

Chapter 7 - Public and Private Roadway Criteria

7.1 General

Chapter 7 sets forth the **minimum** design, technical criteria, and specifications to be used in the preparation of all roadway plans.

These Roadway Standards are for new construction and modification to existing infrastructure. Modifications and additions to existing infrastructure shall comply with these Roadway Standards to the maximum extent practicable.

7.2 Roadway Design and Technical Criteria

The City's Public Works Department has adopted a Functional Street Classification Plan based on projected traffic volumes, land use, and expected growth. This Functional Street Classification Plan designates streets as follows:

- Cul-de-Sac (Local with specific design criteria in accordance with Section 7.3.2)
- Local (Section 7.3.3)
- Entry Street (Local with specific design criteria in accordance with Section 7.3.4)
- Commercial and Industrial (Local with specific design criteria in accordance with Section 7.3.5)
- Major or Minor Collector (Section 7.3.6)
- Minor or Principal Arterial (2- and 4-Lane) (Sections 7.3.7 and 7.3.8)

The projected traffic volumes shall determine the street classifications. The extent of right-of-way widening and improvements at intersections and on the approaches to intersections shall be determined by these Roadway Standards, a Traffic Impact Study, and the City Public Works Department.

Basic considerations in the design of circulation systems must recognize the following factors:

- Safety – for both vehicular and pedestrian traffic
- Efficiency of Service – for all users
- Livability – especially as affected by traffic elements in the circulation system
- Economy – of both construction and use of land

Each of the following principles is an elaboration on one or more of these four factors. The principles are not intended as absolute criteria, because instances may occur where certain principles conflict. The principles should, therefore, be used as guidelines for proper system layout.

- Enable vehicular and pedestrian access
- Minimize through trips
- Minimize or control access to Arterials
- Discourage speeding
- Minimize pedestrian-vehicular conflicts
- Relate street to topography
- Provide parking where applicable
- Increase lifecycle or reduce road maintenance costs

Table 7-1. Summary of Roadway Construction Standards

| Criteria | Local | | Local Special Use | |
|--|---|---|--|--|
| | Cul-de-Sac | Local | Entry Street | Commercial and Industrial |
| Posted Speed (mph) | 25 | 25 | 25 | 25 |
| Design Speed (mph) | 25 | 30 | 30 | 30 |
| Maximum Design Traffic Volume (Vehicles per Day) | 400 | 1,500 | 1,500 | 2,500 |
| Min. Right-of-Way (feet) | 50 SF 60 MF | 50 SF 60 MF | 60 70 for Median | 60 |
| Travel Lanes | 2 | 2 | 2 | 2 |
| Curb and Walks | SF – Mountable with 4-foot walk | SF– Mountable with 4-foot walk | Vertical curb with 5-foot walk | Vertical curb with 5-foot walk |
| | MF – Vertical with 5-foot walk | MF – Vertical with 5-foot walk | | |
| Street Sections | SF – 30-foot paved width, two 2-foot gutter pans, total is 34-foot FL to FL | SF-30-foot paved width, two 2-foot gutter pans, total is 34-foot FL to FL | 36-foot paved width, two 2-foot gutter pans, total is 40-foot FL to FL | 36-foot paved width, two 2-foot gutter pans, total is 40-foot FL to FL |
| | MF – 34-foot paved width, two 2-foot gutter pans, total is 38-foot FL to FL | MF – 34-foot paved width, two 2-foot gutter pans, total is 38-foot FL to FL | 34-foot paved, 16-foot median, two 1-foot median pans, two 2-foot gutter pans, total is 56-foot FL to FL | |
| Horizontal Criteria | | | | |
| Min. Centerline Curve Radii (feet) | 175 | 225 | 225 | 225 |
| Curb Return Radii @ Arterial (feet) | N/A | N/A | 35 | N/A |
| Curb Return Radii @ Collector (feet) | 35 | 35 | 35 | 35 |
| Curb Return Radii @ Local (feet) | 20 to 25 | 20 to 25 | 20 to 25 | N/A |
| Vertical Criteria | | | | |
| K-Value Crest | 19 | 19 | 19 | 19 |
| K-Value Sag | 26 | 37 | 37 | 37 |
| Min. VCL Crest (feet) | 50 | 50 | 50 | 50 |
| Min. VCL Sag (feet) | 50 | 50 | 50 | 50 |

Table 7-1. Summary of Roadway Construction Standards

| Criteria | Local | | Local Special Use | |
|-------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| | Cul-de-Sac | Local | Entry Street | Commercial and Industrial |
| Vertical Gradient | 1% to 6% 7% Mountainous | 1% to 6% 7% Mountainous | 1% to 6% 7% Mountainous | 1% to 6% 7% Mountainous |
| Max Int. Gradient | Refer to Figure 7-21 | Refer to Figure 7-21 | Refer to Figure 7-21 | Refer to Figure 7-21 |

Mountainous terrain applies to developments where 50 percent of the site has existing slopes of 15% or greater. The designer should strive to minimize the use of these grades for considerable lengths and on north-facing slopes.

All curves with a K-Value higher than 167 need special review for drainage issues.

Roadway grades over 6% must have special permission from the applicable Fire District.

Notes:

FL to FL = flowline to flowline

MF = multifamily

mph = mile(s) per hour

N/A = not applicable

SF = single-family

Table 7-1. Summary of Roadway Construction Standards (continued)

| Criteria | Collector | Arterial | |
|--|--|--|--|
| | Major and Minor Collector | Minor Arterial | Principal Arterial |
| Posted Speed (mph) | 30 | 40 Minimum | 40 Minimum |
| Design Speed (mph) | 45 | 55 | 60 |
| Maximum Design Traffic Volume (Vehicles per Day) | 7,000 | 15,000 | 15,000 |
| Min. Right-of-Way (feet) | 60 | 125 | 140 |
| Travel Lanes | 2 | 4 | 4 |
| Street Sections | 34-foot paved width, two 2-foot gutter pans, total is 38-foot FL to FL | 48-foot paved, 16-foot median, two 1-foot median pans, two 2-foot gutter pans, total is 70-foot FL to FL | 48-foot paved, 28-foot median, two 1-foot median pans, two 2-foot gutter pans, total is 82-foot FL to FL |
| Curb and Walks | Vertical curb and 5-foot detached walk | Vertical curb and 10-foot detached walk | Vertical curb and 10-foot detached walk |
| Horizontal Criteria | | | |
| Min. Centerline Curve Radii (feet) | 700 | 1,200 | 1,500 |
| Curb Return Radii @ Arterial (feet) | 50 | 50 | 50 |
| Curb Return Radii @ Collector (feet) | 35 | 50 | 50 |

Table 7-1. Summary of Roadway Construction Standards (continued)

| Criteria | Collector | Arterial | |
|----------------------------------|-----------------------------|----------------------|----------------------|
| | Major and Minor Collector | Minor Arterial | Principal Arterial |
| Curb Return Radii @ Local (feet) | 35 | N/A | N/A |
| Vertical Criteria | | | |
| K-Value Crest | 29 | 84 | 84 |
| K-Value Sag | 49 | 96 | 96 |
| Min. VCL Crest (feet) | 50 | 70 | 110 |
| Min. VCL Sag (feet) | 50 | 60 | 90 |
| Vertical Gradient | 2% to 6%; 7% Mountainous | 2% to 6% | 2% to 6% |
| Max Int. Gradient | Refer to Figure 7-21 | Refer to Figure 7-21 | Refer to Figure 7-21 |

Mountainous terrain applies to developments where 50% of the site has existing slopes of 15% or greater. The designer should strive to minimize the use of these grades for considerable lengths and on north-facing slopes.

All curves with a K-Value higher than 167 need special review for drainage issues.

Roadway grades over 6% must have special permission from applicable Fire District.

Design volumes shown in Table 7-1 are for the purpose of development design and layout and to project vehicular usage. Actual volumes on the street depend on existing conditions, future changes in traffic patterns, and transportation trends..

7.3 Engineering Design and Technical Criteria

7.3.1 Right-of-Way

Any increase in right-of-way width shall be made at intersections only. The line-of-sight shall be within the public right-of-way (see Sight Distance in this Chapter). The right-of-way line behind curb returns shall be a diagonal line (see Standard Drawing No. SD.4a and SD.4b in Appendix A).

Certain circumstances related, but not limited to, line of sight, traffic control devices, and pedestrian improvements may require additional rights-of-way, resulting in site-specific adjustment in the location of the right-of-way line behind a curb return. See right-of-way requirements under each road type section.

