

20. Queue Analysis with a Traffic Signal at Camino Capistrano/ Forster Street Intersection



HCM Signalized Intersection Capacity Analysis FUTURE 2035 CUMULATIVE CONDITIONS
 15: Forster St & Camino Capistrano AM Peak Hour



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↘		↑		↙	↑
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		1.00	1.00
Frbp, ped/bikes	1.00		0.99		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.99		0.97		1.00	1.00
Flt Protected	0.95		1.00		0.95	1.00
Satd. Flow (prot)	1587		1614		1585	1676
Flt Permitted	0.95		1.00		0.39	1.00
Satd. Flow (perm)	1587		1614		654	1676
Volume (vph)	83	5	464	135	18	722
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	87	5	488	142	19	760
RTOR Reduction (vph)	5	0	13	0	0	0
Lane Group Flow (vph)	87	0	617	0	19	760
Confl. Peds. (#/hr)	10	10		10	10	
Turn Type					Perm	
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	3.6		28.4		28.4	28.4
Effective Green, g (s)	3.6		28.4		28.4	28.4
Actuated g/C Ratio	0.09		0.71		0.71	0.71
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)	143		1146		464	1190
v/s Ratio Prot	c0.06		0.38			c0.45
v/s Ratio Perm					0.03	
v/c Ratio	0.61		0.54		0.04	0.64
Uniform Delay, d1	17.5		2.7		1.7	3.1
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	7.5		1.8		0.2	2.6
Delay (s)	25.0		4.5		1.9	5.7
Level of Service	C		A		A	A
Approach Delay (s)	25.0		4.5			5.6
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay		6.4	HCM Level of Service A
HCM Volume to Capacity ratio		0.64	
Actuated Cycle Length (s)		40.0	Sum of lost time (s) 8.0
Intersection Capacity Utilization		56.6%	ICU Level of Service B
Analysis Period (min)		15	

c Critical Lane Group

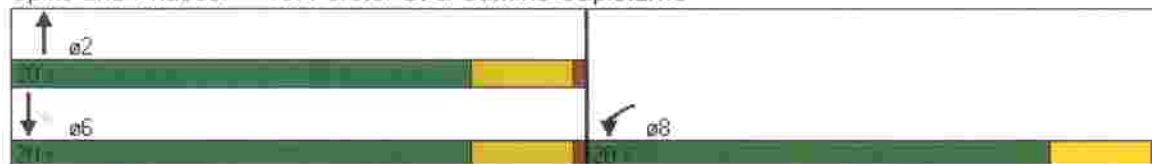
	↙	↖	↑	↗	↘	↓
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙		↑		↘	↓
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	100	
Storage Lanes	1	0		0	1	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50		50	50
Trailing Detector (ft)	0		0		0	0
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99		0.99		1.00	
Frt	0.993		0.970			
Flt Protected	0.955				0.950	
Satd. Flow (prot)	1588	0	1614	0	1593	1676
Flt Permitted	0.955				0.250	
Satd. Flow (perm)	1577	0	1614	0	418	1676
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)	5		44			
Headway Factor	1.14	1.14	1.14	1.14	1.14	1.14
Link Speed (mph)	25		25			25
Link Distance (ft)	174		645			525
Travel Time (s)	4.7		17.6			14.3
Volume (vph)	83	5	464	135	18	722
Confl. Peds. (#/hr)	10	10		10	10	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	87	5	488	142	19	760
Lane Group Flow (vph)	92	0	630	0	19	760
Turn Type					Perm	
Protected Phases	8		2			6
Permitted Phases					6	
Detector Phases	8		2		6	6
Minimum Initial (s)	4.0		4.0		4.0	4.0
Minimum Split (s)	20.0		20.0		20.0	20.0
Total Split (s)	20.0	0.0	20.0	0.0	20.0	20.0
Total Split (%)	50.0%	0.0%	50.0%	0.0%	50.0%	50.0%
Maximum Green (s)	16.0		16.0		16.0	16.0
Yellow Time (s)	3.5		3.5		3.5	3.5
All-Red Time (s)	0.5		0.5		0.5	0.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		C-Min		C-Min	C-Min
Walk Time (s)	5.0		5.0		5.0	5.0
Flash Dont Walk (s)	11.0		11.0		11.0	11.0
Pedestrian Calls (#/hr)	0		0		0	0
Act Effct Green (s)	7.0		33.2		33.2	33.2
Actuated g/C Ratio	0.18		0.83		0.83	0.83
v/c Ratio	0.33		0.47		0.05	0.55
Control Delay	16.4		5.5		4.1	8.1
Queue Delay	0.0		0.0		0.0	0.0

	↙	↖	↑	↗	↘	↓
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Total Delay	16.4		5.5		4.1	8.1
LOS	B		A		A	A
Approach Delay	16.4		5.5			8.0
Approach LOS	B		A			A
Queue Length 50th (ft)	18		0		0	0
Queue Length 95th (ft)	41		#170		8	#304
Internal Link Dist (ft)	94		565			445
Turn Bay Length (ft)					100	
Base Capacity (vph)	638		1345		347	1389
Starvation Cap Reductn	35		0		0	0
Spillback Cap Reductn	0		0		0	0
Storage Cap Reductn	0		0		0	0
Reduced v/c Ratio	0.15		0.47		0.05	0.55

