Rationale for Median Type Recommendations

The purpose of this technical white paper is to provide a summary of the proposed median type standards for incorporation in the Kentucky Highway Access Management Plan. The proposed standards are based on independent engineering analysis and previous research conducted on median type applications. The results of these studies are presented below.

This standard addresses median types for 2-lane and multi-lane roadways having unsignalized, at-grade intersections. The four primary median treatments considered for inclusion in this standard are:

- Undivided roadway
- Undivided roadway with Left-Turn Lanes
- Flush Median
- Nontraversable Median

Each median type identified above has been shown to have desirable operational, safety or economic benefits. The following sections identify the optimum roadway, traffic volume and access characteristics for each median type. It should be noted that traversable raised medians are not dealt with in this paper (and are not recommended) because they neither facilitate left turns nor do they provide positive control over left-turn movements.

Undivided Roadway - Undivided roadways provide an economical solution, where right of way is limited and there is a limited number of low volume access points to the primary roadway. Undivided roadways should only be considered when left turning vehicles do not interfere with advancing or opposing traffic due to 1) infrequency and low volume of the left turn movement and 2) low volume of advancing and opposing traffic.

Undivided Roadway with Left-Turn lanes - When the volume of turning and through traffic exceeds minimal levels, resulting in increasing delay for through and turning traffic, the construction of an exclusive auxiliary left-turn lane should be considered to remove left turning traffic from the advancing traffic stream.

Warrants should be adopted, based on operational and queuing analysis, identifying minimum volume thresholds that would warrant a left-turn lane.

Left-turn lanes should be constructed with adequate length to provide for 1) storage of queued turning vehicles and 2) deceleration on high speed roadways.

Guidelines should be developed or adopted that address proper storage and deceleration length requirements for left-turn lanes.

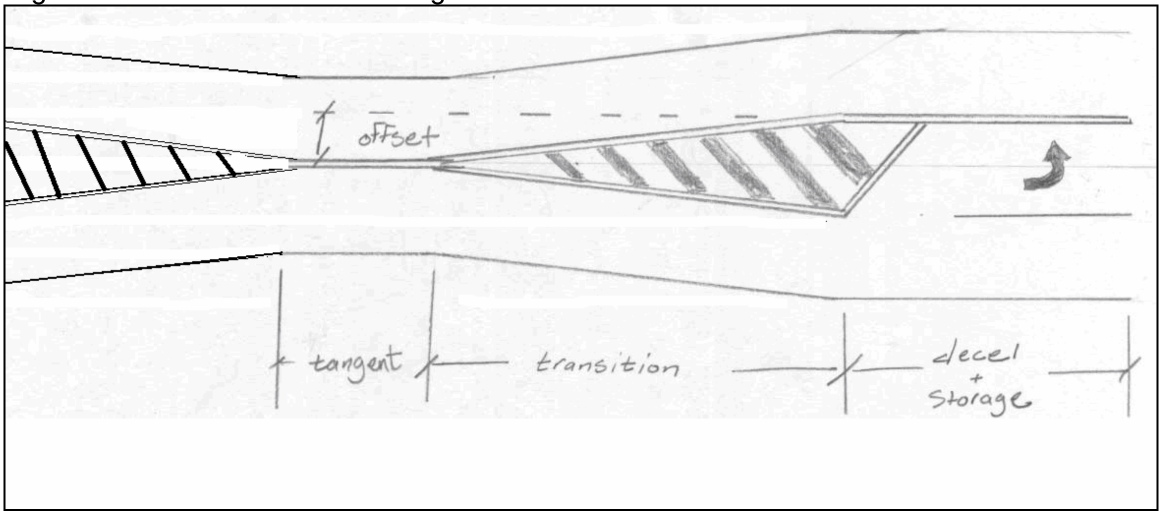
In addition, proper transitions should be used when widening an undivided roadway to provide for a median left-turn lane. Transition lengths can be determined using the Equations 1 and 2, given below (1). A minimum tangent length of 100 feet is recommended between transitions.

