

5. INTERSECTIONS AND INTERCHANGES

Practices and Procedures

5-1 INTERSECTION ALIGNMENT/PROFILE

5-1.01 Intersection Alignment

See Section 9.4.2 Alignment in the *AASHTO Green Book*

5-1.02 Intersection Profile

See [Figure 5-1](#) for an illustration of profile considerations. The following will apply:

1. **Approaching Gradient.** The area where vehicles may store on the leg of an intersection should be as flat as practical. The grade on this landing area (or storage platform) should not exceed 2%, if practical.
2. **Stop-Controlled.** The profile and cross section of the major road will normally be maintained through the intersection. The cross section of the stop-controlled road will be transitioned (or warped) to match the major road. The change in gradient on the stop-controlled leg at its entrance into the intersection should not exceed 6%. If it does, the designer should insert a vertical curve approximately 50 feet long to transition from the grade on the minor road to meet the cross slope on the major road.
3. **Signal-Controlled.** The most desirable option will be to transition all approach legs into a plane section through the intersection. This will ensure that the vehicles that pass through the intersection will not "bottom out." This may be especially appropriate for arterial/arterial intersections. If this option is not practical, the designer should transition one road to meet the profile and cross section of the other road. The change in gradient on the transitioned leg at its entrance into the intersection should not exceed 4%. If it does, the designer should insert a vertical curve approximately 50 feet long to transition from the grade on the minor road to meet the cross slope on the major road.
4. **Drainage.** The profile and transitions at all intersections should be evaluated for their impact on drainage

5-2 INTERSECTION SIGHT DISTANCE

See Section 9.5 Intersection Sight Distance in the *AASHTO Green Book*

5-3 TURNING RADII

5-3.01 Design Vehicle Selection and Path

See Section 2.8 Design Vehicles in the *AASHTO Green Book*.

5-3.02 Inside Clearance

The design vehicle will be assumed to make the right turn while the inner wheels maintain approximately a 2-foot clearance from the pavement edge or curb line throughout the turn.

5-3.03 Encroachment

The following will apply to vehicular encroachment into other lanes:

1. **Initial Position.** Before the turn is made, the turning design vehicle is assumed to be in the lane which will require the most restrictive right-turn maneuver.
2. **Road From Which Turn Made.** The turning design vehicle will not encroach onto the adjacent lane on the road from which the turn is made.
3. **Road Onto Which Turn Made.** For turns onto Corridor Priority 1-4 facilities, the turning design vehicle shall not encroach into the opposing lane(s) of traffic. If there are two or more lanes of traffic moving in the same direction, it is acceptable for the turning design vehicle to occupy both travel lanes. However, if practical, the turning design vehicle will be able to make the turn while remaining entirely in the right through lane.

For turns onto Corridor Priority 6 facilities, the turning design vehicle should not encroach into the opposing lane(s) of traffic. However, if the impacts to adjacent properties because of the geometric design are significant, the designer may decide to accept an encroachment for the turning design vehicle. Turning volumes, through volumes, typical speeds approaching the intersections and the type of traffic control at the intersection shall be evaluated before accepting an encroachment for the turning design vehicle.

4. **Other.** Consideration should be given to accommodating vehicles larger than the turning design vehicle.

5-3.04 Parking Lanes/Shoulders

See Section 9.6.1 Turning Roadways in the *AASHTO Green Book*.

5-3.05 Pedestrians

See Section 9.6.1 Turning Roadways in the *AASHTO Green Book*.

5-3.06 Types of Turning Designs

Once the designer has determined the basic turning parameters (e.g., design vehicle, encroachment, inside clearance), it is necessary to select a type of turning design for the curb return which will meet these criteria and will fit the intersection constraints. The design may be one of the following basic types:

1. simple radius,
2. simple radius with entering and exiting tapers, or
3. 3-centered symmetrical compound curve.

See Figure 5-2 for an illustration of all three basic turning designs. Each design type has its advantages and disadvantages. The simple radius is the easiest to design and construct and, therefore, it is the most common. The 3-centered symmetrical compound curve arrangement provides the "best" fit to the transitional turning paths of vehicles. However, the designer should also consider the benefits of the simple radius with an entering and exiting taper. Some advantages of the simple radius/taper or 3-centered curve designs (as compared to the simple radius design) include:

1. To accommodate a specific vehicle with no encroachment, a simple radius requires greater intersection pavement area than a radius with tapers or 3-centered curve. Another benefit is the reduced right-of-way impact in the intersection corners. For large vehicles, a simple radius is often an unreasonable design, unless a channelized island is used.
2. A simple radius results in greater distances for pedestrians to cross than a radius with tapers or a 3-centered curve.
3. For angles of turn greater than 90°, a radius with tapers or a 3-centered curve is a better design than a simple radius, primarily because less intersection area is required.
4. The simple radius with tapers provides approximately the same transitional benefits as the compound curvature arrangements, but it is easier to design, survey and construct.

