0-5578: Assessment and Validation of Managed Lanes Weaving and Access Guidelines

Background

Managed lanes provide many opportunities to improve flow on urban freeways. They can encourage carpools by giving them priority treatment, potentially increasing the number of people on the freeway while reducing the number of vehicles. Through the use of tolls, managed lanes can also be used to encourage drivers to shift their use of the freeway away from the peak periods, thus using the available capacity more efficiently. Managed lanes are often added between the left general purpose lane and the median in both directions, and can be buffer- or barrier-separated. Managed lanes are usually accessed by maneuvering across several general purpose lanes. The objective of this research was to estimate the maximum number of vehicles which can enter the general purpose lanes from an entrance ramp and then weave across to the access point of the managed lane for a range of conditions found on urban freeways.

What the Researchers Did

A right-side entrance ramp followed by a left-side managed lane access, can be modeled as a two-sided Type C weave (see figure), as specified in the Highway Capacity Manual (HCM). However, the literature review revealed that the procedure in the HCM did not reliably predict capacity for these types of weaves. As such, the researchers used VISSIM, a microscopic simulation model, to develop capacity estimates for the weave across to the access point for the managed lane.

The simulation model was extensively calibrated using data collected on IH 635 (LBJ Freeway) in Dallas. A combination of direct observation, traffic cameras, and test vehicles were used in the data collection effort. The data used in the calibration included average speeds in each general purpose lane, the number of vehicles changing lanes into the managed lane from each of the general purpose lanes, the number of vehicles entering the managed lane at specific points within the access area from an upstream entrance ramp, and the number of vehicles changing lanes out of the managed lane to specific general purpose lanes. A genetic algorithm was used in the calibration process. The calibrated simulation model was validated using data collected from a nearby location (in the opposite direction) along IH 635.

Capacity was estimated for four geometric scenarios:

- right-side entrance ramp followed by the left-side access point to the managed lane,
- left-side access point to the managed lane followed by a right-side exit ramp, and
- above two scenarios with a single intermediate right-side ramp.

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For each scenario, capacity was estimated by gradually increasing the flow in the general purpose lanes for each set of conditions until the simulation model throughput was less than the input flows, indicating the formation of queues. The specific conditions included ramp flows (500 to 1250 vph), ramp to managed lane flows (100 to 400 vph), general purpose lanes to managed lane (200 to 800 vph), and length of weave (1000 to 4000 feet). The ramp to managed lane flows were taken to be the weaving flow.

What They Found

For the first scenario, a weaving capacity of 100 vph was found for weaving areas as short as 1500 feet; increasing weaving capacities required longer weaving areas, 2000 feet for 200 vph, and 2500 to 3000 feet for 300 to 400 vph. The total flow on the ramp and the number of additional vehicles entering the managed lane at the access point were found to have only a minimal effect on the capacity of the weaving flow. Similar results were found for the second scenario (weaving to a downstream exit ramp). The presence of intermediate ramps had little effect on the weaving capacity.

What This Means

These guidelines seen in the table below can be used when selecting access points for managed lanes in order to provide reasonable access for traffic entering or leaving the freeway.

	Weaving Distance			
	Minimum		Desirable	
v_{rm} or v_{mr}, veh/hour	Four general purpose lanes, feet	Per general purpose lane, feet/lane	Four general purpose lanes, feet	Per general purpose lane, feet/lane
up to 200	2000	500	4000	1000
200 to 300	2500	625	4000	1000
300 to 400	3000	750	4000	1000
over 400	3500	875	4000*	1000*

Recommendations for minimum weaving distance between a right-side entrance ramp and the left-side access to a managed lane (v_{rm}) or between the left-side access to a managed lane and a right-side exit ramp (v_{mr}).

****A direct connection to the managed lane should be considered.***

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