

# Performance Evaluation of Two Types of Interchange Design through Simulation



Jannet Loera Gutiérrez, Civil Engineering

Dr. Wen Cheng

Kellogg Honors College Capstone 2012

## Background:

The City of Palm Desert, in cooperation with the California Department of Transportation (Caltrans) District 8 and the County of Riverside, proposes the reconstruction of the westbound ramps at the Interstate 10 (I-10) and Monterey Avenue Interchange (IC) to provide congestion relief for northbound Monterey Avenue to the existing westbound on-ramp. Currently, Monterey Ave has a nonstandard intersection spacing between the on and off ramps of the northbound Monterey Avenue to westbound I-10 causing traffic to exceed the current storage length of the left turn pocket. The proposed ramp design alternative includes realigning the existing westbound off hook ramp to Varner Road and constructing a westbound loop on ramp from Monterey Ave to I-10. The project will relieve the operational deficiencies from increased traffic demand and queuing from the forecasted growth and development in the area.

This study compares the performance of two types of ramp design from different aspects. It is expected to provide additional insights to roadway designers when the right of way is limited.

Current Design



Proposed Design



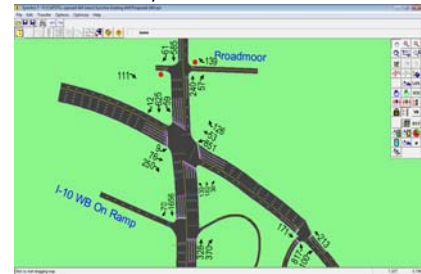
## Analysis:

The evaluation is conducted based on Synchro 7 and VISSIM simulation and under different traffic volume scenarios using real-world traffic data collected from Caltrans during morning and afternoon peak periods. The forecast traffic volume for the year 2035 was calculated using a growth rate factor. Alternative evaluation criteria are employed which include the average intersection delay per cycle length, overall intersection delay over peak hours, and average queue length. Additionally, the statistical modeling technique is utilized to establish the relationship among the level of service, traffic volume and other geometric related factors.

VISSIM Simulation



Synchro 7 Simulation



## Results:

### AM Peak Hour Intersection Analysis

Study Intersection	Existing Design						Proposed Design		
	2009 AM Peak Hour			2035 AM Peak Hour			2035 AM Peak Hour		
	Delay	Max v/c Ratio	Intersection LOS	Delay	Max v/c Ratio	Intersection LOS	Delay	Max v/c Ratio	Intersection LOS
Monterey Ave/Varner Rd	19.8	0.43	B	23.2	0.71	C	33.1	0.95	C
Monterey Ave/I-10 WB Ramps	17.2	0.78	B	36.1	0.92	D	0.39	0.39	A
Varner Rd/I-10 WB Off Ramp	N/A	N/A	N/A	N/A	N/A	N/A	15.8	0.84	B
Monterey Ave/I-10 EB Ramps	13.1	0.66	B	36.2	0.96	D	35.1	0.95	D
Monterey Ave/Dinah Shore Drive	21.7	0.78	C	30.2	0.85	C	29	0.90	C
Monterey Ave/Broadmoor	2.0	0.15	A	2.2	0.25	A	2.2	0.25	A
Varner Rd/Boca Chica	3.0	0.06	A	3.2	0.1	A	3.0	0.25	A
Total	76.8	0.5	--	131.1	0.6	--	118.6	0.6	--

### PM Peak Hour Intersection Analysis

Study Intersection	Existing Design						Proposed Design		
	2009 PM Peak Hour			2035 PM Peak Hour			2035 PM Peak Hour		
	Delay	Max v/c Ratio	Intersection LOS	Delay	Max v/c Ratio	Intersection LOS	Delay	Max v/c Ratio	Intersection LOS
Monterey Ave/Varner Rd	24.5	0.33	C	25.7	0.91	C	45.3	0.54	D
Monterey Ave/I-10 WB Ramps	28.3	0.48	C	56.3	0.99	E	28.3	0.48	C
Varner Rd/I-10 WB Off Ramp	N/A	N/A	N/A	N/A	N/A	N/A	22.5	0.56	C
Monterey Ave/I-10 EB Ramps	13	0.54	B	45.6	0.93	D	35.6	0.7	D
Monterey Ave/Dinah Shore Drive	32.8	0.9	C	72.6	1.07	E	32.8	0.9	C
Monterey Ave/Broadmoor	1.4	0.18	A	1.6	0.3	A	1.4	0.18	A
Varner Rd/Boca Chica	3.0	0.09	A	3.4	0.15	A	3.0	0.09	A
Total	103.0	0.4	--	205.2	0.7	--	168.9	0.5	--

\* Delay is in seconds. N/A = does not apply. LOS = Level of Service

## Conclusion:

The proposed ramp design will provide congestion relief in the rapidly growing area. The design will decrease the intersection delay time overall and the maximum vehicle to capacity ratio. The Intersection Capacity Utilization (ICU) level of service was higher than the regular Level of Service providing additional evidence that the current design will fail by 2035. The proposed design will operate at an acceptable level of service according to CalTrans performance criteria. The reconstruction of the eastbound ramps were not included in this project because they will not reach a deficiency of Level of Service by 2035. However, the possible future improvement design of the eastbound ramps was taken into consideration when designing the westbound ramps.