

Acceleration Distance Provision to Accommodate Trucks on Metered Ramps

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Background

- Ramp metering warrants including Acceleration lane Distance and Queue Storage Distance warrant have been developed by state agencies.
- Balance between these two parameters is needed to ensure preventing the queue spill back to the upstream arterials at the same time of allowing safe merge of the vehicles into the freeway traffic stream.
- In particular, acceleration length required for trucks is an issue because of their lower acceleration capability than compared to passenger cars.

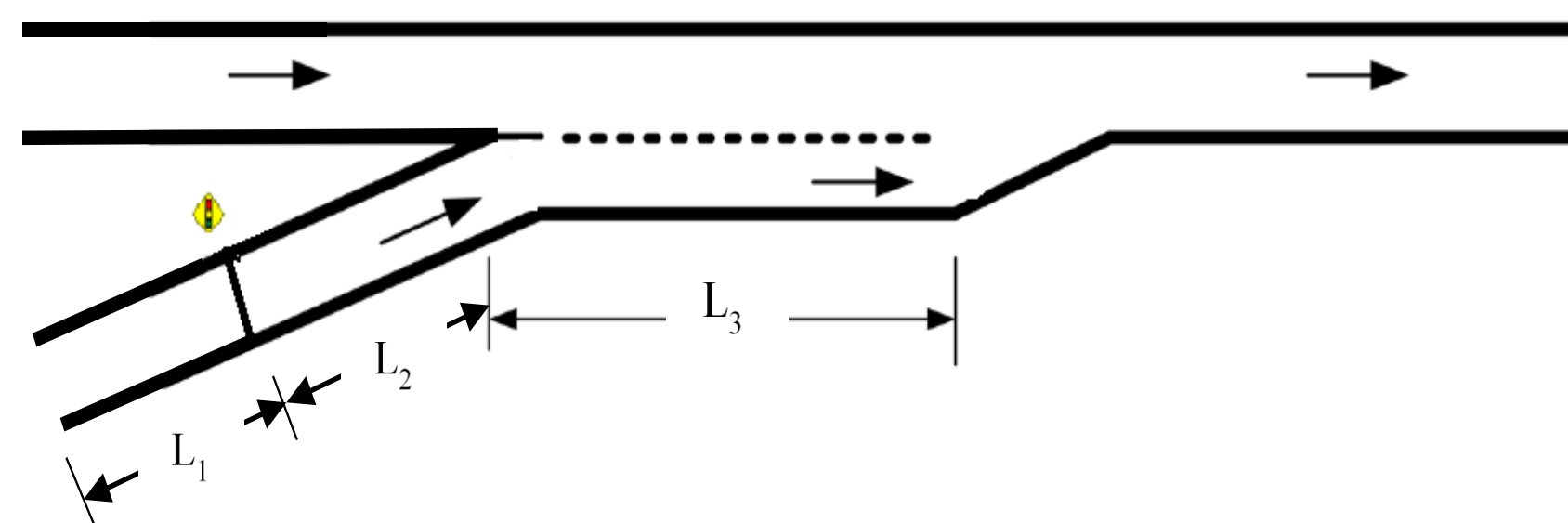


Figure 1: Illustration of the Balance between Queue Storage Length and Available Acceleration Length

Objective

- Investigate the balance between the acceleration distance requirements and queuing storage with consideration of on-ramp truck traffic.
- Assessment of a number of approaches to accommodate trucks so that they can accelerate to an acceptable merging speed.

