North Dakota Department of Transportation

Guidelines for the Installation of Turn Lanes along State Highways

July 2014

These guidelines include the following sections:

1. Turn Lane Criteria for Non-Controlled Approaches with a Posted Speed ≥ 50mph.
2. Turn Lane Criteria for Controlled Approaches or Approaches with a Posted Speed ≤ 45mph
3. Turn Lane Offsets
4. Cost Participation and Programming of Turn Lane Installation
5. Turn Lane Design
6. Turn Lane Maintenance

1. Turn Lane Criteria for Non-Controlled Approaches with a Posted Speed ≥ 50mph

This section is applicable to non-controlled[1] approaches with a posted speed limit ≥ 50mph[2].
Left or right turn lanes may be installed at the option of NDDOT if one of the below criteria is met.

Volume Criteria

1.A The traffic volumes plot within the "Turn Lane Warranted" area of Figure 1, 2, 3, or 4 which start on the next page. When using the figures, AADT turning volumes should be converted to PCE (Passenger Car Equivalent) turning volumes as shown on page 4.

Crash Criteria

1.B There have been 2 crashes in 3 years of crash types susceptible to correction by a turn lane.

Engineering Judgment

1.C A turn lane is recommended based on engineering judgment as part of a traffic operations study. If the traffic operations study is prepared by other than NDDOT staff, NDDOT reserves the right to validate the recommendation.

2. Turn Lane Criteria for Controlled Approaches or Approaches with a Posted Speed ≤ 45mph

This section is applicable to controlled[3] approaches (any speed) and non-controlled approaches with a posted speed limit ≤ 45mph. Left or right turn lanes may be installed at the option of NDDOT if one of the following criteria is met:

