

Simulating Metered Roundabout at Freeway Termini Los Angeles, California

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Abstract: This paper presents result of a microsimulation analysis and findings from the simulation model run performed to evaluate traffic operations of a metered roundabout, located at the I-710 Freeway Off/On Ramps and Shoreline Drive/7th Street intersection, in Los Angeles, California. Shoreline Drive is an uncontrolled, high speed roadway facility and serves as the primary arterial street connecting the Central Business District (CBD) of the City of Long Beach and carries heavy traffic volumes during the peak hours. The City of Long Beach is concerned about the safety (with history of numerous accidents) along this corridor, due to the high speed traffic travelling to and from the I-710 Freeway. To address the safety concern, a roundabout is proposed at the Shoreline Drive/I-710 Ramps/7th St intersection. A simulation model was prepared using VISSIM microsimulation software to evaluate the traffic operations of the proposed roundabout. The major findings from this microsimulation study will be included in this paper, along with future applicability and relative advantage and disadvantage of a metered roundabout.

INTRODUCTION

I-710 is one of the severely congested freeway corridors in the greater Los Angeles area. The south end of the freeway provides access to downtown Long Beach, which is a major tourist destination in this region. Shoreline Drive (via Shoemaker Bridge) connects downtown Long Beach with I-710 freeway and serve as one of the primary entry/exit route to the City. Heavy traffic volume uses the Shoreline Drive during both morning and evening peak hours. At present, traffic from I-710 SB exit at the Shoreline Drive at a high speed and continue to travel at a high speed (over Shoemaker Bridge) before entering the City street network. Existing high speed resulted in high accident rates (including cars that slide over the Shoreline Bridge Side Rails and falls in the LA River) along Shoreline Drive (particularly at Shoemaker Bridge).

METHODOLOGY

VISSIM microsimulation model was used to perform the delay and queue analysis for the proposed roundabout option. Analysis was performed for the morning (7-9 AM) and evening (4 – 6 PM) peak hours. A 20 to 25 mph approach speed was used for all vehicles entering the roundabout. Results obtained from the average of five simulation runs were used for the analysis.

RESULTS

Year 2035 buildout condition analysis for the proposed Shoreline Drive/7th St intersection were performed for three geometric configurations/options. These options include signalized “T” intersection, standard roundabout, and metered roundabout. Signalized “T” intersection option was discarded after preliminary analysis because this option does not address concern’s

about high speed and safety at this location. Results for the other two options (i.e. standard roundabout and metered roundabout) are discussed in this paper.

Average Delay

Table 1 shows the level of service analysis result for the standard roundabout configuration. As shown in **Table 1**, northbound Shoreline Drive is expected to experience high delay during PM peak hour under standard roundabout option. This is because the northbound traffic will have little or no gap to enter the roundabout due to constantly yielding to SB approach traffic. This option will however provide good level of service for the southbound approach (i.e. traffic entering the downtown from SB 710 via southbound Shoreline Drive).

Table 1
Level of Service Analysis Results: Standard Roundabout

Delay & LOS Analysis (Standard Roundabout)						
Intersection Location	Control	Approach (Movement)	AM Peak		PM Peak	
			Del(v/s)	LOS	Del(v/s)	LOS
7th Street/Shoreline Drive	Roundabout (standard)	Northbound	58.0	E	> 900	F
		Southbound	<10.0	A	<10.0	A
		Westbound	109.4	F	84.4	F
		Entire Roundabout	33.6	C	286.2	F

Table 2 shows the level of service analysis result for the metered roundabout configuration. Average vehicle delay along northbound Shoreline Drive is expected to experience significant improvement under this configuration. With this option, both northbound and southbound approaches are expected to serve heavy PM peak hour traffic demand.

Table 2
Level of Service Analysis Results: Metered Roundabout

Delay & LOS Analysis(Metered Roundabout)						
Intersection Location	Control	Approach	AM Peak		PM Peak	
			Del(v/s)	LOS	Del(v/s)	LOS
7th Street/Shoreline Drive	Roundabout (metered with Traffic Signal)	Northbound	54.0	D	47.5	D
		Southbound	13.3	A	50.9	D
		Westbound	85.4	F	82.3	F
		Entire Intersection	30.5	C	49.3	D

Queue Analysis

Table 3 shows the queue analysis result for the standard roundabout configuration. Based on the analysis, northbound approach is expected to experience long queue possibly blocking upstream intersection(s).

Table 3
Queue Analysis Results: Standard Roundabout

Queue Analysis (Standard Roundabout)						
Intersection Location	Control	Approach (Movement)	Avg. Queue (ft.)		Max. Queue (ft.)	
			AM	PM	AM	PM ¹
7th Street/Shoreline Drive	Roundabout (standard)	Northbound	25	1,536	243	1,780
		Southbound	25	25	25	25
		Westbound	25	25	25	25
		Entire Roundabout	575	132	724	723

1. Max. queue during PM peak hour in the northbound approach is expected to back up to the next intersection.

Table 4 shows the queue analysis result for the metered roundabout option. Under this option, the maximum queue length along northbound approach is expected to reduce significantly.