See Section 9.6 Turning Roadways and Channelization in the *AASHTO Green Book* for more information.

5-4 TURNING ROADWAYS

5-4.01 Design Speed

See Section 3.3.7 Turning Roadways in the *AASHTO Green Book*.

5-4.02 Horizontal Curvature

See the following Sections in the *AASHTO Green Book*:

3.3.7 Turning Roadways

9.6.1 Turning Roadways

5-4.03 Superelevation

See Section 9.6.4 Superelevation for Turning Roadways at Intersections in the *AASHTO Green Book*.

The design superelevation rate shall be the same rate of the highway adjacent to the turning roadway. See EI C6 - Superelevation Rate for more information.

5-4.04 Additional Length

At signalized intersections, the storage length on the mainline may block the entrance into the turning roadway. The designer should extend the turning roadway beyond the mainline storage length to allow access by right-turning vehicles if practical.

5-4.05 Sight Distance

See Section 9.6.7 Stopping Sight Distance for Turning Roadways in the *AASHTO Green Book*.

5-5 AUXILIARY LANES

See Section 9.7 Auxiliary Lanes in the *AASHTO Green Book* and Design Guidance – Medians and Islands.

Bypass Lanes

See Figure 5-3 for an illustration of the typical design for a bypass lane. This is a relatively inexpensive design to provide for through and left-turn movements at intersections. The bypass lane is appropriate for T-intersections (signalized or unsignalized) where left-turning volumes are light to moderate. It may also be appropriate at 4-way intersections; however, if right-turn volumes are high enough to warrant a right-turn lane, do not use a bypass lane.

The decision to use either a channelized left-turn lane or the bypass lane will be based on comparative costs, accident history, right-of-way availability, through and turning traffic volumes, design speed and available sight distance.

Dual Left Turn Lanes

All intersection design elements for dual turn lanes must be checked by using the applicable design vehicle turning template. The designer should assume that the WB-67 design vehicle will turn from the inside lane of the dual turn lane, which is the more difficult turning maneuver. The other vehicle can be assumed to be a passenger vehicle turning side by side with the WB-67.

5-6 CONTINUOUS TWO-WAY LEFT TURN LANES

Continuous two-way left-turn lanes (CTWLTL) are used as a cost-effective method to accommodate a continuous left-turn demand and to reduce delay and accidents. These lanes will often improve operations on roadways which were originally intended to serve the through movement but now must accommodate the demand for accessibility created by changes in adjacent land use. All proposed locations and proposed design details for a CTWLTL shall be coordinated with Traffic Engineering.

Lane Width

As per EI C1 – Lane Width and Shoulder Width, the width for a CTWLTL is 12 feet.

5-7 MEDIAN OPENINGS

See Section 9.8 Median Openings in the *AASHTO Green Book*.

5-8 CHANNELIZED ISLANDS

See Section 9.6.2 Channelization and 9.6.3 Islands in the *AASHTO Green Book* and Design Guidance – Medians and Islands.

5-9 ENTRANCE DESIGN

See Design Guidance – Entrance Design and Section 800 of the [Standard Details](#).

For entrances to corner lots, the minimum corner clearance is 75 feet for unsignalized intersections and 125 feet for signalized intersections. Entrances shall not be located on the radius of two intersecting roadways.

5-10 ROUNDABOUT DESIGN

See Design Guidance – Roundabout Design.

5-11 INTERCHANGES

5-11.01 Interchange Types

See Section 10.1 Introduction and General Types of Interchanges in the *AASHTO Green Book*