Studies Provided Useful Parameters

- AASHTO. *A Policy on Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials, Washington, D.C., 2011.
- Gattis, J., M. Bryant, and L. Duncan. *Acceleration Lane Design for Higher Truck Volumes*. Mack-Blackwell Transportation Center, Fayetteville, AR. 2008.
- Tian, Z. et. al., *Queue Storage and Acceleration Lane Length Design at Metered On-ramps in California*. Final Report for California Department of Transportation, Research Project # 65A0486, 2016

Comparison of Acceleration Lane Length Design Recommendations to Merge at Design Speed 70mph

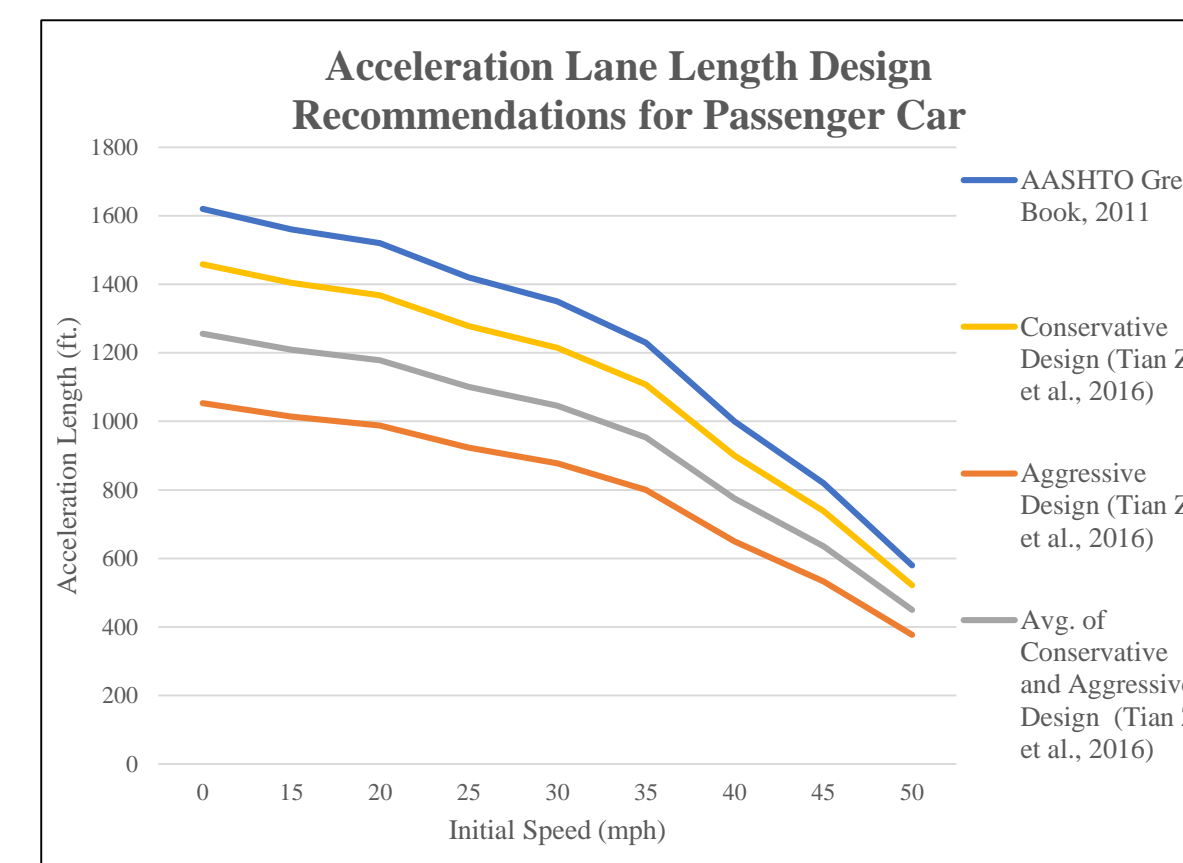


Figure 2 Comparison of PC Acceleration Length Requirements According to Different Sources to merge at design speed 70 mph

