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INSTRUCTIONAL BULLETIN NO. 22-08

Regarding Chapter 2 – Geometric Design
Revisions due to the new Highway System Access Manual

Effective for projects that begin the ROW phase after April 1, 2022, Chapter 2 has been updated to align with the TDOT Highway System Access Manual (HSAM).

The revised sections are shown below:

SECTION 3 – INTERSECTIONS

2-300.00 INTERSECTIONS

Intersections are either at-grade (two roads meet and cross each other) or are grade-separated (i.e. an interchange). Intersections are either uncontrolled, controlled by traffic signals/signs, shared spaces (such as a roundabout), or are interchanges. Chapter 3, Multimodal Design, should be used to ensure that bicycle, pedestrian, and transit are considered in addition to roadway traffic at urban locations. The guidelines also ensure compliance with the Americans with Disabilities Act (ADA) and Public Rights-of-Way Accessibility Guidelines (PROWAG). For more information, please see the TDOT Multimodal Project Scoping Manual.

2-301.00 LANE DROP AFTER INTERSECTION

Existing two-lane highways are often widened to a multi-lane section at intersections to provide additional capacity (especially at signalized locations). When this occurs, the lane may be dropped at the intersection, at a crossroad or may carry through and transition after the intersection. In order to address the resulting lane drop situation, follow the schematic shown in *Figure 2-8, Minimum Length (X) for Lane Extensions through an Intersection Width*, which shows the minimum length for the additional through lanes required to adequately sign the lane drop and minimize lane changing within the intersection. Use *Table 2-2, Guidelines for Advance Placement of Warning Signs*, to help find the “d” value reflected in *Figure 2-8, Minimum Length (X) for Lane Extensions through an Intersection Width.* An example for computing the required transition lengths is also included with this figure.