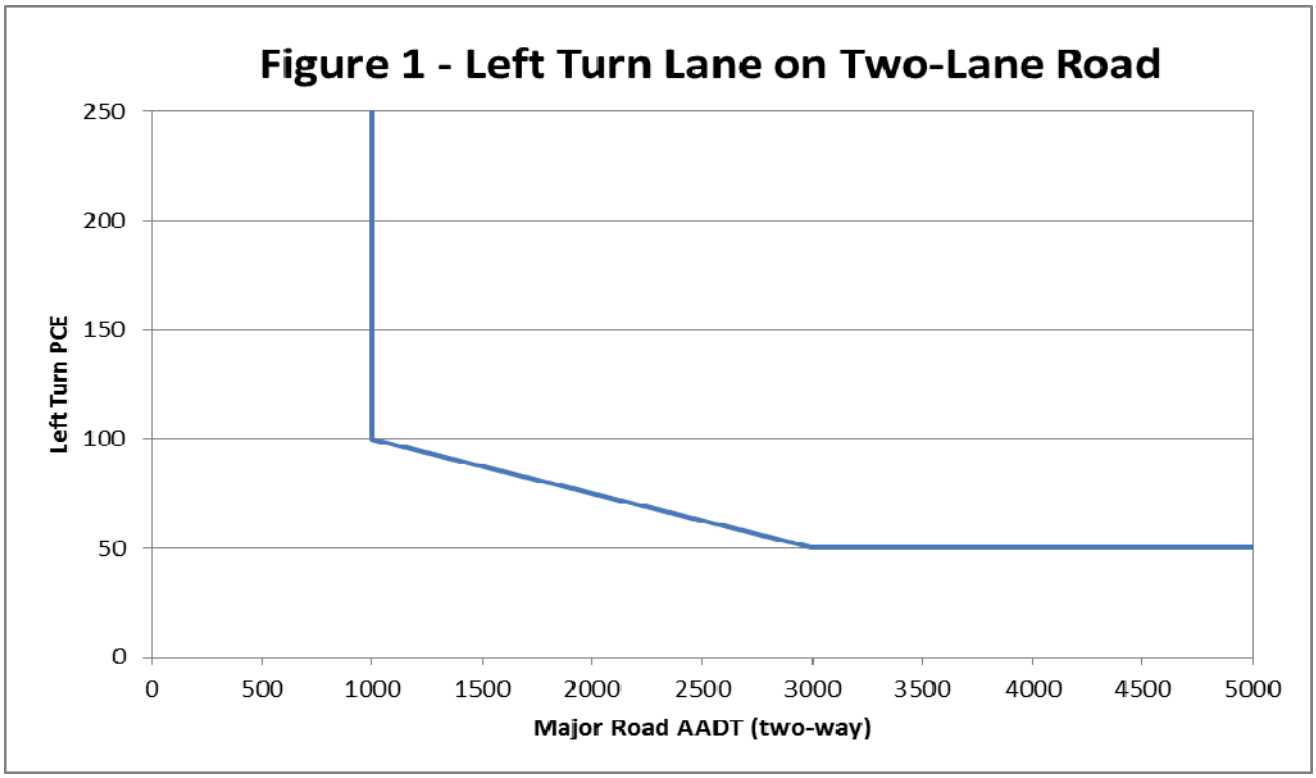
Engineering Judgment

2.A A turn lane is recommended based on engineering judgment as part of a traffic operations study. If the traffic operations study is prepared by other than NDDOT staff, NDDOT reserves the right to validate the recommendation.

1 Non-Controlled means the approach is not controlled with a traffic signal, stop sign, or yield sign. At typical intersections the mainline approaches are non-controlled (i.e. free) and the side street approaches are stop-controlled.

2 50mph is the lower limit for high-speed design, according to the AASHTO Green Book (page 2-58, 2011 Ed.).

3 Controlled means the approach is controlled with a traffic signal, stop sign, or yield sign. At typical intersections the mainline approaches are non-controlled (i.e. free) and the side street approaches are controlled with stop signs.



