.0		
Approach LOS	F						

Intersection Summary			
Average Delay	24.0		
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1344	1088	706
v/c Ratio	0.40	0.32	0.79
Control Delay	9.4	10.8	43.2
Queue Delay	0.0	0.0	0.0
Total Delay	9.4	10.8	43.2
Queue Length 50th (ft)	143	92	233
Queue Length 95th (ft)	208	m261	275
Internal Link Dist (ft)	736	218	493
Turn Bay Length (ft)			
Base Capacity (vph)	3374	3374	1369
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.40	0.32	0.52

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1277	1034	0	571	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.0	
Lane Util. Factor		0.91	0.91		0.97	
Frt		1.00	1.00		0.98	
Flt Protected		1.00	1.00		0.96	
Satd. Flow (prot)		5085	5085		3389	
Flt Permitted		1.00	1.00		0.96	
Satd. Flow (perm)		5085	5085		3389	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1344	1088	0	601	105
RTOR Reduction (vph)	0	0	0	0	16	0
Lane Group Flow (vph)	0	1344	1088	0	690	0
Turn Type						
Protected Phases		4	8		6	
Permitted Phases						
Actuated Green, G (s)		73.0	73.0		28.5	
Effective Green, g (s)		73.0	73.0		28.5	
Actuated g/C Ratio		0.66	0.66		0.26	
Clearance Time (s)		4.5	4.5		4.0	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		3375	3375		878	
v/s Ratio Prot		c0.26	0.21		c0.20	
v/s Ratio Perm						
v/c Ratio		0.40	0.32		0.79	
Uniform Delay, d1		8.5	7.9		37.9	
Progression Factor		1.00	1.25		1.00	
Incremental Delay, d2		0.4	0.2		4.7	
Delay (s)		8.8	10.1		42.6	
Level of Service		A	B		D	
Approach Delay (s)		8.8	10.1		42.6	
Approach LOS		A	B		D	

Intersection Summary			
HCM Average Control Delay	16.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	188	1553	477	1236	240	867	725	160	672
v/c Ratio	0.82	1.03	1.35	0.67	0.38	0.63	0.81	1.20	0.35
Control Delay	38.8	32.2	209.9	31.6	18.3	10.0	14.3	175.7	22.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0
Total Delay	38.8	32.2	209.9	31.6	18.3	10.0	15.2	175.7	22.2
Queue Length 50th (ft)	98	~447	~442	268	77	86	98	~138	109
Queue Length 95th (ft)	m79	m236	#645	320	145	m100	m121	#272	142
Internal Link Dist (ft)		409		995		363			581
Turn Bay Length (ft)	140		160					120	
Base Capacity (vph)	241	1502	354	1858	633	1367	899	133	1944
Starvation Cap Reductn	0	0	0	0	0	0	43	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	1.03	1.35	0.67	0.38	0.63	0.85	1.20	0.35

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	179	1475	0	453	1174	228	0	824	689	152	516	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		0.95	1.00	1.00	0.91	
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		1770	5085	1583		3539	1583	1770	4939	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00	1.00	0.19	1.00	
Satd. Flow (perm)	1770	5085		1770	5085	1583		3539	1583	345	4939	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	188	1553	0	477	1236	240	0	867	725	160	543	129
RTOR Reduction (vph)	0	0	0	0	0	55	0	0	288	0	36	0
Lane Group Flow (vph)	188	1553	0	477	1236	185	0	867	437	160	636	0
Turn Type	Prot		Perm	Prot		Perm			Perm	Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8			2	6		
Actuated Green, G (s)	14.3	32.5		22.0	40.2	40.2		42.5	42.5	42.5	42.5	
Effective Green, g (s)	14.3	32.5		22.0	40.2	40.2		42.5	42.5	42.5	42.5	
Actuated g/C Ratio	0.13	0.30		0.20	0.37	0.37		0.39	0.39	0.39	0.39	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	230	1502		354	1858	579		1367	612	133	1908	
v/s Ratio Prot	0.11	c0.31		c0.27	0.24			0.24			0.13	
v/s Ratio Perm						0.12			0.28	c0.46		
v/c Ratio	0.82	1.03		1.35	0.67	0.32		0.63	0.71	1.20	0.33	
Uniform Delay, d1	46.6	38.8		44.0	29.3	25.1		27.4	28.6	33.8	23.8	
Progression Factor	0.74	0.29		1.00	1.00	1.00		0.32	1.00	1.00	1.00	
Incremental Delay, d2	2.1	18.1		174.1	1.9	1.5		1.0	3.3	142.7	0.5	
Delay (s)	36.6	29.3		218.1	31.2	26.5		9.9	32.0	176.4	24.2	
Level of Service	D	C		F	C	C		A	C	F	C	
Approach Delay (s)		30.1			76.2			20.0			53.5	
Approach LOS		C			E			B			D	

Intersection Summary			
HCM Average Control Delay	45.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	99.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	167	1898	123	1454	247	327	22	43	628	153
v/c Ratio	0.84	1.02	0.96	0.87	0.97	0.26	0.04	0.40	0.78	0.33
Control Delay	77.8	55.6	118.7	37.6	92.5	24.0	9.5	56.4	42.6	10.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.8	55.6	118.7	37.6	92.5	24.0	9.5	56.4	42.6	10.1
Queue Length 50th (ft)	105	~468	79	315	158	80	0	27	192	12
Queue Length 95th (ft)	#225	#574	#196	#393	#318	116	17	63	255	62
Internal Link Dist (ft)		631		1090		191			644	
Turn Bay Length (ft)	200		180		140		60	120		120
Base Capacity (vph)	200	1869	128	1675	255	1255	575	109	911	503
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	1.02	0.96	0.87	0.97	0.26	0.04	0.39	0.69	0.30

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	159	1485	318	117	1295	86	235	311	21	41	597	145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	4951		1770	5038		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	4951		1770	5038		1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	167	1563	335	123	1363	91	247	327	22	43	628	153
RTOR Reduction (vph)	0	33	0	0	7	0	0	0	14	0	0	98
Lane Group Flow (vph)	167	1865	0	123	1447	0	247	327	8	43	628	55
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	10.9	36.1		7.0	32.2		14.0	34.3	34.3	3.5	23.8	23.8
Effective Green, g (s)	10.9	36.1		7.0	32.2		14.0	34.3	34.3	3.5	23.8	23.8
Actuated g/C Ratio	0.11	0.37		0.07	0.33		0.14	0.35	0.35	0.04	0.24	0.24
Clearance Time (s)	4.0	5.0		4.0	5.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	195	1807		125	1640		251	1227	549	63	852	381
v/s Ratio Prot	c0.09	c0.38		0.07	0.29		c0.14	0.09		0.02	c0.18	
v/s Ratio Perm									0.00			0.03
v/c Ratio	0.86	1.03		0.98	0.88		0.98	0.27	0.01	0.68	0.74	0.14
Uniform Delay, d1	43.2	31.4		45.9	31.6		42.3	23.2	21.2	47.2	34.7	29.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	28.9	29.9		75.0	6.0		52.0	0.1	0.0	26.3	3.4	0.2
Delay (s)	72.1	61.3		120.9	37.5		94.3	23.4	21.2	73.5	38.0	29.7
Level of Service	E	E		F	D		F	C	C	E	D	C
Approach Delay (s)		62.2			44.0			52.7			38.3	
Approach LOS		E			D			D			D	

Intersection Summary			
HCM Average Control Delay	51.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	98.9	Sum of lost time (s)	18.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (veh/h)	0	248	0	300	0	0	763	340	0	0
Sign Control	Yield			Free			Free		Yield	
Grade	0%			0%			0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	261	0	316	0	0	803	358	0	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type				None			None			
Median storage veh)										
Upstream signal (ft)							271			
pX, platoon unblocked	0.82		0.82						0.82	0.82
vC, conflicting volume	1477	158	1161			316			1222	1119
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	1472	158	1087			316			1162	1036
tC, single (s)	6.5	6.9	4.1			4.1			7.5	6.5
tC, 2 stage (s)										
tF (s)	4.0	3.3	2.2			2.2			3.5	4.0
p0 queue free %	100	70	100			100			100	100
cM capacity (veh/h)	103	859	523			1241			86	189

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	261	158	158	803	358
Volume Left	0	0	0	0	0
Volume Right	261	0	0	0	358
cSH	859	1700	1700	1700	1700
Volume to Capacity	0.30	0.09	0.09	0.47	0.21
Queue Length 95th (ft)	32	0	0	0	0
Control Delay (s)	11.0	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	11.0	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	0	761	0	0	0	0	0	0	379	370	0
Sign Control		Yield			Yield			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	0	801	0	0	0	0	0	0	399	389	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)											795	
pX, platoon unblocked	0.93	0.93	0.93	0.93	0.93		0.93					
vC, conflicting volume	1187	1187	389	1988	1187	0	389			0		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1163	1163	302	2027	1163	0	302			0		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	0	0	100	100	100			75		
cM capacity (veh/h)	129	136	684	0	136	1085	1167			1623		

Direction, Lane #	EB 1	SB 1	SB 2
Volume Total	801	399	389
Volume Left	0	399	0
Volume Right	801	0	0
cSH	684	1623	1700
Volume to Capacity	1.17	0.25	0.23
Queue Length 95th (ft)	654	24	0
Control Delay (s)	114.1	7.9	0.0
Lane LOS	F	A	
Approach Delay (s)	114.1	4.0	
Approach LOS	F		

Intersection Summary			
Average Delay	59.5		
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	496	410	165	842	368	836
v/c Ratio	0.84	0.67	0.61	0.46	0.37	0.46
Control Delay	32.8	18.1	18.3	7.0	1.2	10.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.8	18.1	18.3	7.0	1.2	10.7
Queue Length 50th (ft)	156	84	24	54	2	97
Queue Length 95th (ft)	#300	170	m#111	70	m6	140
Internal Link Dist (ft)		1190		300		620
Turn Bay Length (ft)	600		90			
Base Capacity (vph)	634	643	272	1823	994	1820
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	9
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.64	0.61	0.46	0.37	0.46

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	471	11	378	157	800	350	0	786	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Lane Util. Factor				1.00	1.00		1.00	0.95	1.00		0.95	
Frt				1.00	0.85		1.00	1.00	0.85		1.00	
Flt Protected				0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)				1770	1592		1770	3539	1583		3534	
Flt Permitted				0.95	1.00		0.28	1.00	1.00		1.00	
Satd. Flow (perm)				1770	1592		528	3539	1583		3534	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	496	12	398	165	842	368	0	827	9
RTOR Reduction (vph)	0	0	0	0	75	0	0	0	178	0	1	0
Lane Group Flow (vph)	0	0	0	496	335	0	165	842	190	0	835	0
Turn Type				Split			Perm		Perm			
Protected Phases				8	8			2			6	
Permitted Phases							2		2			
Actuated Green, G (s)				20.1	20.1		30.9	30.9	30.9		30.9	
Effective Green, g (s)				20.1	20.1		30.9	30.9	30.9		30.9	
Actuated g/C Ratio				0.34	0.34		0.51	0.51	0.51		0.51	
Clearance Time (s)				4.5	4.5		4.5	4.5	4.5		4.5	
Vehicle Extension (s)				3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)				593	533		272	1823	815		1820	
v/s Ratio Prot				c0.28	0.21			0.24			0.24	
v/s Ratio Perm							c0.31		0.12			
v/c Ratio				0.84	0.63		0.61	0.46	0.23		0.46	
Uniform Delay, d1				18.4	16.8		10.3	9.3	8.0		9.2	
Progression Factor				1.00	1.00		0.69	0.64	0.26		1.00	
Incremental Delay, d2				10.0	2.3		7.7	0.7	0.5		0.8	
Delay (s)				28.4	19.1		14.7	6.6	2.6		10.1	
Level of Service				C	B		B	A	A		B	
Approach Delay (s)		0.0			24.2			6.5			10.1	
Approach LOS		A			C			A			B	

Intersection Summary			
HCM Average Control Delay	12.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	68.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	465	440	1125	1268
v/c Ratio	0.79	0.81	0.59	0.67
Control Delay	28.5	29.1	3.6	8.4
Queue Delay	0.0	0.0	0.0	0.1
Total Delay	28.5	29.2	3.7	8.6
Queue Length 50th (ft)	142	126	45	133
Queue Length 95th (ft)	230	#223	m70	168
Internal Link Dist (ft)	434		320	300
Turn Bay Length (ft)				
Base Capacity (vph)	679	626	1895	1895
Starvation Cap Reductn	0	0	24	33
Spillback Cap Reductn	0	1	0	95
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.68	0.70	0.60	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	442	418	0	1069	1205	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		3539	3539	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		3539	3539	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	465	440	0	1125	1268	0
RTOR Reduction (vph)	0	21	0	0	0	0
Lane Group Flow (vph)	465	419	0	1125	1268	0
Turn Type		custom				
Protected Phases				2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	19.9	19.9		32.1	32.1	
Effective Green, g (s)	19.9	19.9		32.1	32.1	
Actuated g/C Ratio	0.33	0.33		0.54	0.54	
Clearance Time (s)	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	587	525		1893	1893	
v/s Ratio Prot				0.32	c0.36	
v/s Ratio Perm	0.26	c0.26				
v/c Ratio	0.79	0.80		0.59	0.67	
Uniform Delay, d1	18.2	18.2		9.5	10.1	
Progression Factor	1.00	1.00		0.24	0.61	
Incremental Delay, d2	7.2	8.3		1.1	1.6	
Delay (s)	25.4	26.5		3.4	7.7	
Level of Service	C	C		A	A	
Approach Delay (s)	25.9			3.4	7.7	
Approach LOS	C			A	A	

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	220	581	374	128	365	97	214	856	525	215	1316	275
v/c Ratio	0.91	0.62	0.57	0.88	0.39	0.20	0.89	0.60	0.76	0.91	0.93	0.38
Control Delay	65.1	22.8	8.0	76.0	19.5	5.8	66.1	16.4	22.5	58.9	24.0	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.1	22.8	8.0	76.0	19.5	5.8	66.1	16.4	22.5	58.9	24.0	3.0
Queue Length 50th (ft)	77	96	15	44	56	0	78	123	133	79	187	5
Queue Length 95th (ft)	#191	143	76	#134	90	29	#188	176	#287	m#155	#356	m14
Internal Link Dist (ft)		612			420			572			320	
Turn Bay Length (ft)	90			80			130			120		
Base Capacity (vph)	244	944	657	147	944	493	240	1424	687	236	1416	732
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.62	0.57	0.87	0.39	0.20	0.89	0.60	0.76	0.91	0.93	0.38

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	209	552	355	122	347	92	203	813	499	204	1250	261
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.49	1.00	1.00	0.30	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	916	3539	1583	552	3539	1583	1770	3539	1583	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	220	581	374	128	365	97	214	856	525	215	1316	275
RTOR Reduction (vph)	0	0	235	0	0	71	0	0	50	0	0	99
Lane Group Flow (vph)	220	581	139	128	365	26	214	856	475	215	1316	176
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	15.9	15.9	15.9	15.9	15.9	15.9	8.1	24.1	24.1	8.0	24.0	24.0
Effective Green, g (s)	15.9	15.9	15.9	15.9	15.9	15.9	8.1	24.1	24.1	8.0	24.0	24.0
Actuated g/C Ratio	0.27	0.27	0.27	0.27	0.27	0.27	0.13	0.40	0.40	0.13	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	243	938	419	146	938	419	239	1421	636	236	1416	633
v/s Ratio Prot		0.16			0.10		c0.12	0.24		0.12	c0.37	
v/s Ratio Perm	c0.24		0.09	0.23		0.02			0.30			0.11
v/c Ratio	0.91	0.62	0.33	0.88	0.39	0.06	0.90	0.60	0.75	0.91	0.93	0.28
Uniform Delay, d1	21.3	19.4	17.8	21.1	18.1	16.5	25.5	14.2	15.3	25.6	17.2	12.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.71	0.34
Incremental Delay, d2	33.4	1.2	0.5	40.2	0.3	0.1	31.7	1.9	7.8	29.4	9.8	0.8
Delay (s)	54.7	20.6	18.2	61.4	18.3	16.5	57.3	16.1	23.2	49.5	21.9	5.0
Level of Service	D	C	B	E	B	B	E	B	C	D	C	A
Approach Delay (s)		26.2			27.4			23.9			22.6	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	210	744	0	477	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	221	783	0	502	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	500					
pX, platoon unblocked						
vC, conflicting volume			1004		472	111
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1004		472	111
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			685		521	922

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2
Volume Total	147	335	522	251	251
Volume Left	0	0	0	0	0
Volume Right	0	261	522	0	0
cSH	1700	1700	1700	1700	1700
Volume to Capacity	0.09	0.20	0.31	0.15	0.15
Queue Length 95th (ft)	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0
Lane LOS					
Approach Delay (s)	0.0			0.0	
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	34.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	213	1806	1171	156
v/c Ratio	0.42	0.51	0.56	0.16
Control Delay	17.3	0.4	10.0	2.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	17.3	0.4	10.0	2.5
Queue Length 50th (ft)	79	0	144	5
Queue Length 95th (ft)	m77	0	195	26
Internal Link Dist (ft)		370	263	
Turn Bay Length (ft)	100			70
Base Capacity (vph)	506	3539	2098	988
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.42	0.51	0.56	0.16

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	0	0	202	1716	1112	148
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.5	4.5	4.5
Lane Util. Factor			1.00	0.95	0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.95	1.00	1.00	1.00
Satd. Flow (prot)			1770	3539	3539	1583
Flt Permitted			0.95	1.00	1.00	1.00
Satd. Flow (perm)			1770	3539	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	213	1806	1171	156
RTOR Reduction (vph)	0	0	0	0	0	50
Lane Group Flow (vph)	0	0	213	1806	1171	106
Turn Type			Prot			Perm
Protected Phases			5	2	6	
Permitted Phases						6
Actuated Green, G (s)			20.0	70.0	41.5	41.5
Effective Green, g (s)			20.0	70.0	41.5	41.5
Actuated g/C Ratio			0.29	1.00	0.59	0.59
Clearance Time (s)			4.0	4.5	4.5	4.5
Vehicle Extension (s)			3.0	3.0	3.0	3.0
Lane Grp Cap (vph)			506	3539	2098	938
v/s Ratio Prot			0.12	c0.51	0.33	
v/s Ratio Perm						0.07
v/c Ratio			0.42	0.51	0.56	0.11
Uniform Delay, d1			20.3	0.0	8.7	6.2
Progression Factor			0.74	1.00	1.00	1.00
Incremental Delay, d2			0.4	0.4	1.1	0.2
Delay (s)			15.5	0.4	9.7	6.5
Level of Service			B	A	A	A
Approach Delay (s)	0.0			2.0	9.4	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	178	172	0	1847	1131	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	187	181	0	1944	1191	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				382	450	
pX, platoon unblocked	0.70	0.79	0.79			
vC, conflicting volume	2163	595	1191			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	450	0	709			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	50	79	100			
cM capacity (veh/h)	376	856	700			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	125	244	972	972	595	595
Volume Left	125	62	0	0	0	0
Volume Right	0	181	0	0	0	0
cSH	376	645	1700	1700	1700	1700
Volume to Capacity	0.33	0.38	0.57	0.57	0.35	0.35
Queue Length 95th (ft)	36	44	0	0	0	0
Control Delay (s)	19.3	13.9	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	15.7		0.0		0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	288	173	25	75	189	1654	19	1028	204
v/c Ratio	0.89	0.20	0.08	0.09	0.53	0.76	0.09	0.62	0.25
Control Delay	56.1	7.0	20.8	11.3	11.6	14.2	4.0	8.8	1.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.1	7.0	20.8	11.3	11.6	14.2	4.0	8.8	1.6
Queue Length 50th (ft)	118	6	8	5	30	227	1	164	2
Queue Length 95th (ft)	#248	27	26	20	61	#490	m2	202	6
Internal Link Dist (ft)		646		699		573		302	
Turn Bay Length (ft)	120		220		200		260		70
Base Capacity (vph)	338	904	308	865	376	2174	216	1649	808
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	0.19	0.08	0.09	0.50	0.76	0.09	0.62	0.25

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	274	34	130	24	31	40	180	1533	38	18	977	194
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	0.88		1.00	0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3119		1770	3242		1770	3526		1770	3539	1583
Flt Permitted	0.71	1.00		0.64	1.00		0.16	1.00		0.12	1.00	1.00
Satd. Flow (perm)	1314	3119		1197	3242		291	3526		229	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	288	36	137	25	33	42	189	1614	40	19	1028	204
RTOR Reduction (vph)	0	103	0	0	32	0	0	2	0	0	0	71
Lane Group Flow (vph)	288	70	0	25	43	0	189	1652	0	19	1028	133
Turn Type	Perm			Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	17.3	17.3		17.3	17.3		44.7	39.9		33.4	32.6	32.6
Effective Green, g (s)	17.3	17.3		17.3	17.3		44.7	39.9		33.4	32.6	32.6
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.64	0.57		0.48	0.47	0.47
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	325	771		296	801		357	2010		127	1648	737
v/s Ratio Prot		0.02			0.01		c0.06	c0.47		0.00	0.29	
v/s Ratio Perm	c0.22			0.02			0.28			0.07		0.08
v/c Ratio	0.89	0.09		0.08	0.05		0.53	0.82		0.15	0.62	0.18
Uniform Delay, d1	25.4	20.3		20.3	20.1		8.0	12.2		11.8	14.1	10.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.58	0.49	0.19
Incremental Delay, d2	23.8	0.1		0.1	0.0		1.4	3.9		0.5	1.6	0.5
Delay (s)	49.2	20.3		20.4	20.1		9.4	16.1		7.4	8.5	2.6
Level of Service	D	C		C	C		A	B		A	A	A
Approach Delay (s)		38.4			20.2			15.4			7.5	
Approach LOS		D			C			B			A	

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	1304	386	1086	108	131	1203
v/c Ratio	0.92	0.48	0.81	0.17	0.76	0.67
Control Delay	42.5	10.1	28.2	6.2	75.4	22.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.5	10.1	28.2	6.2	75.4	22.4
Queue Length 50th (ft)	436	61	306	8	91	323
Queue Length 95th (ft)	#578	144	264	m22	#186	398
Internal Link Dist (ft)	720		1803			515
Turn Bay Length (ft)	240	240		150	215	
Base Capacity (vph)	1438	807	1342	643	180	1812
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.91	0.48	0.81	0.17	0.73	0.66

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	1239	367	1032	103	124	1143
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1304	386	1086	108	131	1203
RTOR Reduction (vph)	0	146	0	42	0	0
Lane Group Flow (vph)	1304	240	1086	66	131	1203
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	45.3	45.3	41.5	41.5	10.7	56.2
Effective Green, g (s)	45.3	45.3	41.5	41.5	10.7	56.2
Actuated g/C Ratio	0.41	0.41	0.38	0.38	0.10	0.51
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1414	652	1335	597	172	1808
v/s Ratio Prot	c0.38		c0.31		c0.07	0.34
v/s Ratio Perm		0.15		0.04		
v/c Ratio	0.92	0.37	0.81	0.11	0.76	0.67
Uniform Delay, d1	30.7	22.4	30.8	22.3	48.4	19.9
Progression Factor	1.00	1.00	0.74	0.56	1.00	1.00
Incremental Delay, d2	10.2	0.4	4.9	0.3	17.9	2.0
Delay (s)	40.9	22.8	27.5	12.8	66.3	21.9
Level of Service	D	C	C	B	E	C
Approach Delay (s)	36.7		26.2			26.2
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	30.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	81.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	245	397	894	1340	271	2240
v/c Ratio	0.52	0.83	0.41	1.07	1.20	0.81
Control Delay	47.2	26.3	11.9	60.1	152.7	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.2	26.3	11.9	60.1	152.7	6.1
Queue Length 50th (ft)	85	62	147	~852	~231	92
Queue Length 95th (ft)	115	171	234	#1127	m#336	638
Internal Link Dist (ft)	1134		595			1803
Turn Bay Length (ft)	75	50			235	
Base Capacity (vph)	687	561	2201	1249	225	2780
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.71	0.41	1.07	1.20	0.81

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	233	377	849	1273	257	2128
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	0.97	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	3539	1583	1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	245	397	894	1340	271	2240
RTOR Reduction (vph)	0	263	0	265	0	0
Lane Group Flow (vph)	245	134	894	1075	271	2240
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	15.1	15.1	68.4	68.4	14.0	86.4
Effective Green, g (s)	15.1	15.1	68.4	68.4	14.0	86.4
Actuated g/C Ratio	0.14	0.14	0.62	0.62	0.13	0.79
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	471	217	2201	984	225	2780
v/s Ratio Prot	0.07		0.25		c0.15	0.63
v/s Ratio Perm		c0.08		c0.68		
v/c Ratio	0.52	0.62	0.41	1.09	1.20	0.81
Uniform Delay, d1	44.1	44.7	10.5	20.8	48.0	6.9
Progression Factor	1.00	1.00	1.00	1.00	0.89	0.53
Incremental Delay, d2	1.0	5.1	0.6	57.4	114.3	1.6
Delay (s)	45.1	49.9	11.1	78.2	156.8	5.2
Level of Service	D	D	B	E	F	A
Approach Delay (s)	48.1		51.3			21.6
Approach LOS	D		D			C

Intersection Summary			
HCM Average Control Delay	37.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	100.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	53	110	1501	164	80	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	56	116	1580	173	84	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						800
pX, platoon unblocked						
vC, conflicting volume	1835	1666			1580	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1835	1666			1580	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	16	3			80	
cM capacity (veh/h)	67	119			416	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	56	116	1753	84	0
Volume Left	56	0	0	84	0
Volume Right	0	116	173	0	0
cSH	67	119	1700	416	1700
Volume to Capacity	0.84	0.97	1.03	0.20	0.00
Queue Length 95th (ft)	99	159	0	19	0
Control Delay (s)	169.8	143.5	0.0	15.8	0.0
Lane LOS	F	F		C	
Approach Delay (s)	152.1		0.0	15.8	
Approach LOS	F				

Intersection Summary			
Average Delay	13.7		
Intersection Capacity Utilization	102.4%	ICU Level of Service	G
Analysis Period (min)	15		

Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2222	1718	541	211	1085	655	1137
v/c Ratio	0.97	1.07	0.49	0.93	1.01	0.97	0.80
Control Delay	45.0	80.4	19.4	88.9	64.3	77.3	44.9
Queue Delay	349.3	325.2	99.5	0.0	121.1	109.9	0.0
Total Delay	394.3	405.5	118.9	88.9	185.4	187.1	44.9
Queue Length 50th (ft)	598	~795	375	169	~313	262	299
Queue Length 95th (ft)	#728	m#718	m371	#324	#417	#382	355
Internal Link Dist (ft)	1037	280			562		836
Turn Bay Length (ft)				330		290	
Base Capacity (vph)	2290	1607	1102	226	1079	672	1428
Starvation Cap Reductn	0	652	654	0	0	0	0
Spillback Cap Reductn	1046	0	0	0	244	154	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.79	1.80	1.21	0.93	1.30	1.26	0.80

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1936	175	0	1632	514	200	1000	30	622	1078	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Lane Util. Factor		0.91			0.95	1.00	1.00	0.91		0.97	0.91	
Frt		0.99			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		5022			3539	1583	1770	5063		3433	5084	
Flt Permitted		1.00			1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		5022			3539	1583	1770	5063		3433	5084	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	2038	184	0	1718	541	211	1053	32	655	1135	2
RTOR Reduction (vph)	0	9	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	2213	0	0	1718	541	211	1083	0	655	1137	0
Turn Type						pm+ov	Prot			Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases						8						
Actuated Green, G (s)		54.5			54.5	78.0	15.3	25.5		23.5	33.7	
Effective Green, g (s)		54.5			54.5	78.0	15.3	25.5		23.5	33.7	
Actuated g/C Ratio		0.45			0.45	0.65	0.13	0.21		0.20	0.28	
Clearance Time (s)		5.5			5.5	5.5	5.5	5.5		5.5	5.5	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2281			1607	1102	226	1076		672	1428	
v/s Ratio Prot		0.44			c0.49	0.10	0.12	c0.21		c0.19	0.22	
v/s Ratio Perm						0.25						
v/c Ratio		0.97			1.07	0.49	0.93	1.01		0.97	0.80	
Uniform Delay, d1		32.0			32.8	10.8	51.8	47.2		48.0	40.0	
Progression Factor		1.00			1.56	2.22	0.85	0.75		1.00	1.00	
Incremental Delay, d2		12.6			32.6	0.0	43.2	28.2		28.2	4.7	
Delay (s)		44.6			83.7	23.9	87.5	63.7		76.2	44.7	
Level of Service		D			F	C	F	E		E	D	
Approach Delay (s)		44.6			69.4			67.6			56.2	
Approach LOS		D			E			E			E	

Intersection Summary			
HCM Average Control Delay	58.7	HCM Level of Service	E
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	96.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	426	2297	45	1866	719	111	399	805	597
v/c Ratio	1.05	0.85	0.52	1.11	1.03	0.38	1.00	0.76	0.80
Control Delay	91.0	36.2	74.9	76.8	88.3	19.2	98.9	43.7	22.5
Queue Delay	47.3	178.0	0.0	301.3	0.0	4.7	649.7	0.0	10.2
Total Delay	138.3	214.2	74.9	378.0	88.3	23.8	748.6	43.7	32.7
Queue Length 50th (ft)	~352	531	0	~583	~218	12	~162	297	157
Queue Length 95th (ft)	m#372	m546	m0	#680	m#282	m37	#267	373	323
Internal Link Dist (ft)		280		585	326			720	
Turn Bay Length (ft)	200		200			130	160		160
Base Capacity (vph)	406	2706	87	1686	699	294	398	1059	745
Starvation Cap Reductn	42	1060	0	0	0	0	0	0	0
Spillback Cap Reductn	0	323	0	638	0	124	398	0	126
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	1.40	0.52	1.78	1.03	0.65	399.00	0.76	0.96

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	405	2155	28	43	1605	168	0	683	105	379	765	567
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91			0.91	1.00	0.97	0.95	1.00
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5076		1770	5013			5085	1583	3433	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	426	2268	29	45	1689	177	0	719	111	399	805	597
RTOR Reduction (vph)	0	1	0	0	11	0	0	0	76	0	0	271
Lane Group Flow (vph)	426	2296	0	45	1855	0	0	719	35	399	805	326
Turn Type	Prot			Prot					Perm	Prot		Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases									2			6
Actuated Green, G (s)	28.6	62.9		4.7	39.0			16.5	16.5	13.9	35.9	35.9
Effective Green, g (s)	28.6	62.9		4.7	39.0			16.5	16.5	13.9	35.9	35.9
Actuated g/C Ratio	0.24	0.52		0.04	0.32			0.14	0.14	0.12	0.30	0.30
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5	5.5	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	422	2661		69	1629			699	218	398	1059	474
v/s Ratio Prot	c0.24	0.45		0.03	c0.37			c0.14		c0.12	0.23	
v/s Ratio Perm									0.02			0.21
v/c Ratio	1.01	0.86		0.65	1.14			1.03	0.16	1.00	0.76	0.69
Uniform Delay, d1	45.7	24.8		56.8	40.5			51.8	45.6	53.0	38.1	37.1
Progression Factor	1.22	1.42		1.01	0.46			1.02	1.12	1.00	1.00	1.00
Incremental Delay, d2	25.6	1.2		17.3	69.5			37.0	1.2	45.7	5.1	7.9
Delay (s)	81.3	36.4		74.4	88.3			89.5	52.4	98.8	43.3	45.0
Level of Service	F	D		E	F			F	D	F	D	D
Approach Delay (s)		43.4			87.9			84.5			56.2	
Approach LOS		D			F			F			E	