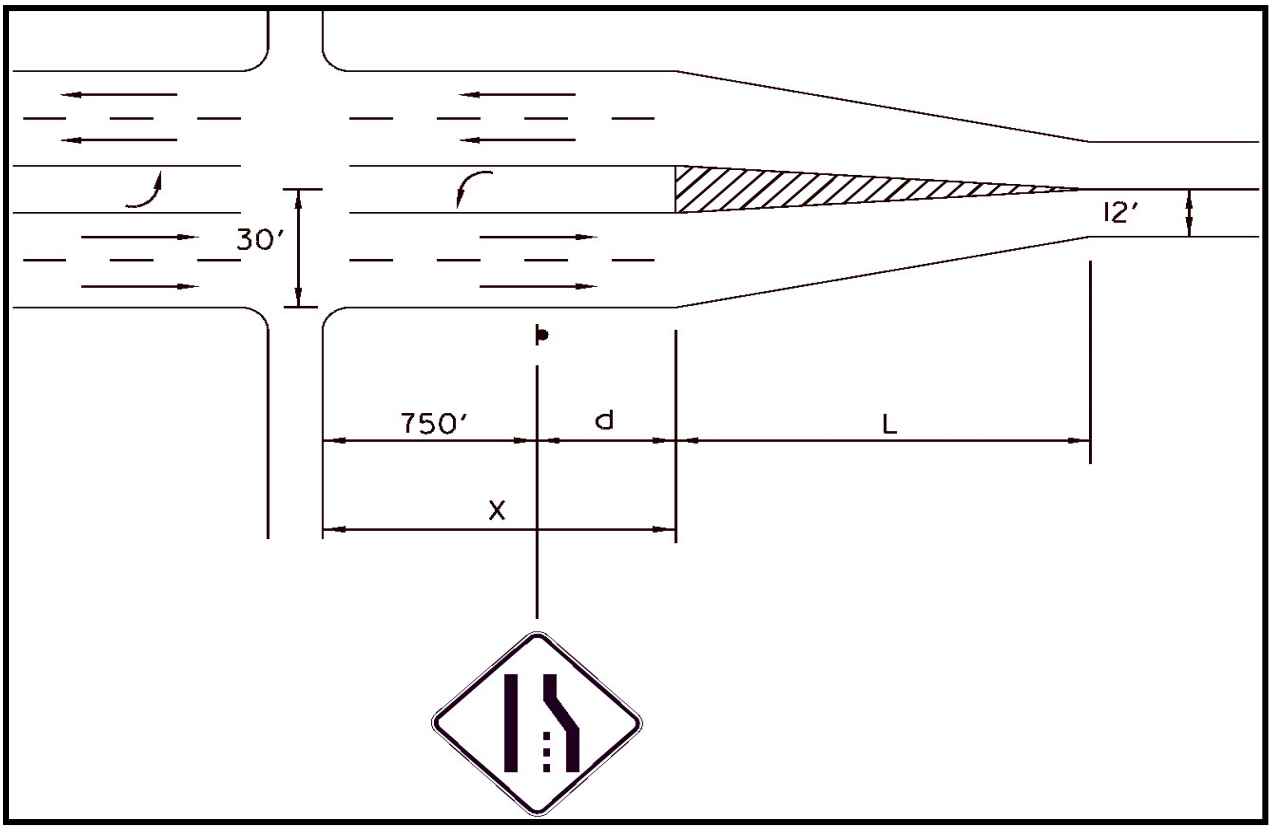

Figure 2-8
Minimum Length (X) for Lane Reduction Transition through an Intersection with A Lane Reduction Taper (L)

$$L = (S^2 \times W)/60 \text{ (for speed less than 45 mph)}$$
$$L = S \times W \text{ (for speed 45 mph or more)}$$

750 ft = Minimum distance at which sign is <u>not</u> visible to traffic approaching intersection (in order to minimize lane changing within intersection).

S = Speed (mph)

W = Width of the offset distance (ft.)

d = As required by *M.U.T.C.D.*, Sec. 2C.05, Table 2C-4, Condition A.

L = Taper length, as required by *M.U.T.C.D.*, Sec. 3B.09, Fig. 3B-14.

Note 1 Terminating the outside lane as a right-turn lane at an intersection may be considered subject to the review and approval of the TDOT Signal Section and the Design Manager.

Note 2 See *M.U.T.C.D* Section 2C.42 for guidance, options, and standard use of Lane Ends Signs.

To find "**d**" use the following table:

Posted or 85th-Percentile Speed	Advance Placement Distance[1]								
	Condition A: Speed reduction and lane changing in heavy traffic[2]	Condition B: Deceleration to the listed Advisory Speed (mph) for the Condition							
		0[3]	10[4]	20[4]	30[4]	40[4]	50[4]	60[4]	70[4]
20 mph	225 ft	100 ft[6]	N/A[5]	-	-	-	-	-	-
25 mph	325 ft	100 ft[6]	N/A[5]	N/A[5]	-	-	-	-	-
30 mph	460 ft	100 ft[6]	N/A[5]	N/A[5]	-	-	-	-	-
35 mph	565 ft	100 ft[6]	N/A[5]	N/A[5]	N/A[5]	-	-	-	-
40 mph	670 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	-	-	-	-
45 mph	775 ft	175 ft	125 ft	100 ft[6]	100 ft[6]	N/A[5]	-	-	-
50 mph	885 ft	250 ft	200 ft	175 ft	125 ft	100 ft[6]	-	-	-
55 mph	990 ft	325 ft	275 ft	225 ft	200 ft	125 ft	N/A[5]	-	-
60 mph	1,100 ft	400 ft	350 ft	325 ft	275 ft	200 ft	100 ft[6]	-	-
65 mph	1,200 ft	475 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft[6]	-
70 mph	1,250 ft	550 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	-
75 mph	1,350 ft	650 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft[6]

Table 2-1
Guidelines for Advance Placement of Warning Signs

Reference: M.U.T.C.D. 2009 Manual (Table 2C-4 of Section 2C.05)

Notes:

[1]The distances are adjusted for a sign legibility distance of 180 ft for Condition A. The distances for Condition B have been adjusted for a sign legibility distance of 250 feet, which is appropriate for an alignment warning symbol sign.