7.3.2 Cul-de-Sac

A Cul-de-Sac has no outlet and includes a Turnaround area at the end of the street. A Cul-de-Sac may have a maximum length of 1,200 feet and a maximum of 40 dwelling units, and the street section shall include two driving lanes plus parallel parking on both sides of the street.

| | |
|---------------------------|--|
| Posted Speed Limit | 25 mph |
| Design Speed Limit | 25 mph |
| Traffic Volumes | Maximum Design Volume is generally 400 vehicles per day. |
| Continuity | Limited |

| | |
|---------------------------------------|--|
| Right-of-Way | Single Family – 50-foot minimum Multifamily – 60-foot minimum |
| Traffic Control | Signage and pavement markings are in accordance with <i>Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)</i> and Chapter 9 of these Roadway Standards. |
| Number of Travel Lanes | 2 |
| Type of Curb, Gutter, and Walk | Single Family – 4-inch mountable curb with 4-foot attached walk – both sides of street Multifamily – 6-inch vertical curb with 5-foot attached walk – both sides of street. |
| Turnarounds | Minimum 45-foot flowline radius |
| Knuckles | 45-foot flowline radius on the inside and outside flowlines. |
| Eyebrows | Eyebrows shall have a 45-foot flowline radius, and a 25-foot curb return radius. |
| Street Section | Single Family – 34 feet, flowline to flowline. Multifamily – 38 feet, flowline to flowline. See Standard Section. |
| Street Grade | 1% to 6%; 7% Mountainous |
| Minimum Centerline Curve Radii | 175 feet |
| Curb Return Radii @ Arterial | N/A |
| Curb Return Radii @ Collector | 35 feet |
| Curb Return Radii @ Local | 20 to 25 feet |
| K-Value Crest | 19 |
| K-Value Sag | 26 |
| Minimum VCL Crest | 50 feet |
| Minimum VCL Sag | 50 feet |
| Maximum Int. Gradient | Refer to Figure 7-21 |

7.3.2.1 Function

Cul-de-Sacs provide direct access to abutting property. Traffic carried by cul-de- sacs should have an origin or a destination within the neighborhood.

7.3.2.2 Access Conditions

Cul-de-Sacs shall only intersect with other Cul-de-Sacs, Local, and Minor Collector streets. Direct access to abutting property is permitted. Cul-de-Sacs shall not intersect Principal Arterial, Minor Arterial, or Major Collector streets. Refer to Chapter 5 of these Roadway Standards.

7.3.2.3 Design Characteristics

A Cul-de-Sac has no outlet and includes a Turnaround area (refer to Figure 7-13, Turnarounds) at the end of the street. A Cul-de-Sac may have a maximum length of 1,200 feet and a maximum of 40 dwelling units. When a Cul-de-Sac is longer than 600 feet, or has more than 25 dwelling units, sprinklers in units may be required in accordance with the National Fire Protection Association. The street section shall

include two through lanes plus parallel parking on one side of the street for single-family developments and on both sides of the street for multifamily developments (Figures 7-1 and 7-2).

Public easements for utilities are required along both sides of the right-of-way. Refer also to Chapter 4, Utility Locations, of these Roadway Standards.

7.3.2.4 Street Section

Figure 7-1. Cul-de-Sac: Single Family

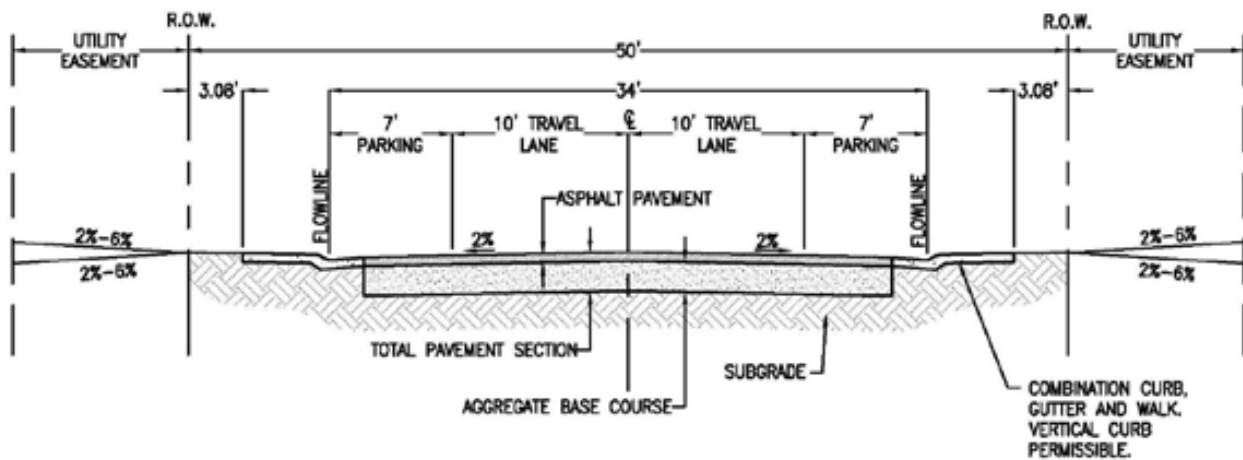
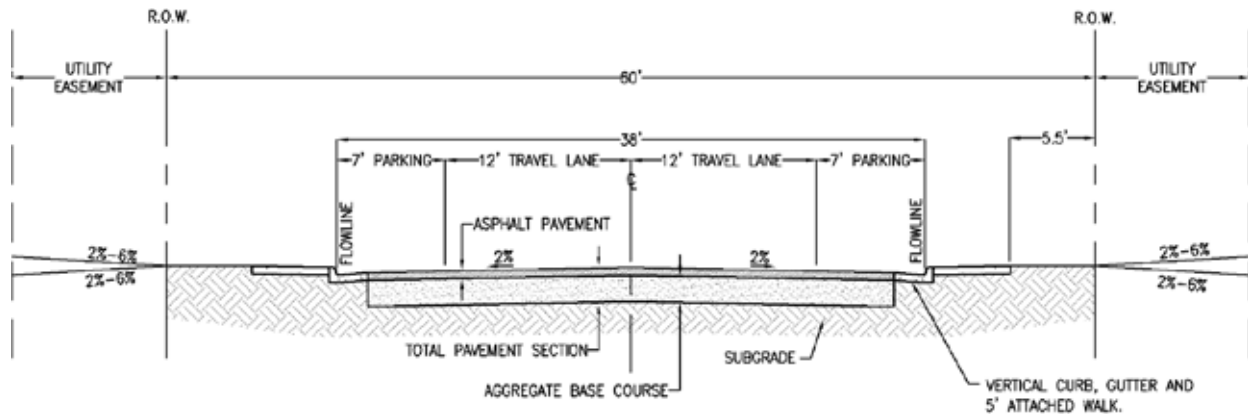


Figure 7-2. Cul-de-Sac: Multifamily



7.3.3 Local

A Local road may be used for all residential land development. The street section shall include two driving lanes plus parallel parking on both sides of the street. Entry, School Access, Commercial, and Industrial street classifications are considered local roads but have different requirements, as noted in Sections 7.3.4 and 7.3.5.

| | |
|--------------------|---|
| Posted Speed Limit | 25 mph |
| Design Speed Limit | 30 mph |
| Traffic Volumes | Maximum Design Volume is generally 1,500 vehicles per day. (Typically, capacity up to 2,500 vehicles per day is considered to be acceptable in fully established communities) |

| | |
|---------------------------------------|---|
| Continuity | Limited |
| Right-of-Way | Single Family – 50-foot minimum Multifamily – 60-foot minimum |
| Traffic Control | Signage and pavement markings in accordance with MUTCD and Chapter 9 of these Roadway Standards |
| Number of Travel Lanes | 2 |
| Type of Curb, Gutter, and Walk | Single Family – 4-inch mountable curb with 4-foot attached walk – both sides of street Multifamily – 6-inch vertical curb with 5-foot attached walk – both sides of street |
| Turnarounds | Not allowed |
| Knuckles | 45-foot flowline radius on the inside and outside flow lines |
| Eyebrows | 45-foot flowline radius, and a 25-foot curb return radius |
| Street Section | Single Family – 34 feet, flowline to flowline Multifamily – 38 feet, flowline to flowline |
| Street Grades | 1% to 6%; 7% Mountainous |
| Minimum Centerline Curve Radii | 225 feet |
| Curb Return Radii @ Arterial | N/A |
| Curb Return Radii @ Collector | 35 feet |
| Curb Return Radii @ Local | 20 to 25 feet |
| K-Value Crest | 19 |
| K-Value Sag | 37 |
| Minimum VCL Crest | 50 feet |
| Minimum VCL Sag | 50 feet |
| Maximum Int. Gradient | Refer to Figure 7-21 |

7.3.3.1 Function

Local streets provide direct access to abutting property. Traffic carried by Local streets should have an origin or a destination within the neighborhood.

7.3.3.2 Access Conditions

Local roads shall only intersect with Local and Minor or Major Collector roads. Direct access to abutting property is permitted. Local streets shall not intersect Principal or Minor Arterial streets. See Chapter 5 of these Roadway Standards.

7.3.3.3 Design Characteristics

Local streets shall be designed to carry traffic that has an origin or destination within the neighborhood. The street section shall include two through lanes plus parallel parking on both sides of the street for

single-family developments and on both sides of the street for multifamily developments. Public easements for utilities are required along both sides of the right-of-way.