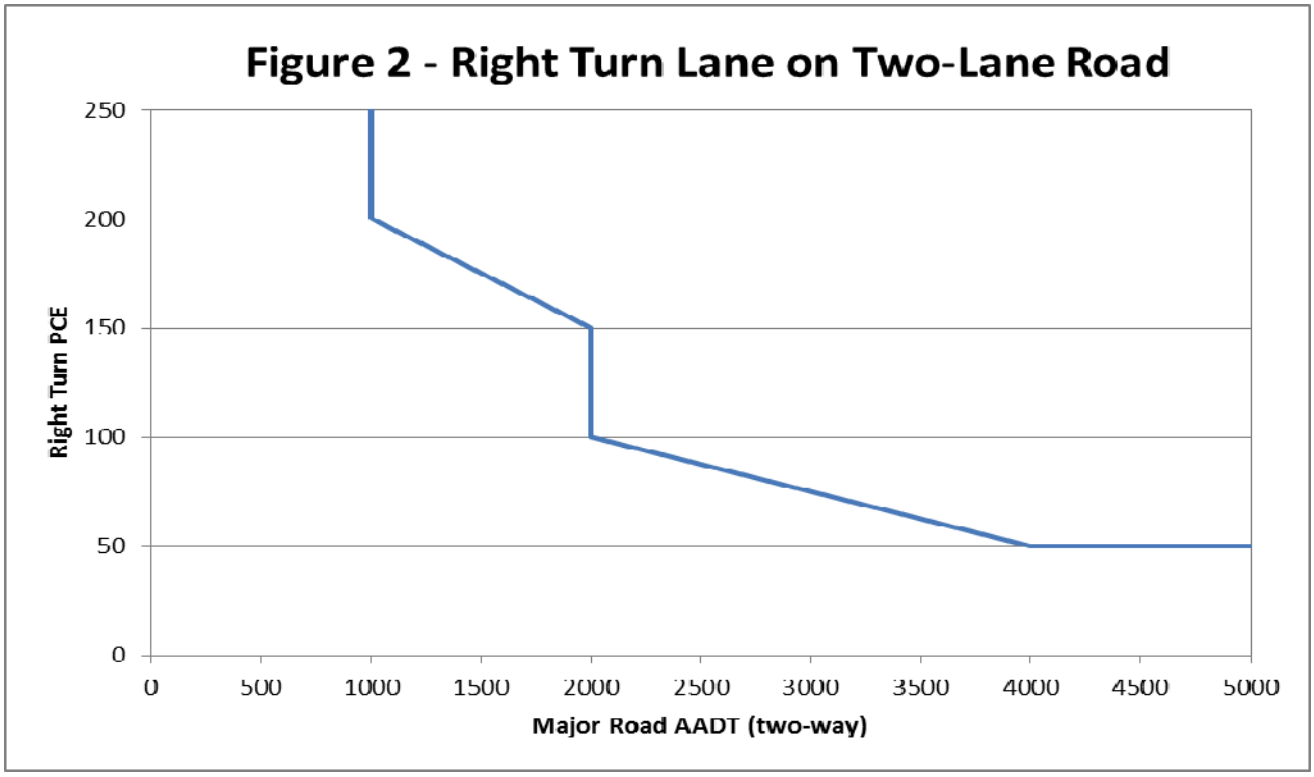
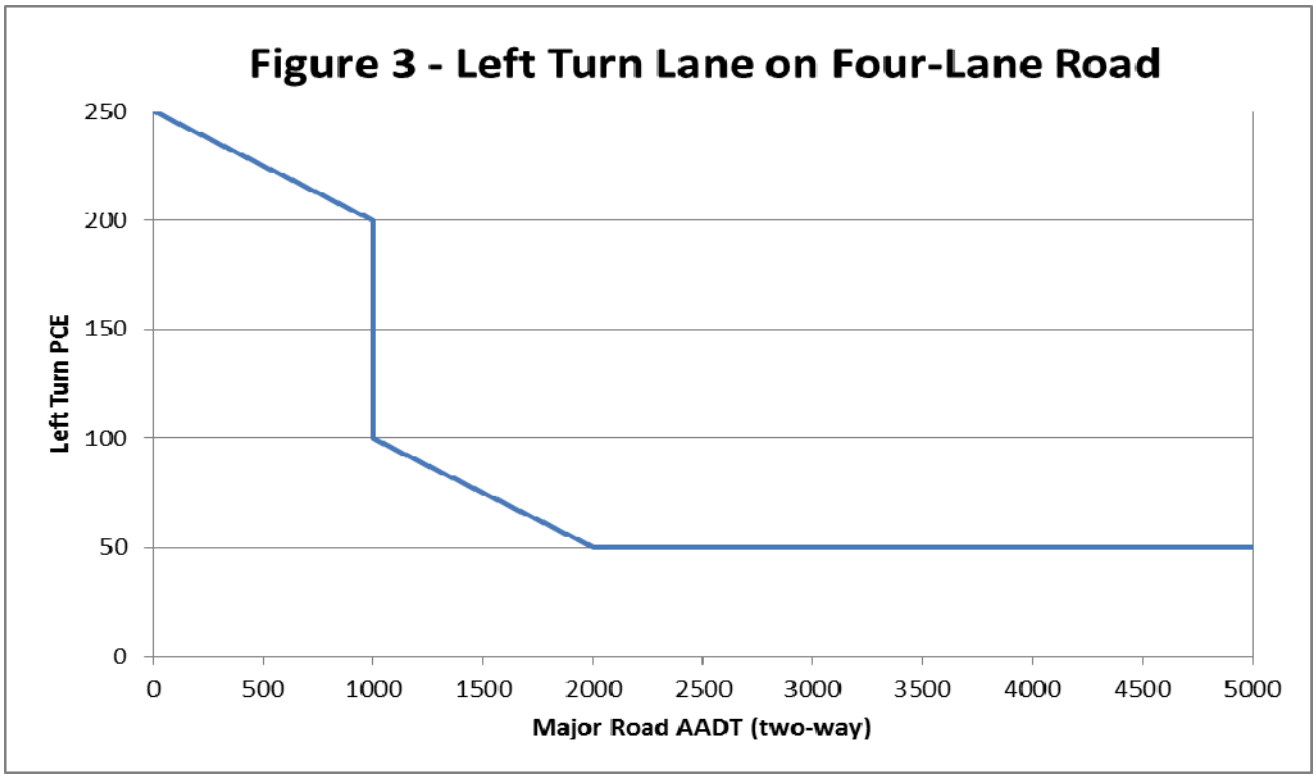


Figure 1 is based on NCHRP Report 745 Figure 2.b.

Figure 2 is based on NCHRP Report 745 Figure 2.a.



