

3.9 Systemwide Issues

Some of the systemwide design issues experienced in other areas involve the following, which should be considered in the design of any HOV or managed lane:

- *Consistency.* Design applications may have to address different operation regulations, but should look alike in signing and pavement markings.
 - *Suggestions:* Use the same geometric, signing and pavement marking criteria for successive projects. Test sign messages on a first project before repeating on successive projects.
- *Need for adequate lane balancing.* When two HOV or managed lanes come together, as often happens with a direct HOV access ramp between connecting facilities, downstream demand may exceed a single lane. These forced merge conditions between two HOV lanes that join from either separate routes or from a mainline and HOV flyover connector can cause queues that offset travel savings. These locations have created bottlenecks that have impacted both safety and operational performance of the respective system.
 - *Suggestions:* Carrying the commensurate number of lanes some distance downstream may be required in the design to effectively address demand. Otherwise, leave sufficient overall width to allow for restriping to two lanes at obvious future bottlenecks where demand may exceed a lane's capacity. Design for future connections and direct access connectors.
- *Communication with Different Users:* Parallel roadways located in tight settings make placement of motorist information difficult. Over the years, many strategies have been tried to simplify messages through the use of carpool and bus symbols, or other strategies to address specific users. Inevitably the roadway sign guidance found in the MUTCD for optimal settings may not be completely applicable in concentrated urban settings with roadway and ramp designs that are below current design standards.
 - *Suggestions:* Local trade-offs will be needed to best accommodate information needs for the greatest number of users. Dynamic message signing (DMS) installations may help such situations, but only if the signing is allowed to address more than one user group, depending on the situation. For example, a DMS located over an HOV lane that normally provides occupancy or pricing information may have to serve a higher and better use by reporting a major accident ahead to all users. Diamond symbols should accompany signing intended for HOV or managed lane audiences, to direct the intended message to the correct audience. Most motorists understand that the use of the diamond on a sign is related to a restricted lane.

➤ **Table 3-7: Preliminary Cost Estimates for ETC Pricing on a Managed Lane Facility**

Description	Unit Price	Quantity	Extended Price
Typical Pole Mount – Dedicated Directional Single Lane Median Divider (covers 2 lanes)			
Lane Controller	\$10,000	1	\$10,000
ETC Reader	\$10,000	1	\$10,000
ETC Antenna	\$2,500	2	\$5,000
Enforcement Cameras	\$5,000	2	\$10,000
Pricing Signage (Type 1)	\$10,000	2	\$20,000
Pole Support	\$10,000	1	\$10,000
Communications Interface	\$5,000	1	\$5,000
Total			\$70,000
Typical Cantilever – Dedicated Directional Single Lane (covers 1 lane)			
Lane Controller	\$10,000	1	\$10,000
ETC Reader	\$10,000	1	\$10,000
ETC Antenna	\$2,500	1	\$2,500
Enforcement Cameras	\$5,000	2	\$10,000
Pricing Signage (Type 2)	\$40,000	1	\$25,000
Cantilever Support	\$20,000	1	\$10,000
Communications Interface	\$5,000	1	\$5,000
Total			\$72,500
Typical Full Span Structure – Dedicated Directional Single Lane (covers 1 lane)			
Lane Controller	\$10,000	1	\$10,000
ETC Reader	\$10,000	1	\$10,000
ETC Antenna	\$2,500	1	\$2,500
Enforcement Cameras	\$5,000	2	\$10,000
Pricing Signage (Type 3)	\$75,000	1	\$75,000
Full Span Support	\$50,000	1	\$50,000
Communications Interface	\$5,000	1	\$5,000
Total			\$165,000

Note: Generic cost estimates do not include any software modifications necessary to integrate sites into an existing system or for the cost of communications infrastructure to link the project to a remote site. No costs have been estimated for other instrumentation necessary to monitor traffic conditions or to provide video surveillance of the facility. No Automatic Vehicle Classification (AVC) equipment is included.

- *Flexibility.* A recent review of HOV projects implemented since 1969 showed that a high percentage had changed either their occupancy requirements, hours of operation, access or mainline design features over time. The reasons for such operation and design changes were many.

- *Suggestions:* Designing in flexibility into the managed lane roadway system helps promote greater opportunity for future changes. Specific features that help promote flexibility include:
 - Locating drainage inlets out of the shoulders or buffer areas
 - Leaving wide clear zones around bridge columns
 - Implementing changeable message signing where near term potential exists to add pricing or access features
 - Casting and placing barriers that are not integral to the pavement, so that relocation can be more easily accommodated
 - Placement of signs on common structures, even if the most optimal placement is compromised
 - Using markings that can be easily altered in access zones until such time that operation confirms the length and location of the zone
 - Providing shoulders on the mainline and ramps
 - Maintaining proper clear zones around gores
 - Avoiding superelevations and other physical separation between managed lanes and general purpose lanes