7.3.3.4 Street Section

Figure 7-3. Local Typical Section: Single Family

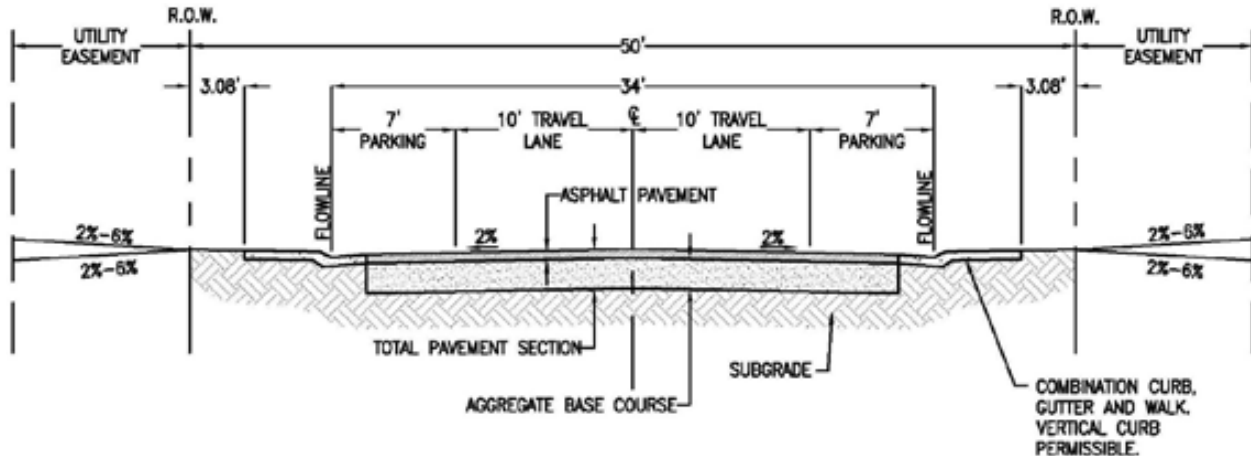
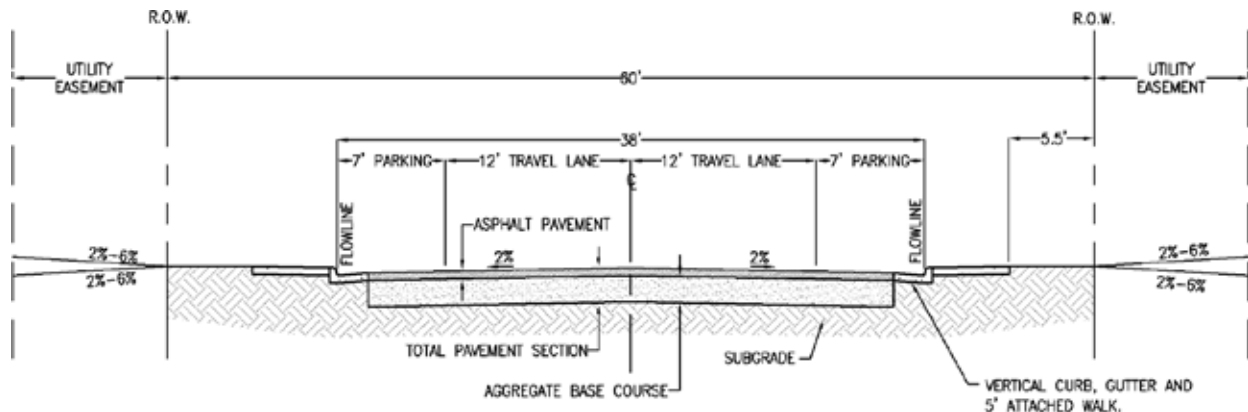


Figure 7-4. Local Typical Section: Multifamily



7.3.4 Entry Street

An Entry Street is generally short (160 feet minimum to the first intersection) with no driveway access and no parking. An Entry Street is intended to allow a reduction in the distance between a Local street and a Collector or Arterial street.

| | |
|--------------------|--|
| Posted Speed Limit | 25 mph |
| Design Speed Limit | 30 mph |
| Traffic Volumes | Maximum Design Volume is generally 1,500 vehicles per day. (Typically, capacity up to 3,000 vehicles per day is considered to be acceptable in fully established communities.) |
| Continuity | Limited |

| | |
|---------------------------------------|---|
| Right-of-Way | 60-foot minimum 70-foot minimum for median |
| Traffic Control | Signage and pavement markings in accordance with MUTCD and Chapter 9 of these Roadway Standards |
| Number of Travel Lanes | 2 |
| Type of Curb, Gutter, and Walk | 6-inch vertical curb with 5-foot attached walk – both sides of street |
| Turnarounds | Not allowed |
| Knuckles | Not allowed |
| Eyebrows | Not allowed |
| Street Section | 40 feet, flowline to flowline 56 feet, flowline to flowline for median |
| Street Grades | 1% to 6%; 7% Mountainous |
| Minimum Centerline Curve Radii | 225 feet |
| Curb Return Radii @ Arterial | 35 feet |
| Curb Return Radii @ Collector | 35 feet |
| Curb Return Radii @ Local | 20 to 25 feet |
| K-Value Crest | 19 |
| K-Value Sag | 37 |
| Minimum VCL Crest | 50 feet |
| Minimum VCL Sag | 50 feet |
| Maximum Int. Gradient | Refer to Figure 7-21 |

7.3.4.1 Function

Entry Streets provide no direct access to abutting property. Traffic carried by entry streets should have an origin or a destination within the neighborhood.

7.3.4.2 Access Conditions

Entry Streets shall only intersect with a Local street on one end, and a Major or Minor Collector or a Principal or Minor Arterial road on the other end. Direct access to abutting property is not permitted. Refer to Chapter 5 of these Roadway Standards.

7.3.4.3 Design Characteristics

This category of street is generally short (160 feet minimum to the first intersection) streets with no driveway access that are intended to allow a reduction in the separation between a Collector street and the first Local street intersection. If accepted by the City Public Works Department, up to 100 units may be allowed on an internally looped local road, using an entry street for primary access.

On-street parking is prohibited. "No Parking" signs shall be installed along both sides of the road in accordance with MUTCD and Chapter 9. An Entry Street is considered a lower classification street than a Collector. Public easements for utilities are required along both sides of the right-of-way. Refer also to Chapter 4 these Roadway Standards.

7.3.4.4 School Access Street

The School Access Street functions as an Entry Street; however, a School Access Street shall include these additional criteria beyond the Entry Street criteria:

- 1) A School Access Street provides direct access to an elementary school.
- 2) The School Access Street may include varied speed limits and varied curb and gutter type.
- 3) The School Access Street will not be allowed on a dead end street.
- 4) The School Access Street may provide direct access to adjacent property.
- 5) This design shall not be used for access to high schools.
- 6) Traffic carried by School Access Streets may have an origin or a destination outside the local neighborhood.
- 7) Streets adjacent to play fields that do not provide direct access to the school would not be considered a School Access Street.
- 8) A School Access Street is considered a lower classification street than a Collector, but higher than a residential street.