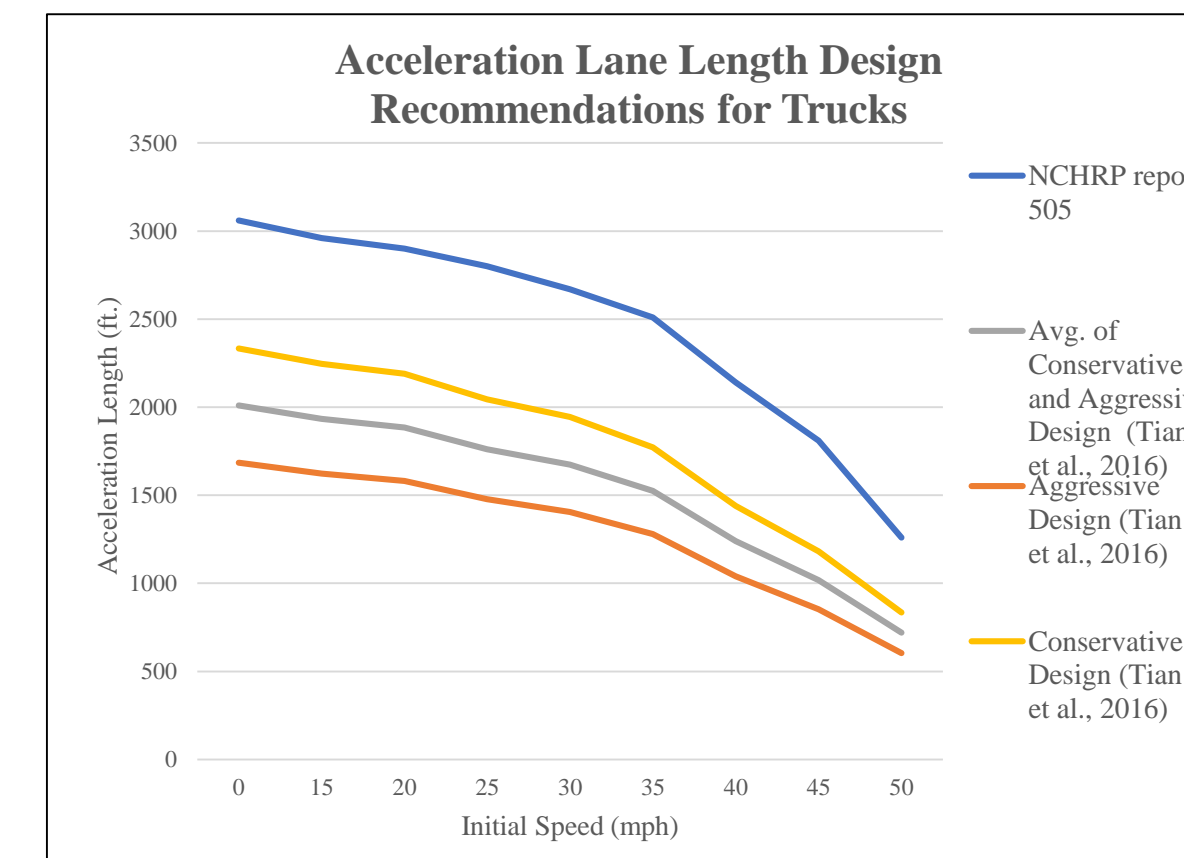


Figure 3 Comparison of Trucks Acceleration Length Requirements According Sources to merge at design speed 70 mph