Diverging Diamond Interchange

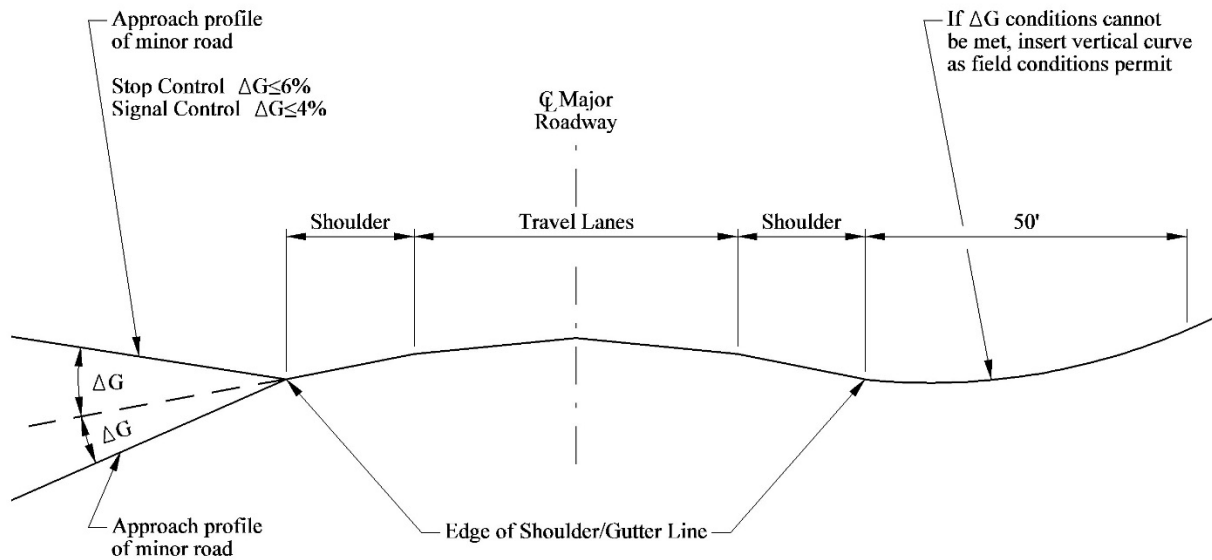
See Section 10.9.3.5 Diverging Diamond Interchanges in the *AASHTO Green Book*.

5-11.02 Ramps/Ramp Junctions

See Section 10.9.6 Ramps in the *AASHTO Green Book*

For both exit and entrance ramp terminals, parallel-type design should be used.

A flat curve (1000-1500 feet radius) should be provided with a tangent section before the first curve of an exit ramp and after the first curve of an entrance ramp.