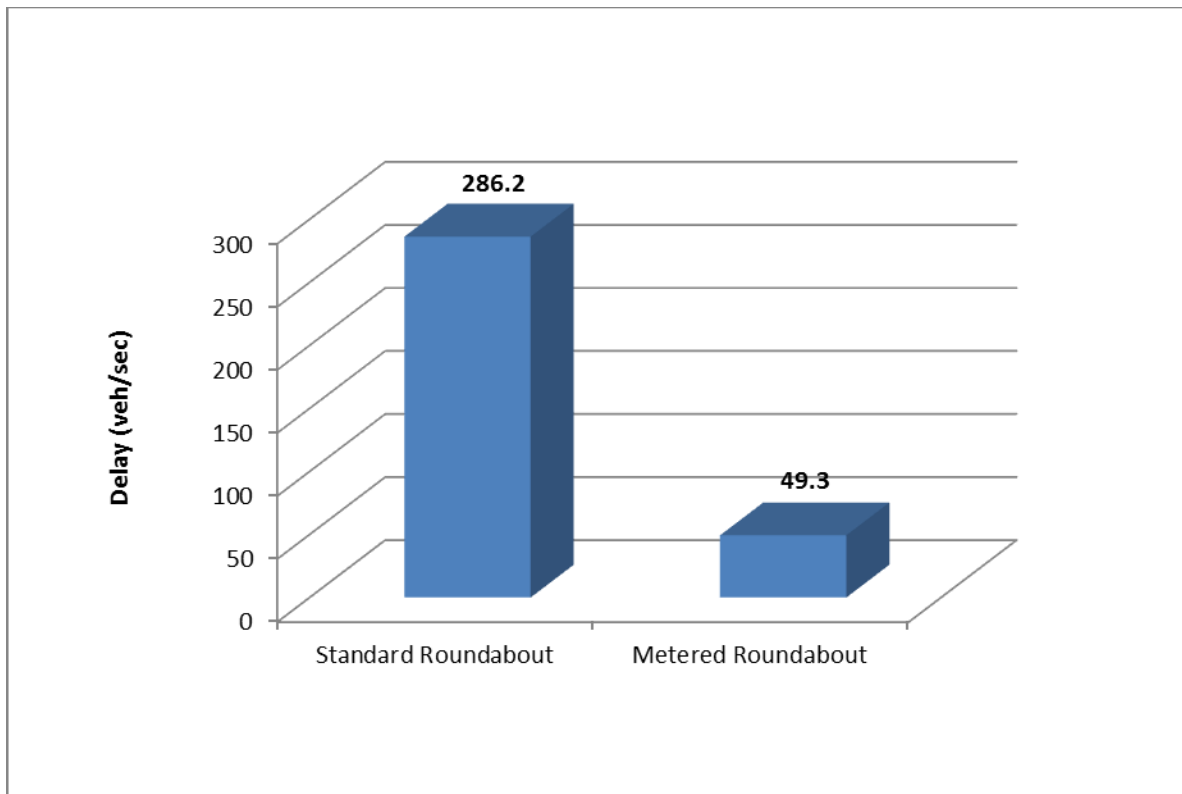
Table 4
Queue Analysis Results: Metered Roundabout

Queue Analysis (Metered Roundabout)						
Intersection Location	Control	Approach (Movement)	Avg. Queue (ft.)		Max. Queue (ft.)	
			AM	PM	AM	PM
7th Street/Shoreline Drive	Roundabout (metered with Traffic Signal)	Northbound	46	367	336	695
		Southbound	25	138	199	898
		Westbound	25	138	199	898
		Entire Roundabout	102	25	723	125

CONCLUSIONS

Based on the analysis, metered roundabout option is expected to provide better traffic operations compared to the standard roundabout option for the Shoreline Drive/7th Street intersection, during both morning and evening peak hours. **Exhibit 1** shows overall delay comparison for standard and metered roundabout during PM peak hour. As shown in **Exhibit 1**, average vehicle delay (all approaches) for metered roundabout option is expected to be 49.3 seconds compared to 286.2 seconds for standard roundabout option.

Exhibit 1
Average Delay Comparison: Standard vs Metered Roundabout



Standard roundabout option will not be able to serve PM peak hour traffic demand for northbound approach (i.e. traffic exiting the downtown and destined for northbound I-710), due to the lack of sufficient gaps. A metered roundabout with signal heads on both northbound and southbound approaches will be able to provide adequate capacity to serve both AM and PM peak hour traffic demand on all approaches. A metered roundabout is expected to minimize the delay and queue by eliminating stop and go condition typically experienced by a standard roundabout when operating under heavy traffic conditions. During off-peak hours (20 out of 24 hours) of the day, the metered roundabout can operate as a standard roundabout, which will result in significant improvement to the environment and fuel consumption. In addition, with a metered roundabout, commuters are expected to travel through the intersection at a lower speed and thereby addressing the safety concern raised by the City.

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