

III-03.01 Stationing

Stationing for projects should be according to Manual 90-1, Field Data Collection for Asphalt and Concrete Pavement Rehabilitation Projects.

III-03.02 Horizontal Alignments, Vertical Alignments, Roadway Width, Foreslopes, Backslopes, Drive Slopes, Ditch Block Slope, Clear Zones, Sight Distance, and Superelevation

Generally, design two lane highways to eliminate the need for no-passing zone pavement markings wherever practicable. The requirements for no-passing zone pavement markings are discussed in Part 3B of the Manual on Uniform Traffic Control Devices (MUTCD). The minimum passing sight distances required to eliminate no-passing zone pavement markings are shown in Table 3B-1 of the MUTCD. The MUTCD can be found on the web at:

<http://mutcd.fhwa.dot.gov/>

See the appropriate *DESIGN GUIDELINES* in Section I-06.03 of this manual for these elements of design.

III-03.03 Spiral Curve

Generally, spirals are used on all curves greater than one degree on rural highways. Spirals should be a minimum length of 100' and stationing should be shown in the plans in increments of 25'. The spiral length should be determined by using the *A POLICY* guidance because safety problems have been found to occur on excessively long spiral curves, due to the driver's inability to judge the sharpness of the approaching curve.

III-03.04 Interchanges

Interchanges should be designed according to *A POLICY*.

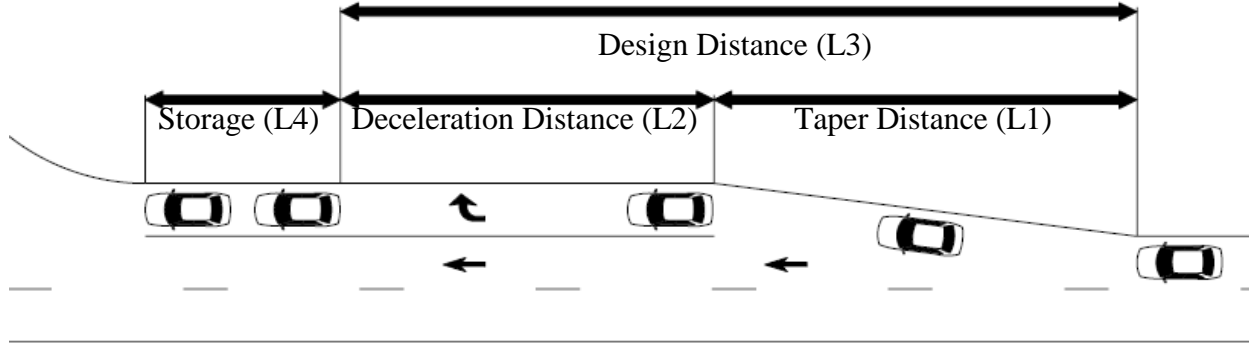
III-03.05 Intersections

Type A & B intersections are shown on Standard Drawing D-203-6.

For any highway that results in a Dead End (T-intersection), it must have a recovery approach constructed or have the proper Traffic Control Devices placed to alert the motorist. For more information, see Section III-03.05.03 and Standard Drawing D-203-7.

III-03.05.01 Turning Lanes

Whether or not turn lanes are needed is addressed in the traffic operations report.



(Drawing Not to Scale)

Taper (L1)

The Green Book states that the rate of taper should be from 8:1 to 15:1, with the smaller taper being a better target. At the lower speeds, a small taper should be used and gradually increase this length with speed, up to the stated limit of 15:1.

Deceleration (L2)

The deceleration through the taper should be considered to be a max of 10 mph. Therefore, it will be assumed that the driver will be able to reduce their speed by 10 mph after the taper distance (L1). A variable deceleration rate of 5 ft/s² to 9 ft/s² is then applied through the deceleration distance (L2) for speeds of 20 to 60 mph respectively.

Storage (L4)

Storage length shall be determined in the traffic operations report. In locations where a traffic operations study will not be completed (such as rural areas), the storage length is to be assumed equal to 0 feet.