Intersection Summary

Area Type: CBD
 Cycle Length: 40
 Actuated Cycle Length: 40
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.55
 Intersection Signal Delay: 7.4 Intersection LOS: A
 Intersection Capacity Utilization 56.6% ICU Level of Service B
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 15: Forster St & Camino Capistrano



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
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		1.00	1.00
Frbp, ped/bikes	1.00		0.99		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.99		0.97		1.00	1.00
Flt Protected	0.96		1.00		0.95	1.00
Satd. Flow (prot)	1579		1615		1587	1676
Flt Permitted	0.96		1.00		0.29	1.00
Satd. Flow (perm)	1579		1615		480	1676
Volume (vph)	124	14	565	159	22	716
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	131	15	595	167	23	754
RTOR Reduction (vph)	13	0	15	0	0	0
Lane Group Flow (vph)	133	0	747	0	23	754
Confl. Peds. (#/hr)	10	10		10	10	
Turn Type					Perm	
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	5.9		26.1		26.1	26.1
Effective Green, g (s)	5.9		26.1		26.1	26.1
Actuated g/C Ratio	0.15		0.65		0.65	0.65
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)	233		1054		313	1094
v/s Ratio Prot	c0.08		c0.46			0.45
v/s Ratio Perm					0.05	
v/c Ratio	0.57		0.71		0.07	0.69
Uniform Delay, d1	15.9		4.5		2.5	4.4
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	3.4		4.0		0.5	3.6
Delay (s)	19.2		8.5		3.0	7.9
Level of Service	B		A		A	A
Approach Delay (s)	19.2		8.5			7.8
Approach LOS	B		A			A
Intersection Summary						
HCM Average Control Delay			9.1		HCM Level of Service	A
HCM Volume to Capacity ratio			0.68			
Actuated Cycle Length (s)			40.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			60.7%		ICU Level of Service	B
Analysis Period (min)			15			

c Critical Lane Group

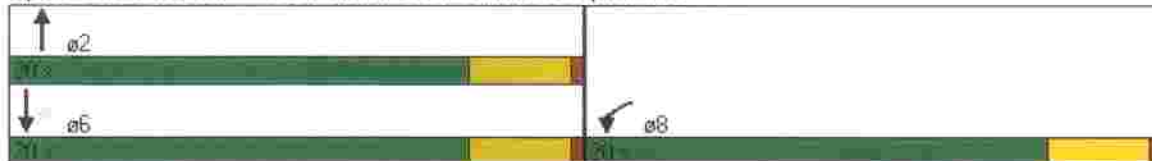
	↙	↖	↑	↗	↘	↓
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙		↑		↘	↓
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	100	
Storage Lanes	1	0		0	1	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50		50	50
Trailing Detector (ft)	0		0		0	0
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99		0.99		1.00	
Frt	0.986		0.970			
Flt Protected	0.957				0.950	
Satd. Flow (prot)	1579	0	1615	0	1593	1676
Flt Permitted	0.957				0.250	
Satd. Flow (perm)	1568	0	1615	0	418	1676
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)	15		42			
Headway Factor	1.14	1.14	1.14	1.14	1.14	1.14
Link Speed (mph)	25		25			25
Link Distance (ft)	174		645			525
Travel Time (s)	4.7		17.6			14.3
Volume (vph)	124	14	565	159	22	716
Confl. Peds. (#/hr)	10	10		10	10	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	131	15	595	167	23	754
Lane Group Flow (vph)	146	0	762	0	23	754
Turn Type					Perm	
Protected Phases	8		2			6
Permitted Phases					6	
Detector Phases	8		2		6	6
Minimum Initial (s)	4.0		4.0		4.0	4.0
Minimum Split (s)	20.0		20.0		20.0	20.0
Total Split (s)	20.0	0.0	20.0	0.0	20.0	20.0
Total Split (%)	50.0%	0.0%	50.0%	0.0%	50.0%	50.0%
Maximum Green (s)	16.0		16.0		16.0	16.0
Yellow Time (s)	3.5		3.5		3.5	3.5
All-Red Time (s)	0.5		0.5		0.5	0.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		C-Min		C-Min	C-Min
Walk Time (s)	5.0		5.0		5.0	5.0
Flash Dont Walk (s)	11.0		11.0		11.0	11.0
Pedestrian Calls (#/hr)	0		0		0	0
Act Effct Green (s)	8.1		29.3		29.3	29.3
Actuated g/C Ratio	0.20		0.73		0.73	0.73
v/c Ratio	0.44		0.64		0.08	0.61
Control Delay	16.2		11.8		5.6	11.4
Queue Delay	0.1		0.0		0.0	0.0