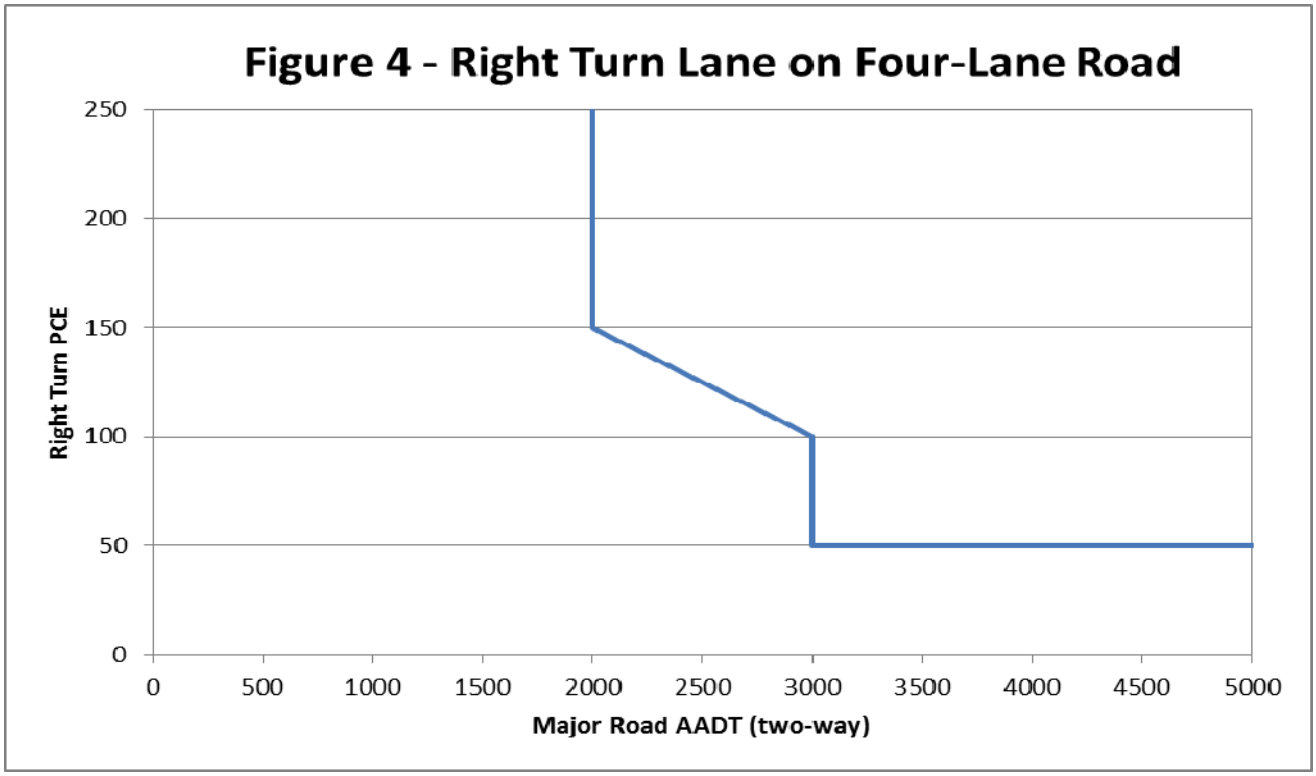


Figure 3 is based on NCHRP Report 745 Figure 3.b.

Figure 4 is based on NCHRP Report 745 Figure 3.a.

How to Convert AADT Turning Volumes to PCE Turning Volumes

PCE Turning Volume = AADT Turning Volume * T_{adj}

$T_{adj} = 1 + P_T*(E_T - 1)$

where

T_{adj} = truck adjustment factor

P_T = the percentage of trucks (expressed as a decimal)

E_T = passenger car equivalent for trucks, from below table

E_T based on Type of Terrain[4]	
Level ≤ 2%	**Rolling > 2%**
1.5	2.5
1 truck = 1.5 cars	1 truck = 2.5 cars

Example Problem

Given:

Two-Lane Road
Speed Limit = 65mph
Major Road Grade = 3.5%
Major Road AADT (two-way) = 3000 veh/day
NB to WB Left Turn AADT = 40 veh/day
NB to WB Left Turn % Trucks = 25

What is the NB to WB Left Turn PCE (Passenger Car Equivalent) Volume?

Method #1 (fewer steps)

T_{adj} = 1 + P_T*(E_T - 1)
= 1 + 0.25*(2.5 - 1)
= 1.375

Left Turn PCE = Left Turn AADT * T_{adj}
= 40 veh/day * 1.375
= **55 PCE/day**

Method #2 (more steps)

Left Turn Trucks = 25% * Left Turn AADT
= 0.25 * 40 veh/day
= 10 trucks/day

Left Turn Cars = Left Turn AADT - Left Turn Trucks
= 40 veh/day - 10 trucks/day
= 30 cars/day

Left Turn PCE = Left Turn Cars + (Left Turn Trucks * E_T)
= 30 cars/day + (10 trucks/day * 2.5)
= 30 + 25
= **55 PCE/day**

Is criterion 1.A satisfied to install a NB to WB left turn lane?