For Conditions A and B, warning signs with less than 6-inch legend or more than four words, a minimum of 100 feet should be added to the advance placement distance to provide adequate legibility of the warning sign.

[2]Typical conditions *a*re locations where the road user must use extra time to adjust speed and change lanes in heavy traffic because of a complex driving situation. Typical signs are Merge and Right Lane Ends. The distances are determined by providing the driver a PRT of 14.0 to 14.5 seconds for vehicle maneuvers (2005 AASHTO Policy, Exhibit 3-3, Decision Sight Distance, Avoidance Maneuver E) minus the legibility distance of 180 feet for the appropriate sign.

[3]Typical condition is the warning of a potential stop situation. Typical signs are Stop Ahead, Yield Ahead, Signal Ahead, and Intersection Warning signs. The distances are based on the 2005 AASHTO Policy, Exhibit 3-1, Stopping Sight Distance, providing a PRT of 2.5 seconds, a deceleration rate of 11.2 feet/second^2, minus the sign legibility distance of 180 feet.

[4]Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are Turn, Curve, Reverse Turn, or Reverse Curve. The distance is determined by providing a 2.5 second PRT, a vehicle deceleration rate of 10 feet/second^2, minus the sign legibility distance of 250 ft.

[5]No suggested distances are provided for these speeds, as the placement location is dependent on site conditions and other signing. An alignment warning sign may be placed anywhere from the point of curvature up to 100 feet in advance of the curve. However, the alignment warning sign should be installed in advance of the curve and at least 100 feet from any other signs.

[6]The minimum advance placement distance is listed as 100 feet to provide adequate spacing between signs.

EXAMPLE:

For Condition A: Speed Reduction and Lane Changing in Heavy Traffic:

Posted speed = 55 mph

X = 750 feet + d = 750 feet + 990 feet = 1,740 feet

L = S × W (for speed 45 mph or more) = 55 × 18 = 990 feet

Where:

S = Posted speed (55 mph)

W= Transition Width (30 feet – 12 feet = 18 feet)

For Condition B: Deceleration from Posted speed of 55mph to speed of 30 mph:

X = 750 feet + d = 750 feet +200 feet = 950 feet

L = (S^2 × W)/60 (for speed less than 45 mph) = (55^2 x 18)/60 = 907.5 feet

Where:

S = Posted speed (55 mph)

W= Transition Width (30 feet – 12 feet = 18 feet)

2-302.00 TURNING LANES AT INTERSECTIONS

Left and right turn lanes are added at intersections to increase capacity and improve safety and traffic flow.

The following guidelines are applicable to right and left-turn lanes and give procedures for desirable design. Design may be limited by geometric or other constraints, but these guidelines shall be followed as closely as possible. *Figure 2-9, Turning Lane Terminology*, shows the terminology for turning lanes.