	↙	↖	↑	↗	↘	↓
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Total Delay	16.3		11.8		5.6	11.4
LOS	B		B		A	B
Approach Delay	16.3		11.8			11.3
Approach LOS	B		B			B
Queue Length 50th (ft)	26		94		2	97
Queue Length 95th (ft)	54		#328		11	#320
Internal Link Dist (ft)	94		565			445
Turn Bay Length (ft)					100	
Base Capacity (vph)	641		1194		306	1228
Starvation Cap Reductn	85		0		0	0
Spillback Cap Reductn	0		0		0	0
Storage Cap Reductn	0		0		0	0
Reduced v/c Ratio	0.26		0.64		0.08	0.61

Intersection Summary

Area Type: CBD
 Cycle Length: 40
 Actuated Cycle Length: 40
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.64
 Intersection Signal Delay: 11.9 Intersection LOS: B
 Intersection Capacity Utilization 60.7% ICU Level of Service B
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 15: Forster St & Camino Capistrano















Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
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		1.00	1.00
Frbp, ped/bikes	1.00		0.99		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.98		0.98		1.00	1.00
Flt Protected	0.96		1.00		0.95	1.00
Satd. Flow (prot)	1568		1627		1586	1676
Flt Permitted	0.96		1.00		0.34	1.00
Satd. Flow (perm)	1568		1627		563	1676
Volume (vph)	85	17	543	116	25	734
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	89	18	572	122	26	773
RTOR Reduction (vph)	16	0	11	0	0	0
Lane Group Flow (vph)	91	0	683	0	26	773
Confl. Peds. (#/hr)	10	10		10	10	
Turn Type					Perm	
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	5.2		26.8		26.8	26.8
Effective Green, g (s)	5.2		26.8		26.8	26.8
Actuated g/C Ratio	0.13		0.67		0.67	0.67
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)	204		1090		377	1123
v/s Ratio Prot	c0.06		0.42			c0.46
v/s Ratio Perm					0.05	
v/c Ratio	0.45		0.63		0.07	0.69
Uniform Delay, d1	16.1		3.8		2.3	4.0
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	1.6		2.7		0.4	3.5
Delay (s)	17.6		6.5		2.6	7.5
Level of Service	B		A		A	A
Approach Delay (s)	17.6		6.5			7.3
Approach LOS	B		A			A

Intersection Summary			
HCM Average Control Delay	7.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		0	100	
Storage Lanes	1	0		0	1	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50		50	50
Trailing Detector (ft)	0		0		0	0
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor	0.99		0.99		1.00	
Frt	0.977		0.976			
Flt Protected	0.960				0.950	
Satd. Flow (prot)	1567	0	1627	0	1593	1676
Flt Permitted	0.960				0.250	
Satd. Flow (perm)	1557	0	1627	0	418	1676
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)	18		32			
Headway Factor	1.14	1.14	1.14	1.14	1.14	1.14
Link Speed (mph)	25		25			25
Link Distance (ft)	174		645			525
Travel Time (s)	4.7		17.6			14.3
Volume (vph)	85	17	543	116	25	734
Confl. Peds. (#/hr)	10	10		10	10	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	89	18	572	122	26	773
Lane Group Flow (vph)	107	0	694	0	26	773
Turn Type					Perm	
Protected Phases	8		2			6
Permitted Phases					6	
Detector Phases	8		2		6	6
Minimum Initial (s)	4.0		4.0		4.0	4.0
Minimum Split (s)	20.0		20.0		20.0	20.0
Total Split (s)	20.0	0.0	20.0	0.0	20.0	20.0
Total Split (%)	50.0%	0.0%	50.0%	0.0%	50.0%	50.0%
Maximum Green (s)	16.0		16.0		16.0	16.0
Yellow Time (s)	3.5		3.5		3.5	3.5
All-Red Time (s)	0.5		0.5		0.5	0.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		C-Min		C-Min	C-Min
Walk Time (s)	5.0		5.0		5.0	5.0
Flash Dont Walk (s)	11.0		11.0		11.0	11.0
Pedestrian Calls (#/hr)	0		0		0	0
Act Effct Green (s)	7.4		30.0		30.0	30.0
Actuated g/C Ratio	0.18		0.75		0.75	0.75
v/c Ratio	0.35		0.57		0.08	0.61
Control Delay	14.9		8.6		5.0	10.3
Queue Delay	0.0		0.0		0.0	0.0

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Total Delay	14.9		8.6		5.0	10.3
LOS	B		A		A	B
Approach Delay	14.9		8.6			10.1
Approach LOS	B		A			B
Queue Length 50th (ft)	18		73		2	93
Queue Length 95th (ft)	43		#271		10	#315
Internal Link Dist (ft)	94		565			445
Turn Bay Length (ft)					100	
Base Capacity (vph)	638		1228		314	1257
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	0.17		0.57		0.08	0.61

Intersection Summary

Area Type: CBD
 Cycle Length: 40
 Actuated Cycle Length: 40
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.61
 Intersection Signal Delay: 9.8
 Intersection Capacity Utilization: 58.1%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service B

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

Splits and Phases: 15: Forster St & Camino Capistrano