Intersection Summary			
HCM Average Control Delay	63.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	99.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	188	926	92	1174	424	48	271	170	531	42
v/c Ratio	0.89	0.32	0.32	0.40	0.39	0.33	0.93	0.56	0.56	0.12
Control Delay	57.0	1.1	16.6	14.2	2.2	58.7	92.6	84.4	81.0	55.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	1.1	16.6	14.2	2.2	58.7	92.6	84.4	81.0	55.3
Queue Length 50th (ft)	73	12	35	171	0	36	110	150	156	24
Queue Length 95th (ft)	m#127	m14	72	204	42	76	#196	m201	m197	m35
Internal Link Dist (ft)		562		597			652		326	
Turn Bay Length (ft)	110		120		200	280		240		60
Base Capacity (vph)	211	2917	292	2954	1097	145	290	304	951	337
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.32	0.32	0.40	0.39	0.33	0.93	0.56	0.56	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	179	783	97	87	1115	403	46	243	14	269	397	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.86	0.86	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (prot)	1770	5001		1770	5085	1583	1770	3510		1522	4755	1583
Flt Permitted	0.19	1.00		0.27	1.00	1.00	0.95	1.00		0.95	0.99	1.00
Satd. Flow (perm)	363	5001		503	5085	1583	1770	3510		1522	4755	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	188	824	102	92	1174	424	48	256	15	283	418	42
RTOR Reduction (vph)	0	13	0	0	0	178	0	4	0	0	0	21
Lane Group Flow (vph)	188	913	0	92	1174	246	48	267	0	170	531	21
Turn Type	Perm			Perm		Perm	Split			Split		Perm
Protected Phases		4			8		2	2		6	6	
Permitted Phases	4			8		8						6
Actuated Green, G (s)	69.7	69.7		69.7	69.7	69.7	9.8	9.8		24.0	24.0	24.0
Effective Green, g (s)	69.7	69.7		69.7	69.7	69.7	9.8	9.8		24.0	24.0	24.0
Actuated g/C Ratio	0.58	0.58		0.58	0.58	0.58	0.08	0.08		0.20	0.20	0.20
Clearance Time (s)	5.5	5.5		5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	211	2905		292	2954	919	145	287		304	951	317
v/s Ratio Prot		0.18			0.23		0.03	c0.08		c0.11	0.11	
v/s Ratio Perm	c0.52			0.18		0.16						0.01
v/c Ratio	0.89	0.31		0.32	0.40	0.27	0.33	0.93		0.56	0.56	0.07
Uniform Delay, d1	21.8	12.9		12.9	13.7	12.5	52.0	54.8		43.2	43.2	38.9
Progression Factor	1.32	0.08		1.00	1.00	1.00	1.00	1.00		1.81	1.83	2.62
Incremental Delay, d2	25.1	0.2		2.8	0.4	0.7	6.0	38.1		4.7	1.5	0.3
Delay (s)	53.9	1.2		15.7	14.1	13.2	58.0	92.9		83.0	80.5	102.3
Level of Service	D	A		B	B	B	E	F		F	F	F
Approach Delay (s)		10.1			14.0			87.6			82.3	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM Average Control Delay	32.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	27	2619	115	306	1885	59	14	140	276	93	69
v/c Ratio	0.31	0.98	0.13	1.05	0.55	0.61	0.10	0.46	1.15	0.29	0.21
Control Delay	43.1	53.3	18.1	76.4	7.9	79.2	52.7	32.2	144.3	44.1	10.9
Queue Delay	0.0	60.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.1	113.7	18.1	76.4	7.9	79.2	52.7	32.2	144.3	44.1	10.9
Queue Length 50th (ft)	21	~824	53	~250	138	45	10	58	~210	61	0
Queue Length 95th (ft)	m24	m#904	m61	m#266	m141	#98	32	124	#402	111	40
Internal Link Dist (ft)		585			1015		352			692	
Turn Bay Length (ft)	270		180								
Base Capacity (vph)	90	2675	860	291	3439	108	155	307	241	373	372
Starvation Cap Reductn	0	384	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	1.14	0.13	1.05	0.55	0.55	0.09	0.46	1.15	0.25	0.19

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	2488	109	291	1751	40	56	13	133	262	88	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5068		1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.70	1.00	1.00	0.49	1.00	1.00
Satd. Flow (perm)	1770	5085	1583	1770	5068		1298	1863	1583	921	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	27	2619	115	306	1843	42	59	14	140	276	93	69
RTOR Reduction (vph)	0	0	30	0	2	0	0	0	46	0	0	56
Lane Group Flow (vph)	27	2619	85	306	1883	0	59	14	94	276	93	13
Turn Type	Prot		Perm	Prot			Perm		Over	pm+pt		Perm
Protected Phases	7	4		3	8			2	3	1	6	
Permitted Phases			4				2			6		6
Actuated Green, G (s)	3.7	59.7	59.7	22.0	78.0		7.8	7.8	22.0	21.8	21.8	21.8
Effective Green, g (s)	3.7	59.7	59.7	22.0	78.0		7.8	7.8	22.0	21.8	21.8	21.8
Actuated g/C Ratio	0.03	0.50	0.50	0.18	0.65		0.06	0.06	0.18	0.18	0.18	0.18
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5		5.5	5.5	5.5	4.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	55	2530	788	325	3294		84	121	290	238	338	288
v/s Ratio Prot	0.02	c0.52		c0.17	0.37			0.01	0.06	c0.10	0.05	
v/s Ratio Perm			0.05				0.05			c0.11		0.01
v/c Ratio	0.49	1.04	0.11	0.94	0.57		0.70	0.12	0.33	1.16	0.28	0.04
Uniform Delay, d1	57.2	30.1	16.0	48.4	11.7		55.0	52.9	42.6	48.1	42.3	40.5
Progression Factor	0.70	1.64	2.15	0.62	0.67		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.4	23.0	0.1	15.0	0.2		23.3	0.4	0.7	108.3	0.4	0.1
Delay (s)	43.3	72.3	34.5	45.2	8.0		78.2	53.3	43.2	156.4	42.7	40.6
Level of Service	D	E	C	D	A		E	D	D	F	D	D
Approach Delay (s)		70.4			13.2			53.6			114.0	
Approach LOS		E			B			D			F	

Intersection Summary			
HCM Average Control Delay	50.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	99.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	37	3023	2424	503
v/c Ratio	0.23	1.10	0.97	0.49
Control Delay	35.6	58.3	26.1	37.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	35.6	58.3	26.1	37.3
Queue Length 50th (ft)	3	~959	~741	172
Queue Length 95th (ft)	m29	m#978	#818	232
Internal Link Dist (ft)		1015	1000	632
Turn Bay Length (ft)				150
Base Capacity (vph)	413	2754	2491	1031
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.09	1.10	0.97	0.49

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	35	2872	2116	187	447	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5		5.5	
Lane Util. Factor	1.00	0.91	0.91		0.97	
Frt	1.00	1.00	0.99		0.99	
Flt Protected	0.95	1.00	1.00		0.96	
Satd. Flow (prot)	1770	5085	5023		3419	
Flt Permitted	0.95	1.00	1.00		0.96	
Satd. Flow (perm)	1770	5085	5023		3419	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	37	3023	2227	197	471	32
RTOR Reduction (vph)	0	0	9	0	3	0
Lane Group Flow (vph)	37	3023	2415	0	500	0
Turn Type	Prot					
Protected Phases	7 9	4	8		6	
Permitted Phases						
Actuated Green, G (s)	7.0	62.8	54.9		36.1	
Effective Green, g (s)	7.0	62.8	54.9		36.1	
Actuated g/C Ratio	0.06	0.52	0.46		0.30	
Clearance Time (s)		5.5	5.5		5.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)	103	2661	2298		1029	
v/s Ratio Prot	c0.02	c0.59	0.48		c0.15	
v/s Ratio Perm						
v/c Ratio	0.36	1.14	1.05		0.49	
Uniform Delay, d1	54.3	28.6	32.5		34.3	
Progression Factor	1.30	0.31	0.50		1.00	
Incremental Delay, d2	0.6	62.9	30.4		1.6	
Delay (s)	71.5	71.7	46.6		36.0	
Level of Service	E	E	D		D	
Approach Delay (s)		71.7	46.6		36.0	
Approach LOS		E	D		D	

Intersection Summary			
HCM Average Control Delay	58.5	HCM Level of Service	E
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	78.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	135	3337	22	72	2481	80	128	216
v/c Ratio	0.69	0.95	0.02	0.83	0.78	0.92	0.81	0.64
Control Delay	38.3	6.8	0.4	114.3	18.2	122.4	85.9	25.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.3	6.8	0.4	114.3	18.2	122.4	85.9	25.3
Queue Length 50th (ft)	101	132	0	56	473	54	98	44
Queue Length 95th (ft)	m101	m120	m0	#144	536	#157	#206	127
Internal Link Dist (ft)		1000			893	425		590
Turn Bay Length (ft)	150			300				
Base Capacity (vph)	195	3513	1099	87	3191	87	159	336
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.95	0.02	0.83	0.78	0.92	0.81	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	3170	21	68	2284	73	29	28	19	122	37	168
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91			1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.97		1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	1770	5062			1766		1770	1634	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.35		0.69	1.00	
Satd. Flow (perm)	1770	5085	1583	1770	5062			633		1294	1634	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	135	3337	22	72	2404	77	31	29	20	128	39	177
RTOR Reduction (vph)	0	0	6	0	3	0	0	10	0	0	136	0
Lane Group Flow (vph)	135	3337	16	72	2478	0	0	70	0	128	80	0
Turn Type	Prot		Perm	Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	13.2	82.9	82.9	5.9	75.6			14.7		14.7	14.7	
Effective Green, g (s)	13.2	82.9	82.9	5.9	75.6			14.7		14.7	14.7	
Actuated g/C Ratio	0.11	0.69	0.69	0.05	0.63			0.12		0.12	0.12	
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	195	3513	1094	87	3189			78		159	200	
v/s Ratio Prot	0.08	c0.66		0.04	c0.49						0.05	
v/s Ratio Perm			0.01					c0.11		0.10		
v/c Ratio	0.69	0.95	0.01	0.83	0.78			0.90		0.81	0.40	
Uniform Delay, d1	51.4	16.7	5.8	56.5	16.1			51.9		51.3	48.6	
Progression Factor	0.69	0.32	0.16	1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	1.0	0.8	0.0	44.8	1.9			77.2		24.8	1.3	
Delay (s)	36.3	6.1	0.9	101.4	18.0			129.1		76.0	49.9	
Level of Service	D	A	A	F	B			F		E	D	
Approach Delay (s)		7.2			20.4			129.1			59.6	
Approach LOS		A			C			F			E	

Intersection Summary			
HCM Average Control Delay	16.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	100.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
3: 7th St & Park Ave

2/20/2013

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	28	1643	252	1203	82	268	340	29	317	20
v/c Ratio	0.12	0.91	0.85	0.51	0.71	0.64	0.71	0.19	0.75	0.05
Control Delay	14.1	28.9	44.5	8.6	63.7	36.4	24.6	28.9	42.0	13.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.1	28.9	44.5	8.6	63.7	36.4	24.6	28.9	42.0	13.6
Queue Length 50th (ft)	7	395	76	147	40	128	88	12	157	2
Queue Length 95th (ft)	26	#642	#228	238	#105	205	181	36	245	19
Internal Link Dist (ft)		588		707		495			498	
Turn Bay Length (ft)	70		180		30		30	100		90
Base Capacity (vph)	226	1820	305	2382	153	561	585	204	561	488
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.90	0.83	0.51	0.54	0.48	0.58	0.14	0.57	0.04

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	1450	111	239	1112	30	78	255	323	28	301	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3501		1770	3525		1770	1863	1583	1770	1863	1583
Flt Permitted	0.23	1.00		0.09	1.00		0.27	1.00	1.00	0.36	1.00	1.00
Satd. Flow (perm)	436	3501		163	3525		507	1863	1583	678	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	28	1526	117	252	1171	32	82	268	340	29	317	20
RTOR Reduction (vph)	0	6	0	0	2	0	0	0	120	0	0	12
Lane Group Flow (vph)	28	1637	0	252	1201	0	82	268	220	29	317	8
Turn Type	Perm			pm+pt			Perm		Perm	Perm		Perm
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2		2	6		6
Actuated Green, G (s)	42.8	42.8		55.5	55.5		18.8	18.8	18.8	18.8	18.8	18.8
Effective Green, g (s)	42.8	42.8		55.5	55.5		18.8	18.8	18.8	18.8	18.8	18.8
Actuated g/C Ratio	0.51	0.51		0.67	0.67		0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	5.0	5.0		3.0	5.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	224	1799		296	2349		114	420	357	153	420	357
v/s Ratio Prot		c0.47		c0.10	0.34			0.14			c0.17	
v/s Ratio Perm	0.06			0.47			0.16		0.14	0.04		0.00
v/c Ratio	0.12	0.91		0.85	0.51		0.72	0.64	0.62	0.19	0.75	0.02
Uniform Delay, d1	10.5	18.5		22.7	7.0		29.8	29.2	29.0	26.1	30.1	25.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	7.3		20.3	0.2		19.4	3.2	3.1	0.6	7.5	0.0
Delay (s)	10.8	25.8		43.0	7.2		49.2	32.3	32.2	26.7	37.6	25.1
Level of Service	B	C		D	A		D	C	C	C	D	C
Approach Delay (s)		25.6			13.4			34.3			36.1	
Approach LOS		C			B			C			D	

Intersection Summary			
HCM Average Control Delay	23.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	83.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix B

Freeway Analyses

Appendix B Includes:

B1. Year 2020 No Build Alternative Freeway Peak Hour LOS Worksheets

B2. Year 2040 No Build Alternative Freeway Peak Hour LOS Worksheets

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Appendix B1

Year 2020 No Build Alternative
Freeway Level of Service (LOS) Worksheets

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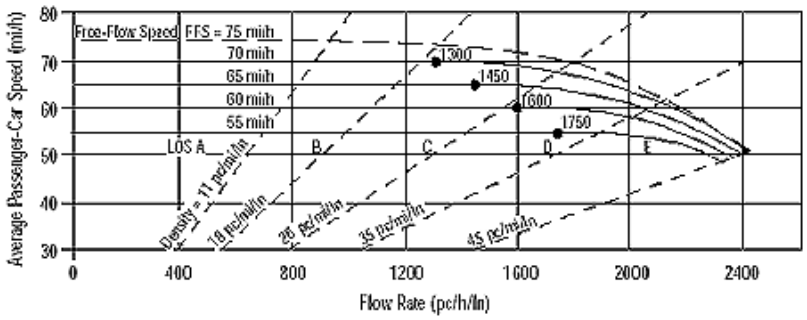
2020 No Build

Freeway Mainline, Ramps, and Ramp-Freeway Junctions and Weaving Level of Service Analysis Worksheets

AM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 1

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

Flow Inputs

Volume, V	9720 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	72.6	mi/h	FFS	72.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2203	pc/h/ln	Design LOS		
S	60.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	36.3	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 70.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9720	0.90	Level	4	0	0.980	1.00	11016
Ramp	1160	0.90	Level	4	0	0.980	1.00	1315
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3264 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8813	9600	No
V_{12}	3264	4400:All	No
V_{FO} = V_F - V_R	7498	9600	No
V_R	1315	3800	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 17.9 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.611 (Exhibit 25-19)

S_R= 52.9 mph (Exhibit 25-19)

S_0= 69.9 mph (Exhibit 25-19)

S = 62.4 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2020 No build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	350	0.90	4	0	1.5	1.2	0.980	1.00	396
Vw2	320	0.90	4	0	1.5	1.2	0.980	1.00	362
Vw				758	Vnw				0
V									758

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.15	0.43
Weaving and non-weaving speeds, Si (mi/h)			22.93	32.51

Number of lanes required for unconstrained operation, Nw 1.70
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	22.93
Weaving segment density, D (pc/mi/ln)	16.53
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 69.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8560	0.90	Level	4	0	0.980	1.00	9701
Ramp	310	0.90	Level	4	0	0.980	1.00	351
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.556 using Equation 4

V_{12}= 5396 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10052	See Exhibit 25-7	Yes
V_{R12}	5747	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 = 42.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.459 (Exibit 25-19)

S_R= 29.2 mph (Exhibit 25-19)

S_0= 63.9 mph (Exhibit 25-19)

S= 38.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.19
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.20
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7483	0.90	4	0	1.5	1.2	0.980	1.00	8480
Vo2	73	0.90	4	0	1.5	1.2	0.980	1.00	82
Vw1	1387	0.90	4	0	1.5	1.2	0.980	1.00	1571
Vw2	347	0.90	4	0	1.5	1.2	0.980	1.00	393
Vw				1964	Vnw				8562
V									10526

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.94	0.41
Weaving and non-weaving speeds, Si (mi/h)			28.97	54.10

Number of lanes required for unconstrained operation, Nw 1.49
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	46.57
Weaving segment density, D (pc/mi/ln)	45.21
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10042
Capacity as a 15-minute flow rate, c (veh/h)	9845
Capacity as a full-hour volume, c_h (veh/h)	8860

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	130	0.90	4	0	1.5	1.2	0.980	1.00	147
Vw2	70	0.90	4	0	1.5	1.2	0.980	1.00	79
Vw				226	Vnw				0
V									226

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			0.89	0.12
Weaving and non-weaving speeds, Si (mi/h)			28.25	37.40

Number of lanes required for unconstrained operation, Nw 1.45
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	28.25
Weaving segment density, D (pc/mi/ln)	4.00
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	68	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.18
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.47
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7089	0.90	4	0	1.5	1.2	0.980	1.00	8034
Vo2	39	0.90	4	0	1.5	1.2	0.980	1.00	44
Vw1	741	0.90	4	0	1.5	1.2	0.980	1.00	839
Vw2	821	0.90	4	0	1.5	1.2	0.980	1.00	930
Vw				1769	Vnw				8078
V									9847

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.91	0.39
Weaving and non-weaving speeds, Si (mi/h)			29.82	56.77

Number of lanes required for unconstrained operation, Nw 1.41
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	48.84
Weaving segment density, D (pc/mi/ln)	40.32
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	10230
Capacity as a 15-minute flow rate, c (veh/h)	10029
Capacity as a full-hour volume, c_h (veh/h)	9026

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 69.2 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7910	0.90	Level	4	0	0.980	1.00	8965
Ramp	620	0.90	Level	4	0	0.980	1.00	703
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.194 using Equation 4

V_{12}= 1736 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9668	See Exhibit 25-7	Yes
V_{R12}	2439	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 = 22.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.352 (Exibit 25-19)

S_R= 59.6 mph (Exhibit 25-19)

S_0= 54.8 mph (Exhibit 25-19)

S= 55.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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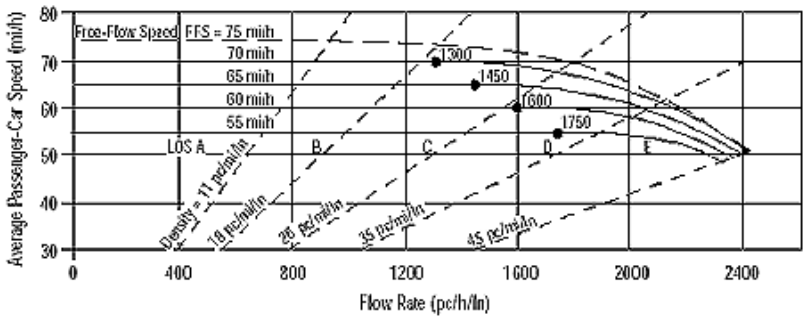
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 23

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

Flow Inputs

Volume, V	8530 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.2	mi/h	FFS	68.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2417	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2020 No build

Inputs

Freeway free-flow speed, SFF (mi/h)	69	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8128	0.90	4	0	1.5	1.2	0.980	1.00	9211
Vo2	22	0.90	4	0	1.5	1.2	0.980	1.00	24
Vw1	408	0.90	4	0	1.5	1.2	0.980	1.00	462
Vw2	428	0.90	4	0	1.5	1.2	0.980	1.00	485
Vw				947	Vnw				9235
V									10182

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.61	0.21		
Weaving and non-weaving speeds, Si (mi/h)	51.70	63.79		

Number of lanes required for unconstrained operation, Nw 0.73
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	62.43
Weaving segment density, D (pc/mi/ln)	32.62
Level of service, LOS	D
Capacity of base condition, c_b (pc/h)	11850
Capacity as a 15-minute flow rate, c (veh/h)	11618
Capacity as a full-hour volume, c_h (veh/h)	10456

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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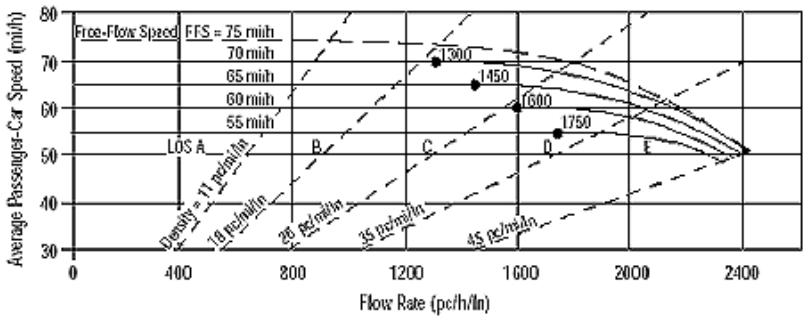
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 25

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

Flow Inputs

Volume, V	8550 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1938	pc/h/ln	Design LOS		
S	65.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8550	0.90	Level	4	0	0.980	1.00	9690
Ramp	1400	0.90	Level	4	0	0.980	1.00	1587
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3190 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7752	9556	No
V_{12}	3190	4400:All	No
$V_{FO} = V_F - V_R$	6165	9556	No
V_R	1587	4100	No

Level of Service Determination (if not F)

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

D_R = 5.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.376 (Exhibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 70.6 mph (Exhibit 25-19)

S = 65.2 mph (Exhibit 25-15)

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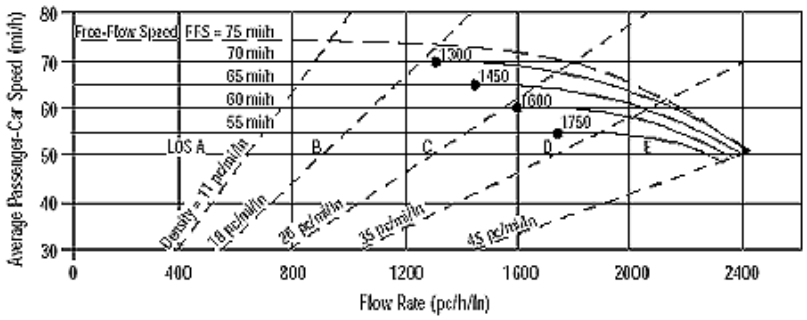
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 27

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

Flow Inputs

Volume, V	7150 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2026	pc/h/ln	Design LOS		
S	63.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	31.8	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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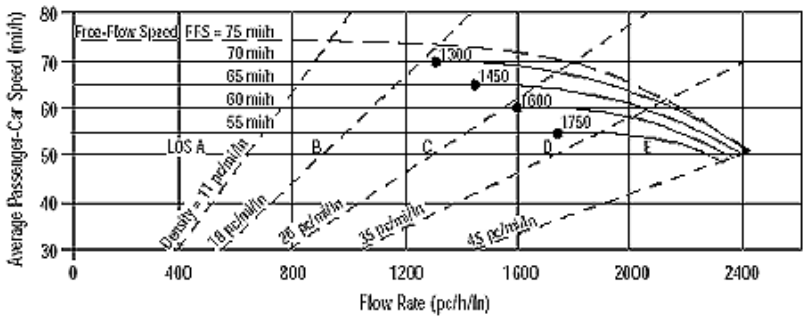
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 29

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

Flow Inputs

Volume, V	7050 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1998	pc/h/ln	Design LOS		
S	64.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	31.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 30

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 68.9 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7050	0.90	Level	4	0	0.980	1.00	7990
Ramp	2800	0.90	Level	4	0	0.980	1.00	3173
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1670 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11163	See Exhibit 25-7	Yes
V_{R12}	4843	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 = 23.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.613 (Exibit 25-19)

S_R= 52.4 mph (Exhibit 25-19)

S_0= 57.2 mph (Exhibit 25-19)

S= 55.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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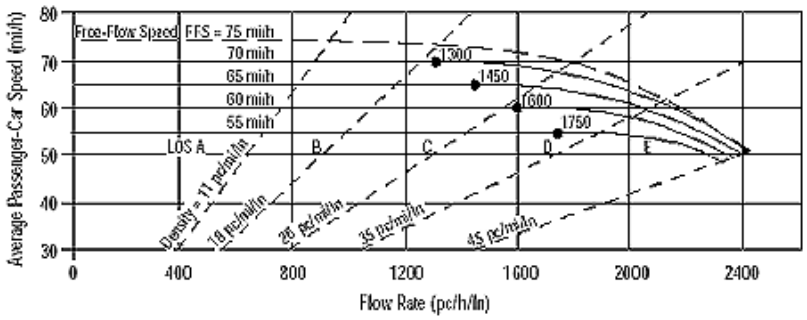
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 31

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

Flow Inputs

Volume, V	9850 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2233	pc/h/ln	Design LOS	
S	58.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	38.2	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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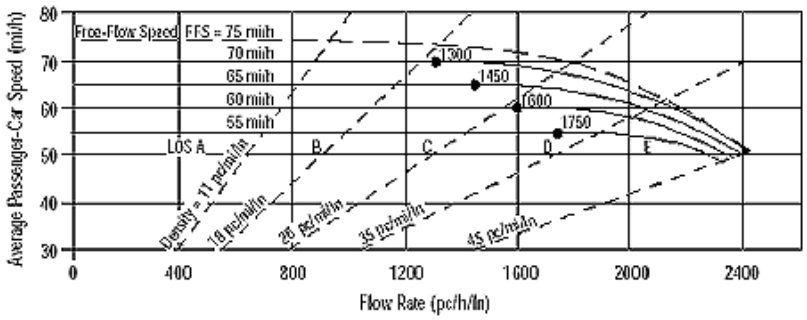
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 32

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

Flow Inputs

Volume, V	10630 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2409	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10630	0.90	Level	4	0	0.980	1.00	12047
Ramp	3270	0.90	Level	4	0	0.980	1.00	3706
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 5248 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9638	9000	Yes
V_{12}	5248	4400:All	Yes
$V_{FO} = V_F - V_R$	5932	9000	No
V_R	3706	4100	No

Level of Service Determination (if not F)

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

D_R = 6.2 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.567 (Exhibit 25-19)

S_R= 47.6 mph (Exhibit 25-19)

S_0= 55.7 mph (Exhibit 25-19)

S = 51.0 mph (Exhibit 25-15)

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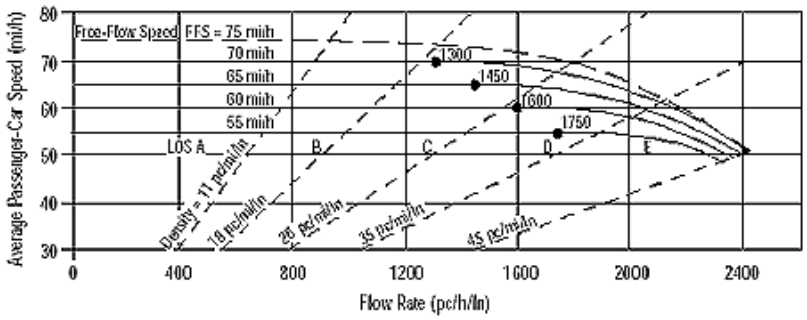

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 34

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

Flow Inputs

Volume, V	6910 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1958	pc/h/ln	Design LOS		
S	54.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	35.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6910	0.90	Level	4	0	0.980	1.00	7831
Ramp	1680	0.90	Level	4	0	0.980	1.00	1904
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.362 using Equation 4

V_{12}= 2835 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9735	See Exhibit 25-7	Yes
V_{R12}	4739	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 34.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.683 (Exibit 25-19)

S_R= 48.9 mph (Exhibit 25-19)

S_0= 56.1 mph (Exhibit 25-19)

S= 52.3 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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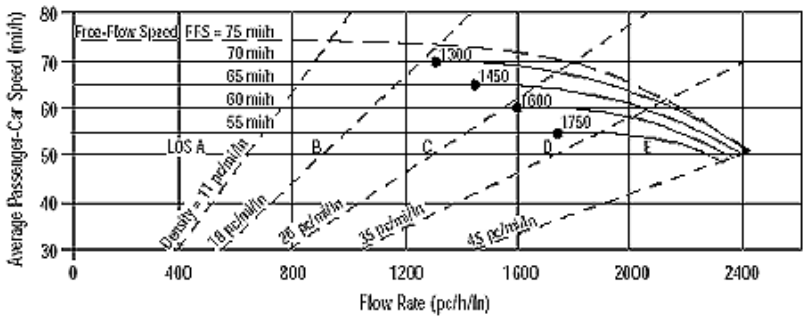

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 36

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

Flow Inputs

Volume, V	8600 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2437	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	55	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.31
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	35	0.90	4	0	1.5	1.2	0.980	1.00	39
Vo2	7945	0.90	4	0	1.5	1.2	0.980	1.00	9004
Vw1	295	0.90	4	0	1.5	1.2	0.980	1.00	334
Vw2	655	0.90	4	0	1.5	1.2	0.980	1.00	742
Vw				1076	Vnw				9043
V									10119

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.79	0.39		
Weaving and non-weaving speeds, Si (mi/h)	40.20	47.30		

Number of lanes required for unconstrained operation, Nw 1.16
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	46.42
Weaving segment density, D (pc/mi/ln)	43.59
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9999
Capacity as a 15-minute flow rate, c (veh/h)	9803
Capacity as a full-hour volume, c_h (veh/h)	8823

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	47	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.24
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	29	0.90	4	0	1.5	1.2	0.980	1.00	32
Vo2	7679	0.90	4	0	1.5	1.2	0.980	1.00	8702
Vw1	171	0.90	4	0	1.5	1.2	0.980	1.00	193
Vw2	551	0.90	4	0	1.5	1.2	0.980	1.00	624
Vw				817	Vnw				8734
V									9551

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.70	0.33		
Weaving and non-weaving speeds, Si (mi/h)	36.81	42.80		

Number of lanes required for unconstrained operation, Nw 1.08
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	42.21
Weaving segment density, D (pc/mi/ln)	45.25
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10070
Capacity as a 15-minute flow rate, c (veh/h)	9873
Capacity as a full-hour volume, c_h (veh/h)	8886

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	46	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	890	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	27	0.90	4	0	1.5	1.2	0.980	1.00	30
Vo2	7337	0.90	4	0	1.5	1.2	0.980	1.00	8315
Vw1	443	0.90	4	0	1.5	1.2	0.980	1.00	502
Vw2	513	0.90	4	0	1.5	1.2	0.980	1.00	581
Vw				1083	Vnw				8345
V									9428

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.25	0.60		
Weaving and non-weaving speeds, Si (mi/h)	30.98	37.48		

Number of lanes required for unconstrained operation, Nw 1.17
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	36.60
Weaving segment density, D (pc/mi/ln)	51.52
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9098
Capacity as a 15-minute flow rate, c (veh/h)	8920
Capacity as a full-hour volume, c_h (veh/h)	8028

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.23
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.40
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	44	0.90	4	0	1.5	1.2	0.980	1.00	49
Vo2	6944	0.90	4	0	1.5	1.2	0.980	1.00	7869
Vw1	1216	0.90	4	0	1.5	1.2	0.980	1.00	1378
Vw2	826	0.90	4	0	1.5	1.2	0.980	1.00	936
Vw				2314	Vnw				7918
V									10232

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.72	0.39		
Weaving and non-weaving speeds, Si (mi/h)	39.39	45.31		

Number of lanes required for unconstrained operation, Nw 1.59
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	43.82
Weaving segment density, D (pc/mi/ln)	46.70
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9918
Capacity as a 15-minute flow rate, c (veh/h)	9724
Capacity as a full-hour volume, c_h (veh/h)	8752

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 46

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8960	0.90	Level	4	0	0.980	1.00	10155
Ramp	570	0.90	Level	4	0	0.980	1.00	646
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.296 using Equation 4

V_{12}= 2268 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8301	See Exhibit 25-7	No
V_{R12}	2914	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.358 (Exibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 46.1 mph (Exhibit 25-19)

S= 47.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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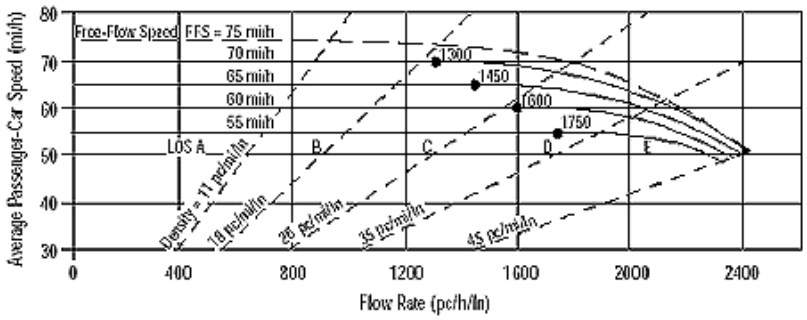
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 47

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

Flow Inputs

Volume, V	9530 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2160	pc/h/ln	Design LOS		
S	52.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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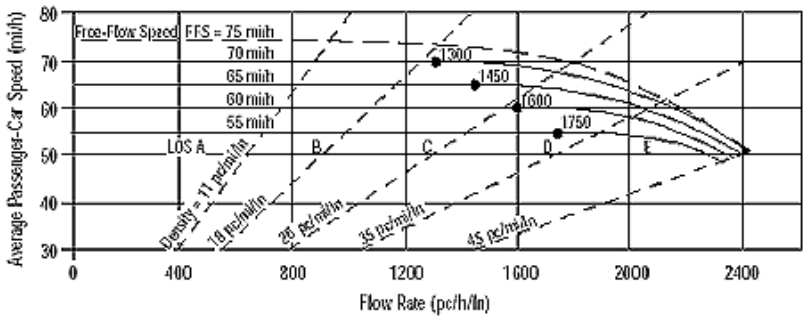
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 48

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

Flow Inputs

Volume, V	4390 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2463	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4390	0.90	Level	5	0	0.976	1.00	5000
Ramp	3180	0.90	Level	5	0	0.976	1.00	3622
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 5000 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5000	4500	Yes
V_{12}	5000	4400:All	Yes
$V_{FO} = V_F - V_R$	1378	4500	No
V_R	3622	3800	No

Level of Service Determination (if not F)

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

D_R = 28.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.754 (Exhibit 25-19)

S_R= 45.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.2 mph (Exhibit 25-15)

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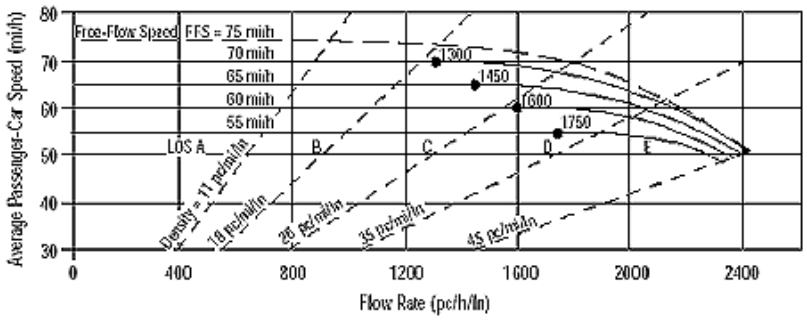
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 50