EQ 1. $L = WS$ (For Speeds greater than or equal to 45 mph)
EQ 2 $L = WS^2/60$ (For Speeds less than 45 mph

Where: L= Length of Transition (ft)
W= Width of Offset (ft)
S= 85^{th} Percentile or Statutory Speed Limit (mph)

Figure 1 shows the various components of the left turn lane design.

Figure 1: Left Turn Lane Design



Flush Median - In order to provide a consistent cross section, a flush median is recommended for roadways with access point densities greater than 10 ap/mi. This density represents the approximate access spacing at which it is impossible to provide proper transitions and tangent lengths as identified in Figure 1 above. At this density a center flush median lane should be considered which can be striped as individual left turn lanes or a Two-Way Left-Turn Lane (TWLTL).

The flush median should be demarcated to provide exclusive left turn lanes when possible. Left turn lanes within a flush median should provide the same storage and deceleration lengths as described above. Transitions and tangent need not be provided between left turn lanes and back to back left turn lanes may be provided. Flush median space not designated as a left turn lane should be demarcated by double yellow lines adjacent to each traffic lane with optional transverse lines in the median.

When access densities increase to the point that it is impossible to provide exclusive left turn lanes with adequate deceleration and storage length, without interfering with adjacent access points, a TWLTL should be considered.

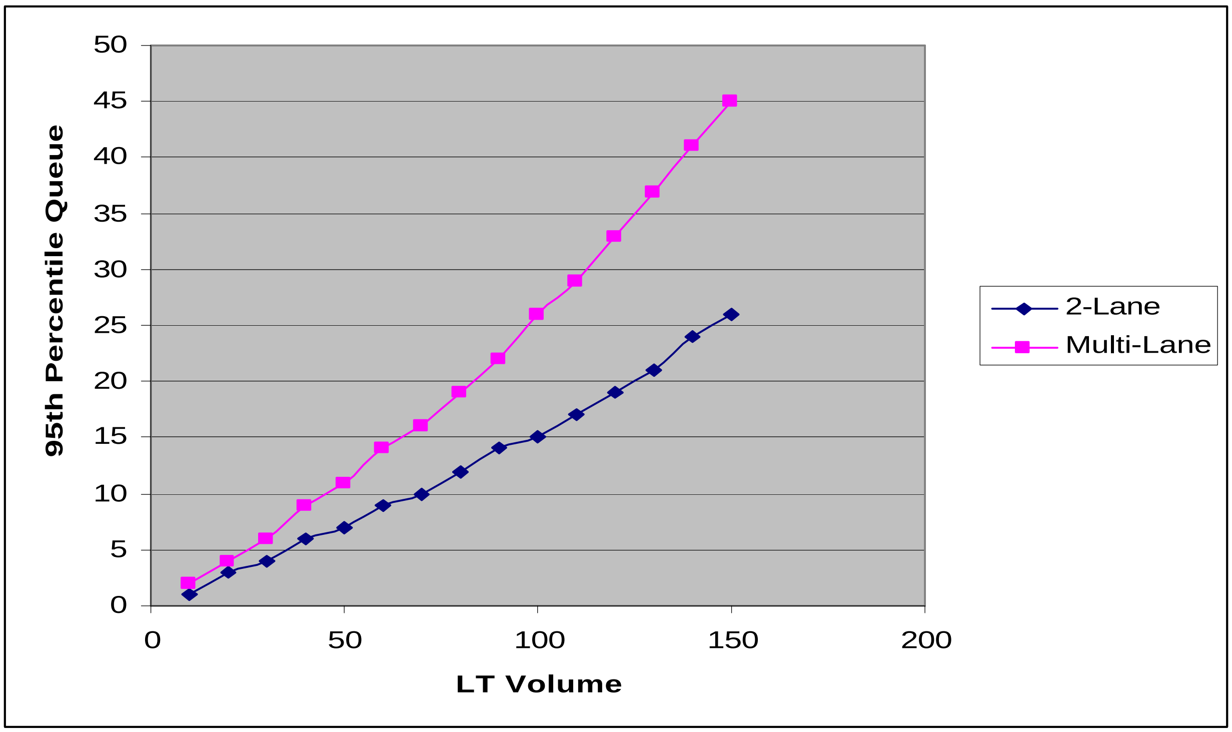
TWLTLs have been shown to provide improvements in safety and operations at moderate traffic volumes with moderate to high access point densities. The primary concern with TWLTLs is the potential for head-on conflicts between turning traffic and queuing conflicts across access points. The following volume and access density thresholds are proposed to ensure the proper operation and safety of TWLTLs.

