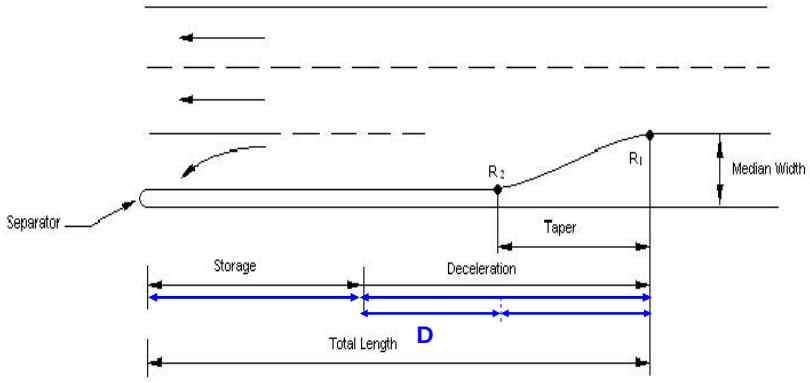
Left-turn Lane Deceleration Lengths Determination Using VISSIM

Lei Guo
Texas Southern University
Instructor: Dr. Yi Qi

Department of Transportation Studies

What is Deceleration Length?



Total length= Deceleration length + Storage length

Deceleration length = Taper Length + Length for Fully Deceleration

Why this Research?

- Surveyed TxDOT Traffic Engineers, District Engineers and Austin Area Chapter of TexITE (26 responses)
- Major findings related to the deceleration length
  - TxDOT manual yields longer deceleration length.
  - In the peak hour, due to relatively low traffic speed, the deceleration length could be shorter

Literature Review: Analytical methods

$$D = \frac{V^2 - V_0^2}{2a}$$

OR

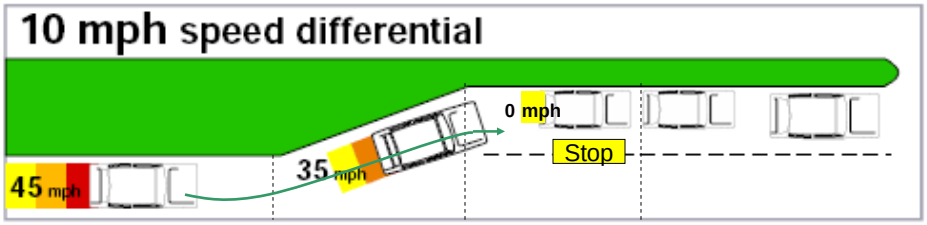
Based on experiences

Table 1: Recommended Length for Deceleration Lane

Source: TxDOT Roadway Design Manual

Speed (mile)	Taper Length (Ft)	Deceleration Length (Ft)
30.00	50.00	160.00
35.00	50.00	215.00
40.00	50.00	275.00
45.00	100.00	345.00
50.00	100.00	425.00
55.00	100.00	510.00

Why Do We Care about Deceleration Distance?



Safety!!!

How to Apply VISSIM to Get Deceleration Length?

- Develop Relationship Between:

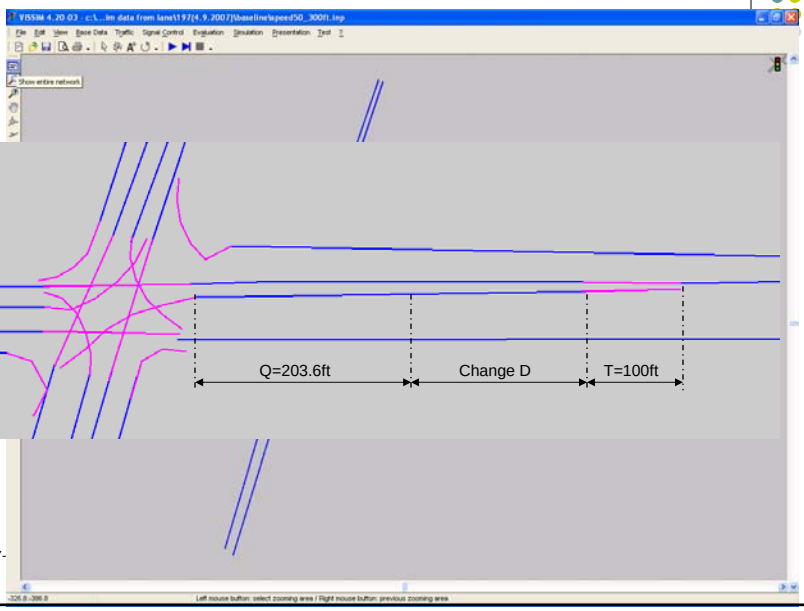
- Find the according deceleration length for the comfortable deceleration rate (9ft/s²)

How to Apply VISSIM to Get Deceleration Length?