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

Flow Inputs

Volume, V	1210 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	689	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	11.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.8 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	1210	0.90	Level	5	0	0.976	1.00	1378
Ramp	770	0.90	Level	5	0	0.976	1.00	877
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1378 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1378	4775	No
V_{12}	1378	4400:All	No
$V_{FO} = V_F - V_R$	501	4775	No
V_R	877	2100	No

Level of Service Determination (if not F)

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

D_R = 6.2 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.312 (Exhibit 25-19)

S_R= 60.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 60.4 mph (Exhibit 25-15)

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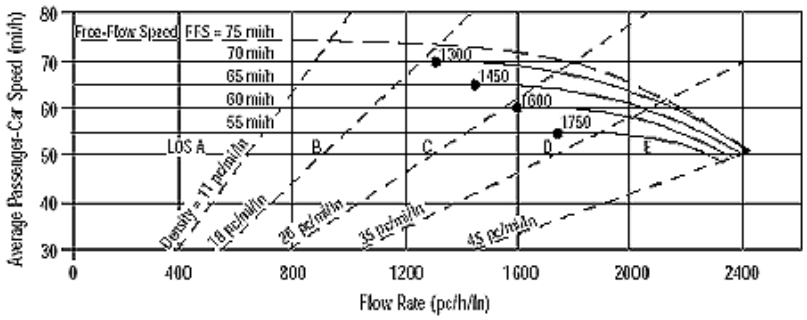
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 52

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

Flow Inputs

Volume, V	450 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	256	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	3.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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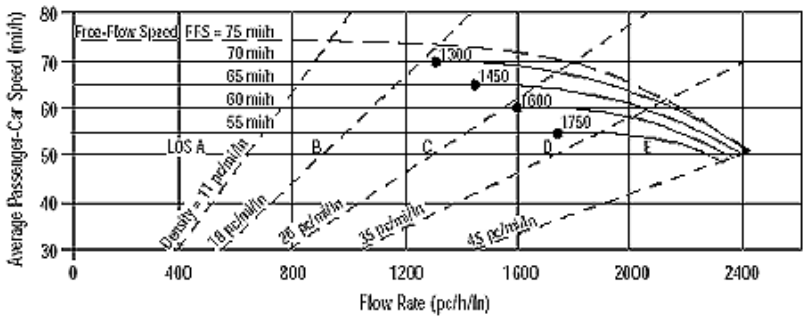
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 54

☑ 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	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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1059	pc/h/ln	Design LOS	
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	15.4	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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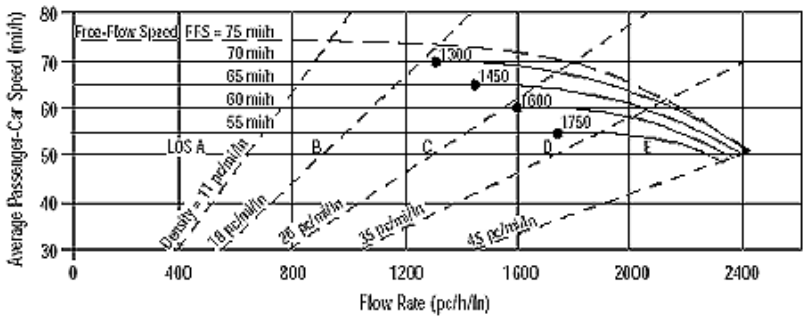
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 56

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

Flow Inputs

Volume, V	5120 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1166	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	17.0	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5120	0.90	Level	5	0	0.976	1.00	5831
Ramp	1120	0.90	Level	5	0	0.976	1.00	1276
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 2881 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	4957	9552	No
V_{12}	2881	4400:All	No
V_{FO} = V_F - V_R	3681	9552	No
V_R	1276	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 0.2 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.478 (Exhibit 25-19)

S_R= 56.0 mph (Exhibit 25-19)

S_0= 75.3 mph (Exhibit 25-19)

S = 62.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4000	0.90	Level	5	0	0.976	1.00	4556
Ramp	1120	0.90	Level	5	0	0.976	1.00	1276
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.241 using Equation 4

V_{12}= 1100 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5832	See Exhibit 25-7	No
V_{R12}	2376	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 = 19.8 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.323 (Exibit 25-19)

S_R= 61.0 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S= 63.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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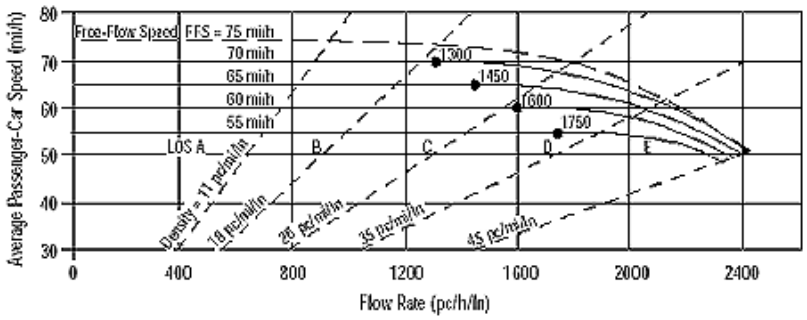
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 60

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

Flow Inputs

Volume, V	5120 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1458	pc/h/ln	Design LOS		
S	69.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5120	0.90	Level	5	0	0.976	1.00	5831
Ramp	780	0.90	Level	5	0	0.976	1.00	888
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.171 using Equation 4

V_{12}= 994 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6719	See Exhibit 25-7	No
V_{R12}	1882	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 = 18.5 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.333 (Exibit 25-19)

S_R= 58.1 mph (Exhibit 25-19)

S_0= 58.9 mph (Exhibit 25-19)

S= 58.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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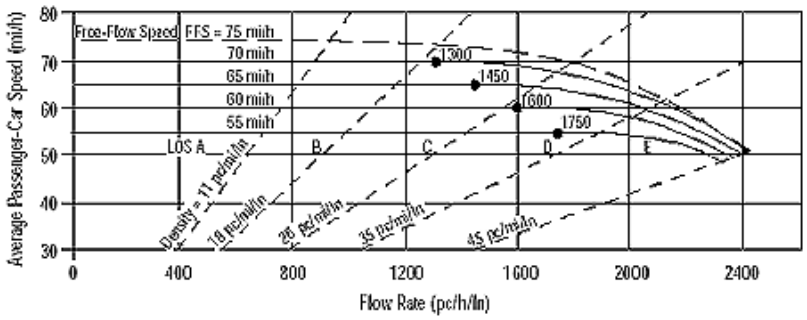
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 62

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

Flow Inputs

Volume, V	5900 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	65.5	mi/h	FFS	65.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1680	pc/h/ln	Design LOS		
S	65.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	25.8	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.5 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5900	0.90	Level	5	0	0.976	1.00	6719
Ramp	960	0.90	Level	5	0	0.976	1.00	1093
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3546 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6719	9420	No
V_{12}	3546	4400:All	No
$V_{FO} = V_F - V_R$	5626	9420	No
V_R	1093	2000	No

Level of Service Determination (if not F)

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

D_R = 32.0 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.526 (Exhibit 25-19)

S_R= 53.1 mph (Exhibit 25-19)

S_0= 69.6 mph (Exhibit 25-19)

S = 59.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4940	0.90	Level	5	0	0.976	1.00	5626
Ramp	460	0.90	Level	5	0	0.976	1.00	524
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.335 using Equation 4

V_{12}= 1887 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6150	See Exhibit 25-7	No
V_{R12}	2411	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 = 20.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.324 (Exibit 25-19)

S_R= 54.8 mph (Exhibit 25-19)

S_0= 56.1 mph (Exhibit 25-19)

S= 55.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7010	0.90	Level	5	0	0.976	1.00	7984
Ramp	490	0.90	Level	5	0	0.976	1.00	558
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.228 using Equation 4

V_{12}= 1818 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8542	See Exhibit 25-7	No
V_{R12}	2376	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.345 (Exibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 56.4 mph (Exhibit 25-19)

S= 57.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7490	0.90	Level	5	0	0.976	1.00	8530
Ramp	250	0.90	Level	5	0	0.976	1.00	285
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.246 using Equation 4

V_{12}= 2097 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8815	See Exhibit 25-7	No
V_{R12}	2382	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.349 (Exibit 25-19)

S_R= 57.7 mph (Exhibit 25-19)

S_0= 54.1 mph (Exhibit 25-19)

S= 55.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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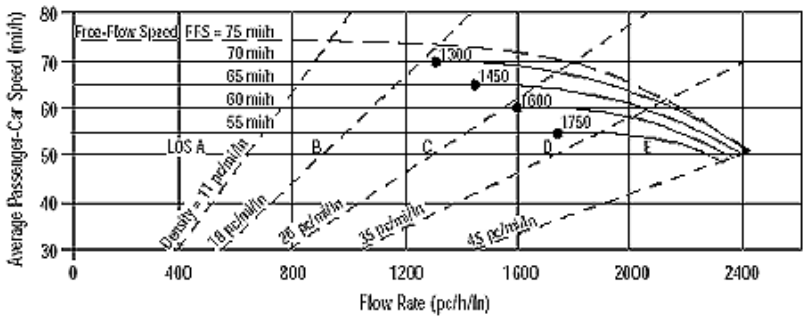
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 71

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

Flow Inputs

Volume, V	7750 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2207	pc/h/ln	Design LOS		
S	58.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	37.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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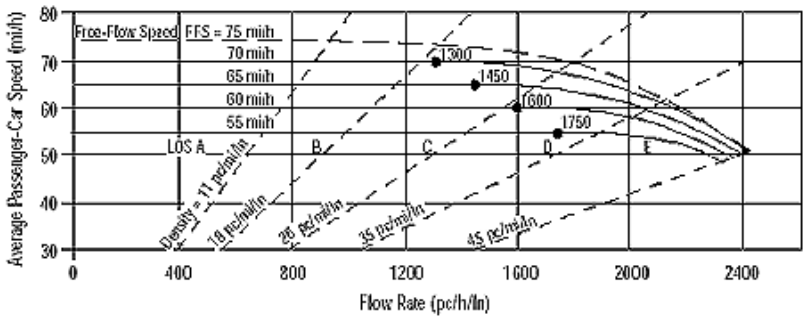
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 72

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

Flow Inputs

Volume, V	7750 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

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	
S	66.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	26.5	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 67.9 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7750	0.90	Level	5	0	0.976	1.00	8826
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 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3740 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7061	9516	No
V_{12}	3740	4400:All	No
$V_{FO} = V_F - V_R$	5888	9516	No
V_R	1173	2000	No

Level of Service Determination (if not F)

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

D_R = 34.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.599 (Exhibit 25-19)

S_R= 52.4 mph (Exhibit 25-19)

S_0= 71.9 mph (Exhibit 25-19)

S = 60.1 mph (Exhibit 25-15)

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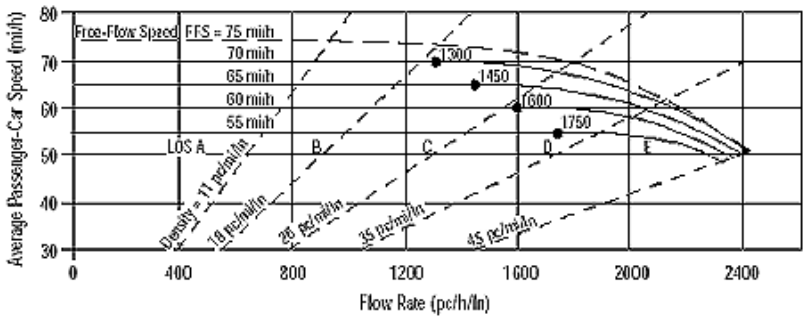
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 74

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

Flow Inputs

Volume, V	6720 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1913	pc/h/ln	Design LOS		
S	66.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	28.8	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.2 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	6720	0.90	Level	5	0	0.976	1.00	7653
Ramp	590	0.90	Level	5	0	0.976	1.00	672
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3716 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7653	9447	No
V_{12}	3716	4400:All	No
V_{FO} = V_F - V_R	6981	9447	No
V_R	672	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.553 (Exhibit 25-19)

S_R= 52.8 mph (Exhibit 25-19)

S_0= 68.8 mph (Exhibit 25-19)

S = 60.0 mph (Exhibit 25-15)

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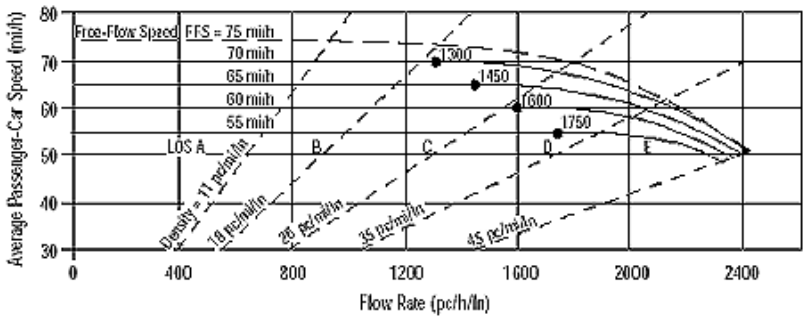
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 76

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

Flow Inputs

Volume, V	6130 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.2	mi/h	FFS	66.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1745	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S	65.3	mi/h	S		mi/h
D = v_p / S	26.7	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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.9 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	6130	0.90	Level	5	0	0.976	1.00	6981
Ramp	1120	0.90	Level	5	0	0.976	1.00	1276
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3763 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6981	9356	No
V_{12}	3763	4400:All	No
$V_{FO} = V_F - V_R$	5705	9356	No
V_R	1276	2000	No

Level of Service Determination (if not F)

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

D_R = 34.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.608 (Exhibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 67.7 mph (Exhibit 25-19)

S = 57.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5010	0.90	Level	5	0	0.976	1.00	5706
Ramp	650	0.90	Level	5	0	0.976	1.00	740
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.412 using Equation 4

V_{12}= 2351 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6446	See Exhibit 25-7	No
V_{R12}	3091	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.344 (Exibit 25-19)

S_R= 56.4 mph (Exhibit 25-19)

S_0= 59.7 mph (Exhibit 25-19)

S= 58.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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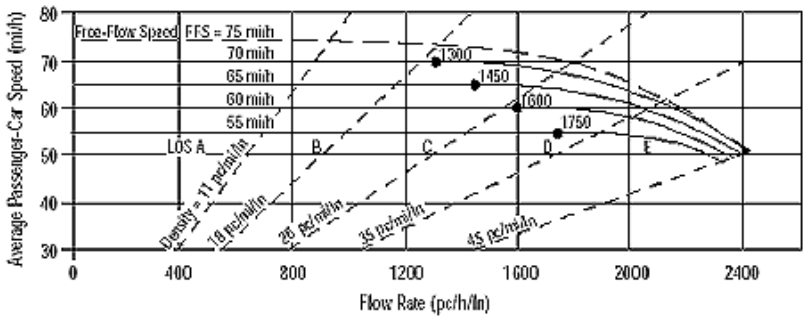
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 84

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

Flow Inputs

Volume, V	5660 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
Driver type adjustment	1.00	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

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1612	pc/h/ln	Design LOS		
S	66.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.3	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.5 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5660	0.90	Level	5	0	0.976	1.00	6446
Ramp	920	0.90	Level	5	0	0.976	1.00	1048
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3402 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	6446	9460	No
V_{12}	3402	4400:All	No
V_{FO} = V_F - V_R	5398	9460	No
V_R	1048	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.327 (Exhibit 25-19)

S_R= 58.5 mph (Exhibit 25-19)

S_0= 70.9 mph (Exhibit 25-19)

S = 63.8 mph (Exhibit 25-15)

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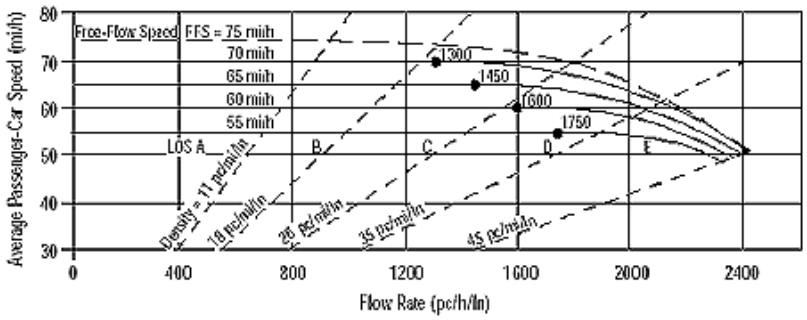
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 86

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

Flow Inputs

Volume, V	4750 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1352	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	19.3	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 87

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

Vu = veh/h

Terrain

S_{FF} = 66.5 mph S_{FR} = 66.5 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

VD = 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 f_{HV} f_p
Freeway	4750	0.90	Level	5	0	0.976	1.00	5410
Ramp	2800	0.90	Level	5	0	0.976	1.00	3189
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3766 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5410	9460	No
V_{12}	3766	4400:All	No
$V_{FO} = V_F - V_R$	2221	9460	No
V_R	3189	4400	No

Level of Service Determination (if not F)

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

D_R = -49.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.306 (Exhibit 25-19)

S_R= 59.0 mph (Exhibit 25-19)

S_0= 73.0 mph (Exhibit 25-19)

S = 62.7 mph (Exhibit 25-15)

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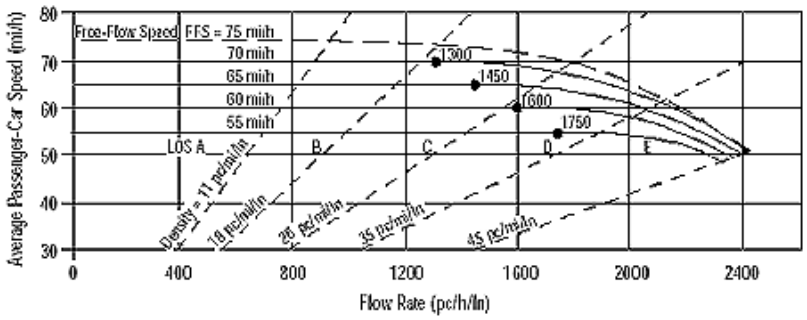
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	3880 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2209	pc/h/ln	Design LOS		
S	57.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.3	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.5 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3880	0.90	Level	5	0	0.976	1.00	4419
Ramp	90	0.90	Level	5	0	0.976	1.00	103
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4419 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4522	See Exhibit 25-7	No
V_{R12}	4522	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 = 38.5 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.645 (Exibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 50.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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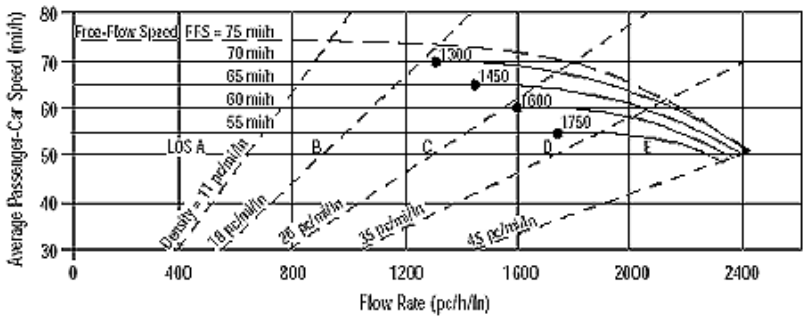
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	4080 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2323	pc/h/ln	Design LOS		
S	54.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	42.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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 f_{HV} f_p
Freeway	1870	0.90	Level	2	0	0.990	1.00	2099
Ramp	2040	0.90	Level	2	0	0.990	1.00	2289
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2099 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4388	See Exhibit 25-7	No
V_{R12}	4388	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 = 37.1 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Speed Estimation

M_S = 0.607 (Exibit 25-19)

S_R= 47.1 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 47.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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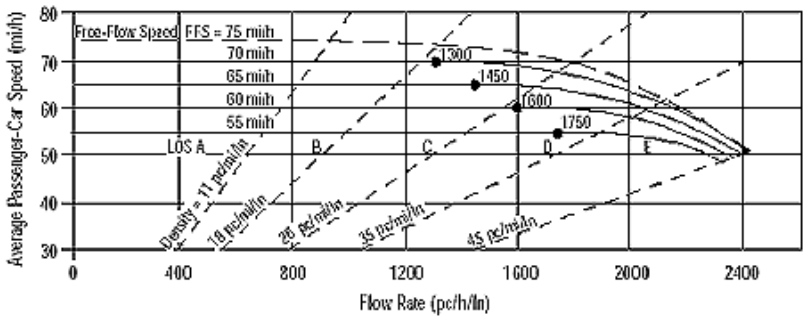

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 92

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

Flow Inputs

Volume, V	3910 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2194	pc/h/ln	Design LOS		
S	60.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	36.4	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3170	0.90	Level	2	0	0.990	1.00	3557
Ramp	520	0.90	Level	2	0	0.990	1.00	584
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3557 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4141	See Exhibit 25-7	No
V_{R12}	4141	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 = 28.1 (pc/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.461 (Exibit 25-19)

S_R= 49.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 49.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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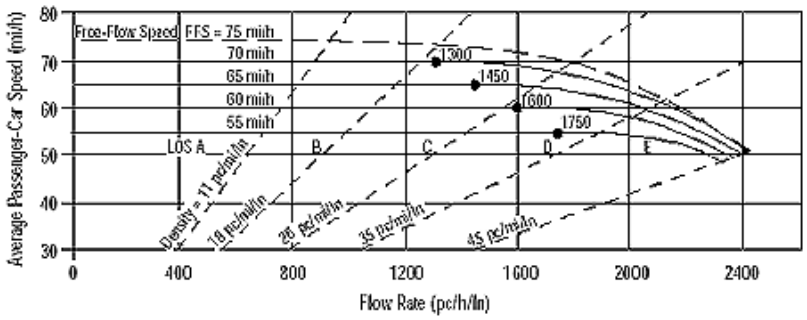
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 96

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

Flow Inputs

Volume, V	3690 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1380	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	19.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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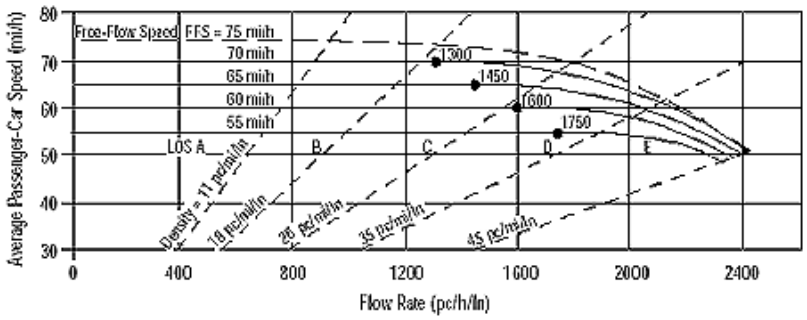
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 97

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

Flow Inputs

Volume, V	3270 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1223	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	17.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	3270	0.90	Level	5	0	0.976	1.00	3724
Ramp	90	0.90	Level	5	0	0.976	1.00	103
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 3724 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	3724	4500	No
V_{12}	3724	4400:All	No
V_{FO} = V_F - V_R	3621	4500	No
V_R	103	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 35.2 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.502 (Exhibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 48.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3180	0.90	Level	2	0	0.990	1.00	3569
Ramp	1210	0.90	Level	2	0	0.990	1.00	1358
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3569 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4927	See Exhibit 25-7	Yes
V_{R12}	4927	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 40.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.831 (Exibit 25-19)

S_R= 44.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 44.2 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9030	0.90	Level	4	0	0.980	1.00	10234
Ramp	870	0.90	Level	4	0	0.980	1.00	986
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 2859 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8188	9000	No
V_{12}	2859	4400:All	No
V_{FO} = V_F - V_R	7202	9000	No
V_R	986	3500	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 12.6 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.712 (Exhibit 25-19)

S_R= 45.7 mph (Exhibit 25-19)

S_0= 53.8 mph (Exhibit 25-19)

S = 50.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8430	0.90	Level	4	0	0.980	1.00	9554
Ramp	580	0.90	Level	4	0	0.980	1.00	657
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3703 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7644	9000	No
V_{12}	3703	4400:All	No
$V_{FO} = V_F - V_R$	6987	9000	No
V_R	657	2100	No

Level of Service Determination (if not F)

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

D_R = 22.6 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

D_s = 0.357 (Exhibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 56.6 mph (Exhibit 25-19)

S = 53.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.0 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8690	0.90	Level	4	0	0.980	1.00	9849
Ramp	780	0.90	Level	4	0	0.980	1.00	884
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3934 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7880	9520	No
V_{12}	3934	4400:All	No
V_{FO} = V_F - V_R	6996	9520	No
V_R	884	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.638 (Exhibit 25-19)

S_R= 51.4 mph (Exhibit 25-19)

S_0= 70.8 mph (Exhibit 25-19)

S = 59.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8310	0.90	Level	4	0	0.980	1.00	9418
Ramp	540	0.90	Level	4	0	0.980	1.00	612
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3630 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7535	9000	No
V_{12}	3630	4400:All	No
$V_{FO} = V_F - V_R$	6923	9000	No
V_R	612	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 26.5 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.678 (Exhibit 25-19)

S_R= 46.2 mph (Exhibit 25-19)

S_0= 56.6 mph (Exhibit 25-19)

S = 51.1 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.3 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9290	0.90	Level	4	0	0.980	1.00	10529
Ramp	1460	0.90	Level	4	0	0.980	1.00	1655
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3415 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8424	9412	No
V_{12}	3415	4400:All	No
V_{FO} = V_F - V_R	6769	9412	No
V_R	1655	3800	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 17.4 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.577 (Exhibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 65.8 mph (Exhibit 25-19)

S = 59.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8920	0.90	Level	4	0	0.980	1.00	10109
Ramp	690	0.90	Level	4	0	0.980	1.00	782
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3967 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8088	9000	No
V_{12}	3967	4400:All	No
V_{FO} = V_F - V_R	7306	9000	No
V_R	782	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 24.0 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.693 (Exhibit 25-19)

S_R= 46.0 mph (Exhibit 25-19)

S_0= 56.2 mph (Exhibit 25-19)

S = 50.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.5 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8980	0.90	Level	4	0	0.980	1.00	10177
Ramp	430	0.90	Level	4	0	0.980	1.00	487
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3825 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8142	9540	No
V_{12}	3825	4400:All	No
V_{FO} = V_F - V_R	7655	9540	No
V_R	487	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.602 (Exhibit 25-19)

S_R= 52.6 mph (Exhibit 25-19)

S_0= 70.6 mph (Exhibit 25-19)

S = 60.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7150	0.90	Level	4	0	0.980	1.00	8103
Ramp	90	0.90	Level	4	0	0.980	1.00	102
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3590 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8103	9556	No
V_{12}	3590	4400:All	No
V_{FO} = V_F - V_R	8001	9556	No
V_R	102	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 33.3 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.307 (Exhibit 25-19)

S_R= 60.6 mph (Exhibit 25-19)

S_0= 70.7 mph (Exhibit 25-19)

S = 65.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.6 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8220	0.90	Level	5	0	0.976	1.00	9362
Ramp	1210	0.90	Level	5	0	0.976	1.00	1378
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 2967 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7490	9503	No
V_{12}	2967	4400:All	No
$V_{FO} = V_F - V_R$	6112	9503	No
V_R	1378	3500	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 25-4)

Speed Estimation

D_s = 0.682 (Exhibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 69.2 mph (Exhibit 25-19)

S = 60.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	3910	0.90	Level	5	0	0.976	1.00	4453
Ramp	740	0.90	Level	5	0	0.976	1.00	843
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4453 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4453	4500	No
V_{12}	4453	4400:All	Yes
$V_{FO} = V_F - V_R$	3610	4500	No
V_R	843	2000	No

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= F (Exhibit 25-4)

Speed Estimation

D_s = 0.569 (Exhibit 25-19)

S_R= 47.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8870	0.90	Level	4	0	0.980	1.00	10053
Ramp	420	0.90	Level	4	0	0.980	1.00	476
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.254 using Equation 4

V_{12}= 1917 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8029	See Exhibit 25-7	No
V_{R12}	2393	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 = 22.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)

S_R= 54.9 mph (Exhibit 25-19)

S_0= 52.0 mph (Exhibit 25-19)

S= 52.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8160	0.90	Level	4	0	0.980	1.00	9248
Ramp	790	0.90	Level	4	0	0.980	1.00	895
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.584 using Equation 4

V_{12}= 5399 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10143	See Exhibit 25-7	Yes
V_{R12}	6294	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 = 44.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 2.327 (Exibit 25-19)

S_R= 24.7 mph (Exhibit 25-19)

S_0= 49.9 mph (Exhibit 25-19)

S= 30.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 113

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7770	0.90	Level	4	0	0.980	1.00	8806
Ramp	1260	0.90	Level	4	0	0.980	1.00	1428
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1840 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10234	See Exhibit 25-7	Yes
V_{R12}	3268	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 = 14.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.241 (Exibit 25-19)

S_R= 51.9 mph (Exhibit 25-19)

S_0= 41.4 mph (Exhibit 25-19)

S= 44.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 114

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 66.7 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7830	0.90	Level	4	0	0.980	1.00	8874
Ramp	860	0.90	Level	4	0	0.980	1.00	975
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.414 using Equation 4

V_{12}= 3678 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9849	See Exhibit 25-7	Yes
V_{R12}	4653	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 = 35.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.660 (Exibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 58.4 mph (Exhibit 25-19)

S= 54.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7850	0.90	Level	4	0	0.980	1.00	8897
Ramp	470	0.90	Level	4	0	0.980	1.00	533
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.438 using Equation 4

V_{12}= 3896 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9430	See Exhibit 25-7	Yes
V_{R12}	4429	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/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.585 (Exibit 25-19)

S_R= 47.4 mph (Exhibit 25-19)

S_0= 47.3 mph (Exhibit 25-19)

S= 47.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 116

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8230	0.90	Level	4	0	0.980	1.00	9327
Ramp	200	0.90	Level	4	0	0.980	1.00	227
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.763 using Equation 4

V_{12}= 7115 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9554	See Exhibit 25-7	Yes
V_{R12}	7342	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 = 51.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 6.216 (Exibit 25-19)

S_R= -25.8 mph (Exhibit 25-19)

S_0= 52.8 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8530	0.90	Level	4	0	0.980	1.00	9667
Ramp	450	0.90	Level	4	0	0.980	1.00	510
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.250 using Equation 4

V_{12}= 2413 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10177	See Exhibit 25-7	Yes
V_{R12}	2923	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 = 26.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.373 (Exibit 25-19)

S_R= 58.4 mph (Exhibit 25-19)

S_0= 53.7 mph (Exhibit 25-19)

S= 55.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8600	0.90	Level	4	0	0.980	1.00	9747
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.744 using Equation 4

V_{12}= 7256 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10121	See Exhibit 25-7	Yes
V_{R12}	7630	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 53.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 8.225 (Exibit 25-19)

S_R= -51.9 mph (Exhibit 25-19)

S_0= 52.3 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No build

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5400	0.90	Level	5	0	0.976	1.00	6150
Ramp	780	0.90	Level	5	0	0.976	1.00	888
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.234 using Equation 4

V_{12}= 1441 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7038	See Exhibit 25-7	No
V_{R12}	2329	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.333 (Exibit 25-19)

S_R= 53.9 mph (Exhibit 25-19)

S_0= 52.9 mph (Exhibit 25-19)

S= 53.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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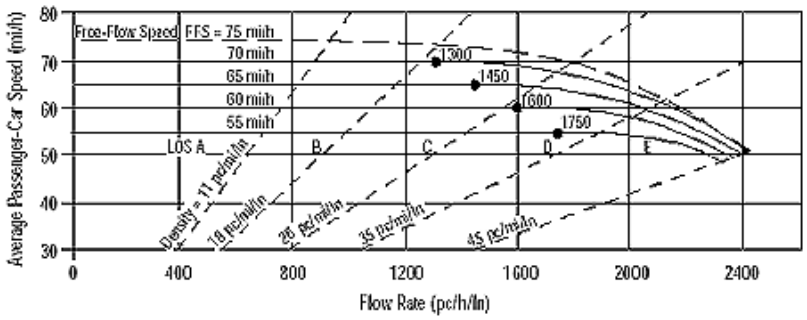
PM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 1

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

Flow Inputs

Volume, V	10090 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2287	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10090	0.90	Level	4	0	0.980	1.00	11435
Ramp	1400	0.90	Level	4	0	0.980	1.00	1587
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3553 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9148	9000	Yes
V_{12}	3553	4400:All	No
V_{FO} = V_F - V_R	7561	9000	No
V_R	1587	3800	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 20.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.636 (Exhibit 25-19)

S_R= 46.7 mph (Exhibit 25-19)

S_0= 53.3 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	380	0.90	4	0	1.5	1.2	0.980	1.00	430
Vw2	520	0.90	4	0	1.5	1.2	0.980	1.00	589
Vw				1019	Vnw				0
V									1019

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.87	0.63
Weaving and non-weaving speeds, Si (mi/h)			21.46	30.35

Number of lanes required for unconstrained operation, Nw 1.75
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	21.46
Weaving segment density, D (pc/mi/ln)	23.74
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8690	0.90	Level	4	0	0.980	1.00	9849
Ramp	370	0.90	Level	4	0	0.980	1.00	419
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.548 using Equation 4