Comparison Between Recommended Existing Acceleration Lane Length

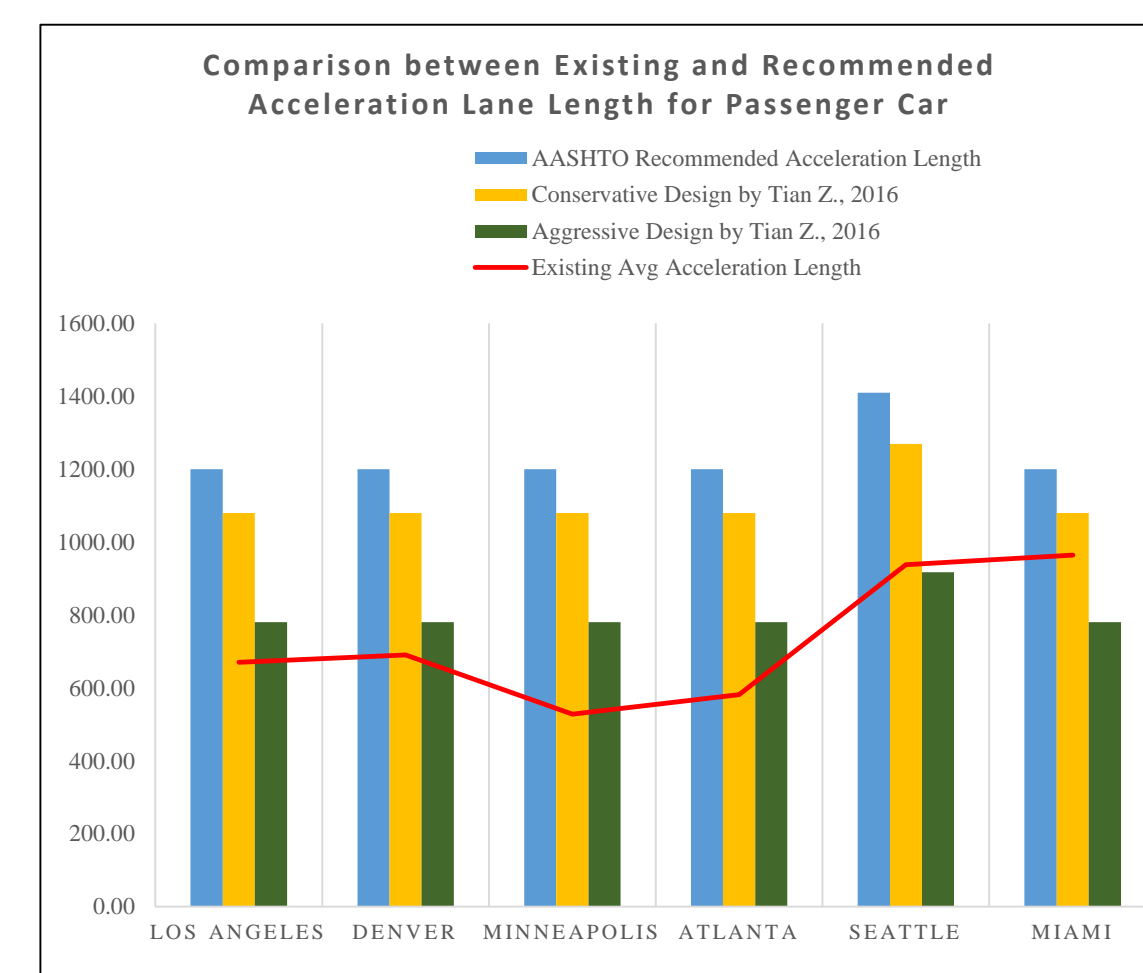


Figure 4 Statistics of the Acceleration Lane Lengths and their Comparison with recommended Design PC Acceleration Length

