406.03 EFFECT OF VERTICAL PROFILES

A vehicle descending a grade requires greater stopping distance than one on level ground. Conversely, a vehicle ascending a grade requires less distance to stop. Grades up to 3 percent have little effect on stopping sight distances. In no case should the grades exceed 6 percent.

For Stop Controlled intersections, the time required to cross a roadway is affected by the crossing grade. If the grade is significant, the sight distance should be increased.

Where the intersection leg grades are other than flat, corrections should be made to the sight distances using the approximate ratios given in Table 400.02.

Table 400.02

t_a Adjustment For Grade Sight Triangle Distances

Ratio, t_a on grade / t_a level (Figure 400.05)

	Crossroad Grade %				
Design Vehicle	-4	-2	0	2	4
P	0.7	0.9	1.0	1.1	1.3
SU	0.8	0.9	1.0	1.1	1.3
WB-15	0.8	0.9	1.0	1.2	1.7

Use this table to adjust t_a values for effect of grade. Based on the likely range of crossing distances.

406.04 LEFT-TURN CHANNELIZATION

General - A left-turn lane expedites through traffic flow, controls turning traffic movement, and improves the intersection safety and capacity.

The left-turn lane should be laid out such that the turning vehicle must make a definite move to enter the lane. The desirable length of the left-turn lane is the sum of the required storage length and deceleration length, including the bay taper length.

Width - The desirable left-turn lane width should be 3.65 m. Three meter wide left-turn lanes may be used on low speed urban roadways. The width is measured from the adjacent edge of travelled way, excluding shy distance.

Medians - To improve left-turn visibility, the left-turn-lane should be placed as far to the left as possible in the median leaving only the painted or curbed nose. Excess width between the left-turn lane and the adjacent same-direction through lane should be treated as painted island. When left-turn lanes are placed in raised (curbed) medians, a minimum nose width of 1.0 m should remain for pedestrian refuge and traffic control devices.

Approach Tapers - On roadways with narrow or no medians, room for the left-turn lane is made by shifting traffic laterally to the right. The taper length used to effect this shift should be 0.6WV, where W = lateral shift (m) and V = design speed (kph).

Bay Tapers - The bay taper length should be short to clearly identify the additional lane. Generally the taper length should be 15:1.

Deceleration Length - Whenever feasible, the left-turn lane should provide deceleration clear of the through lanes. The minimum deceleration lengths, exclusive of bay taper and vehicle storage, for 50, 60 and 80 kph are 70, 100 and 130 m, respectively.

In urban areas, it may not be possible to provide the deceleration lengths and maintain the storage and approach taper lengths required. In these situations, these lengths should be used as a desirable goal.

Storage Length - The storage length should be sufficient:

- To store the number of vehicles during critical periods.
- To avoid left-turning vehicles stopping in the through lanes.
- So the lane entrance is not blocked by standing through traffic.

Refer to the "Highway Capacity Manual, Special Report No. 209", Transportation Research Board, 1986 for further discussion.