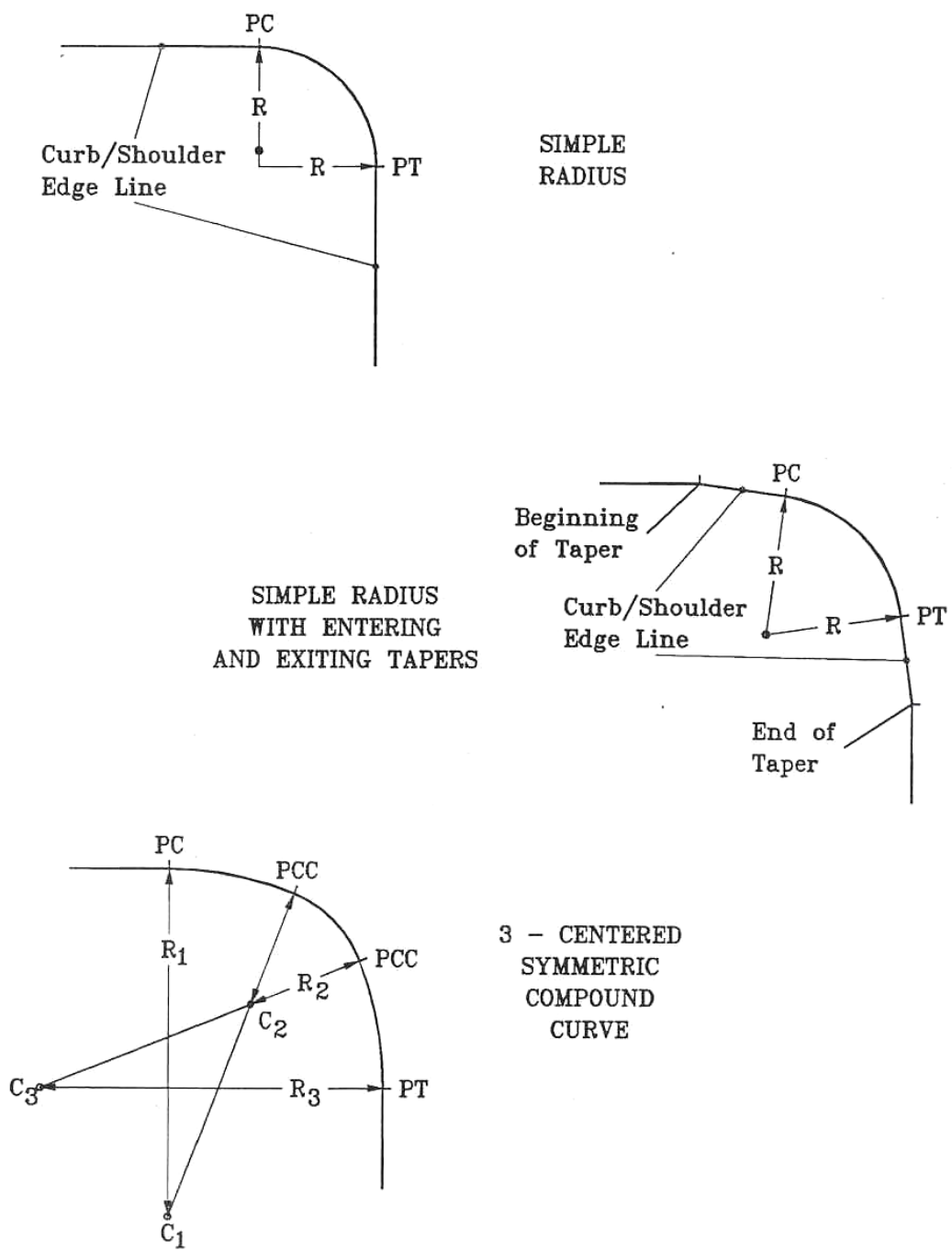


Note:

- ① At signalized intersections, the most desirable option will be to transition all approach legs into a plane section through the intersection.
- ② Pavement transitions on the minor road from normal crown to match the slope of the major road should occur over a distance of 25'-50'.
- ③ If practical, the gradient of the approaching roadway where vehicles may store should not exceed 2%.
- ④ Actual field conditions will determine the final design.

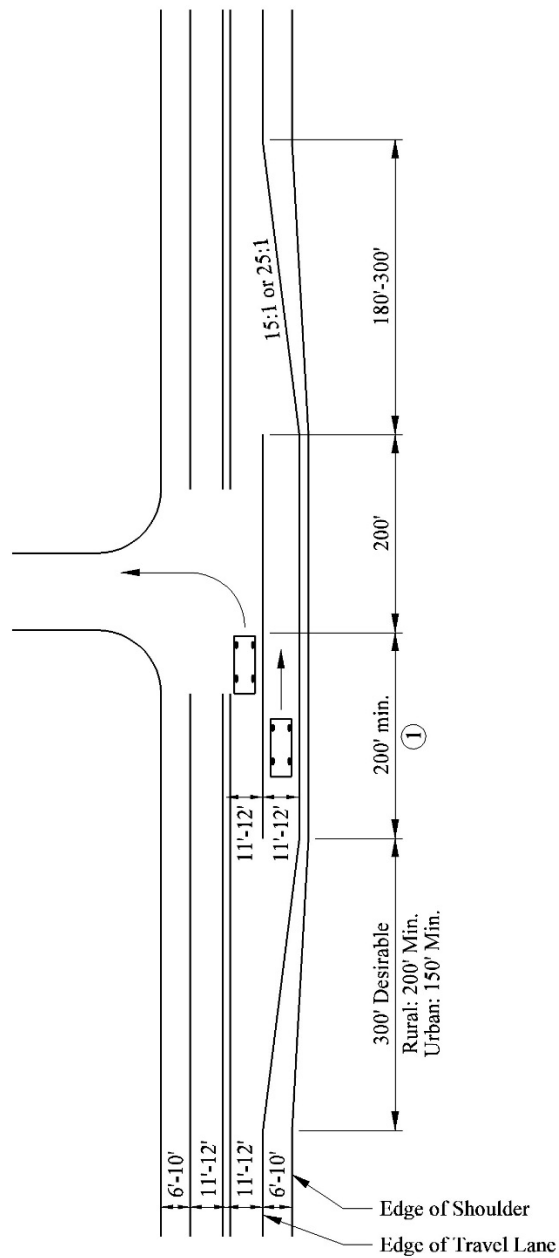
PROFILES OF INTERSECTING ROADS

Figure 5-1



TYPES OF INTERSECTION TURNING DESIGNS

Figure 5-2



Note:

- ① The desirable length is the storage based on 2-minute arrival period plus 100'.

TYPICAL BYPASS LANE ON A TWO-LANE HIGHWAY

Figure 5-3