7.3.4.5 Street Section

Figure 7-5. Entry Street Typical Section: No Median

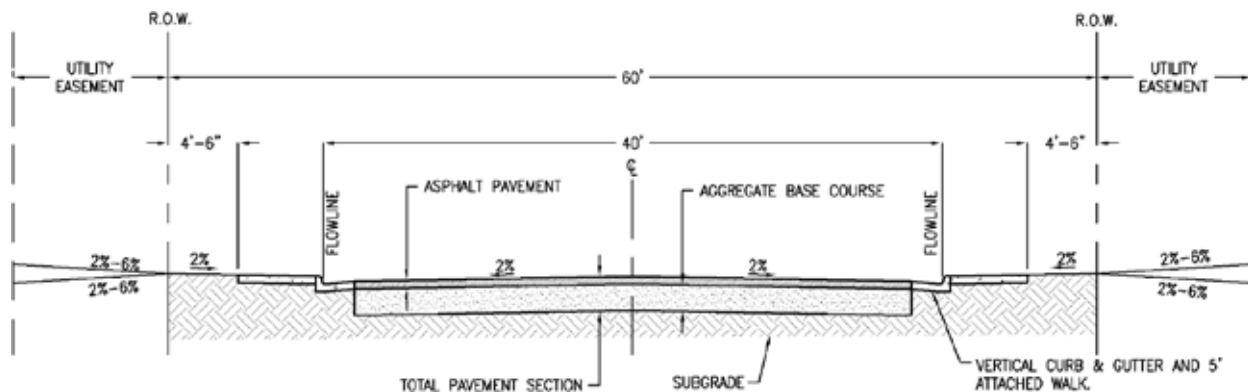


Figure 7-6. Entry Street Typical Section: With Median

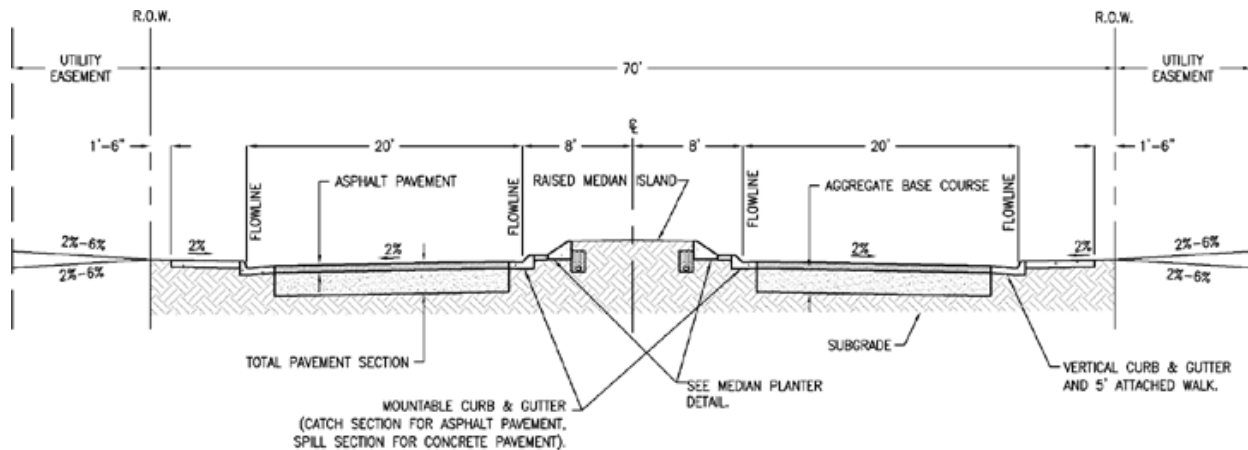
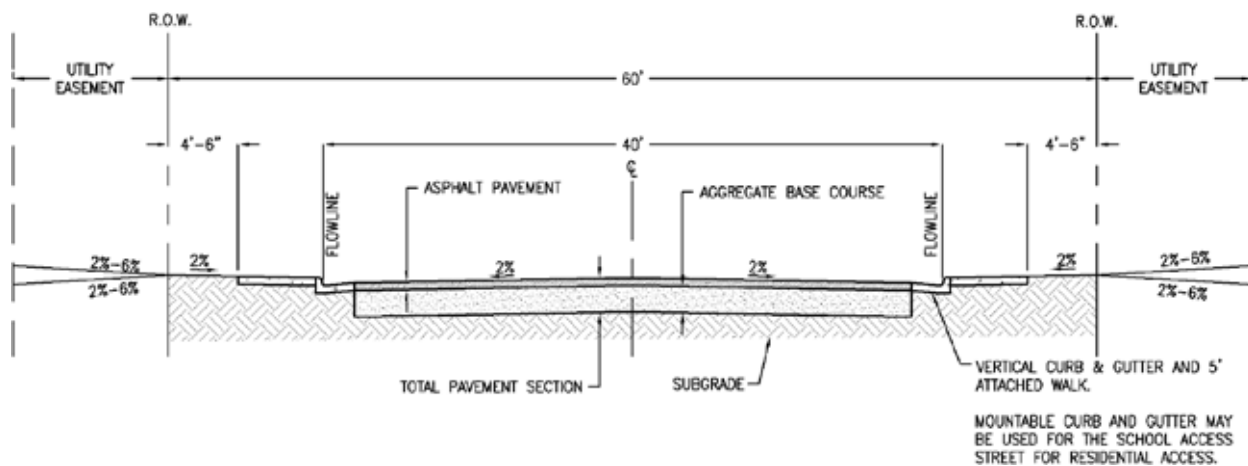


Figure 7-7. School Access Street Typical Section



7.3.5 Commercial and Industrial

Commercial and Industrial streets shall be designed for ease of access to adjacent commercial and industrial developments. On-street parking is not allowed. Backing or loading maneuvers are not allowed in the street.

| | |
|------------------------|---|
| Posted Speed Limit | 25 mph |
| Design Speed Limit | 30 mph |
| Traffic Volumes | Maximum Design Volume is generally 2,500 vehicles per day. (Typically, capacity up to 4,000 vehicles per day is considered to be acceptable in fully established communities) |
| Continuity | Limited |
| Right-of-Way | 60-foot minimum |
| Traffic Control | Signage and pavement markings in accordance with MUTCD and Chapter 9 of these Roadway Standards |
| Number of Travel Lanes | 2 |

| | |
|---------------------------------------|--|
| Type of Curb, Gutter and Walk | 6-inch vertical curb with 5-foot attached walk – both sides of street |
| Turnarounds | The addition of a Turnaround on a Commercial or Industrial road type creates a Commercial and Industrial Cul-de-Sac. The maximum length of Commercial or Industrial Cul-de-Sacs shall be 600 feet. However, the City may impose additional restrictions on lengths based on factors, such as the types and products related to a proposed use, number of trips generated by the proposed use(s), number of employees or customers, types of vehicles used, available capacity, or access for emergency services. Commercial or Industrial Turnarounds shall have a flowline radius of 50 feet. |
| Knuckles | 45-foot flowline radius on the inside and outside flowlines |
| Eyebrows | 45-foot flowline radius, and a 25-foot curb return radius |
| Street Section | 40-foot flowline to flowline |
| Street Grades | 1% to 6%; 7% Mountainous |
| Minimum Centerline Curve Radii | 225 feet |
| Curb Return Radii @ Arterial | N/A |
| Curb Return Radii @ Collector | 35 feet |
| Curb Return Curb Radii @ Local | N/A |
| K-Value Crest | 19 |
| K-Value Sag | 37 |
| Minimum VCL Crest | 50 feet |
| Minimum VCL Sag | 50 feet |
| Maximum Int. Gradient | Refer to Figure 7-21 |

7.3.5.1 Function

Commercial and Industrial streets provide direct access to abutting property. Traffic carried by Commercial and Industrial streets should have an origin or a destination within the commercial or industrial area.

7.3.5.2 Access Conditions

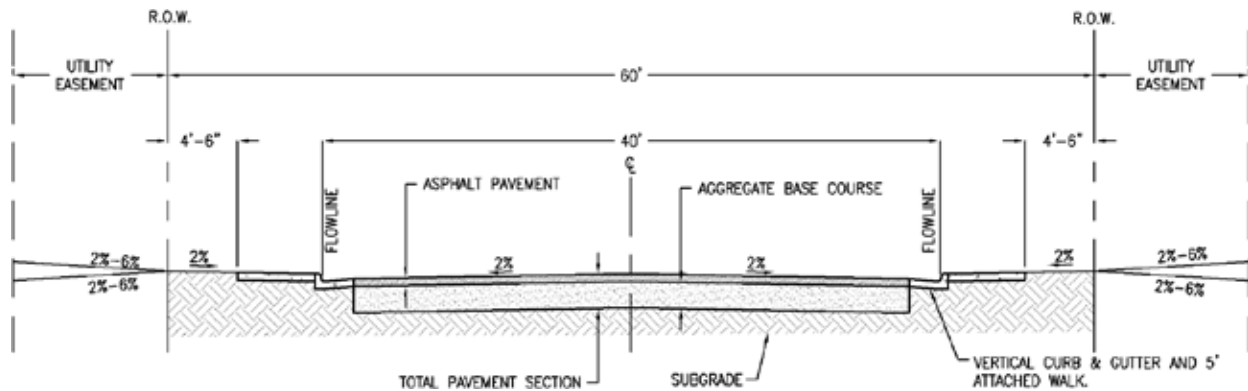
Commercial and Industrial streets shall only intersect with Local or Major and Minor Collector streets. Commercial and Industrial streets shall not intersect Principal or Minor Arterial streets. Direct access to abutting property is permitted. Refer to Chapter 5 of these Roadway Standards.

7.3.5.3 Design Characteristics

Commercial and Industrial streets shall be designed to carry traffic that has an origin or destination within the commercial or industrial area. This category of street shall be for ease of access to adjacent commercial and industrial developments. On-street parking is prohibited. "No Parking" signs shall be installed along both sides of the road in accordance with MUTCD and Chapter 9. Backing or loading maneuvers are not allowed in the street. Public easements for utilities are required along both sides of the right-of-way. Refer also to Chapter 4 of these Roadway Standards.

7.3.5.4 Street Section

Figure 7-8. Commercial and Industrial Typical Section



7.3.6 Collector

Minor and Major Collector streets collect and distribute traffic between Arterial and Local streets and serve as main connectors within communities, linking one neighborhood with another.

| | |
|---|---|
| Posted Speed Limit | 30 mph |
| Design Speed Limit | 45 mph |
| Traffic Volumes | Maximum Design Volume is generally 7,000 vehicles per day. (Typically, capacity up to 10,000 vehicles per day is considered to be acceptable in fully established communities.) |
| Continuity | Less than 2 miles |
| Right-of-Way | 60-foot minimum |
| Traffic Control | Signage and pavement markings in accordance with MUTCD and Chapter 9 of these Roadway Standards |
| Number of Travel Lanes | 2 |
| Type of Curb, Gutter and Walk | 6-inch vertical curb with 5-foot detached walk – both sides of street |
| Turnarounds | Not allowed |
| Knuckles | Not allowed |
| Eyebrows | Not allowed |
| Street Section | 38 feet, flowline to flowline |
| Street Grades | 2% to 6%; 7% Mountainous |
| Minimum Centerline Curve Radii | 700 feet |
| Minimum Length of Tangents Between All Curves | 50 feet |
| Curb Return Radii @ Arterial | 50 feet |
| Curb Return Radii @ Collector | 35 feet |

| | |
|----------------------------------|----------------------|
| Curb Return Radii @ Local | 35 feet |
| K-Value Crest | 29 |
| K-Value Sag | 49 |
| Minimum VCL Crest | 50 feet |
| Minimum VCL Sag | 50 feet |
| Maximum Int. Gradient | Refer to Figure 7-21 |

7.3.6.1 Function

Collector streets collect and distribute traffic between Arterial and Local streets and serve as main connectors within communities, linking one neighborhood with another. Traffic carried by Collector streets should have an origin or a destination within the community.