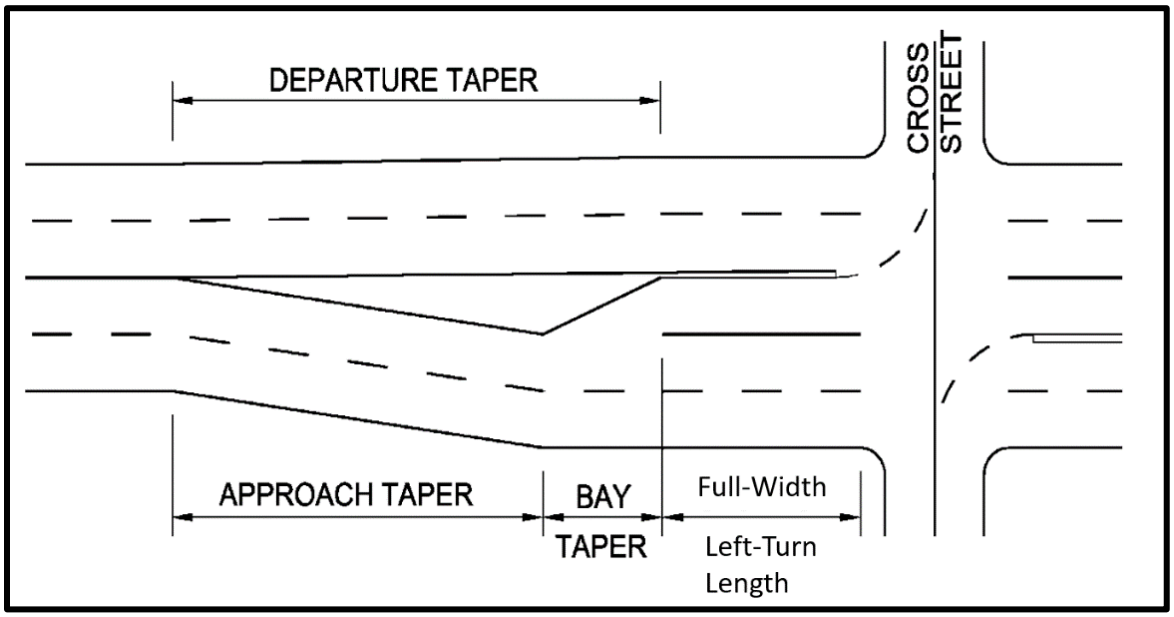

Figure 2-9

Turning Lane Terminology

1) APPROACH TAPER

(a) $L = W \times S$, Speed ≥ 45 mph

(b) $L = \frac{WS^2}{60}$, Speed < 45mph

Where: L = Length of Taper in feet

W = Width of Offset in feet;

S = Design Speed in miles per hour

2) BAY TAPER

$L = \frac{WS}{3}$, L, W, S as defined for approach taper above.

3) FULL-WIDTH LEFT-TURN LANE WIDTH

Refer to TDOT Highway Systems Access Manual, Volume 3 for turn lane warrants and guidance on turn lane sizing.

4) DEPARTURE TAPER

The departure taper begins at the end of the bay taper and ends at the beginning of the approach taper and cannot exceed the approach taper rate criteria.

2-303.00 J-TURN INTERSECTIONS

A J-turn intersection is an intersection that prevents direct crossing and left-turn movements from the minor approach roadway. This is a variation of the restricted crossing u-turn (RCUT). It is often used in areas where the crash rate is high due to motorists attempting to cross a median into oncoming traffic traveling at a high speed. *Figure 2-10***,** *J Turn in Maury County, TN*, is a J-turn located on Canaan Road and US 43/SR 6 in Mt. Pleasant, Maury County, TN. This J-turn was constructed because there were several crashes at the intersection with over 50% involving right angle collisions and a posted speed of 55 mph. From the figure, the J-turn requires side road movements to be made indirectly by making a right turn into traffic (move 1) (opposite than the direction they want to travel), traveling about a quarter-mile on the divided main road (moves 2-3-4), turning left into the median (move 5), proceeding to the J-Turn area (move 6) until it is safe to proceed into traffic (move 7) in the original direction they want to go. Refer to TDOT Highway Systems Access Manual, Volume 3 for design guidance of J-turn intersection and other U-turn dependent designs.

Figure 2-10 (Not to Scale)
J Turn in Maury County, TN

2-304.00 INTERSECTIONS LOCATED NEAR THE LIMITS OF CONSTRUCTION

On new construction or reconstruction projects when an intersection is located at the beginning or end limit of construction the project shall comply with the following:

A. If design of the intersection is included in the scope of the project defined by the technical report, the Designer shall include the entire intersection (i.e. place the construction limit at a point beyond the stop bar on the far side of the intersection from the project.) **This includes installing updates to ensure all ADA and PROWAG measures are met.**

B. If design of the intersection is not included in the scope of the work defined by the Technical Report, the Designer shall exclude the entire intersection (i.e. place the construction limit at a point no closer than the stop bar on the near side of the intersection from the project).