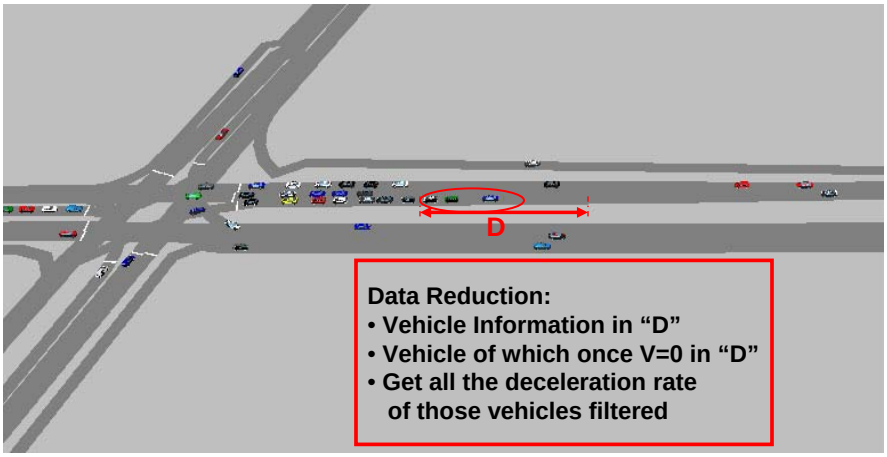
- Static Inputs:
  - Queue Storage Length
  - Taper Length (TxDOT manual)
  - Speed Range

  Variable Input
  - Deceleration Lengths
- Output
  - Speed, Deceleration Rate, Vehicle Location….

Design Speed Deceleration Lengths



Output Analysis

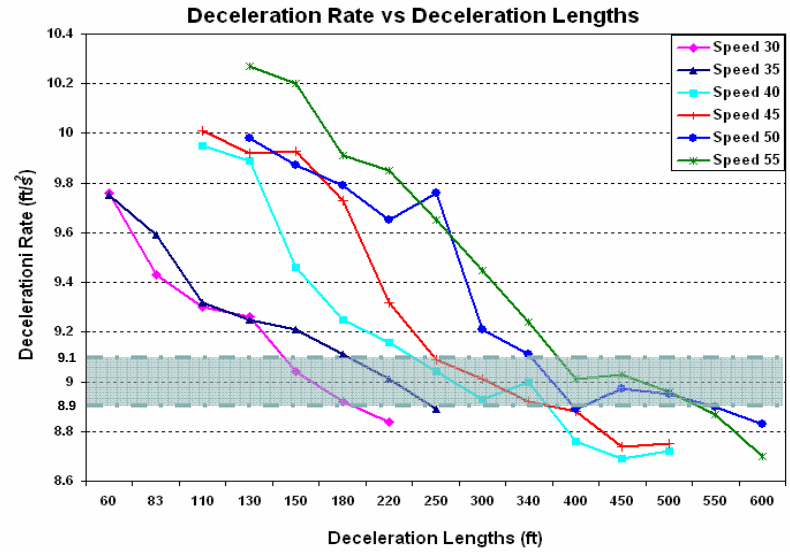


Results Analysis

- 85th percentile “Deceleration Rate (ft/s²)”

Deceleration Lengths(ft)	Speed (mph)					
	30	35	40	45	50	55
60	9.76	9.75				
80	9.43	9.59				
110	9.3	9.32	9.95	10.01		
130	9.26	9.25	9.89	9.92	9.98	10.27
150	9.04	9.21	9.46	9.93	9.87	10.2
180	8.92	9.11	9.25	9.73	9.79	9.91
220	8.84	9.01	9.16	9.32	9.65	9.85
250		8.89	9.04	9.09	9.76	9.65
300			8.93	9.01	9.21	9.45
340			9	8.92	9.07	9.24
400			8.76	8.88	8.96	9.01
450			8.69	8.74	8.91	9.03
500			8.72	8.75	8.88	8.96
550					8.9	8.87
600					8.83	8.7

Results

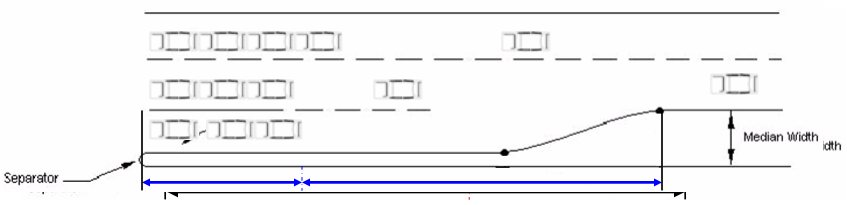


Compare with TxDOT Manual

Speed (mph)	Deceleration Length (ft) (TxDOT)	Deceleration Length (ft) (Our Method)
30	160	150
35	215	220
40	275	250
45	345	300
50	425	380
55	510	450

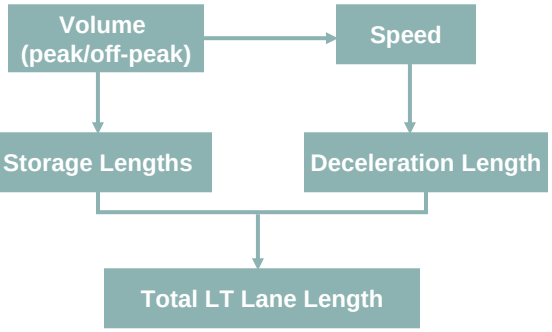
Method for estimating LT lane length

- Impacts of peak hour and off-peak hour traffic conditions:



Off-peak Hour

Method for estimating LT lane length



Minimum Design Length
= Maximum { (Queue Length + Deceleration Length)$|_{\text{peak hour}}$,
(Queue Length + Deceleration Length) $|_{\text{off-peak-hour}}$}

Conclusion

- Simulation method: Dynamic traffic variables can be better considered (“a” is not a constant variable)
- Result: Agree with the survey results
- The impacts of peak hour and off-peak hour traffic conditions can be taken into account for estimating the total length of left-turn lane.

Any Question?