7.3.6.2 Access Conditions

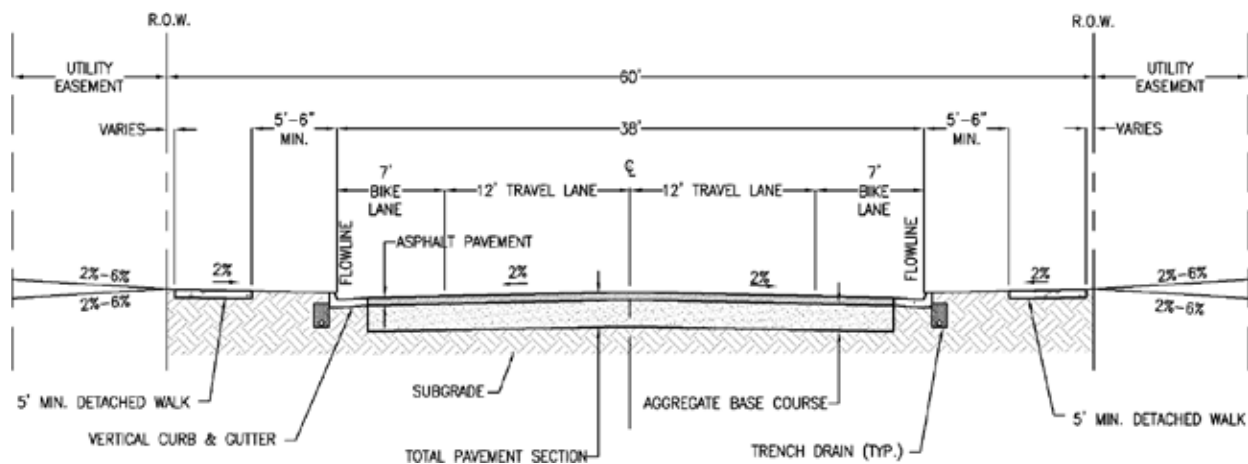
Major and Minor Collector streets shall only intersect with Local, Major or Minor Collector, and Principal or Minor Arterial streets. Single-family residential access is not permitted. Direct access to other zoned abutting property is not permitted unless another access is not reasonably available.

7.3.6.3 Design Characteristic

Collector streets should have continuity throughout a neighborhood but need not extend beyond the neighborhood. On-street parking is prohibited. Intersections and access points shall be spaced a minimum of 330 feet apart. Refer to Chapter 5 of these Roadway Standards. Public easements for utilities are required along both sides of the right-of-way. Refer also to Chapter 4, Utility Locations, of these Roadway Standards.

7.3.6.4 Street Section

Figure 7-9. Collector Typical Section



7.3.7 Minor Arterial

Minor Arterial routes allow rapid and relatively unimpeded traffic movement throughout the City. Arterial roadways are designed to handle traffic volumes from and onto Collector and Arterial roads and State Highways. A Minor Arterial has a minimum distance of a quarter-mile between intersections.

| | |
|--|---|
| Posted Speed Limit | Greater than or equal to 40 mph – Determined by City Public Works Department prior to Construction Plan Submittal |
| Design Speed Limit | 55 mph |
| Traffic Volumes | Maximum Design Volume – 15,000 vehicles per day |
| Continuity | Two or more miles – generally connecting intercity routes |
| Right-of-Way | 125-foot minimum |
| Traffic Control | Signage and pavement markings in accordance with MUTCD and Chapter 9 of these Roadway Standards |
| Number of Travel Lanes | 4 |
| Type of Curb, Gutter and Walk | 6-inch vertical curb with 10-foot detached walk – both sides of street |
| Turnarounds | Not allowed |
| Knuckles | Not allowed |
| Eyebrows | Not allowed |
| Street Section | 70 feet, flowline to flowline |
| Street Grades | 2% to 6% |
| Minimum Centerline Curve Radii | 1,200 feet |
| Minimum Length of Tangents Between All Curves | 100 feet |
| Curb Return Radii @ Arterial | 50 feet |
| Curb Return Radii @ Collector | 50 feet |
| Curb Return Radii @ Local | N/A |
| K-Value Crest | 84 |
| K-Value Sag | 96 |
| Minimum VCL Crest | 70 feet |
| Minimum VCL Sag | 60 feet |
| Maximum Int. Gradient | Refer to Figure 7-21 |

7.3.7.1 Function

Minor Arterial routes allow relatively unimpeded traffic movement and are intended for use on routes where four moving lanes and one left-turn lane are required but where a Major Arterial cross-section would not be warranted.

7.3.7.2 Access Conditions

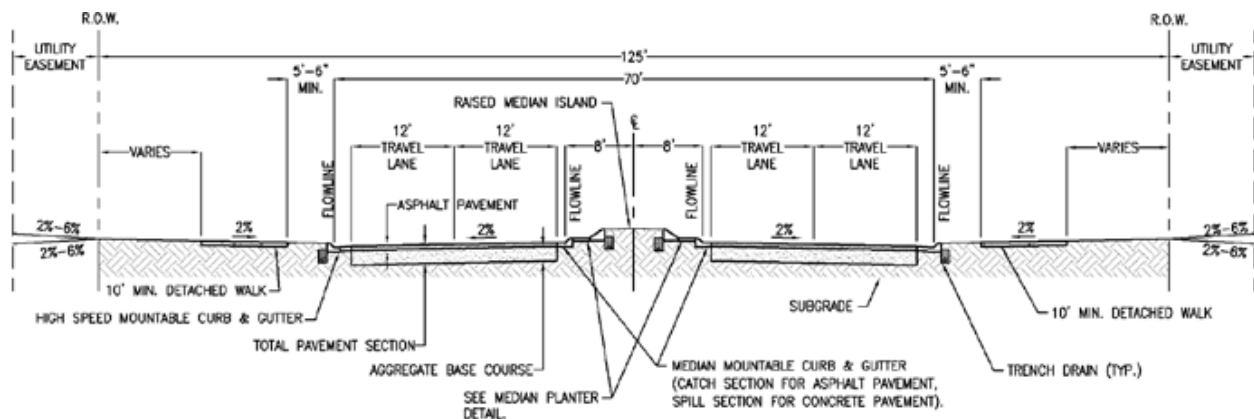
Access from Major or Minor Collector and Minor or Principal Arterial streets will be allowed. Residential access is not permitted. Direct access to other abutting property is not permitted unless no other access is reasonably available.

7.3.7.3 Design Characteristics

Minor Arterials should be spaced from a half a mile to 1 mile apart and should be continuous. On-street parking is prohibited. Intersections and access points should be spaced a minimum of a quarter-mile apart. Refer to Chapter 5 of these Roadway Standards. Public easements for utilities are required along both sides of the right-of-way. Refer also to Chapter 4 of these Roadway Standards.

7.3.7.4 Street Sections

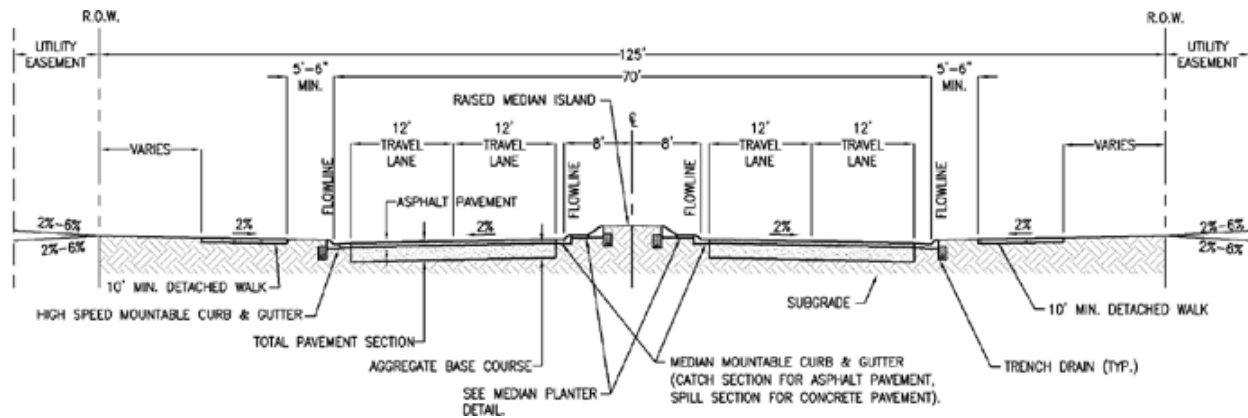
Figure 7-10. Minor Arterial Typical Section