V_{12}= 5394 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10268	See Exhibit 25-7	Yes
V_{R12}	5813	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 = 43.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.542 (Exibit 25-19)

S_R= 35.0 mph (Exhibit 25-19)

S_0= 48.8 mph (Exhibit 25-19)

S= 39.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	41	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.25
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.22
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7198	0.90	4	0	1.5	1.2	0.980	1.00	8157
Vo2	98	0.90	4	0	1.5	1.2	0.980	1.00	111
Vw1	1862	0.90	4	0	1.5	1.2	0.980	1.00	2110
Vw2	512	0.90	4	0	1.5	1.2	0.980	1.00	580
Vw				2690	Vnw				8268
V									10958

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.40	0.52
Weaving and non-weaving speeds, Si (mi/h)			22.05	35.40

Number of lanes required for unconstrained operation, Nw 2.04
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.82
Weaving segment density, D (pc/mi/ln)	71.12
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9008
Capacity as a 15-minute flow rate, c (veh/h)	8831
Capacity as a full-hour volume, c_h (veh/h)	7948

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.08
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	230	0.90	4	0	1.5	1.2	0.980	1.00	260
Vw2	20	0.90	4	0	1.5	1.2	0.980	1.00	22
Vw				282	Vnw				0
V									282

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.10	0.15
Weaving and non-weaving speeds, Si (mi/h)			26.91	36.65

Number of lanes required for unconstrained operation, Nw 1.48
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	26.91
Weaving segment density, D (pc/mi/ln)	5.24
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	39	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.21
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.30
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7121	0.90	4	0	1.5	1.2	0.980	1.00	8070
Vo2	31	0.90	4	0	1.5	1.2	0.980	1.00	35
Vw1	589	0.90	4	0	1.5	1.2	0.980	1.00	667
Vw2	1369	0.90	4	0	1.5	1.2	0.980	1.00	1551
Vw				2218	Vnw				8105
V									10323

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.25	0.46
Weaving and non-weaving speeds, Si (mi/h)			21.82	34.80

Number of lanes required for unconstrained operation, Nw 1.87
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.85
Weaving segment density, D (pc/mi/ln)	66.92
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	8904
Capacity as a 15-minute flow rate, c (veh/h)	8729
Capacity as a full-hour volume, c_h (veh/h)	7856

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8490	0.90	Level	4	0	0.980	1.00	9622
Ramp	300	0.90	Level	4	0	0.980	1.00	340
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.239 using Equation 4

V_{12}= 2300 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9962	See Exhibit 25-7	Yes
V_{R12}	2640	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 = 24.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.362 (Exibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 40.3 mph (Exhibit 25-19)

S= 42.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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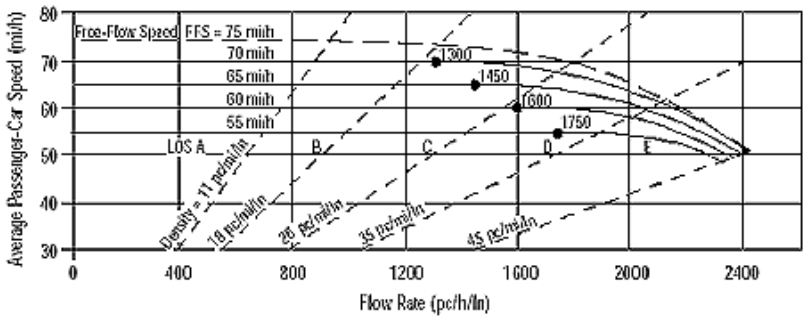
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 23

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

Flow Inputs

Volume, V	8790 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2491	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.34
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8477	0.90	4	0	1.5	1.2	0.980	1.00	9607
Vo2	17	0.90	4	0	1.5	1.2	0.980	1.00	19
Vw1	313	0.90	4	0	1.5	1.2	0.980	1.00	354
Vw2	613	0.90	4	0	1.5	1.2	0.980	1.00	694
Vw				1048	Vnw				9626
V									10674

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.63	0.23		
Weaving and non-weaving speeds, Si (mi/h)	40.70	49.26		

Number of lanes required for unconstrained operation, Nw 1.07
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	48.27
Weaving segment density, D (pc/mi/ln)	44.23
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10836
Capacity as a 15-minute flow rate, c (veh/h)	10624
Capacity as a full-hour volume, c_h (veh/h)	9562

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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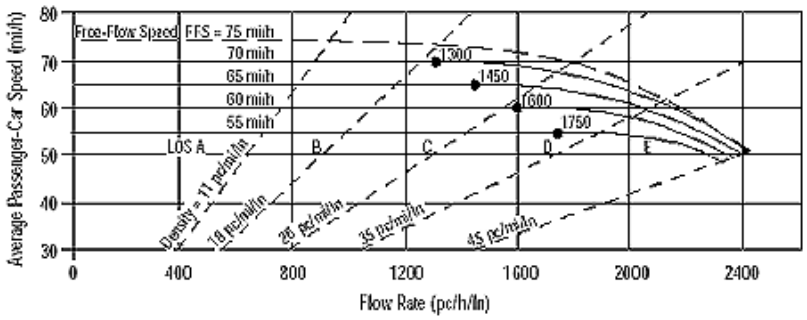
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 25

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

Flow Inputs

Volume, V	9090 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2060	pc/h/ln	Design LOS		
S	53.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9090	0.90	Level	4	0	0.980	1.00	10302
Ramp	1260	0.90	Level	4	0	0.980	1.00	1428
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3200 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8242	9000	No
V_{12}	3200	4400:All	No
$V_{FO} = V_F - V_R$	6814	9000	No
V_R	1428	4100	No

Level of Service Determination (if not F)

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

D_R = 5.7 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.362 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 54.4 mph (Exhibit 25-19)

S = 52.7 mph (Exhibit 25-15)

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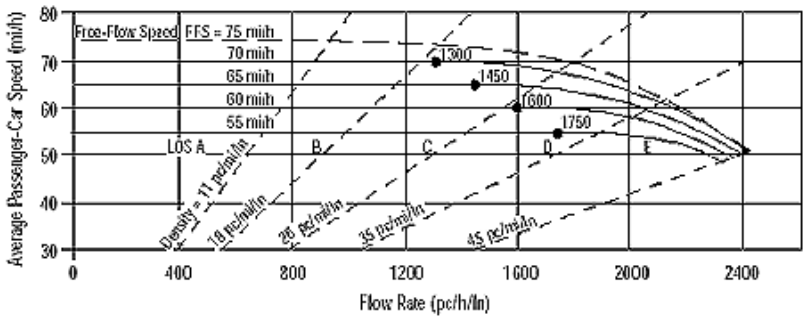
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 27

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

Flow Inputs

Volume, V	7830 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
Driver type adjustment	1.00	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

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2219	pc/h/ln	Design LOS		
S	50.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.7	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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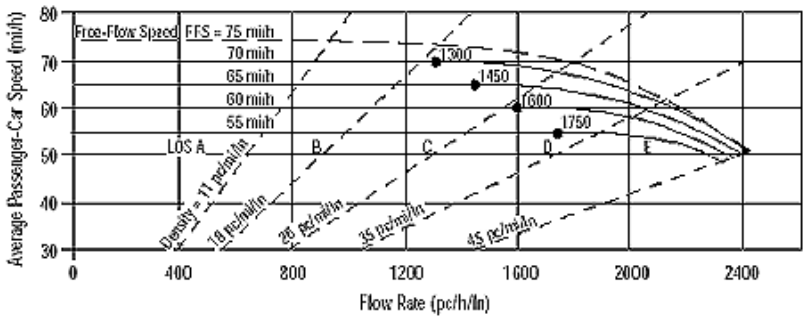
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 29

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

Flow Inputs

Volume, V	7690 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2179	pc/h/ln	Design LOS		
S	51.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	42.2	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 30

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7690	0.90	Level	4	0	0.980	1.00	8715
Ramp	2800	0.90	Level	4	0	0.980	1.00	3173
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1821 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11888	See Exhibit 25-7	Yes
V_{R12}	4994	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 = 24.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.693 (Exibit 25-19)

S_R= 46.0 mph (Exhibit 25-19)

S_0= 41.6 mph (Exhibit 25-19)

S= 43.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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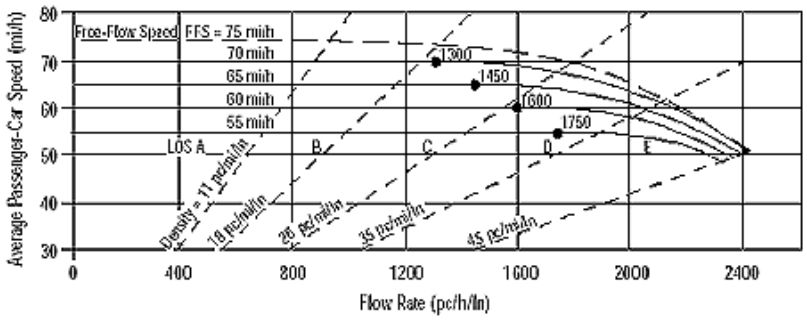
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 31

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

Flow Inputs

Volume, V	10490 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2378	pc/h/ln	Design LOS		
S	53.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	44.4	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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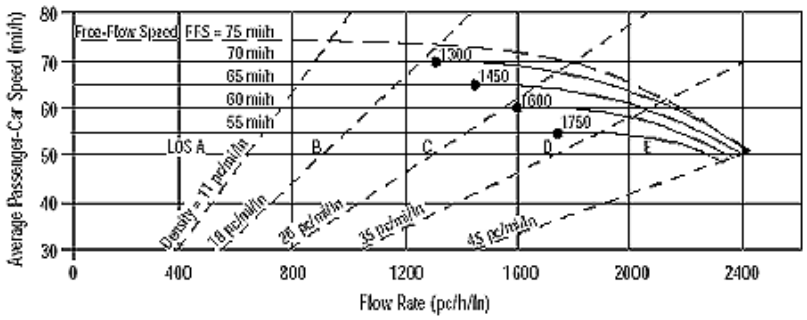
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 32

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

Flow Inputs

Volume, V	11530 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2613	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	11530	0.90	Level	4	0	0.980	1.00	13067
Ramp	3590	0.90	Level	4	0	0.980	1.00	4069
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 5729 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10454	9351	Yes
V_{12}	5729	4400:All	Yes
$V_{FO} = V_F - V_R$	6385	9351	No
V_R	4069	4100	No

Level of Service Determination (if not F)

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

D_R = 10.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.599 (Exhibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= 64.7 mph (Exhibit 25-19)

S = 56.2 mph (Exhibit 25-15)

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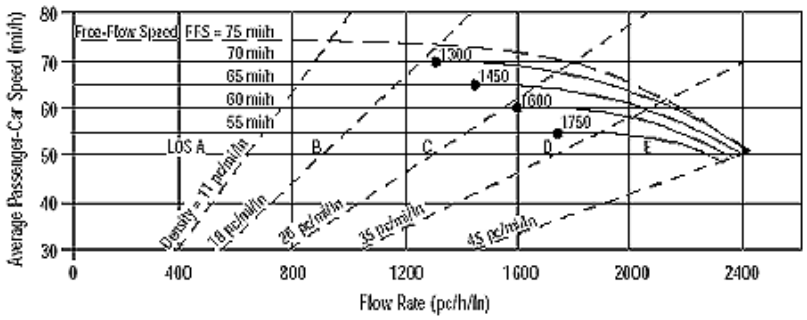
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 34

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

Flow Inputs

Volume, V	7940 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2250	pc/h/ln	Design LOS		
S	54.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.0	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7940	0.90	Level	4	0	0.980	1.00	8999
Ramp	1620	0.90	Level	4	0	0.980	1.00	1836
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.371 using Equation 4

V_{12}= 3335 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10835	See Exhibit 25-7	Yes
V_{R12}	5171	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 = 37.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.924 (Exibit 25-19)

S_R= 43.7 mph (Exhibit 25-19)

S_0= 54.1 mph (Exhibit 25-19)

S= 48.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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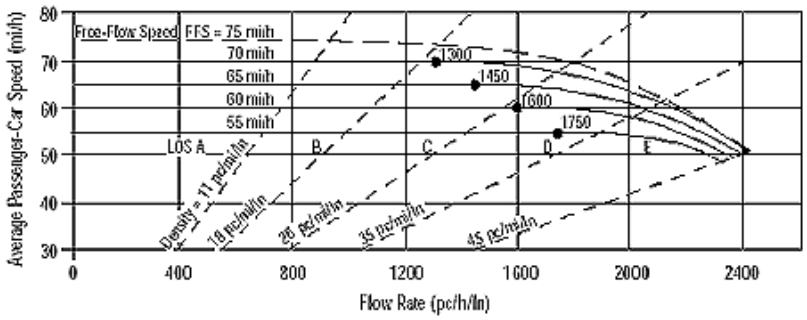
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 36

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

Flow Inputs

Volume, V	9560 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2709	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.28
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	40	0.90	4	0	1.5	1.2	0.980	1.00	45
Vo2	8810	0.90	4	0	1.5	1.2	0.980	1.00	9984
Vw1	290	0.90	4	0	1.5	1.2	0.980	1.00	328
Vw2	750	0.90	4	0	1.5	1.2	0.980	1.00	850
Vw				1178	Vnw				10029
V									11207

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.87	0.45		
Weaving and non-weaving speeds, Si (mi/h)	44.48	53.00		

Number of lanes required for unconstrained operation, Nw 1.11
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	51.96
Weaving segment density, D (pc/mi/ln)	43.14
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11183
Capacity as a 15-minute flow rate, c (veh/h)	10964
Capacity as a full-hour volume, c_h (veh/h)	9868

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.06
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	14	0.90	4	0	1.5	1.2	0.980	1.00	15
Vo2	8824	0.90	4	0	1.5	1.2	0.980	1.00	10000
Vw1	316	0.90	4	0	1.5	1.2	0.980	1.00	358
Vw2	266	0.90	4	0	1.5	1.2	0.980	1.00	301
Vw				659	Vnw				10015
V									10674

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.74	0.35		
Weaving and non-weaving speeds, Si (mi/h)	47.21	56.48		

Number of lanes required for unconstrained operation, Nw 0.80
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	55.81
Weaving segment density, D (pc/mi/ln)	38.25
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11339
Capacity as a 15-minute flow rate, c (veh/h)	11117
Capacity as a full-hour volume, c_h (veh/h)	10005

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	890	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	28	0.90	4	0	1.5	1.2	0.980	1.00	31
Vo2	8608	0.90	4	0	1.5	1.2	0.980	1.00	9755
Vw1	292	0.90	4	0	1.5	1.2	0.980	1.00	330
Vw2	532	0.90	4	0	1.5	1.2	0.980	1.00	602
Vw				932	Vnw				9786
V									10718

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.34	0.64		
Weaving and non-weaving speeds, Si (mi/h)	38.49	48.50		

Number of lanes required for unconstrained operation, Nw 0.91
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	47.43
Weaving segment density, D (pc/mi/ln)	45.20
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10148
Capacity as a 15-minute flow rate, c (veh/h)	9949
Capacity as a full-hour volume, c_h (veh/h)	8954

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2020 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.17
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	44	0.90	4	0	1.5	1.2	0.980	1.00	49
Vo2	8054	0.90	4	0	1.5	1.2	0.980	1.00	9127
Vw1	796	0.90	4	0	1.5	1.2	0.980	1.00	902
Vw2	836	0.90	4	0	1.5	1.2	0.980	1.00	947
Vw				1849	Vnw				9176
V									11025

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.68	0.31		
Weaving and non-weaving speeds, Si (mi/h)	48.27	57.75		

Number of lanes required for unconstrained operation, Nw 1.06
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	55.90
Weaving segment density, D (pc/mi/ln)	39.44
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11548
Capacity as a 15-minute flow rate, c (veh/h)	11322
Capacity as a full-hour volume, c_h (veh/h)	10190

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9460	0.90	Level	4	0	0.980	1.00	10721
Ramp	350	0.90	Level	4	0	0.980	1.00	397
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.327 using Equation 4

V_{12}= 2692 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8618	See Exhibit 25-7	No
V_{R12}	3089	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 = 26.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.372 (Exibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

S_0= 56.5 mph (Exhibit 25-19)

S= 56.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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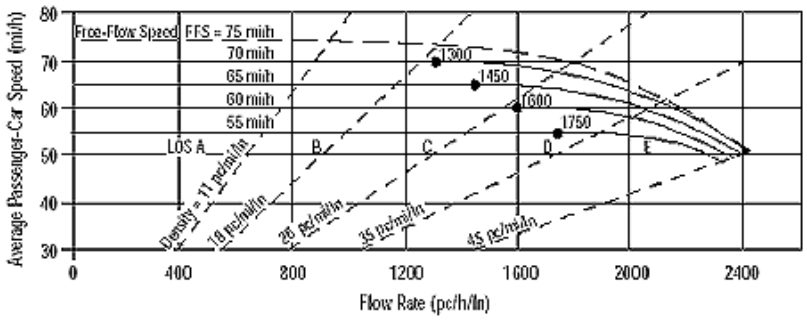

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 47

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

Flow Inputs

Volume, V	9810 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	60.9	mi/h	FFS	60.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2224	pc/h/ln	Design LOS		
S	53.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	41.2	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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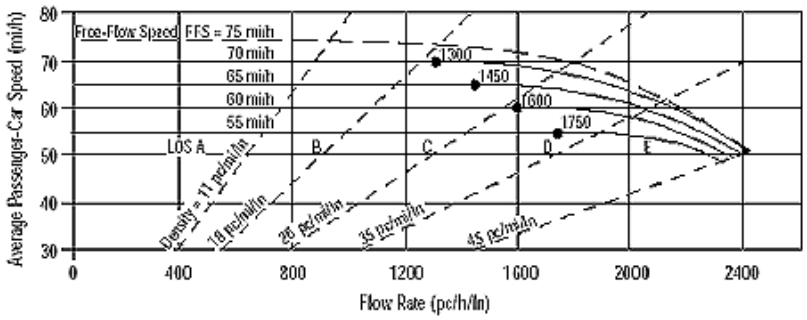

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 48

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

Flow Inputs

Volume, V	4010 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2250	pc/h/ln	Design LOS		
S	58.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	38.4	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4010	0.90	Level	5	0	0.976	1.00	4567
Ramp	2690	0.90	Level	5	0	0.976	1.00	3064
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4567 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4567	4500	Yes
V_{12}	4567	4400:All	Yes
$V_{FO} = V_F - V_R$	1503	4500	No
V_R	3064	3800	No

Level of Service Determination (if not F)

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

D_R = 24.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.704 (Exhibit 25-19)

S_R= 45.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.9 mph (Exhibit 25-15)

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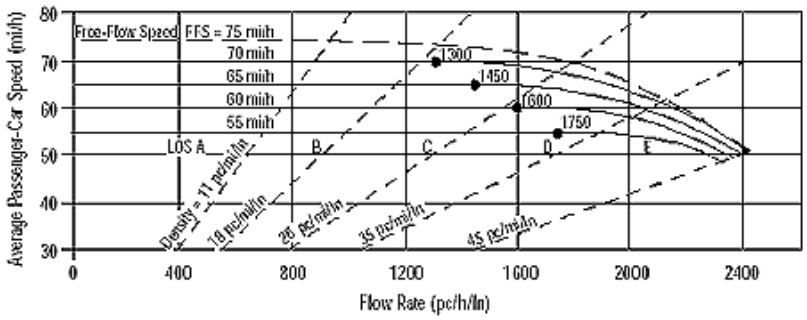

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 50

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

Flow Inputs

Volume, V	1330 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	757	pc/h/ln	Design LOS	
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	12.6	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 62.8 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	1330	0.90	Level	5	0	0.976	1.00	1515
Ramp	440	0.90	Level	5	0	0.976	1.00	501
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 1515 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	1515	4655	No
V_{12}	1515	4400:All	No
V_{FO} = V_F - V_R	1014	4655	No
V_R	501	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 7.4 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.278 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 57.0 mph (Exhibit 25-15)

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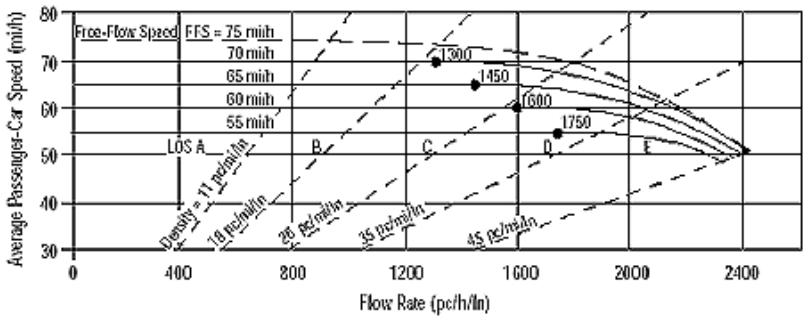

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 52

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

Flow Inputs

Volume, V	890 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	507	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	8.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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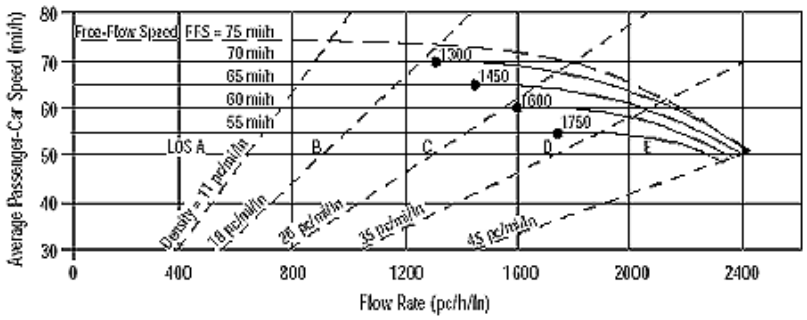

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 54

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

Flow Inputs

Volume, V	4480 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1276	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.3	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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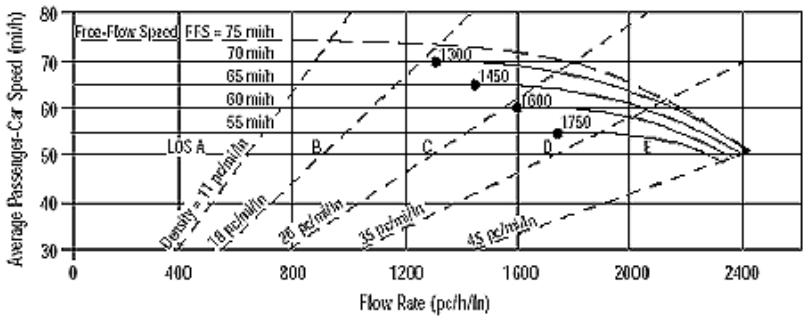
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 56

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

Flow Inputs

Volume, V	5740 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1307	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.8	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5740	0.90	Level	5	0	0.976	1.00	6537
Ramp	870	0.90	Level	5	0	0.976	1.00	991
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 2982 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5557	9311	No
V_{12}	2982	4400:All	No
$V_{FO} = V_F - V_R$	4566	9311	No
V_R	991	2100	No

Level of Service Determination (if not F)

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

D_R = 1.1 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.452 (Exhibit 25-19)

S_R= 53.4 mph (Exhibit 25-19)

S_0= 67.8 mph (Exhibit 25-19)

S = 59.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4870	0.90	Level	5	0	0.976	1.00	5546
Ramp	1460	0.90	Level	5	0	0.976	1.00	1663
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.193 using Equation 4

V_{12}= 1071 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7209	See Exhibit 25-7	No
V_{R12}	2734	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 = 22.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 59.0 mph (Exhibit 25-19)

S_0= 61.5 mph (Exhibit 25-19)

S= 60.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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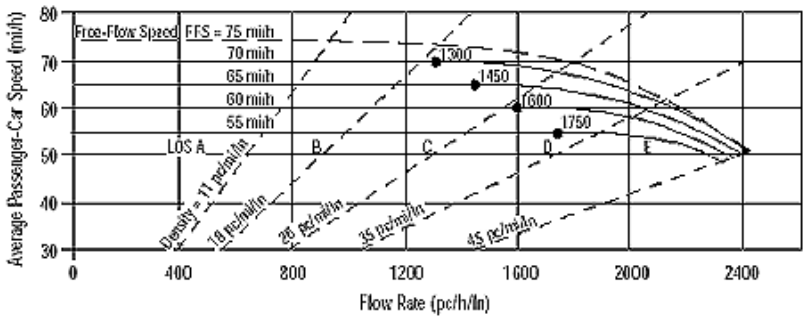
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 60

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

Flow Inputs

Volume, V	6330 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
Driver type adjustment	1.00	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

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

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		
S	67.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.6	pc/mi/ln	S		mi/h
LOS	D		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 60.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6330	0.90	Level	5	0	0.976	1.00	7209
Ramp	1090	0.90	Level	5	0	0.976	1.00	1241
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.126 using Equation 4

V_{12}= 911 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8450	See Exhibit 25-7	No
V_{R12}	2152	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 20.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.341 (Exibit 25-19)

S_R= 54.2 mph (Exhibit 25-19)

S_0= 48.9 mph (Exhibit 25-19)

S= 50.1 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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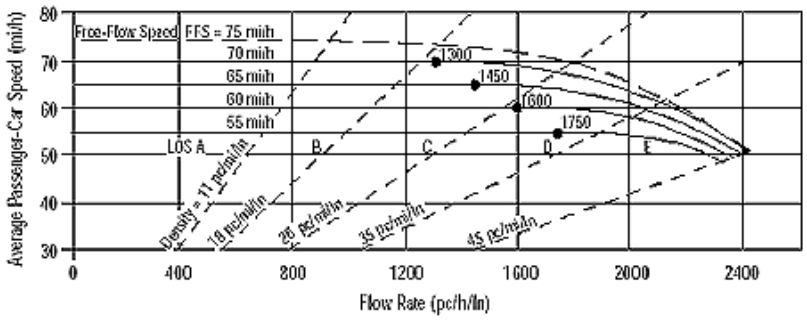
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 62

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

Flow Inputs

Volume, V	7420 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.6	mi/h	FFS	59.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2113	pc/h/ln	Design LOS		
S	55.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	37.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.6 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7420	0.90	Level	5	0	0.976	1.00	8451
Ramp	940	0.90	Level	5	0	0.976	1.00	1071
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4289 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8451	9183	No
V_{12}	4289	4400:All	No
V_{FO} = V_F - V_R	7380	9183	No
V_R	1071	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 38.4 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.524 (Exhibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 61.2 mph (Exhibit 25-19)

S = 55.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 58.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6470	0.90	Level	5	0	0.976	1.00	7369
Ramp	510	0.90	Level	5	0	0.976	1.00	581
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.328 using Equation 4

V_{12}= 2420 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7950	See Exhibit 25-7	No
V_{R12}	3001	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 = 25.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.359 (Exibit 25-19)

S_R= 52.3 mph (Exhibit 25-19)

S_0= 50.4 mph (Exhibit 25-19)

S= 51.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 68

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 65.4 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6540	0.90	Level	5	0	0.976	1.00	7448
Ramp	410	0.90	Level	5	0	0.976	1.00	467
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.239 using Equation 4

V_{12}= 1781 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7915	See Exhibit 25-7	No
V_{R12}	2248	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 = 21.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.340 (Exibit 25-19)

S_R= 57.4 mph (Exhibit 25-19)

S_0= 55.7 mph (Exhibit 25-19)

S= 56.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6950	0.90	Level	5	0	0.976	1.00	7915
Ramp	330	0.90	Level	5	0	0.976	1.00	376
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.235 using Equation 4

V_{12}= 1856 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8291	See Exhibit 25-7	No
V_{R12}	2232	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 = 21.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)

S_R= 56.1 mph (Exhibit 25-19)

S_0= 52.6 mph (Exhibit 25-19)

S= 53.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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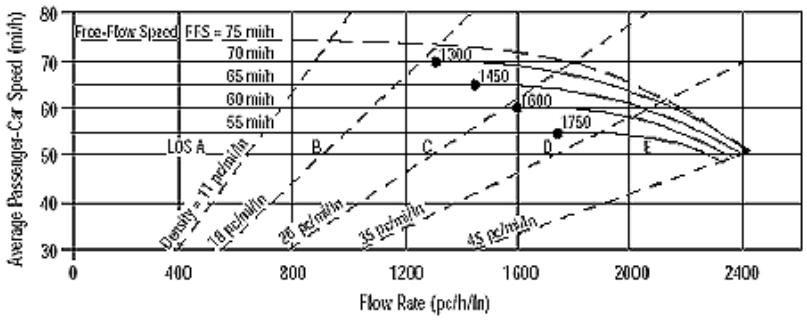
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 71

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

Flow Inputs

Volume, V	7280 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2073	pc/h/ln	Design LOS		
S	59.3	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	35.0	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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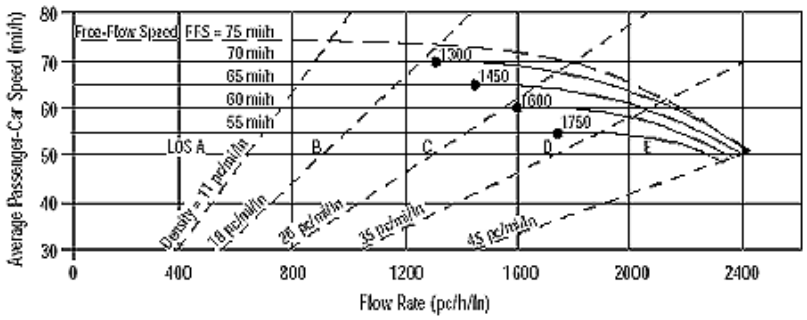
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 72

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

Flow Inputs

Volume, V	7280 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1658	pc/h/ln	Design LOS		
S	63.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 63.8 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7280	0.90	Level	5	0	0.976	1.00	8291
Ramp	1440	0.90	Level	5	0	0.976	1.00	1640
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3817 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6633	9351	No
V_{12}	3817	4400:All	No
$V_{FO} = V_F - V_R$	4993	9351	No
V_R	1640	2000	No

Level of Service Determination (if not F)

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

D_R = 35.3 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.641 (Exhibit 25-19)

S_R= 49.8 mph (Exhibit 25-19)

S_0= 68.4 mph (Exhibit 25-19)

S = 56.3 mph (Exhibit 25-15)

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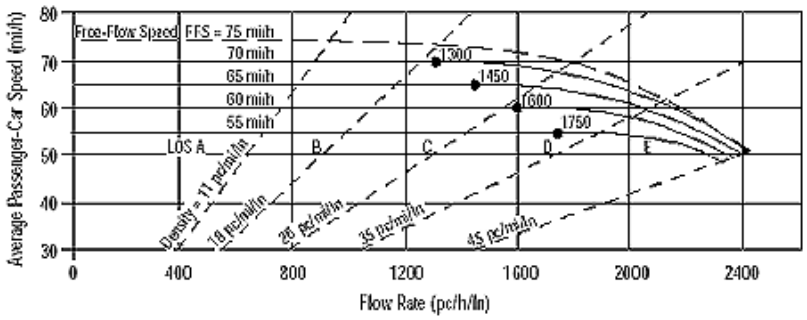
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 74

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

Flow Inputs

Volume, V	5840 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1663	pc/h/ln	Design LOS		
S	69.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 61.4 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5840	0.90	Level	5	0	0.976	1.00	6651
Ramp	560	0.90	Level	5	0	0.976	1.00	638
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3260 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6651	9256	No
V_{12}	3260	4400:All	No
$V_{FO} = V_F - V_R$	6013	9256	No
V_R	638	2000	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 25-4)

Speed Estimation

D_s = 0.550 (Exhibit 25-19)

S_R= 50.7 mph (Exhibit 25-19)

S_0= 64.6 mph (Exhibit 25-19)

S = 57.0 mph (Exhibit 25-15)

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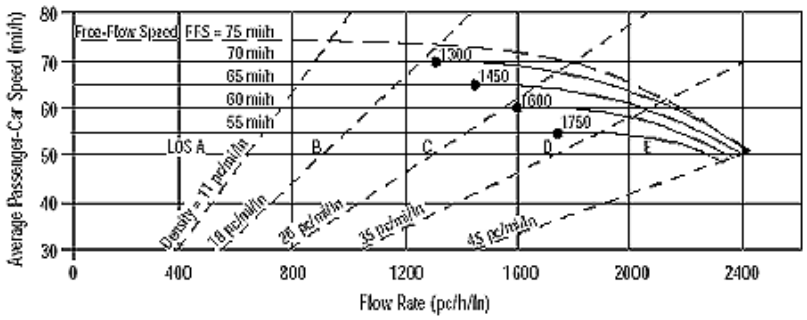
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 76

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

Flow Inputs

Volume, V	5280 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
Driver type adjustment	1.00	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

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	61.4	mi/h	FFS	61.4	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1503	pc/h/ln	Design LOS		
S	61.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5280	0.90	Level	5	0	0.976	1.00	6013
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 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3283 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6013	9000	No
V_{12}	3283	4400:All	No
$V_{FO} = V_F - V_R$	4840	9000	No
V_R	1173	2000	No

Level of Service Determination (if not F)

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

D_R = 30.5 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.599 (Exhibit 25-19)

S_R= 47.2 mph (Exhibit 25-19)

S_0= 58.9 mph (Exhibit 25-19)

S = 51.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 79

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4250	0.90	Level	5	0	0.976	1.00	4840
Ramp	890	0.90	Level	5	0	0.976	1.00	1014
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.378 using Equation 4

V_{12}= 1828 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5854	See Exhibit 25-7	No
V_{R12}	2842	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 = 21.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.325 (Exibit 25-19)

S_R= 50.8 mph (Exhibit 25-19)