Turn lane table for non-controlled approaches

DESIGN SPEED (MPH)	SPEED (MPH) After Taper)	TAPER	TAPER DISTANCE (FT) (L1)	DECELERATION RATE (FT/S ²)	STOPPING DISTANCE (FT) (L2)	TOTAL DISTANCE (FT)	DESIGN DISTANCE* (FT) (L3)	STORAGE DISTANCE (FT) (L4)
30	20	8:1	96	5	86	182	190*	See Note 1
35	25	8:1	96	5.5	122	218	220*	See Note 1
40	30	8:1	96	6	161	257	260*	See Note 1
45	35	12:1	144	6.5	203	347	350*	See Note 1
50	40	12:1	144	7	246	390	390*	See Note 1
55	45	15:1	180	7.5	290	470	470*	See Note 1
60	50	15:1	180	8	336	516	520*	See Note 1
65	55	15:1	180	8.5	383	563	570*	See Note 1
70	60	15:1	180	9	430	610	610*	See Note 1

Note 1: Storage length shall be determined in the traffic operations report. In locations where a traffic operations study will not be completed (such as rural areas), the storage length is to be assumed equal to 0 feet.

Note 2: Values shown above are for non-controlled approaches. Turn lane lengths for approaches with signal-control or stop-control will be determined in the traffic operations study.

*In the case that the design distance is unattainable, use engineering judgment.

III-03.05.02 Radial “T” Intersection Guide

Generally, this type of intersection is used to eliminate tangent approaches at an intersection located within a horizontal curve.

- Whether or not to use this intersection should be discussed in the Project Concept Report.
- Use for section line or county roads that intersect a state highway.
- Where two (2) state highways intersect, the traffic volumes will be reviewed to determine if the existing curve should be removed and replaced with a regular T or a radial T intersection.
- Where the Radial T is constructed the following criteria should be used:
 - The desirable superelevation on the curve should not exceed .04 ft/ft with a maximum of .06 ft/ft.
 - The horizontal curve should not exceed a curvature of 2 degrees 30 minutes.
 - The maximum grade on the curve should not exceed 2%.
 - The maximum breakover between the adjoining road and the curve portion of the pavement should not exceed 5%.
 - To improve the visibility of the intersection for vehicles traveling on the low side of the curve, delineators should be placed along both sides of the adjoining road including the radii.
 - The adjoining road should have a 50 foot level space just prior to reaching the state highway.
 - The shoulder on the high side of the curve should also be flattened to improve visibility.

III-03.05.03 Recovery Approaches

North Dakota Century Code, Section 24-01-49, states:

Approach or escape road to be built at all dead end roads or intersection of county and state highways. Whenever any highway on the state or county highway system has an intersection or dead end, there must be constructed, whenever feasible, an approach or

escape road, and when not feasible other protective devices such as warning signs, rumble strips, or barricades. This section applies to new road construction and reconstruction after July 1, 1975.

Intersection conditions where the construction of a recovery approach is not feasible must be discussed in the project concept report. The determination not to construct a recovery approach should be a decision item for approval by the Deputy Director for Engineering. Unfeasible conditions usually involve other roadway hazards such as: recovery approach that would lead into a lake, wetlands, rip-rap, steep back slope, deep ravine, or when extreme amounts of fill and right of way are needed. Note that some small wetlands can safely be traversed by the recovery approach.

Signing and/or rumble strips will be included in the intersection design when the Traffic Operations Section in the Planning and Programming Division has identified a crash problem.

There are 4 design scenarios for T-intersections:

1. A recovery approach will be constructed at all T-intersections of county and state highways, unless it is not feasible.
2. If a recovery approach is not feasible and a crash problem has not been identified, the intersection will be signed with intersection warning signs, Two-Direction Large Arrow sign (W1-7) and the T-Symbol sign (W2-4).
3. If a recovery approach is not feasible and a crash problem has been identified, the intersection will be signed with intersection warning signs, Two-Direction Large Arrow sign (W1-7) and the T-symbol sign (W2-4), and rumble strips may be installed as shown on standard drawing D-960-1.
4. If a recovery approach is feasible and a crash problem has been identified, a recovery approach will be constructed. The intersection will be signed with intersection warning signs, W1-7 and W2-4, and rumble strips may be installed as shown on standard drawing D-960-1.

If a recovery approach is constructed, a 90-1 survey should be conducted to determine what other safety work should be done to the portion of the approaching county or state highway which lies within the right of way of the highway being improved (Example: flattening of inslopes, relocation of pipes out of the clear zone).

Refer to standard drawing D-203-7 for guidance on the width, grade, radius, and location of recovery approaches in relation to the approaching highway. In addition, Figure M in Appendix III-09 A shows the signing requirements for a T-intersection.

The Traffic Operations Section of the Planning and Programming Division will provide the crash analysis and traffic control recommendations.