Plot point on Figure 1 (Major Road AADT = 3000, Left Turn PCE = 55).
Point is located in the area that says "Left Turn Lane Warranted".
Yes, criterion 1.A is satisfied.

4 E_T based on TRB's Highway Capacity Manual (page 14-15 2010 Ed.).

3. Turn Lane Offsets

3.A Left Turn Lane Offsets

Left turn lanes are sometimes installed with a negative offset (Figure 5a), especially at divided highway intersections. However, as appropriate, a traffic operations study may recommend that opposing left turn lanes be installed with zero offset or positive offset (Figure 5) based on engineering judgment. Positive offset left turn lanes improve the visibility of oncoming through traffic, allow left-turning drivers to utilize the available gaps more effectively, and decrease the possible conflict between opposing left-turning vehicles.

If feasible, positive offset or zero offset left turn lanes should be installed at:

- -intersections with left turn crash trends,
- -intersections with sight distance issues,
- -unsignalized intersections where the mainline left turn lanes each have a left turn PCE of 300 or more,
- -signalized intersections with permissive-only or protected-permissive left turn phasing.

3.B Right Turn Lane Offsets

Right turn lanes are typically installed adjacent to the through lane. However, as appropriate, a traffic operations study may recommend that an offset right turn lane (Figure 6) be installed based on engineering judgment. Offset right turn lanes give drivers on the minor approach (at the stop bar) an unobstructed view of through traffic in the near lanes, which allows for more effective use of gaps. When implementing offset right turn lanes, ensure the horizontal geometry of the roadway does not negate the line-of-sight improvement.

Some examples of locations where offset right turn lanes may be beneficial are:

- -intersections where a crash trend (susceptible to correction by an offset right turn lane) has been identified,
- -intersections with large volumes of turning trucks, or
- -intersections with sight distance issues.

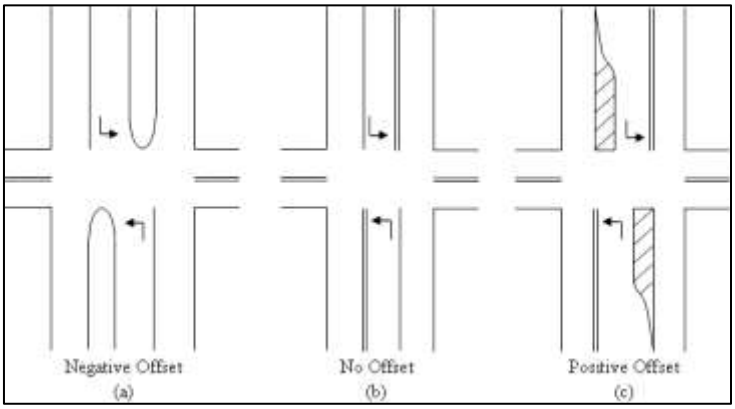


Figure 5 – Left Turn Lane Offsets


Figure 6 – Offset Right Turn Lane

4. Cost Participation and Programming of Turn Lane Installation

Cost Participation

A. Locations where the development is pre-existing that meet Criteria 1.A through 1.C or Criteria 2.A shall be funded by NDDOT. See item 4.C regarding project programming.

B. Proposed development locations that meet Criteria 1.A through 1.C or Criteria 2.A may be funded by the local governmental agency in conjunction with the zoning and platting process if immediate installation is desired. Otherwise, NDDOT will consider funding installation and follow project programming as stated in item 4.C.

Programming

C. Timing of turn lane installation is dependent upon multiple factors, such as: availability of funds, the approval process, weather, possibly waiting so the turn lane installation can be tied to an upcoming construction project, etc.

   If NDDOT is paying to install a turn lane and if there is an upcoming project in the STIP (Statewide Transportation Improvement Program), consideration should be given to installing the turn lane as part of the upcoming project (typically using the project's funding, rather than HSIP funding).

5. Turn Lane Design

A. New turn lanes shall be designed according to section III-03.05.01 of NDDOT's Design Manual.

B. Plans and specifications for all turn lanes to be installed off of or onto state highways shall be subject to approval by NDDOT.

C. Turn lanes, including the taper area, should be kept clear of any additional points of access.

D. Section III-16 of the NDDOT Design Manual discusses driveways and access management.

6. Turn Lane Maintenance

A. After installation and final acceptance, maintenance will follow NDDOT policies.