7.3.7.5 Typical Minor Arterial Road Section

- Minimum of four 12-foot through lanes and two 2-foot gutter pans
- Minimum 16-foot median, measured curb face to curb face, with two barrier curbs and gutter (Note: If asphalt pavement is used, a 1-foot catch curb and gutter is required. A median planter may be constructed in this median.)
- Two detached sidewalks, minimum 10 feet each; 5.5-foot minimum setback from curb face
- Minimum 125-foot right-of-way
- Variable size of utility easement adjacent to each right-of-way line

Figure 7-11. Minor Arterial Typical Section



7.3.7.6 Typical Arterial Road Section at Intersection

- Minimum of four 12-foot through lanes and two 2-foot gutter pans
- Minimum 12-foot left turn lane
- Minimum one 12-foot acceleration and one 12-foot deceleration lane
- Minimum 1-foot painted median
- Two detached sidewalks, minimum 10 feet each; 5.5-foot minimum setback from curb face
- Minimum 130-foot right-of-way
- Variable size of utility easement adjacent to each right-of-way line

7.3.8 Principal Arterial

Principal Arterials should be spaced approximately 1 mile apart and should traverse an entire city. Major Arterial streets should not bisect neighborhoods but should act as boundaries between them. Arterial routes allow rapid and relatively unimpeded traffic movement throughout the City. Arterial roadways are designed to handle traffic volumes from and onto Collectors, Arterial roads, and State Highways. Principal Arterials have a minimum distance of a quarter-mile between intersections.

| | |
|--------------------------------------|--|
| Posted Speed Limit | Greater than or equal to 40 mph – Determined by the City Public Works Department prior to Construction Plan Submittal |
| Design Speed Limit | 60 mph |
| Traffic Volumes | Design Volume is generally over 15,000 vehicles per day for a Principal Arterial. (Phasing of lane requirements may be considered based on Traffic Impact Analysis.) |
| Continuity | Several miles, generally connecting inter and intra city routes |
| Right-of-Way | 140-feet, four-lane minimum |
| Traffic Control | Signage and pavement markings in accordance with MUTCD and Chapter 9 of these Roadway Standards |
| Number of Travel Lanes | 4 |
| Type of Curb, Gutter and Walk | 6-inch barrier curb and gutter with 10-foot detached sidewalk on both sides |
| Turnarounds | Not allowed |
| Knuckles | Not allowed |

| | |
|--|-------------------------------|
| Eyebrows | Not allowed |
| Street Section | 82 feet, flowline to flowline |
| Street Grades | 2% to 6% |
| Minimum Centerline Curve Radii | 1,500 feet |
| Minimum Length of Tangents Between All Curves | 100 feet |
| Curb Return Radii @ Arterial | 50 feet |
| Curb Return Radii @ Collector | 50 feet |
| Curb Return Radii @ Local | N/A |
| K-Value Crest | 84 |
| K-Value Sag | 96 |
| Minimum VCL Crest | 110 feet |
| Minimum VCL Sag | 90 feet |
| Maximum Int. Gradient | Refer to Figure 7-21 |

7.3.8.1 Function

Principal Arterial routes allow rapid and relatively unimpeded traffic movement throughout the City, connecting major land uses.

7.3.8.2 Access Conditions

Access from Collector and Arterial streets will be allowed. Direct access to abutting property is not permitted.

7.3.8.3 Design Characteristics

Principal Arterials should be spaced approximately 1 mile apart and should traverse an entire city. On-street parking is prohibited. Intersections and access points should be spaced a minimum of a quarter-mile apart. Refer to Chapter 5, Access Requirements and Criteria, and these Roadway Standards. Public easements for utilities are required along both sides of the right-of-way. Refer also to Chapter 4, Utility Locations Design and Construction Standards, of these Roadway Standards.

7.3.8.4 Street Section

Figure 7-12. Principal Arterial: Four-Lane Road Section

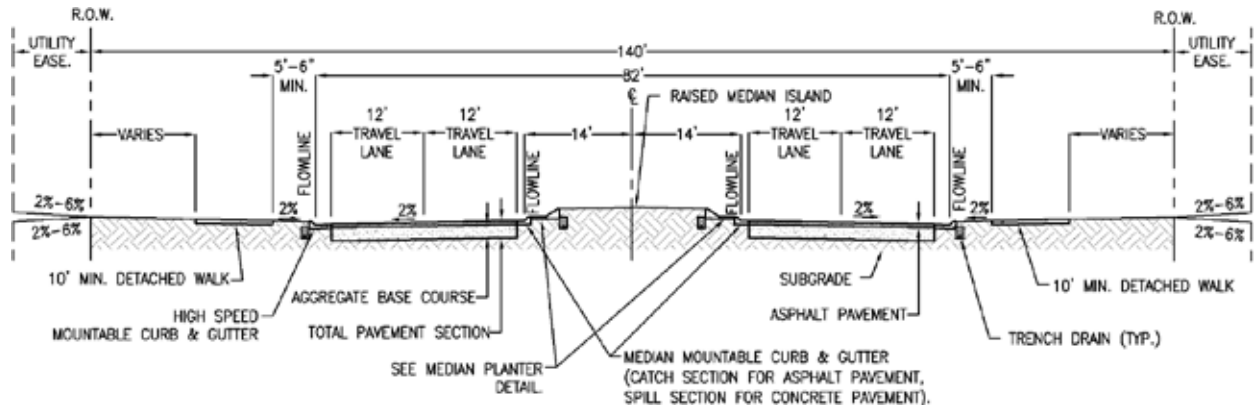


Figure 7-13. Turnarounds

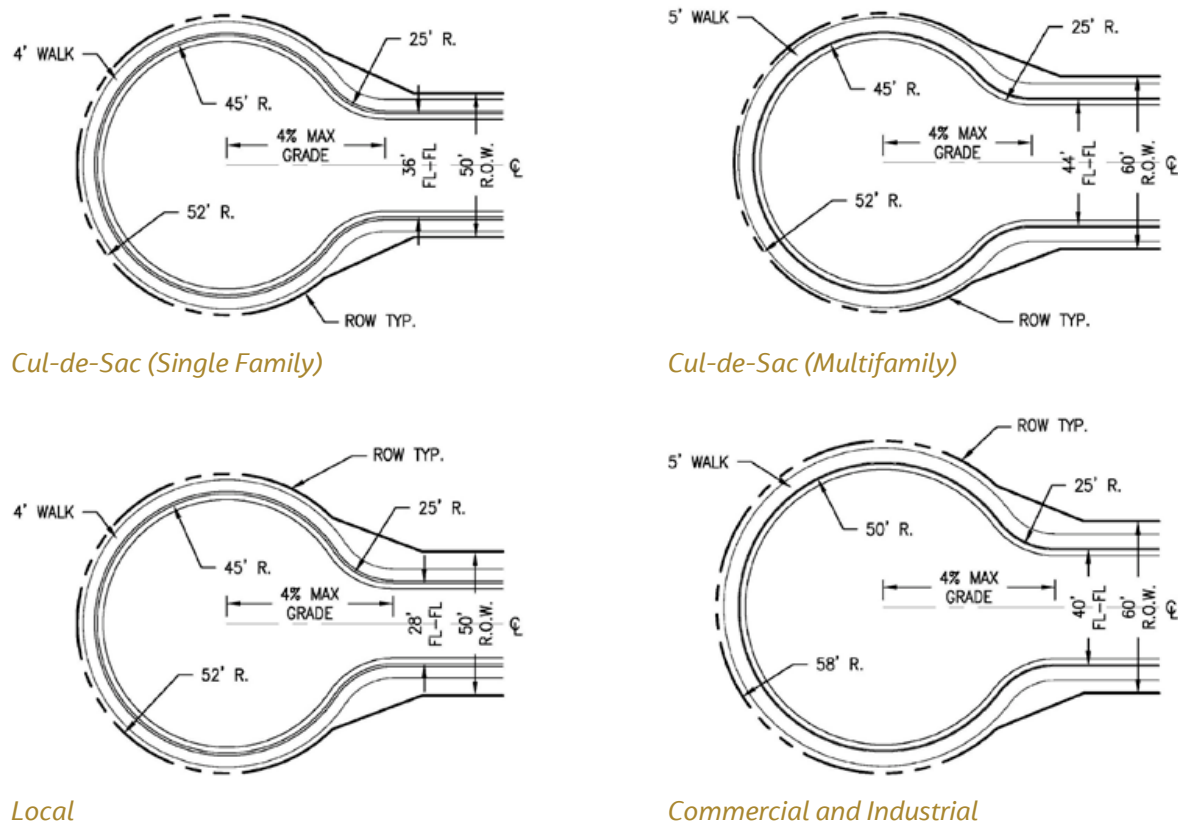
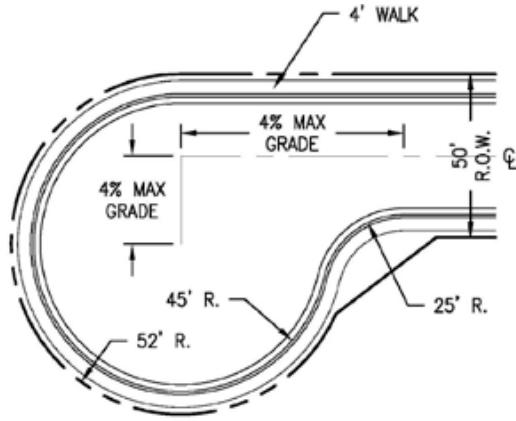
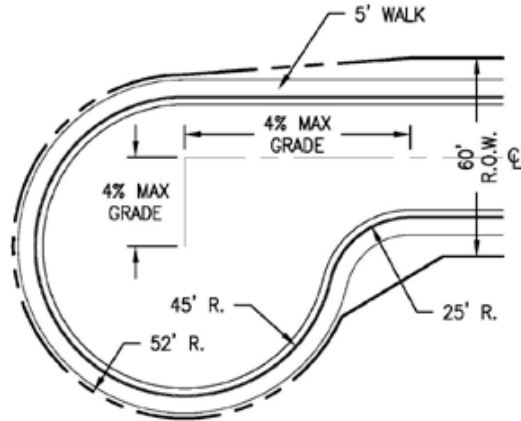