TWLTLs are not recommended on three lane roadways having an ADT greater than 17,000 and multi-lane roadways having an ADT greater than 24,000 (2,3). At higher ADTs the availability of adequate gaps to clear left turning traffic become less frequent, increasing the delay and queuing of left turning traffic and increasing the potential for queuing conflicts and traffic interfering with the through movement.

Additionally, TWLTLs are not recommended on roadways having an access point density greater than 85 ap/mi. This density is based on an average access point spacing of 125 feet, which provides adequate separation of ingress and egress turning movements based on field studies of vehicular turning and lane change behaviors (4,5). Higher access densities have the potential to significantly increase the likelihood of conflicts between turning traffic.

TWLTLs are also not recommended at access points serving left turning ingress volumes greater than 100 vph for multi-lane roadways and 150 vph for three lane roadways. These volume thresholds are based on operational and queuing analysis, and represent the volume at which the 95th percentile queue exceeds 1 vehicle (25 ft). This analysis was conducted assuming maximum opposing volume given by the recommended maximum ADT thresholds noted above, and applying K and D factors of 0.10 and 0.6, respectively. Figure 3 illustrates the queuing analysis for two-lane and multi-lane roadways.

Figure 3: Queuing Analysis



Nontraversable Median - A nontraversable median is recommended on all existing roadways in which the ADT, access density and/or turning volumes exceed the maximum thresholds established above for a TWLTL. When the TWLTL thresholds are exceeded the conversion of the access points to Right-In Right-Out (RIRO) movements, has the ability to remove conflict points from turning traffic and improve corridor operations by eliminating left mid-block turning movements.

Nontraversable medians are also recommended for the following general conditions (3,6):

- All new multilane arterials
- Existing rural multilane arterials
- Crossroads in the vicinity of interchanges
- Multilane roadways with high pedestrian activity

Summary of Median Type Guidelines

Individual left-turn lanes recommended for:

- Locations where left-turn volume exceeds warrant (to be determined), and
- Access point density <= 10 ap/mi

TWLTL generally appropriate for:

- Urban/suburban 3-lane roadways with:
  - projected ADT<17,000
  - access point density > 10 ap/mi and < 85 ap/mi
  - left-turn volume < 150 vph
- Urban/suburban multi-lane roadways with:
  - projected ADT<24,000
  - access point density > 10 ap/mi and < 85 ap/mi
  - left-turn volume < 100 vph

Nontraversable medians recommended for:

- All new multilane arterials
- Existing roadways where ADT, access density, and/or turning volumes exceed thresholds established above for TWLTLs
- Existing rural multilane arterials
- Crossroads in the vicinity of interchanges
- Multilane roadways with high pedestrian activity

Note: Traversable raised medians are not recommended since they neither facilitate left turns nor do they provide positive control over left turn movements.

References

1. "Manual on Uniform Traffic Control Devices". Federal Highway Administration. Washington, D.C., 2003.
2. "NCHRP Report 420: Impacts of Access Management Techniques." Transportation Research Board, Washington, D.C., 1999.
3. "Access Management Manual" Transportation Research Board. Washington D.C., 2003.
4. "Brevard Transportation Plan." Wilbur Smith and Associates. Cocoa FL., 2002.
5. "NYS Route 31 Transportation Study." Hamlet of Egypt, NY. 2001.
6. "NCHRP Synthesis 332: Access Management on Crossroads in the Vicinity of Interchanges" Transportation Research Board, Washington, D.C., 2004.