C. In no case shall the Designer place the construction limits between the stop bars of a signalized intersection.

SECTION 4 – INTERCHANGES

2-400.00 INTERCHANGES

There are several types of interchanges including diamond, directional, cloverleaf, single point urban interchanges (SPUI), and diverging diamonds. Information on Interchanges can be found in *A Policy of Geometric Design of Highways and Streets,* Chapter 10, AASHTO, 2018. See *Figure 2-11, Types of Interchanges*.

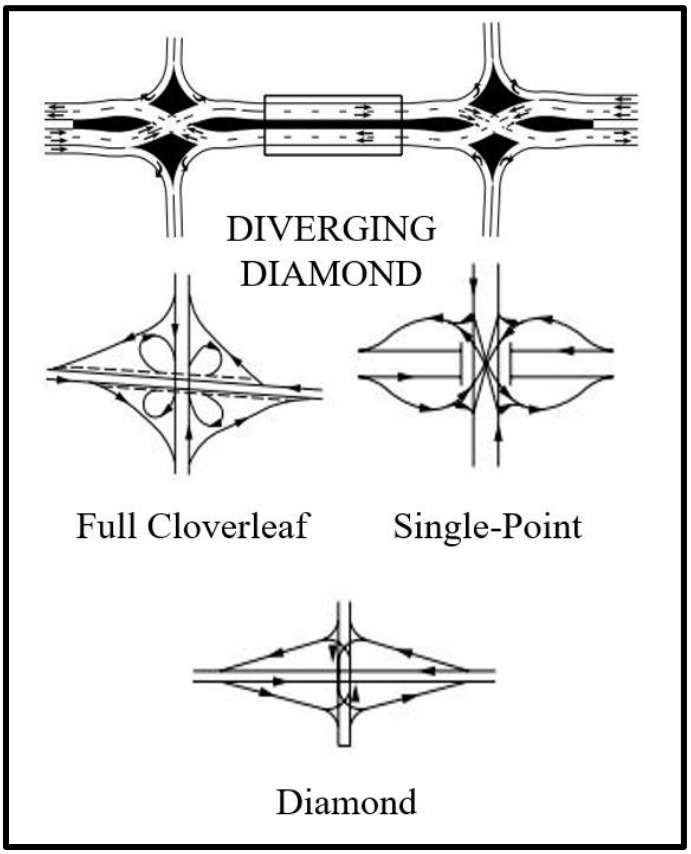

Figure 2-11

Types of Interchanges

2-400.01 INTERCHANGE RAMP DESIGN

A ramp is used to connect two or more legs at an interchange. They are composed of a terminal at each leg and a connecting road. See *A Policy of Geometric Design of Highways and Streets,* Section 10.9.6.1, AASHTO, 2018 for more information. See *Figure 2-12, Common Ramp Types*.