S_0= 51.4 mph (Exhibit 25-19)

S= 51.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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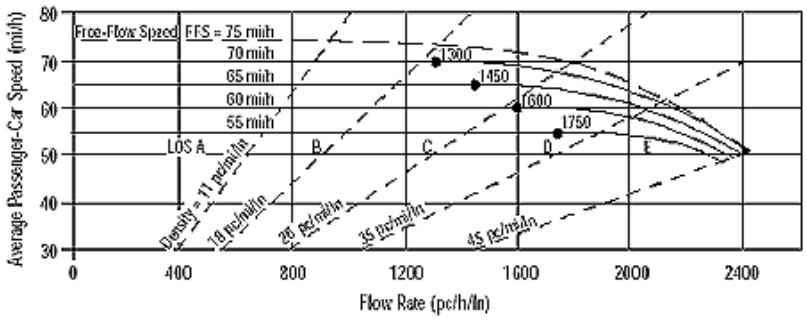

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 84

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

Flow Inputs

Volume, V	5140 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
Driver type adjustment	1.00	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

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1463	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.5	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5140	0.90	Level	5	0	0.976	1.00	5854
Ramp	1120	0.90	Level	5	0	0.976	1.00	1276
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3272 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5854	9191	No
V_{12}	3272	4400:All	No
$V_{FO} = V_F - V_R$	4578	9191	No
V_R	1276	2100	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 25-4)

Speed Estimation

D_s = 0.348 (Exhibit 25-19)

S_R= 53.6 mph (Exhibit 25-19)

S_0= 64.5 mph (Exhibit 25-19)

S = 57.9 mph (Exhibit 25-15)

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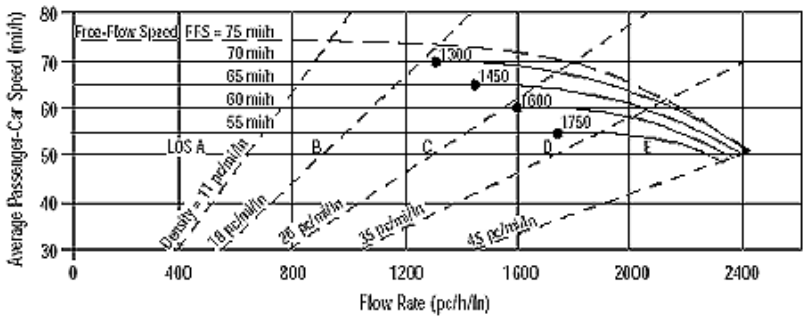

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 86

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

Flow Inputs

Volume, V	4020 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1145	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	16.4	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 59.8 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4020	0.90	Level	5	0	0.976	1.00	4578
Ramp	2800	0.90	Level	5	0	0.976	1.00	3189
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3550 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4578	9191	No
V_{12}	3550	4400:All	No
$V_{FO} = V_F - V_R$	1389	9191	No
V_R	3189	4400	No

Level of Service Determination (if not F)

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

D_R = -51.6 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.393 (Exhibit 25-19)

S_R= 52.8 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 55.2 mph (Exhibit 25-15)

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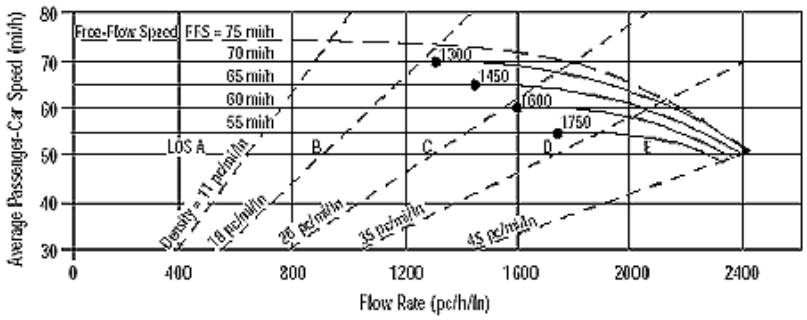

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	2420 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1378	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	23.0	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2420	0.90	Level	5	0	0.976	1.00	2756
Ramp	140	0.90	Level	5	0	0.976	1.00	159
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2756 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	2915	See Exhibit 25-7	No
V_{R12}	2915	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 = 25.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.358 (Exibit 25-19)

S_R= 53.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 53.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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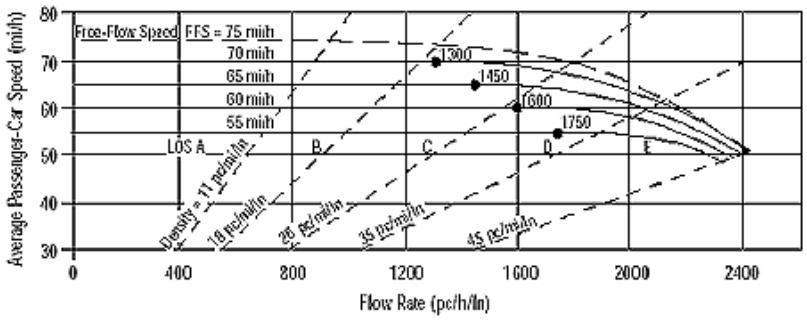

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	2720 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1549	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	25.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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 f_{HV} f_p
Freeway	2540	0.90	Level	2	0	0.990	1.00	2850
Ramp	1360	0.90	Level	2	0	0.990	1.00	1526
UpStream								
DownStream								

Estimation of v_{12} — Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2850 pc/h

Estimation of v_{12} — Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4376	See Exhibit 25-7	No
V_{R12}	4376	4600:All	No

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F		See Exhibit 25-14	
V_{12}		4400:All	
V_{FO} = V_F - V_R		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 37.3 (pc/ m/ln)

LOS = E (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.604 (Exibit 25-19)

S_R= 47.2 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 47.2 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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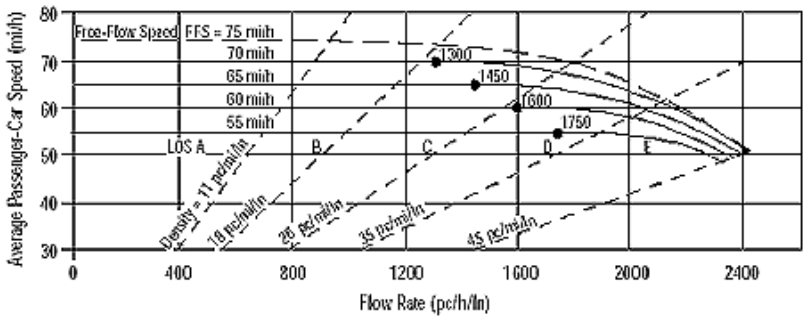
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No build

Project Description Segment ID 92

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

Flow Inputs

Volume, V	3900 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2188	pc/h/ln	Design LOS		
S	60.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	36.2	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2490	0.90	Level	2	0	0.990	1.00	2794
Ramp	370	0.90	Level	2	0	0.990	1.00	415
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2794 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3209	See Exhibit 25-7	No
V_{R12}	3209	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 = 20.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.313 (Exibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 50.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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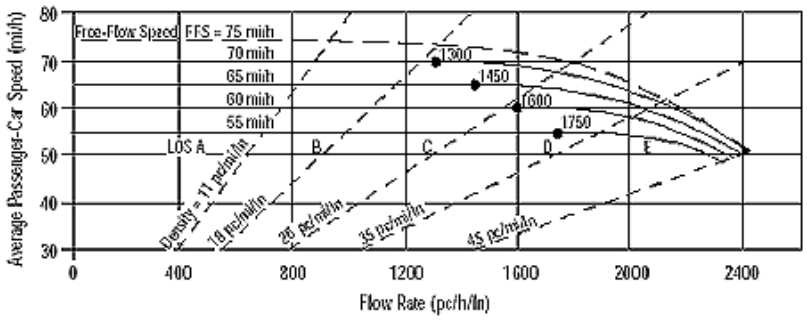
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 96

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

Flow Inputs

Volume, V	2870 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1074	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	15.3	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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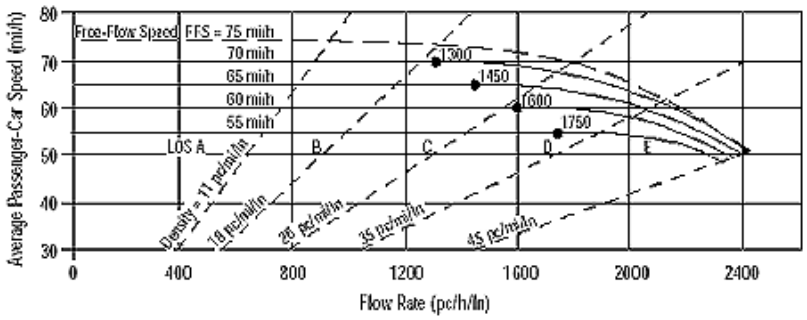
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 97

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

Flow Inputs

Volume, V	3160 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1182	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	16.9	pc/mi/ln	S		mi/h
LOS	B		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	3160	0.90	Level	5	0	0.976	1.00	3599
Ramp	560	0.90	Level	5	0	0.976	1.00	638
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 3599 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	3599	4500	No
V_{12}	3599	4400:All	No
$V_{FO} = V_F - V_R$	2961	4500	No
V_R	638	2000	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 25-4)

Speed Estimation

D_s = 0.550 (Exhibit 25-19)

S_R= 47.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2600	0.90	Level	2	0	0.990	1.00	2918
Ramp	1410	0.90	Level	2	0	0.990	1.00	1582
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2918 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4500	See Exhibit 25-7	No
V_{R12}	4500	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 37.3 (pc/ m/ln)

LOS = E (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.644 (Exibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 46.6 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.2 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9730	0.90	Level	4	0	0.980	1.00	11027
Ramp	880	0.90	Level	4	0	0.980	1.00	997
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3031 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8822	9447	No
V_{12}	3031	4400:All	No
$V_{FO} = V_F - V_R$	7825	9447	No
V_R	997	3500	No

Level of Service Determination (if not F)

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

D_R = 14.1 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.713 (Exhibit 25-19)

S_R= 49.0 mph (Exhibit 25-19)

S_0= 65.2 mph (Exhibit 25-19)

S = 58.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.8 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9420	0.90	Level	4	0	0.980	1.00	10676
Ramp	280	0.90	Level	4	0	0.980	1.00	317
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3903 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8541	9432	No
V_{12}	3903	4400:All	No
V_{FO} = V_F - V_R	8224	9432	No
V_R	317	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 24.3 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.327 (Exhibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 67.0 mph (Exhibit 25-19)

S = 62.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9110	0.90	Level	4	0	0.980	1.00	10325
Ramp	620	0.90	Level	4	0	0.980	1.00	703
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3998 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8260	9000	No
V_{12}	3998	4400:All	No
V_{FO} = V_F - V_R	7557	9000	No
V_R	703	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 29.6 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.621 (Exhibit 25-19)

S_R= 46.9 mph (Exhibit 25-19)

S_0= 55.9 mph (Exhibit 25-19)

S = 51.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 64.7 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9450	0.90	Level	4	0	0.980	1.00	10710
Ramp	560	0.90	Level	4	0	0.980	1.00	635
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4094 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8568	9387	No
V_{12}	4094	4400:All	No
$V_{FO} = V_F - V_R$	7933	9387	No
V_R	635	1900	No

Level of Service Determination (if not F)

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

D_R = 30.5 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.680 (Exhibit 25-19)

S_R= 49.3 mph (Exhibit 25-19)

S_0= 66.2 mph (Exhibit 25-19)

S = 56.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9670	0.90	Level	4	0	0.980	1.00	10959
Ramp	1960	0.90	Level	4	0	0.980	1.00	2221
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3923 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8768	9000	No
V_{12}	3923	4400:All	No
$V_{FO} = V_F - V_R$	6547	9000	No
V_R	2221	3800	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 25-4)

Speed Estimation

D_s = 0.628 (Exhibit 25-19)

S_R= 46.8 mph (Exhibit 25-19)

S_0= 54.8 mph (Exhibit 25-19)

S = 50.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9880	0.90	Level	4	0	0.980	1.00	11197
Ramp	790	0.90	Level	4	0	0.980	1.00	895
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4410 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8958	9400	No
V_{12}	4410	4400:All	Yes
V_{FO} = V_F - V_R	8063	9400	No
V_R	895	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 27.8 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.704 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

S_0= 66.3 mph (Exhibit 25-19)

S = 56.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9420	0.90	Level	4	0	0.980	1.00	10676
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3935 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8541	9000	No
V_{12}	3935	4400:All	No
V_{FO} = V_F - V_R	8167	9000	No
V_R	374	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 35.8 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.592 (Exhibit 25-19)

S_R= 47.3 mph (Exhibit 25-19)

S_0= 55.3 mph (Exhibit 25-19)

S = 51.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7830	0.90	Level	4	0	0.980	1.00	8874
Ramp	140	0.90	Level	4	0	0.980	1.00	159
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3959 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8874	9000	No
V_{12}	3959	4400:All	No
$V_{FO} = V_F - V_R$	8715	9000	No
V_R	159	2100	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 25-4)

Speed Estimation

D_s = 0.312 (Exhibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 54.7 mph (Exhibit 25-19)

S = 52.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.4 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7940	0.90	Level	5	0	0.976	1.00	9043
Ramp	1400	0.90	Level	5	0	0.976	1.00	1594
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3061 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7235	9416	No
V_{12}	3061	4400:All	No
V_{FO} = V_F - V_R	5641	9416	No
V_R	1594	3500	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 14.4 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.701 (Exhibit 25-19)

S_R= 49.0 mph (Exhibit 25-19)

S_0= 67.5 mph (Exhibit 25-19)

S = 58.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	3900	0.90	Level	5	0	0.976	1.00	4442
Ramp	1400	0.90	Level	5	0	0.976	1.00	1594
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4442 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4442	4500	No
V_{12}	4442	4400:All	Yes
$V_{FO} = V_F - V_R$	2848	4500	No
V_R	1594	2000	No

Level of Service Determination (if not F)

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

D_R = 40.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.636 (Exhibit 25-19)

S_R= 46.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 46.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2020 No Build

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9060	0.90	Level	4	0	0.980	1.00	10268
Ramp	610	0.90	Level	4	0	0.980	1.00	691
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.227 using Equation 4

V_{12}= 1763 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8459	See Exhibit 25-7	No
V_{R12}	2454	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 = 22.4 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.345 (Exibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 44.3 mph (Exhibit 25-19)

S= 45.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8860	0.90	Level	4	0	0.980	1.00	10041
Ramp	610	0.90	Level	4	0	0.980	1.00	691
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.609 using Equation 4

V_{12}= 6118 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10732	See Exhibit 25-7	Yes
V_{R12}	6809	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 = 48.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 3.749 (Exibit 25-19)

S_R= -24.5 mph (Exhibit 25-19)

S_0= 60.9 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8890	0.90	Level	4	0	0.980	1.00	10075
Ramp	840	0.90	Level	4	0	0.980	1.00	952
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2106 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11027	See Exhibit 25-7	Yes
V_{R12}	3058	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 = 12.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.222 (Exibit 25-19)

S_R= 58.6 mph (Exhibit 25-19)

S_0= 46.8 mph (Exhibit 25-19)

S= 49.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7710	0.90	Level	4	0	0.980	1.00	8738
Ramp	1400	0.90	Level	4	0	0.980	1.00	1587
UpStream								
DownStream								

Estimation of v_{12} — Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.338 using Equation 4

V_{12}= 2953 pc/h

Estimation of v_{12} — Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10325	See Exhibit 25-7	Yes
V_{R12}	4540	4600:All	No

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 33.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.616 (Exibit 25-19)

S_R= 47.0 mph (Exhibit 25-19)

S_0= 44.9 mph (Exhibit 25-19)

S= 45.8 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9140	0.90	Level	4	0	0.980	1.00	10359
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.459 using Equation 4

V_{12}= 4756 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10722	See Exhibit 25-7	Yes
V_{R12}	5119	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 = 39.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.910 (Exibit 25-19)

S_R= 44.2 mph (Exhibit 25-19)

S_0= 56.5 mph (Exhibit 25-19)

S= 49.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9090	0.90	Level	4	0	0.980	1.00	10302
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.744 using Equation 4

V_{12}= 7670 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10676	See Exhibit 25-7	Yes
V_{R12}	8044	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 = 56.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 12.344 (Exibit 25-19)

S_R= -225.7 mph (Exhibit 25-19)

S_0= 62.7 mph (Exhibit 25-19)

S= 1677.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8790	0.90	Level	4	0	0.980	1.00	9962
Ramp	630	0.90	Level	4	0	0.980	1.00	714
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.224 using Equation 4

V_{12}= 2233 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10676	See Exhibit 25-7	Yes
V_{R12}	2947	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 26.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.374 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 39.1 mph (Exhibit 25-19)

S= 41.6 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9560	0.90	Level	4	0	0.980	1.00	10835
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.744 using Equation 4

V_{12}= 8066 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11209	See Exhibit 25-7	Yes
V_{R12}	8440	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 = 59.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 18.246 (Exibit 25-19)

S_R= -334.0 mph (Exhibit 25-19)

S_0= 60.6 mph (Exhibit 25-19)

S= 549.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2020 No Build

Project Description Segment ID 119

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 57.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6990	0.90	Level	5	0	0.976	1.00	7961
Ramp	730	0.90	Level	5	0	0.976	1.00	831
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.241 using Equation 4

V_{12}= 1921 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8792	See Exhibit 25-7	No
V_{R12}	2752	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 = 24.1 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.354 (Exibit 25-19)

S_R= 51.7 mph (Exhibit 25-19)

S_0= 46.2 mph (Exhibit 25-19)

S= 47.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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Appendix B2

Year 2040 No Build Alternative
Freeway Level of Service (LOS) Worksheets

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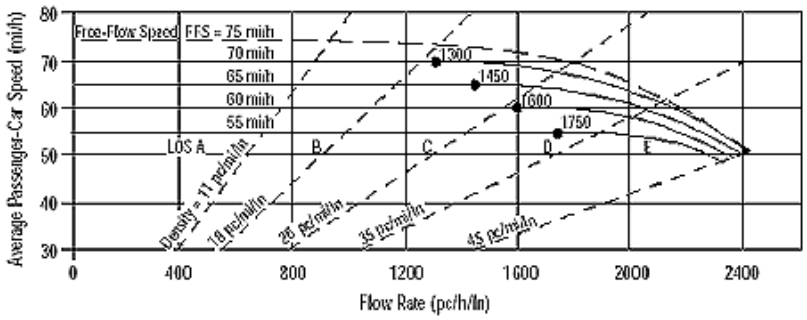
2040 No Build

Freeway Mainline, Ramps, and Ramp-Freeway Junctions and Weaving Level of Service Analysis Worksheets

AM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 1

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

Flow Inputs

Volume, V	10500 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	72.6	mi/h	FFS	72.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2380	pc/h/ln	Design LOS		
S	54.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 70.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10500	0.90	Level	4	0	0.980	1.00	11900
Ramp	1250	0.90	Level	4	0	0.980	1.00	1417
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3524 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9520	9600	No
V_{12}	3524	4400:All	No
V_{FO} = V_F - V_R	8103	9600	No
V_R	1417	3800	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 20.2 (pc/ mi /ln)

LOS= C (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.621 (Exhibit 25-19)

S_R= 52.6 mph (Exhibit 25-19)

S_0= 69.0 mph (Exhibit 25-19)

S = 61.9 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2040 No build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.48
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	350	0.90	4	0	1.5	1.2	0.980	1.00	396
Vw2	320	0.90	4	0	1.5	1.2	0.980	1.00	362
Vw				758	Vnw				0
V									758

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.15	0.43
Weaving and non-weaving speeds, Si (mi/h)			22.93	32.51

Number of lanes required for unconstrained operation, Nw 1.70
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	22.93
Weaving segment density, D (pc/mi/ln)	16.53
Level of service, LOS	B
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 69.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9250	0.90	Level	4	0	0.980	1.00	10483
Ramp	330	0.90	Level	4	0	0.980	1.00	374
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.553 using Equation 4

V_{12}= 5801 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10857	See Exhibit 25-7	Yes
V_{R12}	6175	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 = 45.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 2.111 (Exibit 25-19)

S_R= 11.1 mph (Exhibit 25-19)

S_0= 63.0 mph (Exhibit 25-19)

S= 17.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.19
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.20
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8089	0.90	4	0	1.5	1.2	0.980	1.00	9167
Vo2	79	0.90	4	0	1.5	1.2	0.980	1.00	89
Vw1	1501	0.90	4	0	1.5	1.2	0.980	1.00	1701
Vw2	381	0.90	4	0	1.5	1.2	0.980	1.00	431
Vw				2132	Vnw				9256
V									11388

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.17	0.45
Weaving and non-weaving speeds, Si (mi/h)			28.18	52.90

Number of lanes required for unconstrained operation, Nw 1.51
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	45.44
Weaving segment density, D (pc/mi/ln)	50.13
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10038
Capacity as a 15-minute flow rate, c (veh/h)	9841
Capacity as a full-hour volume, c_h (veh/h)	8857

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	fHV	fp	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	130	0.90	4	0	1.5	1.2	0.980	1.00	147
Vw2	70	0.90	4	0	1.5	1.2	0.980	1.00	79
Vw				226	Vnw				0
V									226

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			0.89	0.12
Weaving and non-weaving speeds, Si (mi/h)			28.25	37.40

Number of lanes required for unconstrained operation, Nw 1.45
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	28.25
Weaving segment density, D (pc/mi/ln)	4.00
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	68	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.18
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.47
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7662	0.90	4	0	1.5	1.2	0.980	1.00	8683
Vo2	42	0.90	4	0	1.5	1.2	0.980	1.00	47
Vw1	798	0.90	4	0	1.5	1.2	0.980	1.00	904
Vw2	888	0.90	4	0	1.5	1.2	0.980	1.00	1006
Vw				1910	Vnw				8730
V									10640

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.14	0.43
Weaving and non-weaving speeds, Si (mi/h)			29.01	55.57

Number of lanes required for unconstrained operation, Nw 1.42
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	47.73
Weaving segment density, D (pc/mi/ln)	44.59
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10231
Capacity as a 15-minute flow rate, c (veh/h)	10030
Capacity as a full-hour volume, c_h (veh/h)	9027

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 22

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 69.2 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8560	0.90	Level	4	0	0.980	1.00	9701
Ramp	670	0.90	Level	4	0	0.980	1.00	759
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.187 using Equation 4

V_{12}= 1811 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10460	See Exhibit 25-7	Yes
V_{R12}	2570	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 = 23.9 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.358 (Exibit 25-19)

S_R= 59.5 mph (Exhibit 25-19)

S_0= 52.8 mph (Exhibit 25-19)

S= 54.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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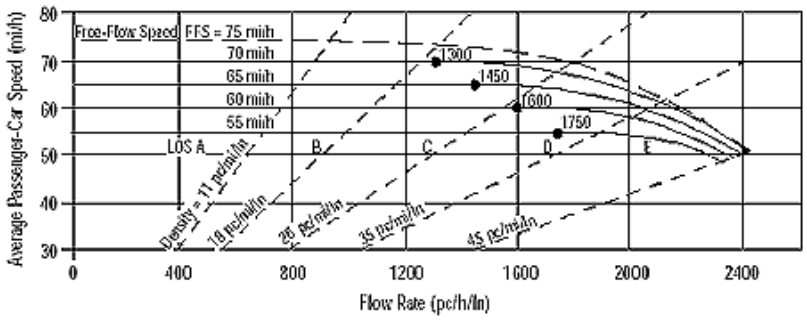
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 23

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

Flow Inputs

Volume, V	9220 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.2	mi/h	FFS	68.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2612	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2040 No build

Inputs

Freeway free-flow speed, SFF (mi/h)	69	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	8774	0.90	4	0	1.5	1.2	0.980	1.00	9943
Vo2	24	0.90	4	0	1.5	1.2	0.980	1.00	27
Vw1	446	0.90	4	0	1.5	1.2	0.980	1.00	505
Vw2	466	0.90	4	0	1.5	1.2	0.980	1.00	528
Vw				1033	Vnw				9970
V									11003

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.64	0.23		
Weaving and non-weaving speeds, Si (mi/h)	50.92	63.07		

Number of lanes required for unconstrained operation, Nw 0.73
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	61.69
Weaving segment density, D (pc/mi/ln)	35.67
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11850
Capacity as a 15-minute flow rate, c (veh/h)	11618
Capacity as a full-hour volume, c_h (veh/h)	10456

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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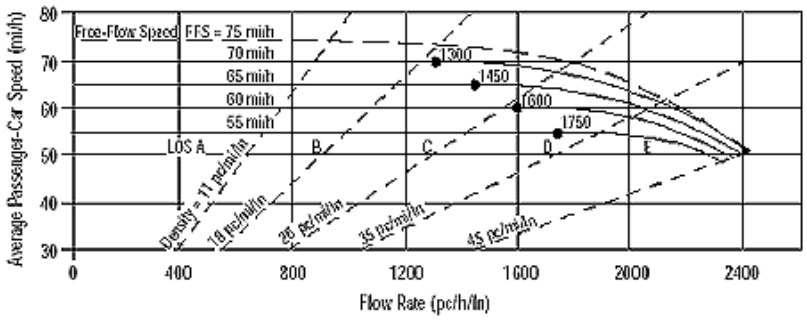
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 25

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

Flow Inputs

Volume, V	9240 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2094	pc/h/ln	Design LOS		
S	62.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	33.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9240	0.90	Level	4	0	0.980	1.00	10472
Ramp	1520	0.90	Level	4	0	0.980	1.00	1723
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3453 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8378	9556	No
V_{12}	3453	4400:All	No
$V_{FO} = V_F - V_R$	6655	9556	No
V_R	1723	4100	No

Level of Service Determination (if not F)

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

D_R = 7.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.388 (Exhibit 25-19)

S_R= 58.5 mph (Exhibit 25-19)

S_0= 69.9 mph (Exhibit 25-19)

S = 64.7 mph (Exhibit 25-15)

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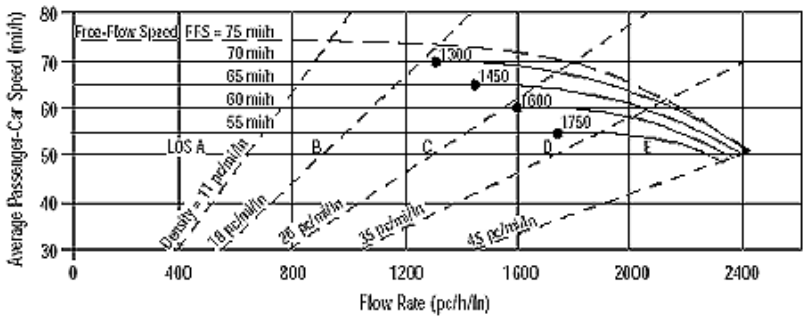
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 27

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

Flow Inputs

Volume, V	7730 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2190	pc/h/ln	Design LOS		
S	59.7	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	36.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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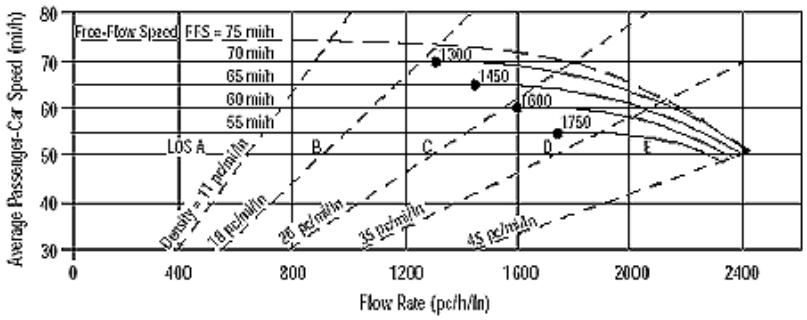
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 29

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

Flow Inputs

Volume, V	7630 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2162	pc/h/ln	Design LOS		
S	60.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	35.8	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 30

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 68.9 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7630	0.90	Level	4	0	0.980	1.00	8647
Ramp	3030	0.90	Level	4	0	0.980	1.00	3434
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1807 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12081	See Exhibit 25-7	Yes
V_{R12}	5241	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 = 26.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.855 (Exibit 25-19)

S_R= 45.9 mph (Exhibit 25-19)

S_0= 55.7 mph (Exhibit 25-19)

S= 51.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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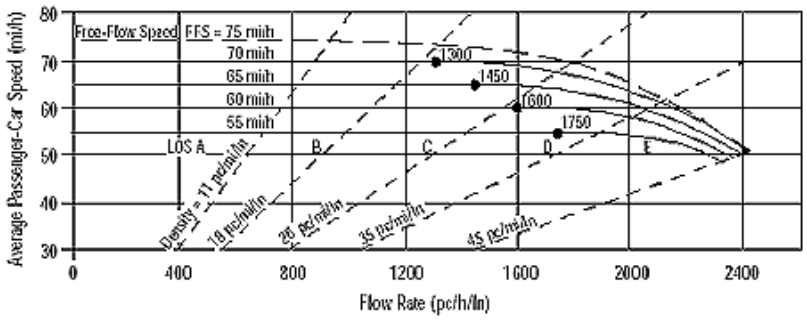
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 31

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

Flow Inputs

Volume, V	10660 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2416	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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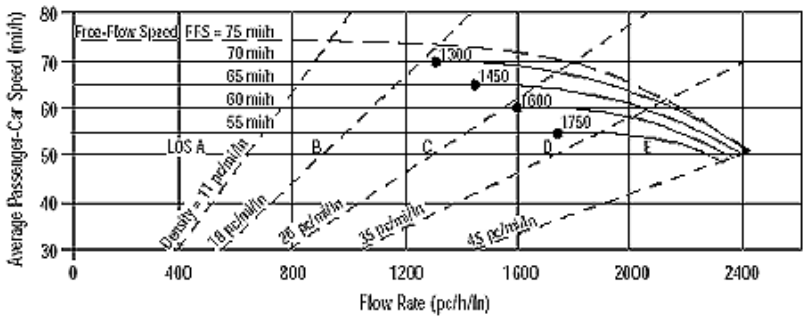
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 32

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

Flow Inputs

Volume, V	11010 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2496	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	11010	0.90	Level	4	0	0.980	1.00	12478
Ramp	3540	0.90	Level	4	0	0.980	1.00	4012
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 5564 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9983	9000	Yes
V_{12}	5564	4400:All	Yes
V_{FO} = V_F - V_R	5971	9000	No
V_R	4012	4100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 8.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.594 (Exhibit 25-19)

S_R= 47.3 mph (Exhibit 25-19)

S_0= 55.6 mph (Exhibit 25-19)

S = 50.6 mph (Exhibit 25-15)

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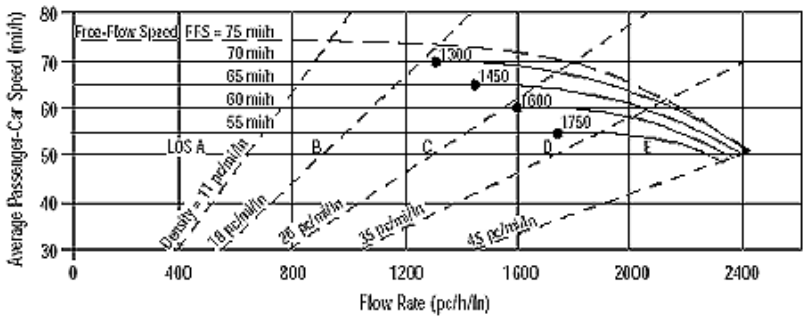

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 34

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

Flow Inputs

Volume, V	7470 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2117	pc/h/ln	Design LOS		
S	52.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	40.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7470	0.90	Level	4	0	0.980	1.00	8466
Ramp	1820	0.90	Level	4	0	0.980	1.00	2063
UpStream								
DownStream								

Estimation of v_{12} — Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.342 using Equation 4

V_{12}= 2897 pc/h

Estimation of v_{12} — Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10529	See Exhibit 25-7	Yes
V_{R12}	4960	4600:All	Yes

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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/ m/ln)

LOS = F (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.793 (Exibit 25-19)

S_R= 46.5 mph (Exhibit 25-19)

S_0= 54.4 mph (Exhibit 25-19)

S= 50.4 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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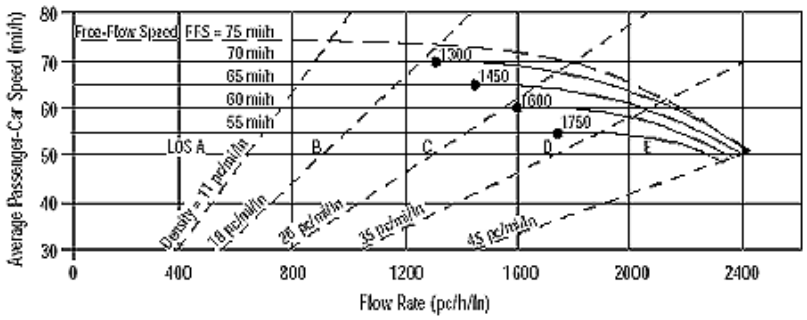

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 36

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

Flow Inputs

Volume, V	9290 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2632	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	55	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.30
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	38	0.90	4	0	1.5	1.2	0.980	1.00	43
Vo2	8578	0.90	4	0	1.5	1.2	0.980	1.00	9721
Vw1	312	0.90	4	0	1.5	1.2	0.980	1.00	353
Vw2	712	0.90	4	0	1.5	1.2	0.980	1.00	806
Vw				1159	Vnw				9764
V									10923