Figure 7-14. Offset Turnarounds

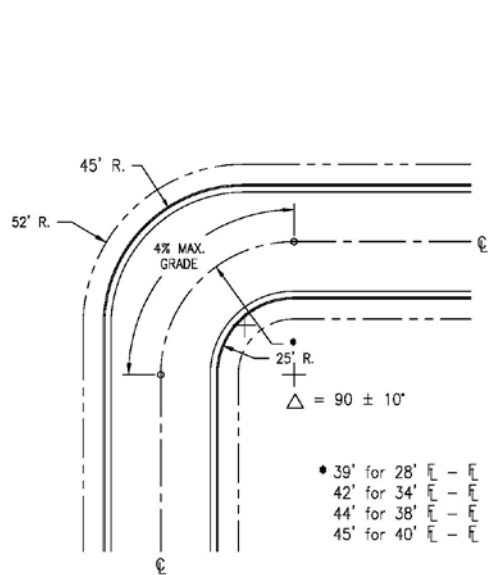


50-foot Right-of-Way

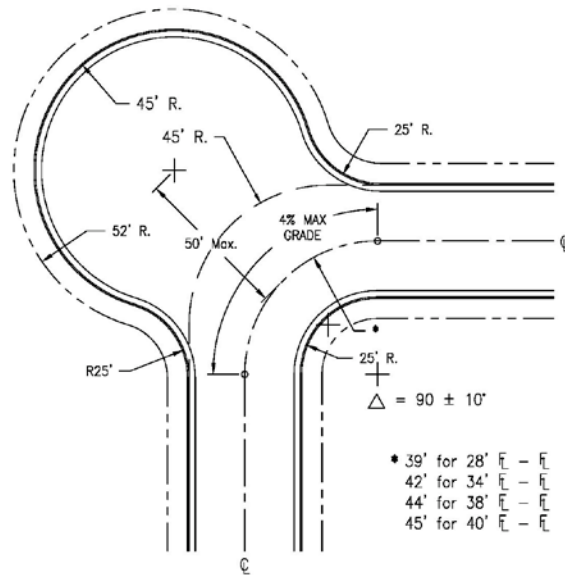


60-foot Right-of-Way

Figure 7-15. Knuckles

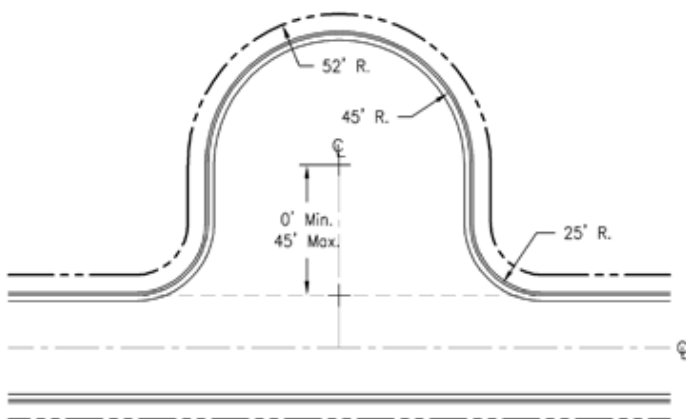


Without Bubble



With Bubble

Figure 7-16. Eyebrows



7.4 Sidewalks, Trails, and Curb Ramps

All sidewalks that run parallel with the public street shall be located within the City right-of-way. If a sidewalk meanders outside of the City right-of-way, it must be located in a Sidewalk Easement for public use. Concentrated storm water runoff must not be discharged across the sidewalk. (See Section 7.6.3)

State law (CRS 43-2-107[2]) requires that curb ramps be installed at all intersections and at mid-block crossing locations for all new construction or reconstruction of curbs and sidewalks. Curb ramps shall be constructed in accordance with City of Castle Pines Standard Details found in Appendix A of these Roadway Standards. Curb ramps shall be shown at all curb returns and at all "T" intersections where sidewalks are required or proposed. Whenever referencing a curb ramp, call out the specific City of Castle Pines Standard Detail to be used to construct that ramp. Special consideration for ramp design may be necessary because of site-specific issues, such as cross slope or drainage, with acceptance by the City.

At least one *Americans with Disabilities Act* (ADA) accessible route shall be provided within a site from accessible parking spaces and accessible passenger loading zones, public streets and sidewalks, and public transportation stops to the accessible building or facility entrance they serve. All curb ramp designs must be in compliance with the latest ADA design guidance. ADA compliance supersedes the Standard Details.

Grade-separated pedestrian crossings at Collector and Arterial roads shall be constructed whenever possible for regional or neighborhood trails, golf cart crossings, and equestrian crossings.

Contact the City to determine whether there are planned designated City of Castle Pines Bicycle Facilities or existing or planned designated school routes that need to be considered in the design.

7.5 Cuts and Driveways

Curb cuts and driveways shall be constructed in accordance with City of Castle Pines Standard Details found in Appendix A of these Roadway Standards. See Chapter 5 for additional curb cut and driveway criteria.

7.6 Drainage

The minor and major storm drainage systems are to be designed in accordance with City Standards. In the case of a conflict caused by requirements of other criteria manuals, the most restrictive shall govern.

7.6.1 Crossspans

Crossspans are not allowed to cross the major street at an intersection. In the event the roadways have the same classification, then the road with the higher assumed volume is considered the major street. No mid-block crossspans will be allowed.

Crossspans shall be constructed in accordance with the City of Castle Pines Standard Details. Crossspans are not permitted across Arterial roadways.

Local road intersections require a minimum 8-foot-wide crossspan.

Minor Collector road intersections require a minimum 10-foot-wide crossspan.

Arterial road intersections do not allow a crossspan.

7.6.2 Inlets

Inlets shall be constructed in accordance with the City of Castle Pines Standard Details. Type R inlets are required along roadways owned and maintained by the City. Type R inlets shall be 5, 10, or 15 feet in length. Type R inlets 20 feet in length may be allowed on a case-by-case basis. Inlets exceeding 20 feet in length are not acceptable.

Inlets shall be located to intercept the curb flow at the point the allowable curb flow capacity is exceeded by the storm runoff. Inlets shall also be installed to intercept cross-pavement flows at points of transition in super-elevations.

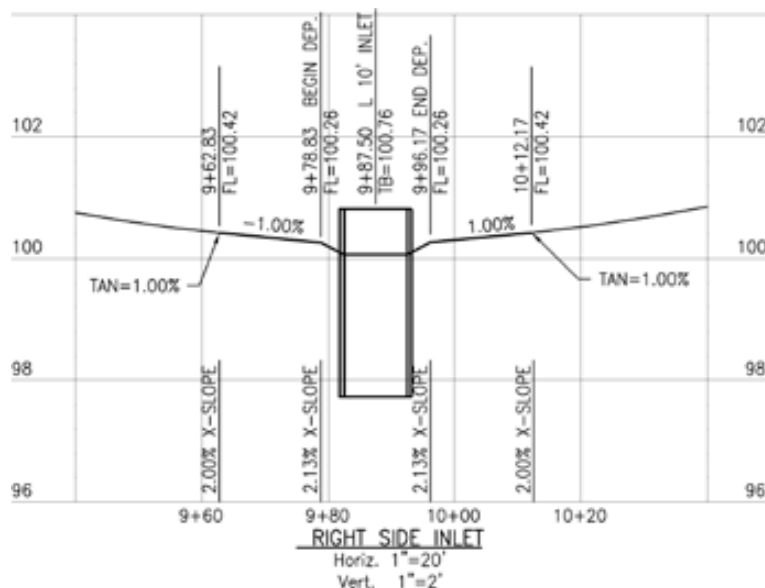
For all streets with raised medians constructed with asphalt, the median shall be constructed with a “catch” curb and gutter, with inlets required along the median to reduce ponding at curb and gutter low points and to eliminate concentrated flow crossing over the lanes of traffic at the nose of the median. The final design and construction drawings must address inlet sizing, dimensions, and required curb and gutter transitions. Refer to the Standard Details, which present a conceptual representation of options available for placing median nose inlets.