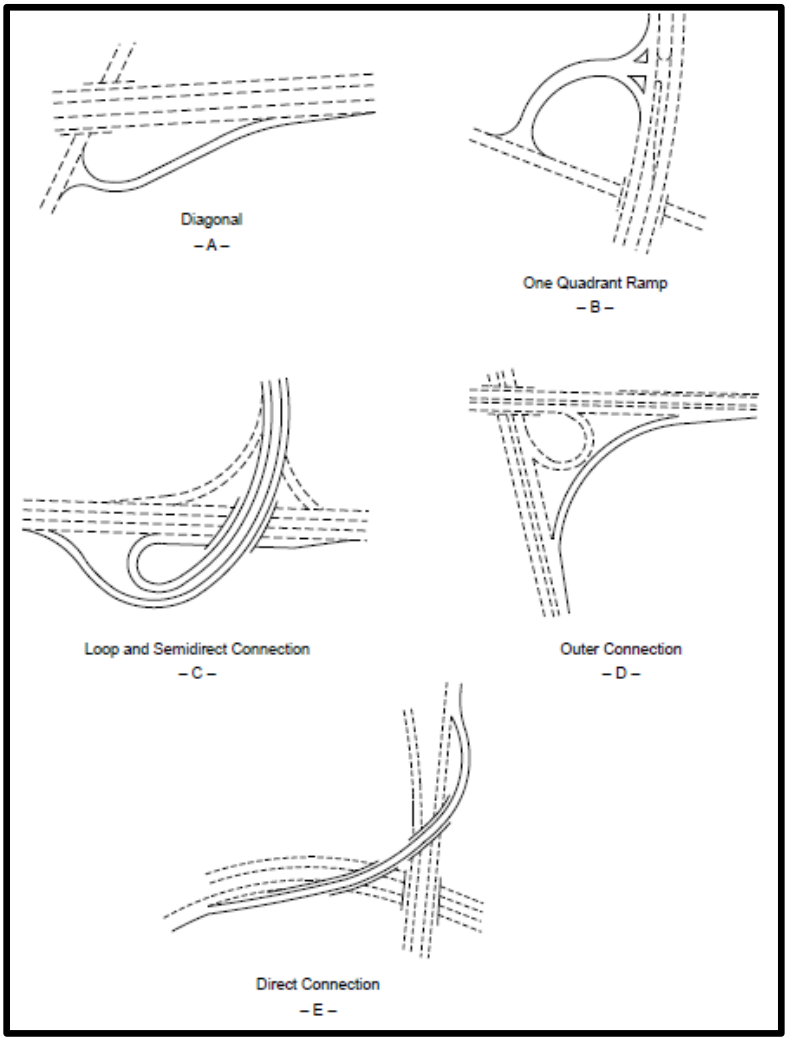

Figure 2-12

Common Ramp Types

2-400.02 TWO-LANE ENTRANCE RAMPS ON FREEWAYS AND EXPRESSWAYS

Designers shall use the parallel design when introducing two-lane entrance ramps to freeways and expressways. Parallel ramps are preferred on both single and multi-lane ramps.

The parallel design is preferable for two reasons: (1) past experience with the tapered design has been undesirable from an operational and safety standpoint; (2) uniformity of design due to the fact that most two-lane entrance ramps statewide are the parallel type.

For examples of the parallel design for two-lane entrance ramps, refer to *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2018, Figure 10-76 and Figure 10-77.

2-400.03 ACCESS CONTROL AT INTERCHANGE RAMPS

Refer to TDOT Highway Systems Access Manual, Volume 3 for spacing requirements of across points near interchange ramps.

Refer to the AASHTO Highway Safety Manual and the Interstate System Access Informational Guide for additional guidance on access control at interchange ramps.

SECTION 5 – MEDIANS

2-500.00 MEDIANS

Safety and improved traffic operations dictate the need for providing roadways with medians in the State of Tennessee. Both flush and depressed median widths and other general median principles are shown in the RD11-TS series - Typical Sections and Design Criteria section of the Roadway Standard Drawings and discussed in TDOT Highway Systems Access Manual, Volume 3. Due to safety concerns, many median divided roadways are access controlled and do not allow an opening for every private drive.

2-500.01 MEDIAN OPENING SPACING

Refer to TDOT Highway Systems Access Manual, Volume 3 for median opening spacing requirements.

2-500.02 MEDIAN OPENING SPACING - EXAMPLES

Refer to the Median Opening Spacing Guide for example problems detailing the procedure to be used in determining the appropriate median opening spacing.