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.85	0.43		
Weaving and non-weaving speeds, Si (mi/h)	39.38	46.38		

Number of lanes required for unconstrained operation, Nw 1.17
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	45.52
Weaving segment density, D (pc/mi/ln)	47.99
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10001
Capacity as a 15-minute flow rate, c (veh/h)	9805
Capacity as a full-hour volume, c_h (veh/h)	8824

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	47	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.23
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	32	0.90	4	0	1.5	1.2	0.980	1.00	36
Vo2	8302	0.90	4	0	1.5	1.2	0.980	1.00	9408
Vw1	178	0.90	4	0	1.5	1.2	0.980	1.00	201
Vw2	598	0.90	4	0	1.5	1.2	0.980	1.00	677
Vw				878	Vnw				9444
V									10322

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.75	0.37		
Weaving and non-weaving speeds, Si (mi/h)	36.14	42.10		

Number of lanes required for unconstrained operation, Nw 1.08
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	41.52
Weaving segment density, D (pc/mi/ln)	49.73
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10070
Capacity as a 15-minute flow rate, c (veh/h)	9873
Capacity as a full-hour volume, c_h (veh/h)	8886

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	46	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.12
Weaving seg length, L (ft)	890	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	30	0.90	4	0	1.5	1.2	0.980	1.00	34
Vo2	7920	0.90	4	0	1.5	1.2	0.980	1.00	8976
Vw1	480	0.90	4	0	1.5	1.2	0.980	1.00	544
Vw2	560	0.90	4	0	1.5	1.2	0.980	1.00	634
Vw				1178	Vnw				9010
V									10188

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.35	0.67		
Weaving and non-weaving speeds, Si (mi/h)	30.31	36.60		

Number of lanes required for unconstrained operation, Nw 1.19
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	35.74
Weaving segment density, D (pc/mi/ln)	57.01
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9093
Capacity as a 15-minute flow rate, c (veh/h)	8915
Capacity as a full-hour volume, c_h (veh/h)	8023

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.23
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.40
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	47	0.90	4	0	1.5	1.2	0.980	1.00	53
Vo2	7507	0.90	4	0	1.5	1.2	0.980	1.00	8507
Vw1	1313	0.90	4	0	1.5	1.2	0.980	1.00	1488
Vw2	893	0.90	4	0	1.5	1.2	0.980	1.00	1012
Vw				2500	Vnw				8560
V									11060

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.76	0.42		
Weaving and non-weaving speeds, Si (mi/h)	38.83	44.65		

Number of lanes required for unconstrained operation, Nw 1.60
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	43.18
Weaving segment density, D (pc/mi/ln)	51.22
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9919
Capacity as a 15-minute flow rate, c (veh/h)	9725
Capacity as a full-hour volume, c_h (veh/h)	8752

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9690	0.90	Level	4	0	0.980	1.00	10982
Ramp	620	0.90	Level	4	0	0.980	1.00	703
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.289 using Equation 4

V_{12}= 2453 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9185	See Exhibit 25-7	Yes
V_{R12}	3156	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 = 26.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.378 (Exibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 44.2 mph (Exhibit 25-19)

S= 46.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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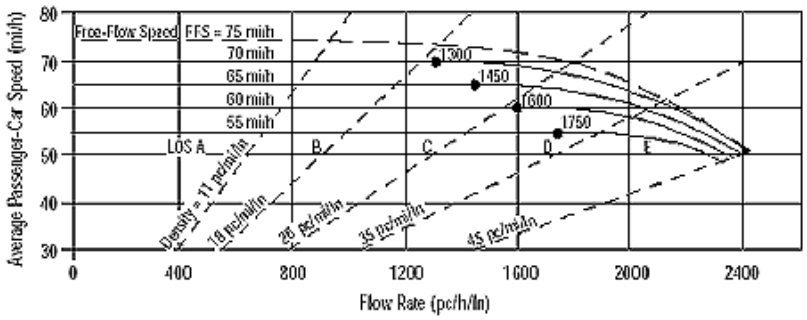
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 47

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

Flow Inputs

Volume, V	10300 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2335	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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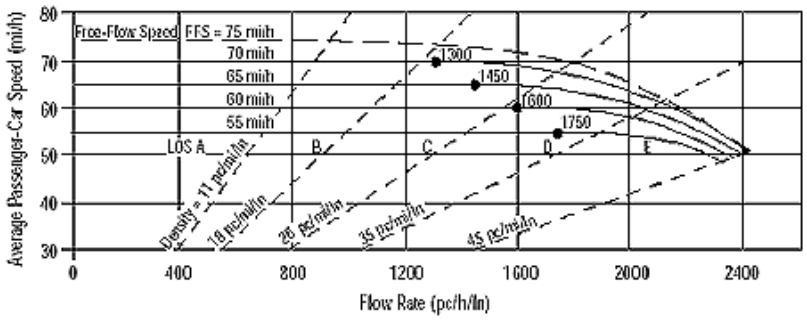
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 48

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

Flow Inputs

Volume, V	4750 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2665	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4750	0.90	Level	5	0	0.976	1.00	5410
Ramp	3430	0.90	Level	5	0	0.976	1.00	3906
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 5410 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5410	4500	Yes
V_{12}	5410	4400:All	Yes
$V_{FO} = V_F - V_R$	1504	4500	No
V_R	3906	3800	Yes

Level of Service Determination (if not F)

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

D_R = 31.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.780 (Exhibit 25-19)

S_R= 44.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 44.9 mph (Exhibit 25-15)

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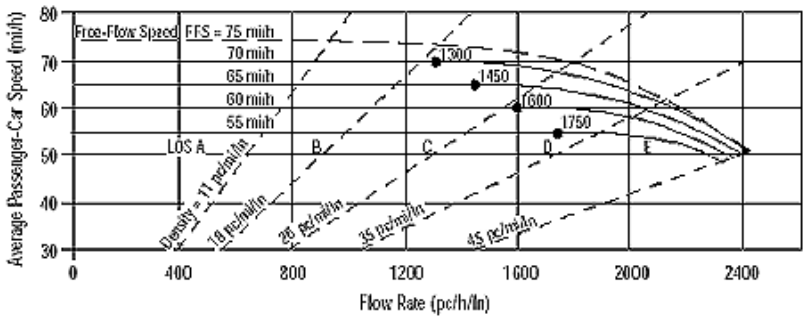
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 50

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

Flow Inputs

Volume, V	1310 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	746	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	12.4	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.8 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	1310	0.90	Level	5	0	0.976	1.00	1492
Ramp	830	0.90	Level	5	0	0.976	1.00	945
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1492 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1492	4775	No
V_{12}	1492	4400:All	No
$V_{FO} = V_F - V_R$	547	4775	No
V_R	945	2100	No

Level of Service Determination (if not F)

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

D_R = 7.2 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.318 (Exhibit 25-19)

S_R= 60.3 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 60.3 mph (Exhibit 25-15)

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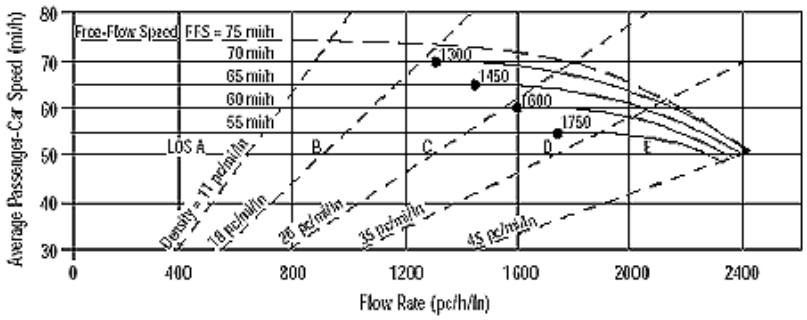

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 52

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

Flow Inputs

Volume, V	490 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	279	pc/h/ln	Design LOS		
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	4.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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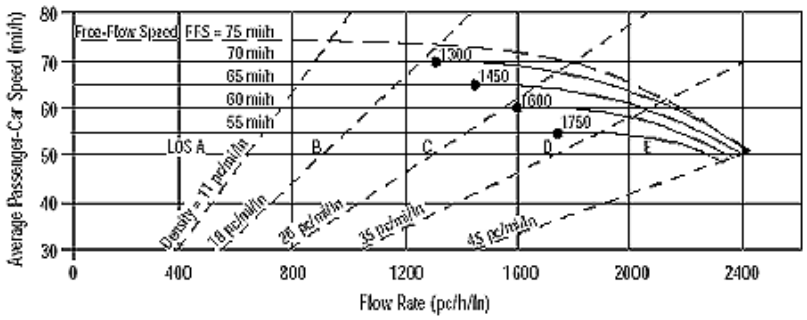
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 54

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

Flow Inputs

Volume, V	4020 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1145	pc/h/ln	Design LOS	
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	16.6	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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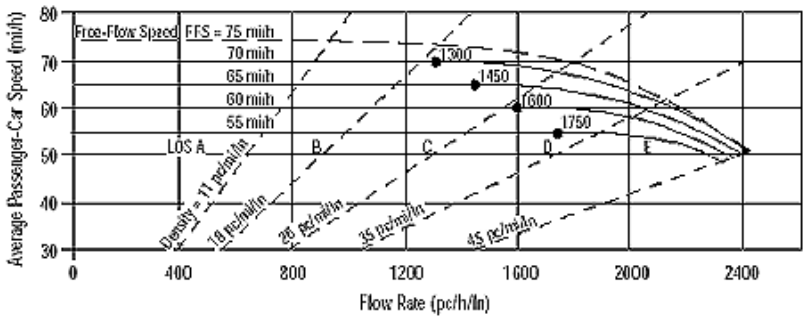
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 56

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

Flow Inputs

Volume, V	5540 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.8	mi/h	FFS	68.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1262	pc/h/ln	Design LOS	
S	68.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	18.3	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5540	0.90	Level	5	0	0.976	1.00	6309
Ramp	1210	0.90	Level	5	0	0.976	1.00	1378
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3115 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5363	9552	No
V_{12}	3115	4400:All	No
$V_{FO} = V_F - V_R$	3985	9552	No
V_R	1378	2100	No

Level of Service Determination (if not F)

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

D_R = 2.2 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.487 (Exhibit 25-19)

S_R= 55.7 mph (Exhibit 25-19)

S_0= 75.0 mph (Exhibit 25-19)

S = 62.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4320	0.90	Level	5	0	0.976	1.00	4920
Ramp	1210	0.90	Level	5	0	0.976	1.00	1378
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.229 using Equation 4

V_{12}= 1125 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6298	See Exhibit 25-7	No
V_{R12}	2503	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 = 20.8 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.328 (Exibit 25-19)

S_R= 60.8 mph (Exhibit 25-19)

S_0= 65.0 mph (Exhibit 25-19)

S= 63.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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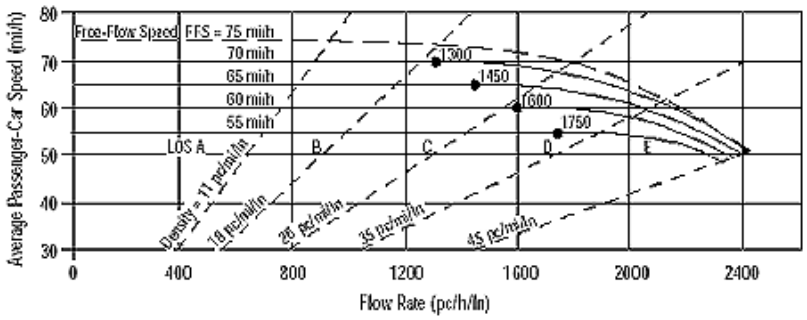

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 60

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

Flow Inputs

Volume, V	5540 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1577	pc/h/ln	Design LOS		
S	69.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	22.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5540	0.90	Level	5	0	0.976	1.00	6309
Ramp	850	0.90	Level	5	0	0.976	1.00	968
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.161 using Equation 4

V_{12}= 1013 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7277	See Exhibit 25-7	No
V_{R12}	1981	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/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.335 (Exibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 57.5 mph (Exhibit 25-19)

S= 57.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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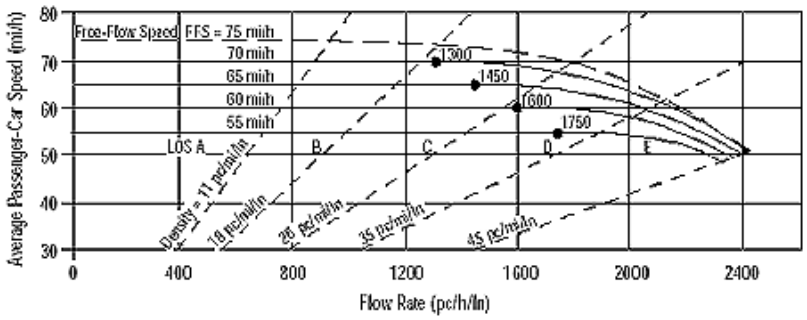
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 62

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

Flow Inputs

Volume, V	6380 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	65.5	mi/h	FFS	65.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1817	pc/h/ln	Design LOS		
S	64.2	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	28.3	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.5 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	6380	0.90	Level	5	0	0.976	1.00	7266
Ramp	1040	0.90	Level	5	0	0.976	1.00	1184
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3836 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7266	9420	No
V_{12}	3836	4400:All	No
V_{FO} = V_F - V_R	6082	9420	No
V_R	1184	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 34.5 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.535 (Exhibit 25-19)

S_R= 52.9 mph (Exhibit 25-19)

S_0= 69.1 mph (Exhibit 25-19)

S = 59.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 65

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 61.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5340	0.90	Level	5	0	0.976	1.00	6082
Ramp	500	0.90	Level	5	0	0.976	1.00	569
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.330 using Equation 4

V_{12}= 2006 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6651	See Exhibit 25-7	No
V_{R12}	2575	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.332 (Exibit 25-19)

S_R= 54.7 mph (Exhibit 25-19)

S_0= 55.5 mph (Exhibit 25-19)

S= 55.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7580	0.90	Level	5	0	0.976	1.00	8633
Ramp	530	0.90	Level	5	0	0.976	1.00	604
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.222 using Equation 4

V_{12}= 1916 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9237	See Exhibit 25-7	No
V_{R12}	2520	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 = 23.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.352 (Exibit 25-19)

S_R= 58.6 mph (Exhibit 25-19)

S_0= 54.7 mph (Exhibit 25-19)

S= 55.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.1 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8100	0.90	Level	5	0	0.976	1.00	9225
Ramp	270	0.90	Level	5	0	0.976	1.00	308
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.243 using Equation 4

V_{12}= 2242 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9533	See Exhibit 25-7	Yes
V_{R12}	2550	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/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.357 (Exibit 25-19)

S_R= 57.5 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S= 53.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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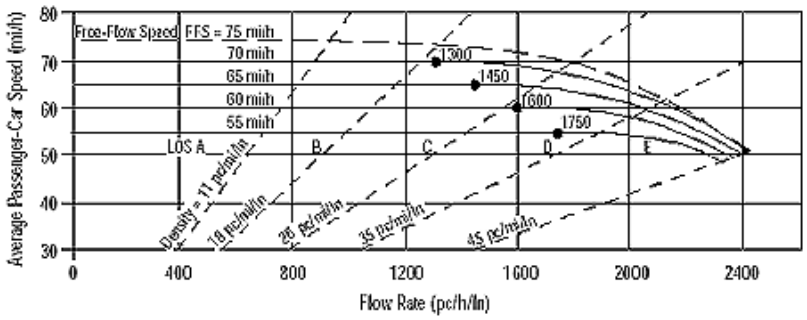

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 71

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

Flow Inputs

Volume, V	8370 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2383	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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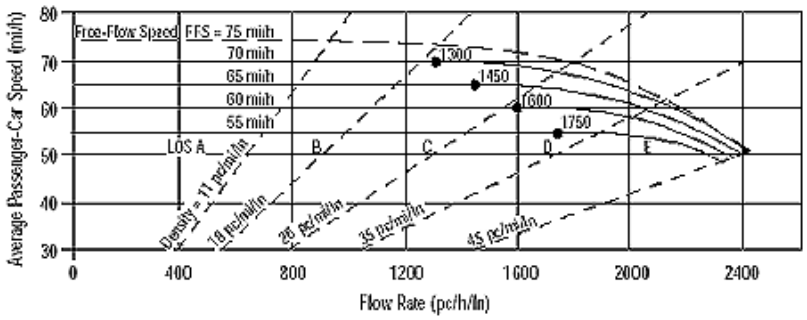

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 72

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

Flow Inputs

Volume, V	8370 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	67.9	mi/h	FFS	67.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1907	pc/h/ln	Design LOS	
S	64.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	29.4	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.9 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8370	0.90	Level	5	0	0.976	1.00	9533
Ramp	1110	0.90	Level	5	0	0.976	1.00	1264
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4038 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7627	9516	No
V_{12}	4038	4400:All	No
$V_{FO} = V_F - V_R$	6363	9516	No
V_R	1264	2000	No

Level of Service Determination (if not F)

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

D_R = 37.2 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.607 (Exhibit 25-19)

S_R= 52.2 mph (Exhibit 25-19)

S_0= 71.4 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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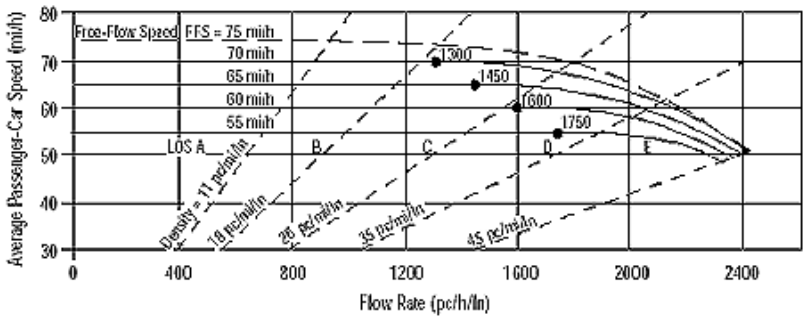
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 74

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

Flow Inputs

Volume, V	7260 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2067	pc/h/ln	Design LOS		
S	63.5	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	32.6	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.2 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7260	0.90	Level	5	0	0.976	1.00	8268
Ramp	640	0.90	Level	5	0	0.976	1.00	729
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4016 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8268	9447	No
V_{12}	4016	4400:All	No
$V_{FO} = V_F - V_R$	7539	9447	No
V_R	729	2000	No

Level of Service Determination (if not F)

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

D_R = 36.8 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.559 (Exhibit 25-19)

S_R= 52.7 mph (Exhibit 25-19)

S_0= 68.2 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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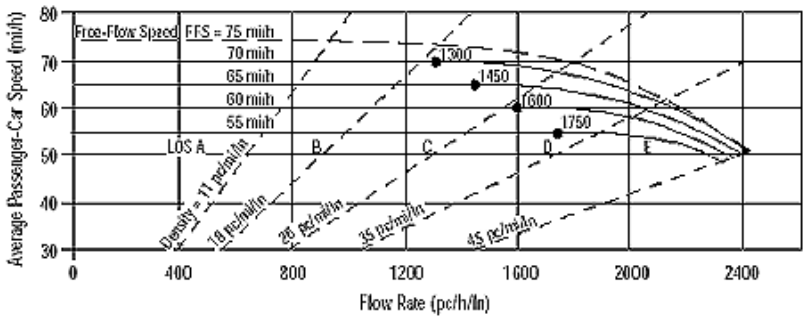
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 76

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

Flow Inputs

Volume, V	6630 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.2	mi/h	FFS	66.2	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1888	pc/h/ln	Design LOS		
S	63.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.9 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	6630	0.90	Level	5	0	0.976	1.00	7551
Ramp	1210	0.90	Level	5	0	0.976	1.00	1378
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4069 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7551	9356	No
V_{12}	4069	4400:All	No
$V_{FO} = V_F - V_R$	6173	9356	No
V_R	1378	2000	No

Level of Service Determination (if not F)

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

D_R = 37.2 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.617 (Exhibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 67.2 mph (Exhibit 25-19)

S = 57.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.9 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5410	0.90	Level	5	0	0.976	1.00	6161
Ramp	710	0.90	Level	5	0	0.976	1.00	809
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.403 using Equation 4

V_{12}= 2485 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6970	See Exhibit 25-7	No
V_{R12}	3294	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 = 25.2 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.363 (Exibit 25-19)

S_R= 55.9 mph (Exhibit 25-19)

S_0= 59.1 mph (Exhibit 25-19)

S= 57.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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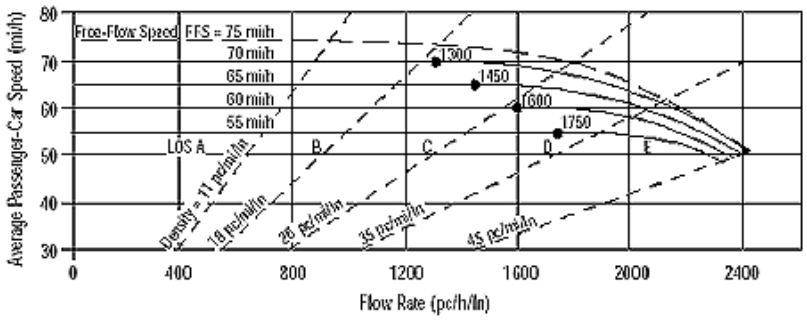
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 84

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

Flow Inputs

Volume, V	6120 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1743	pc/h/ln	Design LOS		
S	65.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.6	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 85

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

Vu = veh/h

Terrain

S_{FF} = 66.5 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{down} = ft

VD = 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 f_{HV} f_p
Freeway	6120	0.90	Level	5	0	0.976	1.00	6970
Ramp	990	0.90	Level	5	0	0.976	1.00	1128
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3675 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6970	9460	No
V_{12}	3675	4400:All	No
$V_{FO} = V_F - V_R$	5842	9460	No
V_R	1128	2100	No

Level of Service Determination (if not F)

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

D_R = 33.4 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.335 (Exhibit 25-19)

S_R= 58.3 mph (Exhibit 25-19)

S_0= 70.4 mph (Exhibit 25-19)

S = 63.5 mph (Exhibit 25-15)

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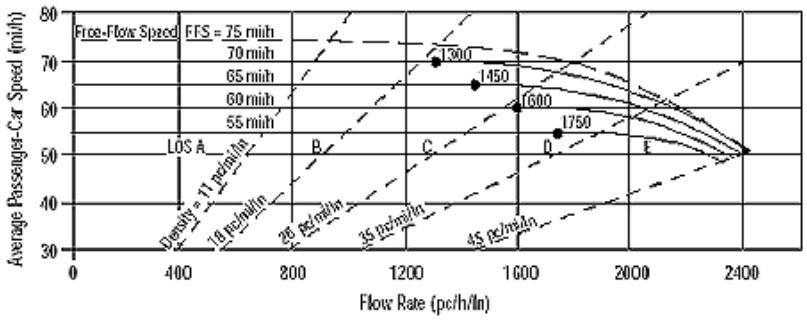
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 86

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

Flow Inputs

Volume, V	5130 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1461	pc/h/ln	Design LOS		
S	69.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	20.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 66.5 mph S_{FR} = 66.5 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5130	0.90	Level	5	0	0.976	1.00	5843
Ramp	3030	0.90	Level	5	0	0.976	1.00	3451
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 4073 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	5843	9460	No
V_{12}	4073	4400:All	No
V_{FO} = V_F - V_R	2392	9460	No
V_R	3451	4400	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = -47.1 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.329 (Exhibit 25-19)

S_R= 58.4 mph (Exhibit 25-19)

S_0= 73.0 mph (Exhibit 25-19)

S = 62.2 mph (Exhibit 25-15)

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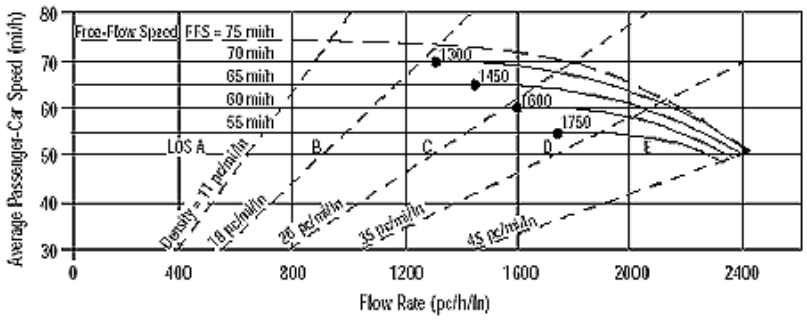
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	4200 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2392	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.5 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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 f_{HV} f_p
Freeway	4200	0.90	Level	5	0	0.976	1.00	4783
Ramp	100	0.90	Level	5	0	0.976	1.00	114
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 4783 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4897	See Exhibit 25-7	Yes
V_{R12}	4897	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 = 41.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.808 (Exibit 25-19)

S_R= 46.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 46.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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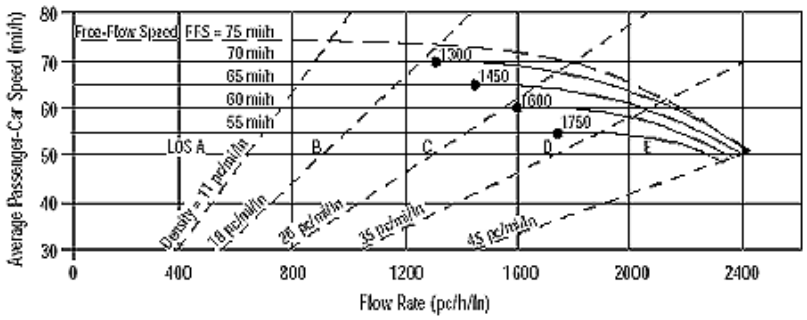

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	4400 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	66.5	mi/h	FFS	66.5	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2506	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2020	0.90	Level	2	0	0.990	1.00	2267
Ramp	2200	0.90	Level	2	0	0.990	1.00	2469
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2267 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4736	See Exhibit 25-7	Yes
V_{R12}	4736	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 = 39.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.738 (Exibit 25-19)

S_R= 45.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 45.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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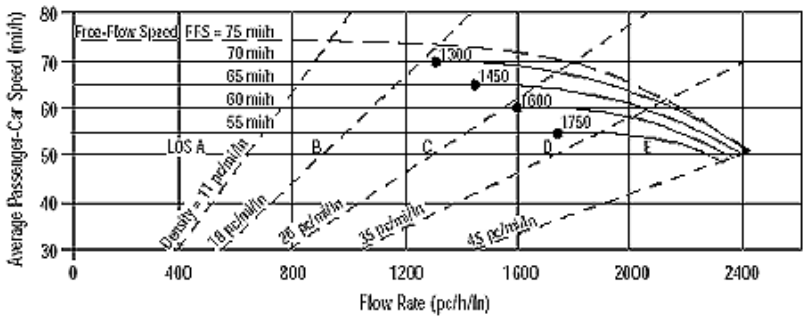

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 92

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

Flow Inputs

Volume, V	4220 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2368	pc/h/ln	Design LOS		
S	54.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.4	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3420	0.90	Level	2	0	0.990	1.00	3838
Ramp	570	0.90	Level	2	0	0.990	1.00	640
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3838 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4478	See Exhibit 25-7	No
V_{R12}	4478	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/ m/ln)

LOS = D (Exhibit 25-4)

Speed Estimation

M_S = 0.559 (Exibit 25-19)

S_R= 47.7 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 47.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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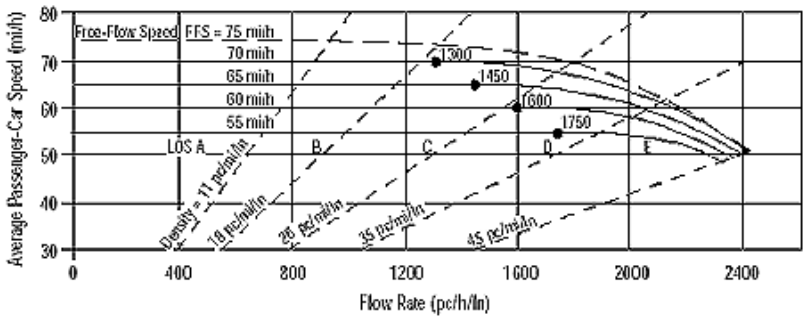
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 96

☑ 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	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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1493	pc/h/ln	Design LOS		
S	69.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.4	pc/mi/ln	S		mi/h
LOS	C		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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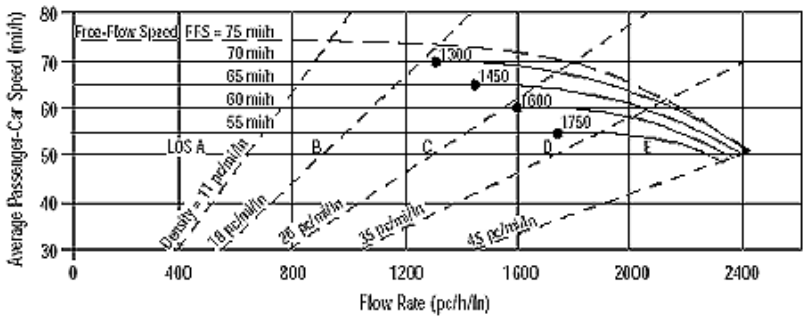
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 97

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

Flow Inputs

Volume, V	3540 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1324	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	3540	0.90	Level	5	0	0.976	1.00	4032
Ramp	100	0.90	Level	5	0	0.976	1.00	114
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 4032 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	4032	4500	No
V_{12}	4032	4400:All	No
V_{FO} = V_F - V_R	3918	4500	No
V_R	114	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 37.8 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.503 (Exhibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 48.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	3430	0.90	Level	2	0	0.990	1.00	3849
Ramp	1310	0.90	Level	2	0	0.990	1.00	1470
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3849 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	5319	See Exhibit 25-7	Yes
V_{R12}	5319	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 43.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 1.089 (Exibit 25-19)

S_R= 40.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 40.8 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9770	0.90	Level	4	0	0.980	1.00	11073
Ramp	940	0.90	Level	4	0	0.980	1.00	1065
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3091 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8859	9000	No
V_{12}	3091	4400:All	No
$V_{FO} = V_F - V_R$	7794	9000	No
V_R	1065	3500	No

Level of Service Determination (if not F)

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

D_R = 14.6 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.719 (Exhibit 25-19)

S_R= 45.7 mph (Exhibit 25-19)

S_0= 53.0 mph (Exhibit 25-19)

S = 50.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 45.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9110	0.90	Level	4	0	0.980	1.00	10325
Ramp	630	0.90	Level	4	0	0.980	1.00	714
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4004 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8260	9000	No
V_{12}	4004	4400:All	No
$V_{FO} = V_F - V_R$	7546	9000	No
V_R	714	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.362 (Exhibit 25-19)

S_R= 50.3 mph (Exhibit 25-19)

S_0= 55.9 mph (Exhibit 25-19)

S = 53.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9390	0.90	Level	4	0	0.980	1.00	10642
Ramp	840	0.90	Level	4	0	0.980	1.00	952
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4249 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8514	9520	No
V_{12}	4249	4400:All	No
V_{FO} = V_F - V_R	7562	9520	No
V_R	952	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 31.8 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.644 (Exhibit 25-19)

S_R= 51.3 mph (Exhibit 25-19)

S_0= 70.2 mph (Exhibit 25-19)

S = 59.3 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8990	0.90	Level	4	0	0.980	1.00	10189
Ramp	590	0.90	Level	4	0	0.980	1.00	669
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3932 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8152	9000	No
V_{12}	3932	4400:All	No
V_{FO} = V_F - V_R	7483	9000	No
V_R	669	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.683 (Exhibit 25-19)

S_R= 46.1 mph (Exhibit 25-19)

S_0= 56.0 mph (Exhibit 25-19)

S = 50.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.3 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10040	0.90	Level	4	0	0.980	1.00	11379
Ramp	1580	0.90	Level	4	0	0.980	1.00	1791
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3692 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9104	9412	No
V_{12}	3692	4400:All	No
V_{FO} = V_F - V_R	7313	9412	No
V_R	1791	3800	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 19.8 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.589 (Exhibit 25-19)

S_R= 51.6 mph (Exhibit 25-19)

S_0= 65.0 mph (Exhibit 25-19)

S = 58.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9650	0.90	Level	4	0	0.980	1.00	10937
Ramp	750	0.90	Level	4	0	0.980	1.00	850
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4294 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8750	9000	No
V_{12}	4294	4400:All	No
$V_{FO} = V_F - V_R$	7900	9000	No
V_R	850	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.700 (Exhibit 25-19)

S_R= 45.9 mph (Exhibit 25-19)

S_0= 55.5 mph (Exhibit 25-19)

S = 50.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 68.5 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9710	0.90	Level	4	0	0.980	1.00	11005
Ramp	470	0.90	Level	4	0	0.980	1.00	533
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4139 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8804	9540	No
V_{12}	4139	4400:All	No
V_{FO} = V_F - V_R	8271	9540	No
V_R	533	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 37.6 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.606 (Exhibit 25-19)

S_R= 52.4 mph (Exhibit 25-19)

S_0= 69.9 mph (Exhibit 25-19)

S = 60.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 68.9 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7730	0.90	Level	4	0	0.980	1.00	8761
Ramp	100	0.90	Level	4	0	0.980	1.00	113
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3884 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8761	9556	No
V_{12}	3884	4400:All	No
V_{FO} = V_F - V_R	8648	9556	No
V_R	113	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 35.9 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.308 (Exhibit 25-19)