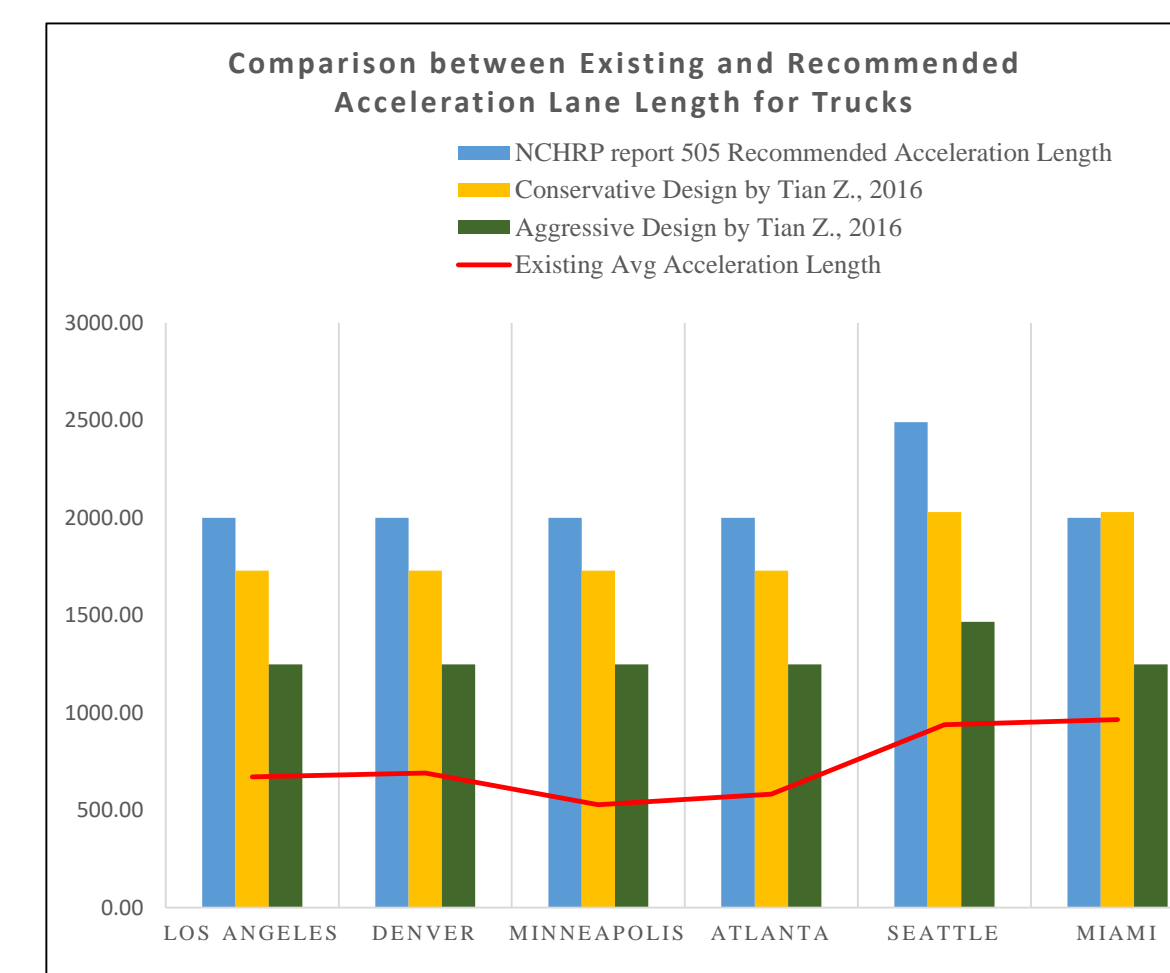


Figure 5 Statistics of the Acceleration Lane Lengths and their Comparison with recommended Design PC Acceleration Length

Approaches to Accommodate Trucks

- Not to include the on-ramp in the metering
- Pushing the metering stop line back on the on-ramp increasing the acceleration distance
- Providing truck preemption on the on-ramp to turn the ramp metering signal to green once a truck is detected
- allow the truck to accelerate to an acceptable speed when merging
- Providing a lane for truck by-pass at a distance that allows the truck to accelerate to an acceptable speed when merging
- Diverting the truck traffic to other ramps with sufficient acceleration lengths during the ramp metering periods