2-500.03 LEFT TURN LANES IN MEDIANS

As discussed in *A Policy of Geometric Design of Highways and Streets*, Chapter 9, it is desirable to align left-turn lanes in medians – see *Figure 2-16, Left-Turn Lane Alignment*. The advantages of this placement are:

a) Better visibility of opposing through traffic as left turners look for gaps.

b) Decreased conflict between opposing left-turn vehicle paths.

c) Increased numbers of left-turn vehicles served in a given period of time. The farther left the turn lane, the shorter the crossing distance for left-turn vehicles, allowing drivers to choose shorter gaps in opposing traffic and clear the intersection. There is also an increase in capacity at signalized intersections, due to more flexibility in left-turn phasing and shorter clearance intervals.

The following guidelines apply to four-lane divided roadways with a maximum median width of 48 feet. For medians greater than 48 feet, designers should offset left turn lanes to reduce the length required for the left turn onto an intersecting road.

The centerline of left-turn lanes shall be placed along the centerline of the median, so that opposing left-turn lanes are directly opposite each other. Excess pavement area between the turn lane and adjacent through lane shall be marked with channelization striping (see *Figure 2-16, Left-Turn Lane Alignment*).

For future traffic signal warrants, see Chapter 4 in the TDOT Traffic Design Manual and use the Hourly Percentages. More information can be found in the TDOT Highway Systems Access Manual, Volume 3.

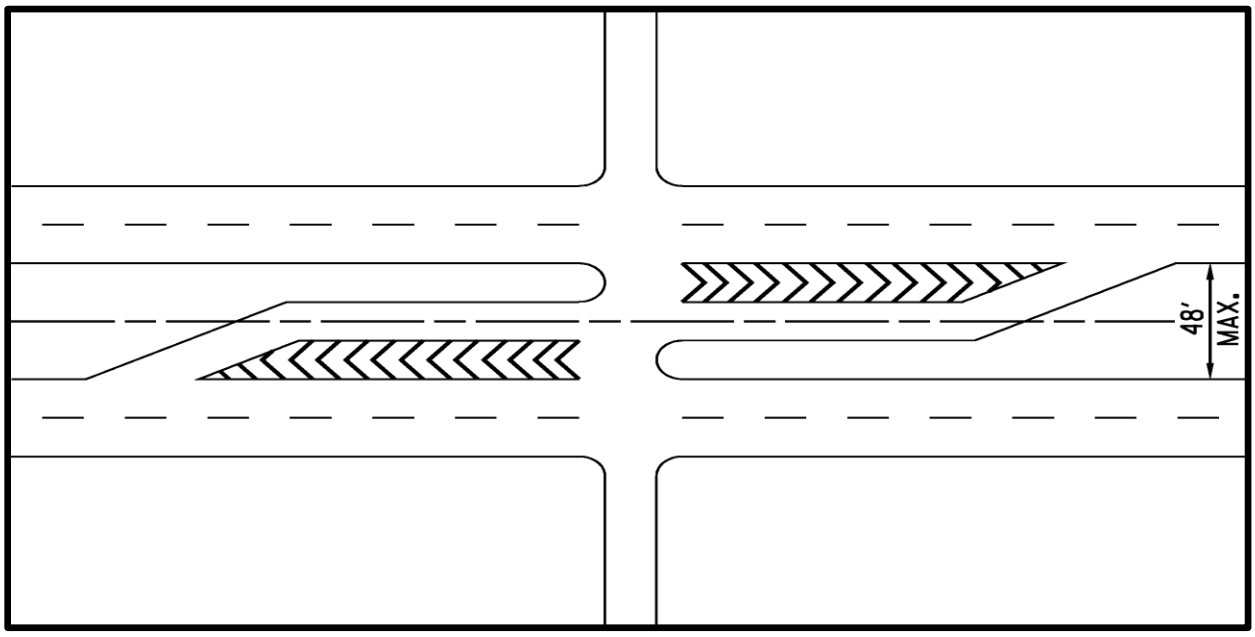

Figure 2-16

Left-Turn Lane Alignment

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KJL:LHC:MBB:WKA
May 5, 2022