S_R= 60.6 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

S = 65.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 67.6 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8890	0.90	Level	5	0	0.976	1.00	10125
Ramp	1310	0.90	Level	5	0	0.976	1.00	1492
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3210 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8100	9503	No
V_{12}	3210	4400:All	No
$V_{FO} = V_F - V_R$	6608	9503	No
V_R	1492	3500	No

Level of Service Determination (if not F)

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

D_R = 15.7 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.692 (Exhibit 25-19)

S_R= 49.9 mph (Exhibit 25-19)

S_0= 68.5 mph (Exhibit 25-19)

S = 59.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4220	0.90	Level	5	0	0.976	1.00	4806
Ramp	800	0.90	Level	5	0	0.976	1.00	911
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4806 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4806	4500	Yes
V_{12}	4806	4400:All	Yes
$V_{FO} = V_F - V_R$	3895	4500	No
V_R	911	2000	No

Level of Service Determination (if not F)

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

D_R = 43.6 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.575 (Exhibit 25-19)

S_R= 47.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 61.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9590	0.90	Level	4	0	0.980	1.00	10869
Ramp	460	0.90	Level	4	0	0.980	1.00	521
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.248 using Equation 4

V_{12}= 2078 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8890	See Exhibit 25-7	No
V_{R12}	2599	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.352 (Exibit 25-19)

S_R= 54.7 mph (Exhibit 25-19)

S_0= 50.0 mph (Exhibit 25-19)

S= 51.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8830	0.90	Level	4	0	0.980	1.00	10007
Ramp	860	0.90	Level	4	0	0.980	1.00	975
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.574 using Equation 4

V_{12}= 5742 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10982	See Exhibit 25-7	Yes
V_{R12}	6717	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 = 48.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 3.439 (Exibit 25-19)

S_R= 10.3 mph (Exhibit 25-19)

S_0= 49.1 mph (Exhibit 25-19)

S= 14.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8400	0.90	Level	4	0	0.980	1.00	9520
Ramp	1360	0.90	Level	4	0	0.980	1.00	1541
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1990 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11061	See Exhibit 25-7	Yes
V_{R12}	3531	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 16.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.272 (Exibit 25-19)

S_R= 51.5 mph (Exhibit 25-19)

S_0= 39.7 mph (Exhibit 25-19)

S= 42.8 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.7 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8460	0.90	Level	4	0	0.980	1.00	9588
Ramp	930	0.90	Level	4	0	0.980	1.00	1054
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.405 using Equation 4

V_{12}= 3880 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10642	See Exhibit 25-7	Yes
V_{R12}	4934	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.793 (Exibit 25-19)

S_R= 47.1 mph (Exhibit 25-19)

S_0= 56.8 mph (Exhibit 25-19)

S= 51.9 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8480	0.90	Level	4	0	0.980	1.00	9611
Ramp	510	0.90	Level	4	0	0.980	1.00	578
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.432 using Equation 4

V_{12}= 4154 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10189	See Exhibit 25-7	Yes
V_{R12}	4732	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 = 36.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.701 (Exibit 25-19)

S_R= 45.9 mph (Exhibit 25-19)

S_0= 45.9 mph (Exhibit 25-19)

S= 45.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 116

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8900	0.90	Level	4	0	0.980	1.00	10087
Ramp	260	0.90	Level	4	0	0.980	1.00	295
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.754 using Equation 4

V_{12}= 7609 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10382	See Exhibit 25-7	Yes
V_{R12}	7904	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 = 55.7 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 10.757 (Exibit 25-19)

S_R= -84.8 mph (Exhibit 25-19)

S_0= 52.3 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 68.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9220	0.90	Level	4	0	0.980	1.00	10449
Ramp	490	0.90	Level	4	0	0.980	1.00	555
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.244 using Equation 4

V_{12}= 2550 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11004	See Exhibit 25-7	Yes
V_{R12}	3105	4600:All	No

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.387 (Exibit 25-19)

S_R= 58.1 mph (Exhibit 25-19)

S_0= 51.8 mph (Exhibit 25-19)

S= 53.4 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9290	0.90	Level	4	0	0.980	1.00	10529
Ramp	350	0.90	Level	4	0	0.980	1.00	397
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.742 using Equation 4

V_{12}= 7808 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10926	See Exhibit 25-7	Yes
V_{R12}	8205	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 = 58.0 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 14.466 (Exibit 25-19)

S_R= -133.1 mph (Exhibit 25-19)

S_0= 51.9 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No build

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5840	0.90	Level	5	0	0.976	1.00	6651
Ramp	840	0.90	Level	5	0	0.976	1.00	957
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.226 using Equation 4

V_{12}= 1500 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7608	See Exhibit 25-7	No
V_{R12}	2457	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.339 (Exibit 25-19)

S_R= 53.8 mph (Exhibit 25-19)

S_0= 51.6 mph (Exhibit 25-19)

S= 52.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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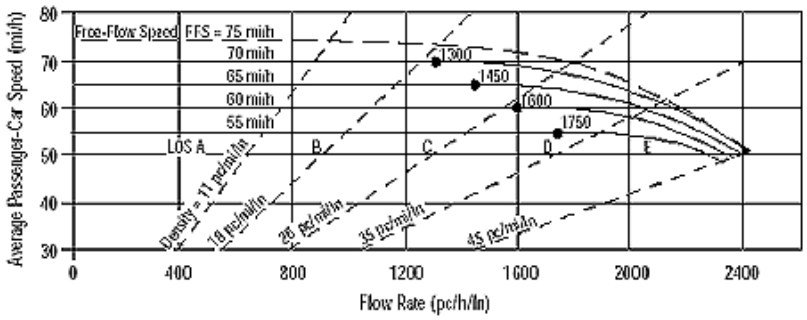
PM Peak Hour

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	To Lakewood Blvd off ramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 1

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

Flow Inputs

Volume, V	10910 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2473	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 2

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10910	0.90	Level	4	0	0.980	1.00	12365
Ramp	1520	0.90	Level	4	0	0.980	1.00	1723
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3847 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9892	9000	Yes
V_{12}	3847	4400:All	No
$V_{FO} = V_F - V_R$	8169	9000	No
V_R	1723	3800	No

Level of Service Determination (if not F)

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

D_R = 22.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.648 (Exhibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= 52.4 mph (Exhibit 25-19)

S = 50.0 mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Lakewood on - Willow St off
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	930	Weaving ratio, R	0.42
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	380	0.90	4	0	1.5	1.2	0.980	1.00	430
Vw2	520	0.90	4	0	1.5	1.2	0.980	1.00	589
Vw				1019	Vnw				0
V									1019

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			2.87	0.63
Weaving and non-weaving speeds, Si (mi/h)			21.46	30.35

Number of lanes required for unconstrained operation, Nw 1.75
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	21.46
Weaving segment density, D (pc/mi/ln)	23.74
Level of service, LOS	C
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 8

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9390	0.90	Level	4	0	0.980	1.00	10642
Ramp	400	0.90	Level	4	0	0.980	1.00	453
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.543 using Equation 4

V_{12}= 5784 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11095	See Exhibit 25-7	Yes
V_{R12}	6237	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 = 46.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 2.231 (Exibit 25-19)

S_R= 26.0 mph (Exhibit 25-19)

S_0= 47.7 mph (Exhibit 25-19)

S= 32.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	Willow ONR - L Coyotes OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	41	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.25
Weaving seg length, L (ft)	1200	Weaving ratio, R	0.22
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7786	0.90	4	0	1.5	1.2	0.980	1.00	8824
Vo2	106	0.90	4	0	1.5	1.2	0.980	1.00	120
Vw1	2014	0.90	4	0	1.5	1.2	0.980	1.00	2282
Vw2	554	0.90	4	0	1.5	1.2	0.980	1.00	627
Vw				2909	Vnw				8944
V									11853

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.66	0.58
Weaving and non-weaving speeds, Si (mi/h)			21.65	34.67

Number of lanes required for unconstrained operation, Nw 2.06
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.21
Weaving segment density, D (pc/mi/ln)	78.47
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	9008
Capacity as a 15-minute flow rate, c (veh/h)	8831
Capacity as a full-hour volume, c_h (veh/h)	7948

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - BellFl OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	35	Weaving type	A
Weaving number of lanes, N	2	Volume ratio, VR	1.00
Weaving seg length, L (ft)	650	Weaving ratio, R	0.08
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vo2	0	0.90	4	0	1.5	1.2	0.980	1.00	0
Vw1	230	0.90	4	0	1.5	1.2	0.980	1.00	260
Vw2	20	0.90	4	0	1.5	1.2	0.980	1.00	22
Vw				282	Vnw				0
V									282

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			1.10	0.15
Weaving and non-weaving speeds, Si (mi/h)			26.91	36.65

Number of lanes required for unconstrained operation, Nw 1.48
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	26.91
Weaving segment density, D (pc/mi/ln)	5.24
Level of service, LOS	A
Capacity of base condition, c_b (pc/h)	
Capacity as a 15-minute flow rate, c (veh/h)	
Capacity as a full-hour volume, c_h (veh/h)	

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB CD
Weaving Seg Location	L Coyotes ONR - Woodruff OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	39	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.22
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.30
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	7694	0.90	4	0	1.5	1.2	0.980	1.00	8719
Vo2	34	0.90	4	0	1.5	1.2	0.980	1.00	38
Vw1	636	0.90	4	0	1.5	1.2	0.980	1.00	720
Vw2	1486	0.90	4	0	1.5	1.2	0.980	1.00	1684
Vw				2404	Vnw				8757
V									11161

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)			0.15	0.00
b (Exhibit 24-6)			4.00	4.00
c (Exhibit 24-6)			0.97	1.30
d (Exhibit 24-6)			0.80	0.75
Weaving intensity factor, Wi			3.51	0.52
Weaving and non-weaving speeds, Si (mi/h)			21.43	34.14

Number of lanes required for unconstrained operation, Nw 1.88
Maximum number of lanes, Nw (max) 1.40

☐ If Nw < Nw(max) unconstrained operation ☑ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	30.27
Weaving segment density, D (pc/mi/ln)	73.75
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	8904
Capacity as a 15-minute flow rate, c (veh/h)	8729
Capacity as a full-hour volume, c_h (veh/h)	7856

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 22

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9180	0.90	Level	4	0	0.980	1.00	10404
Ramp	320	0.90	Level	4	0	0.980	1.00	363
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.236 using Equation 4

V_{12}= 2457 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10767	See Exhibit 25-7	Yes
V_{R12}	2820	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/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.372 (Exibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 38.4 mph (Exhibit 25-19)

S= 40.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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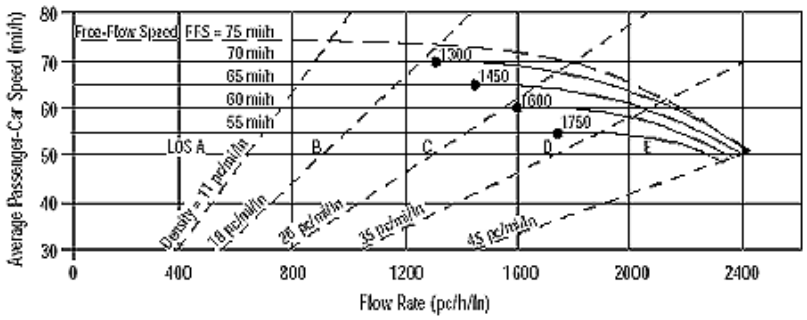
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Woodruff ONR to Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 23

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

Flow Inputs

Volume, V	9500 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2692	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 SB
Weaving Seg Location	Stearns ONR to Studebaker OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	52	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.10
Weaving seg length, L (ft)	1100	Weaving ratio, R	0.33
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	9168	0.90	4	0	1.5	1.2	0.980	1.00	10390
Vo2	18	0.90	4	0	1.5	1.2	0.980	1.00	20
Vw1	332	0.90	4	0	1.5	1.2	0.980	1.00	376
Vw2	662	0.90	4	0	1.5	1.2	0.980	1.00	750
Vw				1126	Vnw				10410
V									11536

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.67	0.24		
Weaving and non-weaving speeds, Si (mi/h)	40.16	48.78		

Number of lanes required for unconstrained operation, Nw 1.06
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	47.78
Weaving segment density, D (pc/mi/ln)	48.29
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10836
Capacity as a 15-minute flow rate, c (veh/h)	10624
Capacity as a full-hour volume, c_h (veh/h)	9562

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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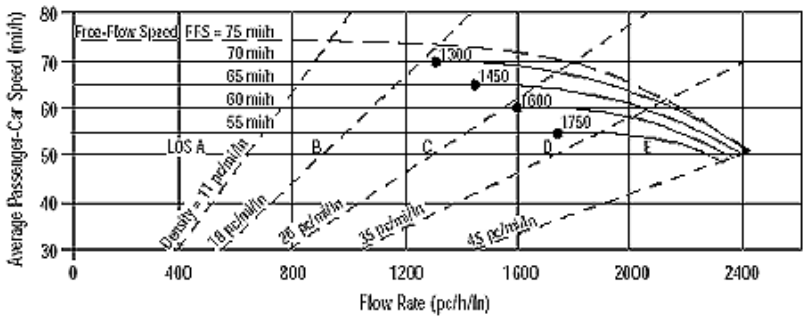
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	Studebaker OFR to 605NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 25

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

Flow Inputs

Volume, V	9830 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2228	pc/h/ln	Design LOS		
S	50.6	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	44.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 26

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 50.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9830	0.90	Level	4	0	0.980	1.00	11141
Ramp	1360	0.90	Level	4	0	0.980	1.00	1541
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3458 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	8913	9000	No
V_{12}	3458	4400:All	No
V_{FO} = V_F - V_R	7372	9000	No
V_R	1541	4100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 7.9 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.372 (Exhibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 53.6 mph (Exhibit 25-19)

S = 52.2 mph (Exhibit 25-15)

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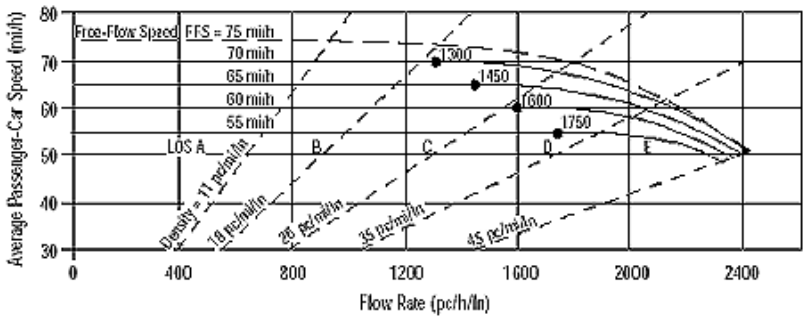
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 27

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

Flow Inputs

Volume, V	8460 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2397	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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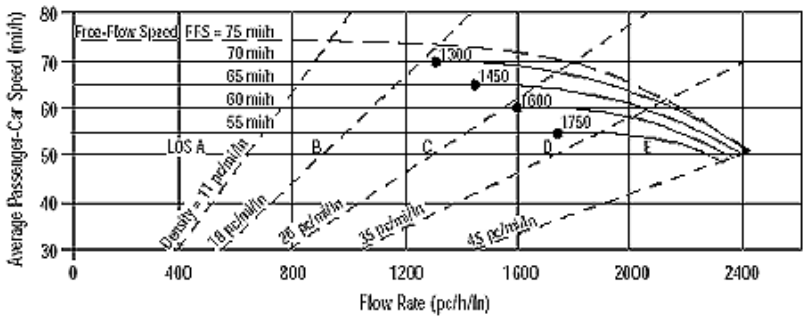
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB OFR to I-605 Sb ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 29

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

Flow Inputs

Volume, V	8310 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	55.0	mi/h	FFS	55.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2355	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 30

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
V_u = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	V_D = veh/h
	Sketch (show lanes, L_A, L_D, V_R, V_f)	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8310	0.90	Level	4	0	0.980	1.00	9418
Ramp	3030	0.90	Level	4	0	0.980	1.00	3434
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 1968 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12852	See Exhibit 25-7	Yes
V_{R12}	5402	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 = 27.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.983 (Exibit 25-19)

S_R= 42.2 mph (Exhibit 25-19)

S_0= 39.9 mph (Exhibit 25-19)

S= 40.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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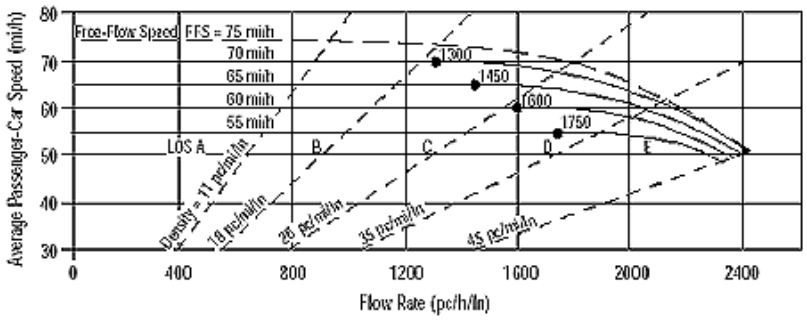

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 SB
Agency or Company	Parsons	From/To	I-605 SB ONR to 7th St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 31

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

Flow Inputs

Volume, V	11340 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	68.9	mi/h	FFS	68.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2570	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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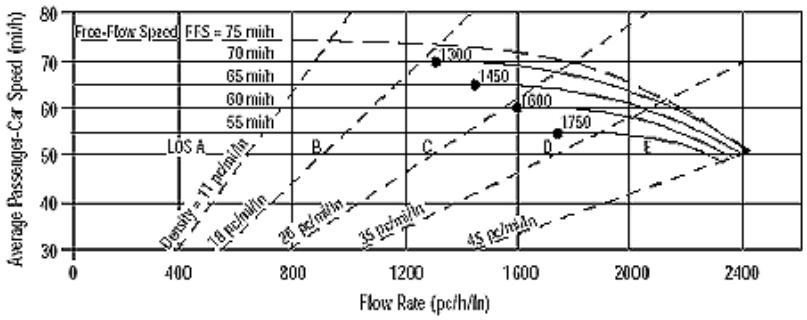

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	to I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 32

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

Flow Inputs

Volume, V	12470 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2827	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	I-605 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 33

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 63.8 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	12470	0.90	Level	4	0	0.980	1.00	14133
Ramp	3880	0.90	Level	4	0	0.980	1.00	4397
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 6194 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	11307	9351	Yes
V_{12}	6194	4400:All	Yes
V_{FO} = V_F - V_R	6910	9351	No
V_R	4397	4100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 14.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.629 (Exhibit 25-19)

S_R= 50.1 mph (Exhibit 25-19)

S_0= 63.9 mph (Exhibit 25-19)

S = 55.5 mph (Exhibit 25-15)

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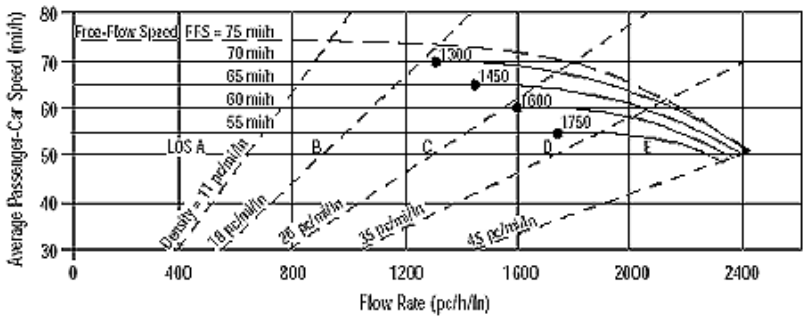

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB OFR to I-605 Sb OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 34

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

Flow Inputs

Volume, V	8590 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2434	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	I-605 SB/NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 35

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8590	0.90	Level	4	0	0.980	1.00	9735
Ramp	1750	0.90	Level	4	0	0.980	1.00	1983
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.352 using Equation 4

V_{12}= 3429 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11718	See Exhibit 25-7	Yes
V_{R12}	5412	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 = 39.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.111 (Exibit 25-19)

S_R= 39.6 mph (Exhibit 25-19)

S_0= 52.2 mph (Exhibit 25-19)

S= 45.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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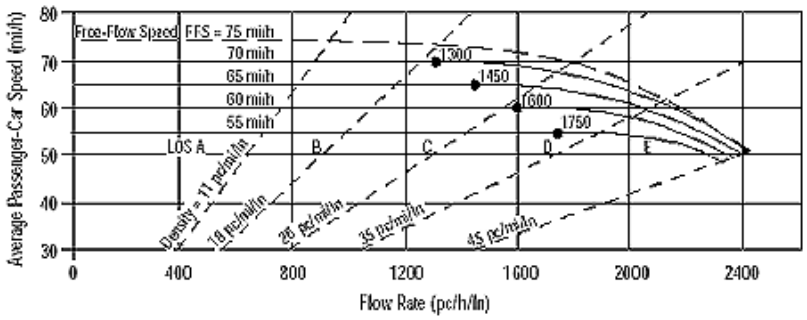
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	I-605 NB/SB ONR to Studeba ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 36

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

Flow Inputs

Volume, V	10330 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2927	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Studeb ONR - Palo Verde OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.11
Weaving seg length, L (ft)	1700	Weaving ratio, R	0.27
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	43	0.90	4	0	1.5	1.2	0.980	1.00	48
Vo2	9513	0.90	4	0	1.5	1.2	0.980	1.00	10781
Vw1	307	0.90	4	0	1.5	1.2	0.980	1.00	347
Vw2	817	0.90	4	0	1.5	1.2	0.980	1.00	925
Vw				1272	Vnw				10829
V									12101

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.93	0.49		
Weaving and non-weaving speeds, Si (mi/h)	43.46	51.81		

Number of lanes required for unconstrained operation, Nw 1.12
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	50.78
Weaving segment density, D (pc/mi/ln)	47.66
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11183
Capacity as a 15-minute flow rate, c (veh/h)	10964
Capacity as a full-hour volume, c_h (veh/h)	9868

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Palo Verde ONR to Woodruff OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.06
Weaving seg length, L (ft)	1750	Weaving ratio, R	0.46
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	15	0.90	4	0	1.5	1.2	0.980	1.00	17
Vo2	9545	0.90	4	0	1.5	1.2	0.980	1.00	10817
Vw1	335	0.90	4	0	1.5	1.2	0.980	1.00	379
Vw2	285	0.90	4	0	1.5	1.2	0.980	1.00	323
Vw				702	Vnw				10834
V									11536

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	0.79	0.39		
Weaving and non-weaving speeds, Si (mi/h)	46.20	55.41		

Number of lanes required for unconstrained operation, Nw 0.80
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	54.74
Weaving segment density, D (pc/mi/ln)	42.14
Level of service, LOS	E
Capacity of base condition, c_b (pc/h)	11339
Capacity as a 15-minute flow rate, c (veh/h)	11117
Capacity as a full-hour volume, c_h (veh/h)	10005

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/16/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Woodruff ONR to Bellflower OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	65	Weaving type	A
Weaving number of lanes, N	5	Volume ratio, VR	0.09
Weaving seg length, L (ft)	890	Weaving ratio, R	0.35
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	31	0.90	4	0	1.5	1.2	0.980	1.00	35
Vo2	9301	0.90	4	0	1.5	1.2	0.980	1.00	10541
Vw1	309	0.90	4	0	1.5	1.2	0.980	1.00	350
Vw2	579	0.90	4	0	1.5	1.2	0.980	1.00	656
Vw				1006	Vnw				10576
V									11582

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.15	0.00		
b (Exhibit 24-6)	2.20	4.00		
c (Exhibit 24-6)	0.97	1.30		
d (Exhibit 24-6)	0.80	0.75		
Weaving intensity factor, Wi	1.45	0.71		
Weaving and non-weaving speeds, Si (mi/h)	37.49	47.17		

Number of lanes required for unconstrained operation, Nw 0.92
Maximum number of lanes, Nw (max) 1.40

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	46.14
Weaving segment density, D (pc/mi/ln)	50.21
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	10148
Capacity as a 15-minute flow rate, c (veh/h)	9949
Capacity as a full-hour volume, c_h (veh/h)	8954

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	
Agency/Company	Parsons
Date Performed	10/17/2012
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-405 NB
Weaving Seg Location	Bellflower ONR to Lakewood OFR
Jurisdiction	
Analysis Year	2040 No Build

Inputs

Freeway free-flow speed, SFF (mi/h)	66	Weaving type	B
Weaving number of lanes, N	5	Volume ratio, VR	0.17
Weaving seg length, L (ft)	1300	Weaving ratio, R	0.49
Terrain	Level		

Conversions to pc/h Under Base Conditions

(pc/h)	V	PHF	Truck %	RV %	E_T	E_R	f_{HV}	f_p	v
Vo1	48	0.90	4	0	1.5	1.2	0.980	1.00	54
Vo2	8719	0.90	4	0	1.5	1.2	0.980	1.00	9881
Vw1	862	0.90	4	0	1.5	1.2	0.980	1.00	976
Vw2	902	0.90	4	0	1.5	1.2	0.980	1.00	1022
Vw				1998	Vnw				9935
V									11933

Weaving and Non-Weaving Speeds

	Unconstrained		Constrained	
	Weaving (i = w)	Non-Weaving (i = nw)	Weaving (i = w)	Non-Weaving (= nw)
a (Exhibit 24-6)	0.08	0.00		
b (Exhibit 24-6)	2.20	6.00		
c (Exhibit 24-6)	0.70	1.00		
d (Exhibit 24-6)	0.50	0.50		
Weaving intensity factor, Wi	0.72	0.34		
Weaving and non-weaving speeds, Si (mi/h)	47.52	56.94		

Number of lanes required for unconstrained operation, Nw 1.07
Maximum number of lanes, Nw (max) 3.50

☑ If Nw < Nw(max) unconstrained operation ☐ if Nw > Nw (max) constrained operation

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

Weaving segment speed, S (mi/h)	55.11
Weaving segment density, D (pc/mi/ln)	43.30
Level of service, LOS	F
Capacity of base condition, c_b (pc/h)	11549
Capacity as a 15-minute flow rate, c (veh/h)	11323
Capacity as a full-hour volume, c_h (veh/h)	10191

Notes

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".
b. Capacity constrained by basic freeway capacity.
c. Capacity occurs under constrained operating conditions.
d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 46

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10230	0.90	Level	4	0	0.980	1.00	11594
Ramp	370	0.90	Level	4	0	0.980	1.00	419
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.325 using Equation 4

V_{12}= 2953 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9513	See Exhibit 25-7	Yes
V_{R12}	3372	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 = 28.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.400 (Exibit 25-19)

S_R= 56.3 mph (Exhibit 25-19)

S_0= 54.7 mph (Exhibit 25-19)

S= 55.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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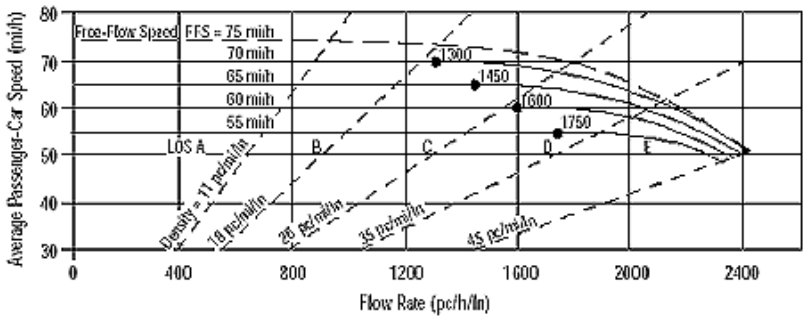
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-405 NB
Agency or Company	Parsons	From/To	Lakewood ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 47

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

Flow Inputs

Volume, V	10610 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	60.9	mi/h	FFS	60.9	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2405	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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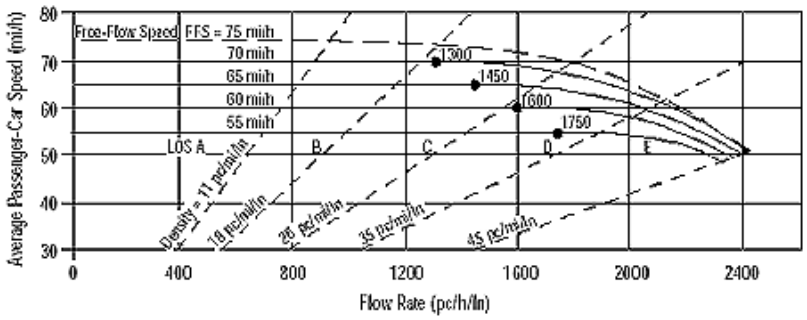
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	to I-40 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 48

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

Flow Inputs

Volume, V	4340 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2435	pc/h/ln	Design LOS		
S		mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S		pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 49

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4340	0.90	Level	5	0	0.976	1.00	4943
Ramp	2910	0.90	Level	5	0	0.976	1.00	3314
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 4943 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4943	4500	Yes
V_{12}	4943	4400:All	Yes
$V_{FO} = V_F - V_R$	1629	4500	No
V_R	3314	3800	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= F (Exhibit 25-4)

Speed Estimation

D_s = 0.726 (Exhibit 25-19)

S_R= 45.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 45.6 mph (Exhibit 25-15)

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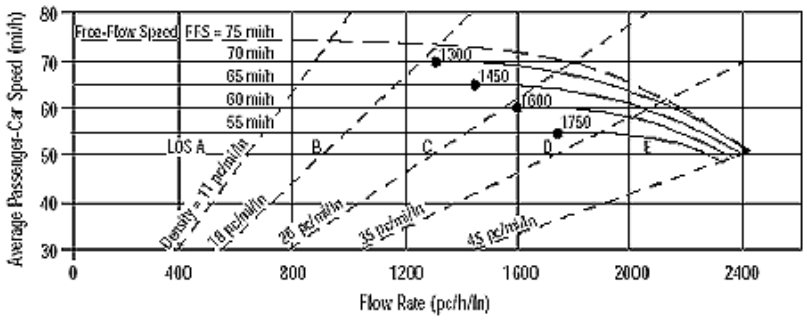
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 50

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

Flow Inputs

Volume, V	1430 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	60.0	mi/h	FFS	60.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	814	pc/h/ln	Design LOS		
S	60.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	13.6	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 51

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 62.8 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	1430	0.90	Level	5	0	0.976	1.00	1629
Ramp	480	0.90	Level	5	0	0.976	1.00	547
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =1.000 using Equation 0

V_{12} = 1629 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	1629	4655	No
V_{12}	1629	4400:All	No
$V_{FO} = V_F - V_R$	1082	4655	No
V_R	547	2100	No

Level of Service Determination (if not F)

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

D_R = 8.4 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.282 (Exhibit 25-19)

S_R= 56.9 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 56.9 mph (Exhibit 25-15)

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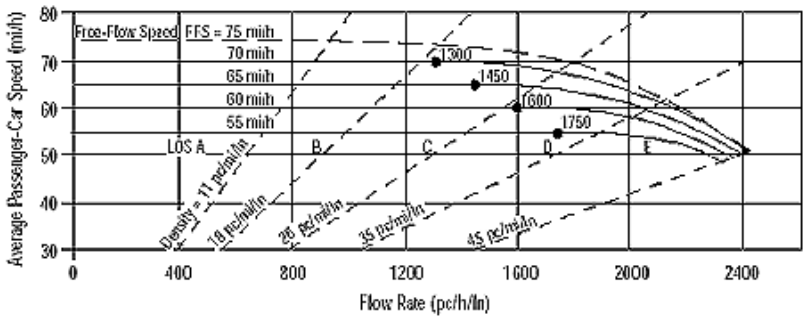

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 52

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

Flow Inputs

Volume, V	960 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	547	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	8.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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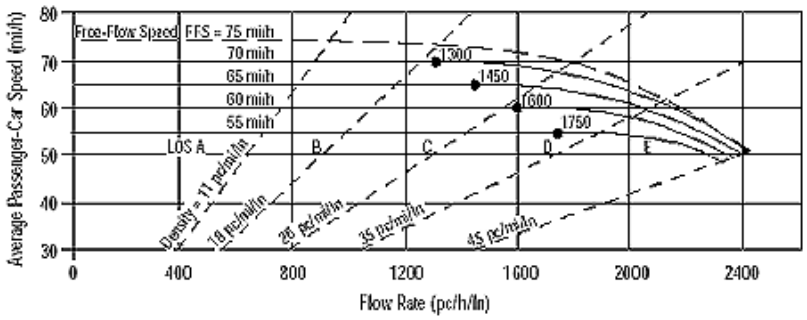

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 NB ONR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 54

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

Flow Inputs

Volume, V	4840 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1378	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	21.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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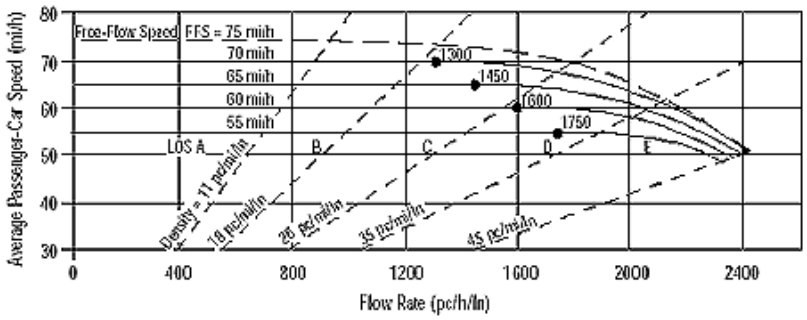
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	I-405 SB ONR to Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 56

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

Flow Inputs

Volume, V	6200 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	62.8	mi/h	FFS	62.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1412	pc/h/ln	Design LOS		
S	62.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	22.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 57