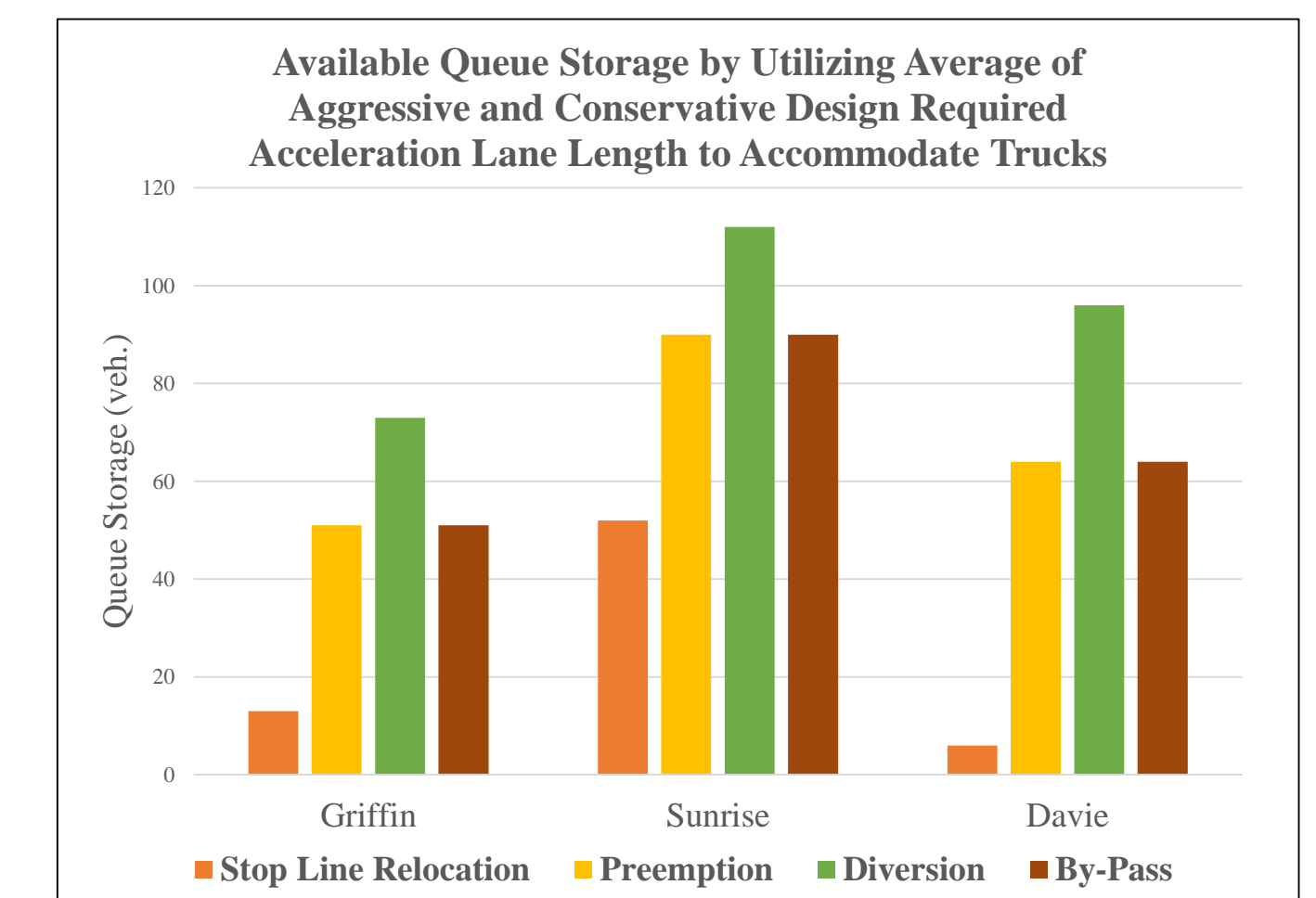


Figure 6 Assessment of Different Alternatives in terms of Available Queue Storage

Conclusion & Recommendations

- Queue Storage analysis shows that diversion of all trucks to another ramp with sufficient acceleration lane length supplies maximum queue storage. This approach may provide a good balance between acceleration length and queue storage length.
- Preemption of trucks and providing By-pass lane for trucks can also be a beneficial solution, on the other hand stop line relocation may solve acceleration lane length problem but also has higher probability of generating queue spillback to the arterials.
- The results from this study can be used to assess the trade-offs associated with the selection of the above alternatives