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 62.8 mph S_{FR} = 40.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	6200	0.90	Level	5	0	0.976	1.00	7061
Ramp	940	0.90	Level	5	0	0.976	1.00	1071
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3067 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	5649	9311	No
V_{12}	3067	4400:All	No
$V_{FO} = V_F - V_R$	4578	9311	No
V_R	1071	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 1.8 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.459 (Exhibit 25-19)

S_R= 53.2 mph (Exhibit 25-19)

S_0= 67.8 mph (Exhibit 25-19)

S = 59.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Willow St ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 59

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 67.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	5260	0.90	Level	5	0	0.976	1.00	5991
Ramp	1580	0.90	Level	5	0	0.976	1.00	1799
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.176 using Equation 4

V_{12}= 1055 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	7790	See Exhibit 25-7	No
V_{R12}	2854	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 = 23.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.348 (Exibit 25-19)

S_R= 58.8 mph (Exhibit 25-19)

S_0= 60.3 mph (Exhibit 25-19)

S= 59.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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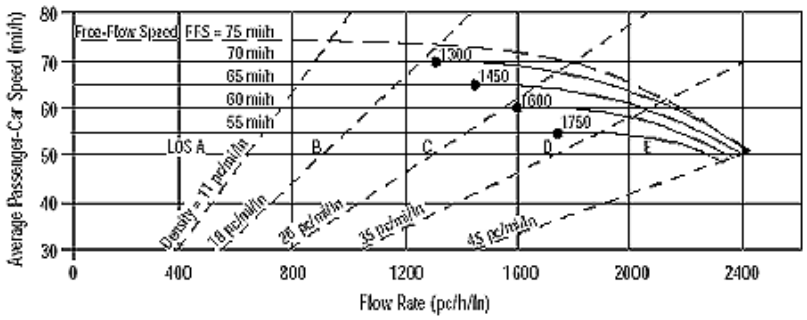
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Willow St ONR to Cerritos ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 60

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

Flow Inputs

Volume, V	6840 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1948	pc/h/ln	Design LOS		
S	65.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	29.6	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Cerritos Ave ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 61

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 60.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	6840	0.90	Level	5	0	0.976	1.00	7790
Ramp	1180	0.90	Level	5	0	0.976	1.00	1344
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.114 using Equation 4

V_{12}= 884 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9134	See Exhibit 25-7	No
V_{R12}	2228	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 = 21.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)

S_R= 54.2 mph (Exhibit 25-19)

S_0= 47.1 mph (Exhibit 25-19)

S= 48.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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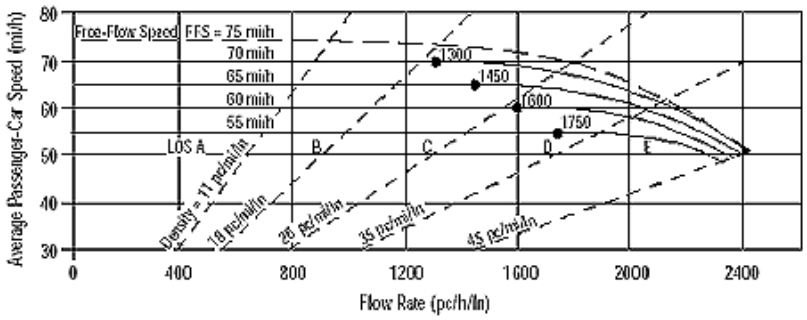
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 NB
Agency or Company	Parsons	From/To	Cerritos ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 62

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

Flow Inputs

Volume, V	8020 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.6	mi/h	FFS	59.6	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2283	pc/h/ln	Design LOS		
S	51.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	44.4	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 63

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.6 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8020	0.90	Level	5	0	0.976	1.00	9134
Ramp	1020	0.90	Level	5	0	0.976	1.00	1162
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4638 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9134	9183	No
V_{12}	4638	4400:All	Yes
$V_{FO} = V_F - V_R$	7972	9183	No
V_R	1162	2000	No

Level of Service Determination (if not F)

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

D_R = 41.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.533 (Exhibit 25-19)

S_R= 50.2 mph (Exhibit 25-19)

S_0= 60.5 mph (Exhibit 25-19)

S = 54.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 65

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 58.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7000	0.90	Level	5	0	0.976	1.00	7972
Ramp	560	0.90	Level	5	0	0.976	1.00	638
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.321 using Equation 4

V_{12}= 2561 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8610	See Exhibit 25-7	No
V_{R12}	3199	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 = 26.5 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.376 (Exibit 25-19)

S_R= 52.0 mph (Exhibit 25-19)

S_0= 49.0 mph (Exhibit 25-19)

S= 50.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 68

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7070	0.90	Level	5	0	0.976	1.00	8052
Ramp	440	0.90	Level	5	0	0.976	1.00	501
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.235 using Equation 4

V_{12}= 1891 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8553	See Exhibit 25-7	No
V_{R12}	2392	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 = 22.3 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.346 (Exibit 25-19)

S_R= 57.3 mph (Exhibit 25-19)

S_0= 54.2 mph (Exhibit 25-19)

S= 55.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 70

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.5 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7510	0.90	Level	5	0	0.976	1.00	8553
Ramp	350	0.90	Level	5	0	0.976	1.00	399
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.232 using Equation 4

V_{12}= 1981 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8952	See Exhibit 25-7	No
V_{R12}	2380	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 = 22.6 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.349 (Exibit 25-19)

S_R= 56.0 mph (Exhibit 25-19)

S_0= 51.1 mph (Exhibit 25-19)

S= 52.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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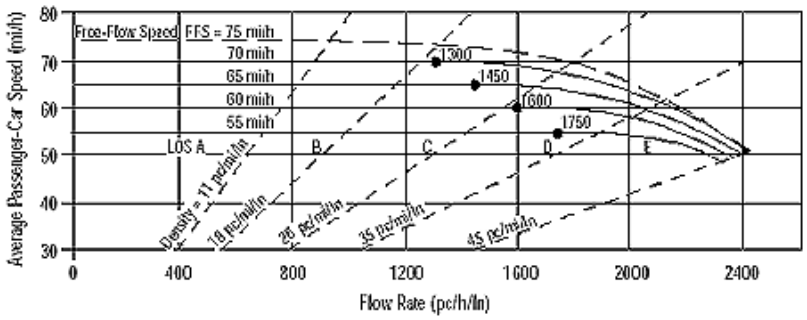
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Carson ONR to 5 lane section
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 71

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

Flow Inputs

Volume, V	7870 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
Driver type adjustment	1.00	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

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2241	pc/h/ln	Design LOS		
S	55.1	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	40.6	pc/mi/ln	S		mi/h
LOS	E		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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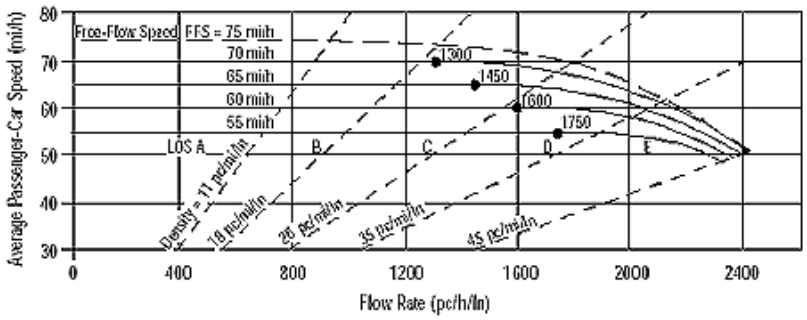
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	5 lane section to Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 72

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

Flow Inputs

Volume, V	7870 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	5		f_N		mi/h
FFS (measured)	63.8	mi/h	FFS	63.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1793	pc/h/ln	Design LOS	
S	63.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	28.5	pc/mi/ln	S	mi/h
LOS	D		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

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

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Spring OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 73

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 63.8 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	7870	0.90	Level	5	0	0.976	1.00	8963
Ramp	1560	0.90	Level	5	0	0.976	1.00	1777
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4129 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7171	9351	No
V_{12}	4129	4400:All	No
V_{FO} = V_F - V_R	5394	9351	No
V_R	1777	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 38.0 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.653 (Exhibit 25-19)

S_R= 49.6 mph (Exhibit 25-19)

S_0= 68.0 mph (Exhibit 25-19)

S = 56.0 mph (Exhibit 25-15)

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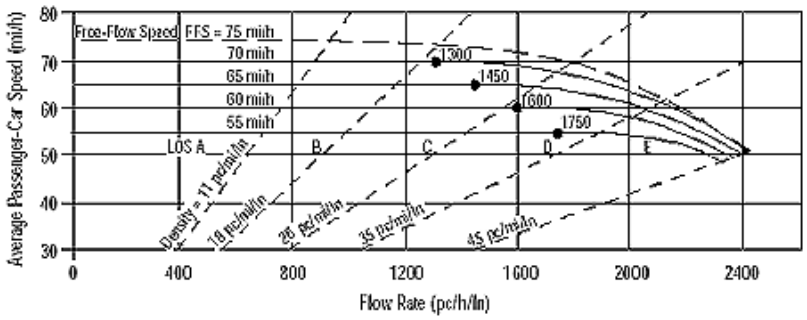
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Spring OFR to Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 74

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

Flow Inputs

Volume, V	6310 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1797	pc/h/ln	Design LOS		
S	67.9	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 75

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 61.4 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	6310	0.90	Level	5	0	0.976	1.00	7186
Ramp	610	0.90	Level	5	0	0.976	1.00	695
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3525 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	7186	9256	No
V_{12}	3525	4400:All	No
V_{FO} = V_F - V_R	6491	9256	No
V_R	695	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.556 (Exhibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 64.1 mph (Exhibit 25-19)

S = 56.7 mph (Exhibit 25-15)

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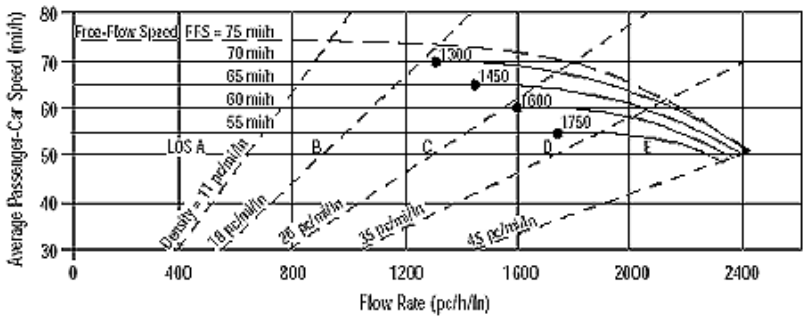

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow OFR to Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 76

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

Flow Inputs

Volume, V	5720 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	61.4	mi/h	FFS	61.4	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1629	pc/h/ln	Design LOS	
S	61.4	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	26.5	pc/mi/ln	S	mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow OFR CD
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 77

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 30.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5710	0.90	Level	5	0	0.976	1.00	6503
Ramp	1110	0.90	Level	5	0	0.976	1.00	1264
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 3548 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	6503	9000	No
V_{12}	3548	4400:All	No
V_{FO} = V_F - V_R	5239	9000	No
V_R	1264	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 32.7 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.607 (Exhibit 25-19)

S_R= 47.1 mph (Exhibit 25-19)

S_0= 58.5 mph (Exhibit 25-19)

S = 51.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 79

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	4600	0.90	Level	5	0	0.976	1.00	5239
Ramp	960	0.90	Level	5	0	0.976	1.00	1093
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.368 using Equation 4

V_{12}= 1927 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6332	See Exhibit 25-7	No
V_{R12}	3020	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 = 22.9 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.338 (Exibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 50.8 mph (Exhibit 25-19)

S= 50.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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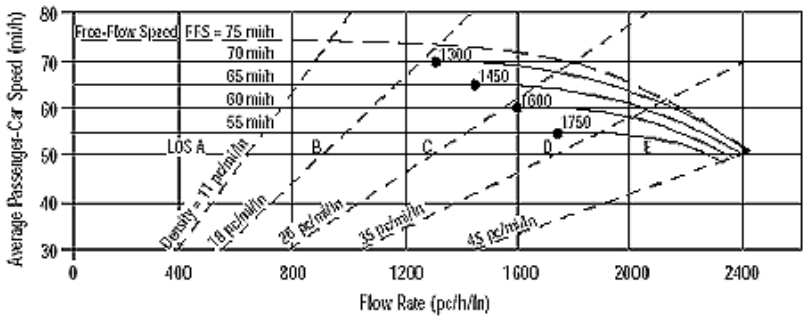
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	Willow ONR CD to I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 84

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

Flow Inputs

Volume, V	5560 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1583	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	26.5	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 NB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 85

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 59.8 mph S_{FR} = 50.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	5560	0.90	Level	5	0	0.976	1.00	6332
Ramp	1210	0.90	Level	5	0	0.976	1.00	1378
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3538 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	6332	9191	No
V_{12}	3538	4400:All	No
$V_{FO} = V_F - V_R$	4954	9191	No
V_R	1378	2100	No

Level of Service Determination (if not F)

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

D_R = 32.2 (pc/ mi /ln)

LOS= D (Exhibit 25-4)

Speed Estimation

D_s = 0.357 (Exhibit 25-19)

S_R= 53.4 mph (Exhibit 25-19)

S_0= 64.1 mph (Exhibit 25-19)

S = 57.7 mph (Exhibit 25-15)

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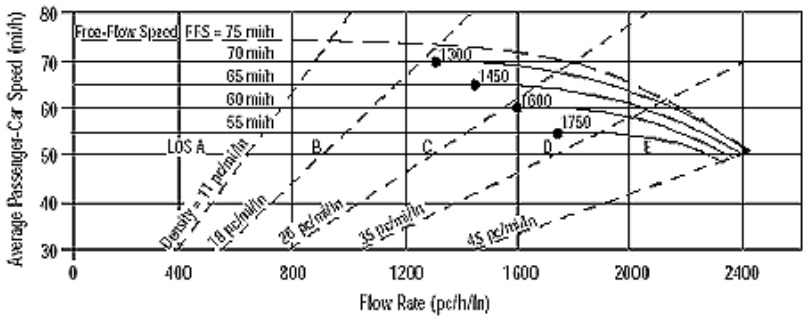
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 NB OFR to I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 86

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

Flow Inputs

Volume, V	4340 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	4		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1236	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	17.7	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 87

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 59.8 mph S_{FR} = 59.8 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4340	0.90	Level	5	0	0.976	1.00	4943
Ramp	3030	0.90	Level	5	0	0.976	1.00	3451
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3839 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	4943	9191	No
V_{12}	3839	4400:All	No
$V_{FO} = V_F - V_R$	1492	9191	No
V_R	3451	4400	No

Level of Service Determination (if not F)

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

D_R = -49.1 (pc/ mi /ln)

LOS= A (Exhibit 25-4)

Speed Estimation

D_s = 0.416 (Exhibit 25-19)

S_R= 52.4 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 54.9 mph (Exhibit 25-15)

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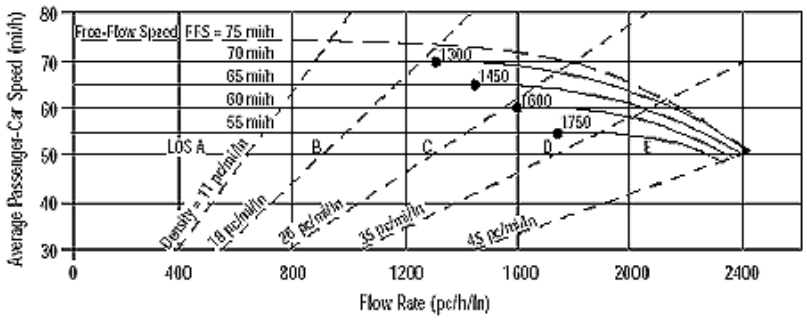

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB OFR to I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 88 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	2620 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1492	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	24.9	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	I-405 SB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 89 coded as 2 lanes, double volume

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 59.8 mph S_{FR} = 50.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2620	0.90	Level	5	0	0.976	1.00	2984
Ramp	150	0.90	Level	5	0	0.976	1.00	171
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 2984 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3155	See Exhibit 25-7	No
V_{R12}	3155	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/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.377 (Exibit 25-19)

S_R= 53.1 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 53.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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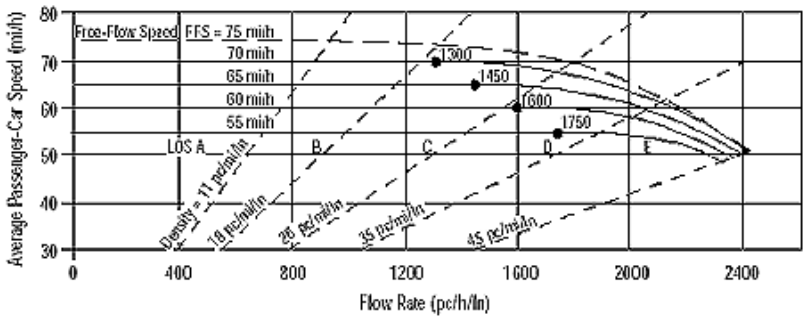
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	I-605 SB
Agency or Company	Parsons	From/To	I-405 SB ONR to I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 90 coded as 2 lanes, double volume

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

Flow Inputs

Volume, V	2940 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
Driver type adjustment	1.00	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	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	59.8	mi/h	FFS	59.8	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1674	pc/h/ln	Design LOS		
S	59.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	28.0	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	I-405 NB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 91 coded for ramp being the mainline

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 55.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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 f_{HV} f_p
Freeway	2750	0.90	Level	2	0	0.990	1.00	3086
Ramp	1470	0.90	Level	2	0	0.990	1.00	1650
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3086 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4736	See Exhibit 25-7	Yes
V_{R12}	4736	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 = 40.1 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.738 (Exibit 25-19)

S_R= 45.4 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 45.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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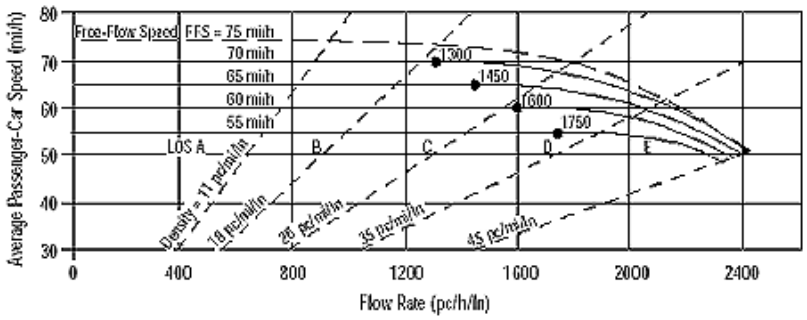
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	I-405 NB ONR to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No build

Project Description Segment ID 92

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

Flow Inputs

Volume, V	4210 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	2		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	2362	pc/h/ln	Design LOS		
S	54.8	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	43.1	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 95

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2700	0.90	Level	2	0	0.990	1.00	3030
Ramp	400	0.90	Level	2	0	0.990	1.00	449
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3030 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	3479	See Exhibit 25-7	No
V_{R12}	3479	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 = 23.0 (pc/ m/ln)

LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 0.342 (Exibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 50.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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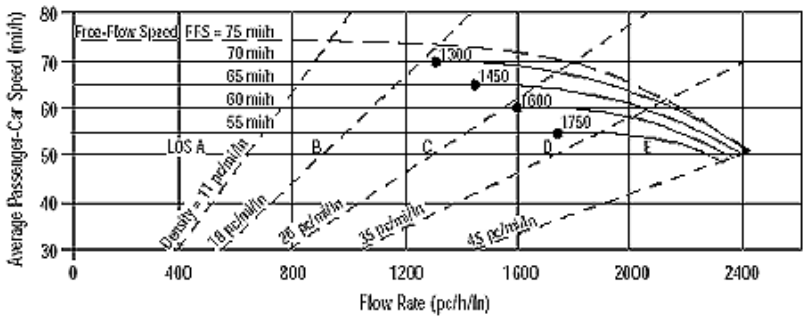
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St WB
Agency or Company	Parsons	From/To	StudeB ONR to
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 96

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

Flow Inputs

Volume, V	3100 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1160	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	16.6	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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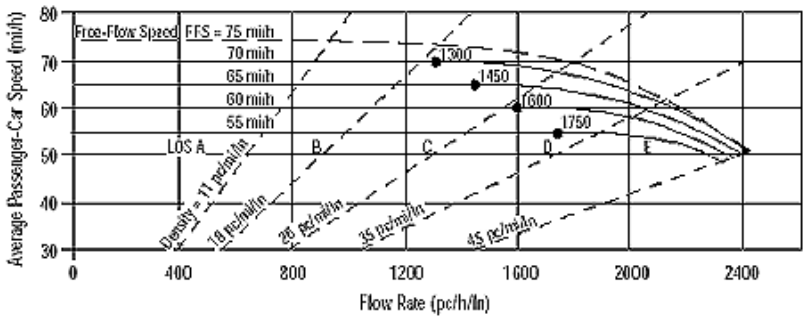
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

Analyst		Highway/Direction of Travel	7th St EB
Agency or Company	Parsons	From/To	to StudeB OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 97

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

Flow Inputs

Volume, V	3420 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	mi
Driver type adjustment	1.00	Up/Down %	

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	0.990

Speed Inputs / Calc Speed Adj and FFS

Lane Width	12.0	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	6.0	ft	f_{LC}		mi/h
Interchange Density	0.50	I/mi	f_{ID}		mi/h
Number of Lanes, N	3		f_N		mi/h
FFS (measured)	70.0	mi/h	FFS	70.0	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	1279	pc/h/ln	Design LOS		
S	70.0	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	18.3	pc/mi/ln	S		mi/h
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 - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 98

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	3420	0.90	Level	5	0	0.976	1.00	3895
Ramp	610	0.90	Level	5	0	0.976	1.00	695
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 3895 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	3895	4500	No
V_{12}	3895	4400:All	No
V_{FO} = V_F - V_R	3200	4500	No
V_R	695	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.556 (Exhibit 25-19)

S_R= 47.8 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 47.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	7th St EB
Agency or Company	Parsons	Junction	StudeB ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 100

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	2810	0.90	Level	2	0	0.990	1.00	3153
Ramp	1530	0.90	Level	2	0	0.990	1.00	1717
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 1.000 using Equation 0

V_{12}= 3153 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	4870	See Exhibit 25-7	Yes
V_{R12}	4870	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 40.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.801 (Exibit 25-19)

S_R= 44.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S= 44.6 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Lakewood Blvd Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 101

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 66.2 mph S_{FR} = 20.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10520	0.90	Level	4	0	0.980	1.00	11923
Ramp	950	0.90	Level	4	0	0.980	1.00	1077
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.260 using Equation 0
V_{12}= pc/h	V_{12} = 3277 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9539	9447	Yes
V_{12}	3277	4400:All	No
V_{FO} = V_F - V_R	8462	9447	No
V_R	1077	3500	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 16.2 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.720 (Exhibit 25-19)

S_R= 48.8 mph (Exhibit 25-19)

S_0= 64.3 mph (Exhibit 25-19)

S = 58.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 102

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.8 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10180	0.90	Level	4	0	0.980	1.00	11537
Ramp	300	0.90	Level	4	0	0.980	1.00	340
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4216 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9230	9432	No
V_{12}	4216	4400:All	No
V_{FO} = V_F - V_R	8890	9432	No
V_R	340	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.329 (Exhibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 66.3 mph (Exhibit 25-19)

S = 62.2 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Woodruff Ave Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 103

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 25.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	9850	0.90	Level	4	0	0.980	1.00	11163
Ramp	670	0.90	Level	4	0	0.980	1.00	759
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4322 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8931	9000	No
V_{12}	4322	4400:All	No
$V_{FO} = V_F - V_R$	8172	9000	No
V_R	759	1900	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 25-4)

Speed Estimation

D_s = 0.626 (Exhibit 25-19)

S_R= 46.9 mph (Exhibit 25-19)

S_0= 55.2 mph (Exhibit 25-19)

S = 50.8 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 104

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 64.7 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10220	0.90	Level	4	0	0.980	1.00	11583
Ramp	610	0.90	Level	4	0	0.980	1.00	691
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4430 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9267	9387	No
V_{12}	4430	4400:All	Yes
V_{FO} = V_F - V_R	8576	9387	No
V_R	691	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 33.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.685 (Exhibit 25-19)

S_R= 49.1 mph (Exhibit 25-19)

S_0= 65.4 mph (Exhibit 25-19)

S = 56.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 105

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10450	0.90	Level	4	0	0.980	1.00	11843
Ramp	2120	0.90	Level	4	0	0.980	1.00	2403
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 4242 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	9475	9000	Yes
V_{12}	4242	4400:All	No
$V_{FO} = V_F - V_R$	7072	9000	No
V_R	2403	3800	No

Level of Service Determination (if not F)

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

D_R = 24.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.644 (Exhibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= 54.0 mph (Exhibit 25-19)

S = 50.4 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 106

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft		L_{down} = ft
Vu = veh/h	S_{FF} = 65.0 mph S_{FR} = 20.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10690	0.90	Level	4	0	0.980	1.00	12115
Ramp	860	0.90	Level	4	0	0.980	1.00	975
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4776 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9692	9400	Yes
V_{12}	4776	4400:All	Yes
V_{FO} = V_F - V_R	8717	9400	No
V_R	975	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 30.9 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.711 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 65.6 mph (Exhibit 25-19)

S = 56.0 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Studebaker Offramp
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 107

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	10180	0.90	Level	4	0	0.980	1.00	11537
Ramp	350	0.90	Level	4	0	0.980	1.00	397
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4248 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9230	9000	Yes
V_{12}	4248	4400:All	No
V_{FO} = V_F - V_R	8833	9000	No
V_R	397	1900	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 38.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.594 (Exhibit 25-19)

S_R= 47.3 mph (Exhibit 25-19)

S_0= 54.5 mph (Exhibit 25-19)

S = 50.9 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	7th Street OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 108

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 45.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8460	0.90	Level	4	0	0.980	1.00	9588
Ramp	150	0.90	Level	4	0	0.980	1.00	170
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =0.436 using Equation 8
V_{12}= pc/h	V_{12} = 4276 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	9588	9000	Yes
V_{12}	4276	4400:All	No
V_{FO} = V_F - V_R	9418	9000	Yes
V_R	170	2100	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 39.2 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.313 (Exhibit 25-19)

S_R= 50.9 mph (Exhibit 25-19)

S_0= 53.9 mph (Exhibit 25-19)

S = 52.5 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	I-605 SB
Agency or Company	Parsons	Junction	Carson OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 109

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 65.4 mph S_{FR} = 25.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	8590	0.90	Level	5	0	0.976	1.00	9783
Ramp	1520	0.90	Level	5	0	0.976	1.00	1731
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

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 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.260 using Equation 0

V_{12} = 3316 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7827	9416	No
V_{12}	3316	4400:All	No
$V_{FO} = V_F - V_R$	6096	9416	No
V_R	1731	3500	No

Level of Service Determination (if not F)

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

D_R = 16.6 (pc/ mi /ln)

LOS= B (Exhibit 25-4)

Speed Estimation

D_s = 0.714 (Exhibit 25-19)

S_R= 48.7 mph (Exhibit 25-19)

S_0= 66.8 mph (Exhibit 25-19)

S = 57.7 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst		Freeway/Dir of Travel	7th St WB
Agency or Company	Parsons	Junction	Studebaker OFR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 110

Inputs

Upstream Adj Ramp	Terrain	Downstream Adj Ramp
☐ Yes ☐ On		☐ Yes ☐ On
☐ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 30.0 mph	L_{down} = ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 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 f_{HV} f_p
Freeway	4210	0.90	Level	5	0	0.976	1.00	4795
Ramp	1520	0.90	Level	5	0	0.976	1.00	1731
UpStream								
DownStream								

Merge Areas	Diverge Areas
Estimation of v_{12}	**Estimation of v_{12}**
$V_{12} = V_F (P_{FM})$	$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-2 or 25-3)	L_{EQ} = (Equation 25-8 or 25-9)
P_{FM}= using Equation	P_{FD} =1.000 using Equation 0
V_{12}= pc/h	V_{12} = 4795 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Capacity Checks

	Actual	Maximum	LOS F?
V_{FI}=V_F	4795	4500	Yes
V_{12}	4795	4400:All	Yes
V_{FO} = V_F - V_R	3064	4500	No
V_R	1731	2000	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 = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

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

D_R = 43.5 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Speed Estimation

D_s = 0.649 (Exhibit 25-19)

S_R= 46.6 mph (Exhibit 25-19)

S_0= N/A mph (Exhibit 25-19)

S = 46.6 mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Willow ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	AM Peak	Analysis Year	2040 No Build

Project Description Segment ID 111

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9800	0.90	Level	4	0	0.980	1.00	11107
Ramp	660	0.90	Level	4	0	0.980	1.00	748
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.220 using Equation 4

V_{12}= 1892 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9355	See Exhibit 25-7	Yes
V_{R12}	2640	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/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.355 (Exibit 25-19)

S_R= 50.4 mph (Exhibit 25-19)

S_0= 42.1 mph (Exhibit 25-19)

S= 44.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Lakewood ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 112

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.2 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9580	0.90	Level	4	0	0.980	1.00	10857
Ramp	660	0.90	Level	4	0	0.980	1.00	748
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.602 using Equation 4

V_{12}= 6538 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11605	See Exhibit 25-7	Yes
V_{R12}	7286	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 = 52.6 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 5.909 (Exibit 25-19)

S_R= -76.8 mph (Exhibit 25-19)

S_0= 60.2 mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 113

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.4 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9620	0.90	Level	4	0	0.980	1.00	10903
Ramp	910	0.90	Level	4	0	0.980	1.00	1031
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.209 using Equation 0

V_{12}= 2279 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11934	See Exhibit 25-7	Yes
V_{R12}	3310	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/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.246 (Exibit 25-19)

S_R= 58.1 mph (Exhibit 25-19)

S_0= 44.8 mph (Exhibit 25-19)

S= 47.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Bellflower ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 114

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8330	0.90	Level	4	0	0.980	1.00	9441
Ramp	1520	0.90	Level	4	0	0.980	1.00	1723
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.321 using Equation 4

V_{12}= 3031 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11164	See Exhibit 25-7	Yes
V_{R12}	4754	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 = 35.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.704 (Exibit 25-19)

S_R= 45.9 mph (Exhibit 25-19)

S_0= 43.0 mph (Exhibit 25-19)

S= 44.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Woodruff ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 115

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 66.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9880	0.90	Level	4	0	0.980	1.00	11197
Ramp	340	0.90	Level	4	0	0.980	1.00	385
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.456 using Equation 4

V_{12}= 5110 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11582	See Exhibit 25-7	Yes
V_{R12}	5495	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 = 42.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 1.208 (Exibit 25-19)

S_R= 37.0 mph (Exhibit 25-19)

S_0= 55.0 mph (Exhibit 25-19)

S= 44.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Palo Verde ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 116

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 65.6 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9830	0.90	Level	4	0	0.980	1.00	11141
Ramp	350	0.90	Level	4	0	0.980	1.00	397
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.742 using Equation 4

V_{12}= 8262 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11538	See Exhibit 25-7	Yes
V_{R12}	8659	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 = 61.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 22.666 (Exibit 25-19)

S_R= -469.3 mph (Exhibit 25-19)

S_0= 62.2 mph (Exhibit 25-19)

S= 414.7 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2		Freeway/Dir of Travel	I-405 SB
Agency or Company	Parsons	Junction	Stearns ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 117

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	9500	0.90	Level	4	0	0.980	1.00	10767
Ramp	680	0.90	Level	4	0	0.980	1.00	771
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.217 using Equation 4

V_{12}= 2336 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	11538	See Exhibit 25-7	Yes
V_{R12}	3107	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 = 27.5 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.387 (Exibit 25-19)

S_R= 50.0 mph (Exhibit 25-19)

S_0= 37.0 mph (Exhibit 25-19)

S= 39.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-405 NB
Agency or Company	Parsons	Junction	Studebaker ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 118

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 63.8 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	10330	0.90	Level	4	0	0.980	1.00	11707
Ramp	350	0.90	Level	4	0	0.980	1.00	397
UpStream								
DownStream								

Estimation of v_{12}

Merge Areas

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.742 using Equation 4

V_{12}= 8682 pc/h

Diverge Areas

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	12104	See Exhibit 25-7	Yes
V_{R12}	9079	4600:All	Yes

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

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 = 64.8 (pc/ m/ln)

LOS = F (Exhibit 25-4)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

M_S = 34.395 (Exibit 25-19)

S_R= -686.0 mph (Exhibit 25-19)

S_0= 60.2 mph (Exhibit 25-19)

S= 326.7 mph (Exhibit 25-14)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst2		Freeway/Dir of Travel	I-605 NB
Agency or Company	Parsons	Junction	Carson ONR
Date Performed	10/16/2012	Jurisdiction	
Analysis Time Period	PM Peak	Analysis Year	2040 No Build

Project Description Segment ID 119

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☐ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain Level

S_{FF} = 57.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

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	$v=V/PHF\ f_{HV}\ f_p$
Freeway	7560	0.90	Level	5	0	0.976	1.00	8610
Ramp	790	0.90	Level	5	0	0.976	1.00	900
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.233 using Equation 4

V_{12}= 2004 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9510	See Exhibit 25-7	Yes
V_{R12}	2904	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 = 25.2 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.364 (Exibit 25-19)

S_R= 51.5 mph (Exhibit 25-19)

S_0= 44.5 mph (Exhibit 25-19)

S= 46.4 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

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

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

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

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

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