Because of the presence of curb ramps, inlets are not allowed in the curb return, but will be located at the tangent points of the curb returns.

Refer to the City's Storm Drainage Design Criteria and City of Castle Pines Standard Details located in Appendix A of these Roadway Standards for inlet types allowed.

The City requires a minimum 1% flowline grade into all sump inlets. See Figure 7-17.

Figure 7-17. Sump Inlet Profile



An 8-inch opening should be included on the upgrade side of an on-grade inlet and on each end of a sump inlet to accommodate trench drain installation. See City of Castle Pines Standard Details for criteria.

7.6.3 Sidewalk Chases

Sidewalk chases will only be permitted as a final alternative through the variance process. Typically, sidewalk chases are allowed only for retrofit projects as accepted by the City. When permitted, sidewalk chases are to be used to allow surface drainage to enter into the street gutter, and not to avoid the use of a standard inlet.

There are numerous reasons why sidewalk chase sections should be limited in use and allowed only in retrofit situations. These reasons include the following:

- Cost of future maintenance
- Excessive ice buildup in the gutter or street
- Algae growth within the gutter
- Pedestrian tripping hazard

Experience has also shown that in many instances where a sidewalk chase is warranted, the need for the sidewalk chase dissipates and eventually disappears over time.

Storm water from concentrated points of discharge (that is, sump pumps and roof drains) shall not be allowed to flow over sidewalks. Sidewalk chase sections will not be allowed where homeowners have routed their sump pump discharge pipe or roof drains directly to the back of the sidewalk. Sidewalk chase sections should only be used where it is not feasible to use other forms of mitigation.

In the event a sidewalk chase is accepted, the chase sections shall not be located within the curb cut or driveway. Accepted sidewalk chase sections are to be constructed in accordance with the City of Castle Pines Standard Details found in Appendix A of these Roadway Standards. The Applicant shall be responsible for replacing the property corner offset in its original location in conformance with state statutes.

7.6.4 Trench Drains

Trench drains are required along both sides of all public Collectors and Arterials with curb and gutter. Trench drains are not required if the street has shoulders and roadside ditches. All proposed irrigated landscaping adjacent to a public street must have a positive draining trench drain located behind the curb, or behind the sidewalk if attached.

The trench drain must flow into either a storm inlet or a natural drainageway.

- If the trench drain ties into the storm sewer, the inlet must be indicated on the plan, and a detail of the storm sewer tie in must be included.
- If the trench drain discharges into a natural drainageway, the name of the drainageway must be called out on the plan, and the trench drain discharge point indicated on the plan. A detail of the outlet with permanent erosion protection must also be included on the plan. A concrete collar (3 inches minimum around pipe and 6 inches thick) with a minimum 2-foot-by-6-foot pad of type L riprap placed over filter fabric is required. A drainage easement is required for a trench drain outside of the public right-of-way. The plan also needs to call for a marker post to identify the trench drain discharge point.

If a proposed trench drain is not following the road grade, a profile of the trench drain is required on the plan, including the surface ground elevation and the tie into the storm sewer or discharge point to a natural drainageway.

An exception to the trench drain requirements may be considered for the following conditions:

- If soils in the area are non-expansive, the Applicant may submit a Variance Request (signed and stamped by a Colorado-registered Geotechnical Professional Engineer [PE]), which states that there will not be a problem with water migrating under the roadway from the irrigated landscaping proposed adjacent to this public street. If this Variance Request is accepted by the City Public Works Department, a trench drain will not be required.
- If the ground behind the curb or attached sidewalk falls away from the public street at a minimum of 6% for a total of 25 feet from the back of curb or walk, a trench drain may not be required.

7.6.5 Rural Roadside Ditches

The City does not use rural road section or rural roadside ditches.

7.6.6 Temporary Erosion and Sediment Control

Temporary erosion control is required along and at the ends of all roadways that are not completed for reasons, such as project phasing or subdivision boundaries, in accordance with the City of Castle Pines Grading, Erosion and Sediment Control Manual.

7.7 Horizontal Alignment

7.7.1 General

The major considerations in alignment design are safety, grade, profile, road section, design speed, sight distance, topography, drainage, and vehicular operation. Alignment should provide for safe and continuous operation at a uniform design speed. Road layout shall bear a logical relationship to existing or platted roads in adjacent properties.

7.7.2 Horizontal Curves

Refer to Table 7-1.

7.7.3 Intersection Curb Return Radii

Refer to Table 7-1.

7.7.4 Design Speed

Horizontal alignment design speed shall be consistent with the requirement for vertical alignment design speed.

Speed limits posted on new roads are typically 5 mph under the design speed. Posted speed limits may be adjusted by the City to reflect actual roadway conditions and circumstances.

7.7.5 Superelevation

Superelevation shall not be used on any roadway classifications with a design speed of 50 mph or less.

Superelevation shall not be used without prior acceptance by the City Public Works Department. If a superelevated design is applied for, American Association of State Highway and Transportation Officials (AASHTO) design standards shall be used.

7.7.6 Railroad Crossings

Railroad crossings are not permitted unless the City and the affected railroad company accept them.

7.8 Vertical Alignment

7.8.1 Permissible Roadway Grades (refer also to Sight Distance on Vertical Curves)

A minimum longitudinal flowline grade of 1.0% shall be required on all Local streets.

A minimum longitudinal grade of 2.0% shall be required along the centerline of all Collector and Arterial streets.

The maximum allowable grade for any roadway is shown on Table 7-1 of these Roadway Standards.

The minimum flowline grade around Knuckles or Eyebrows shall be 2.0%, which may require the street grade to be steeper than 1.0%.

The maximum centerline grade within a Turnaround is 4.0%. The maximum centerline grade within a Knuckle is 4.0%.

Figure 7-18. Flowline Grade around Curves

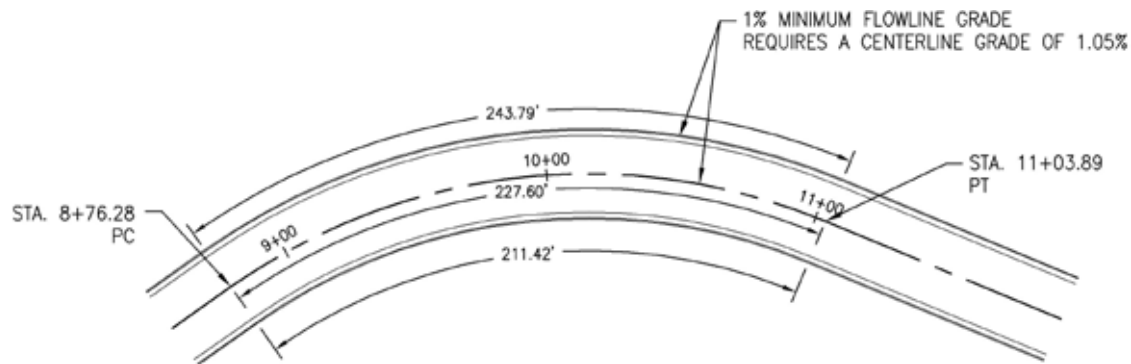
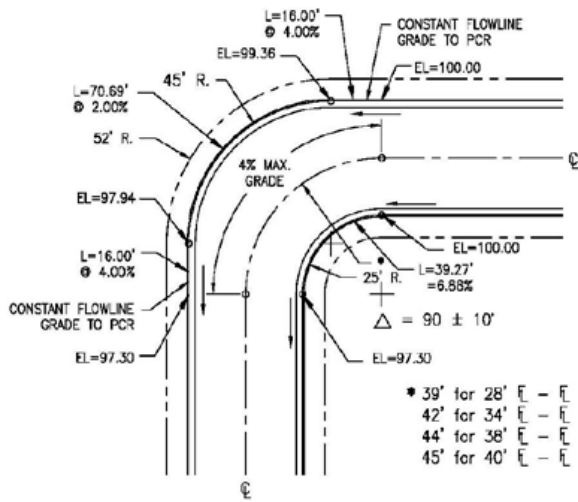
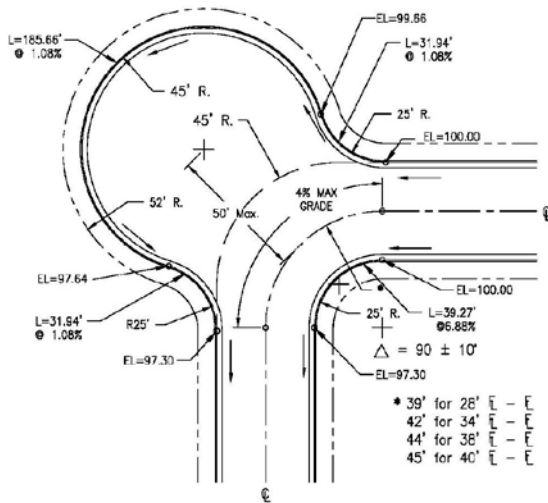


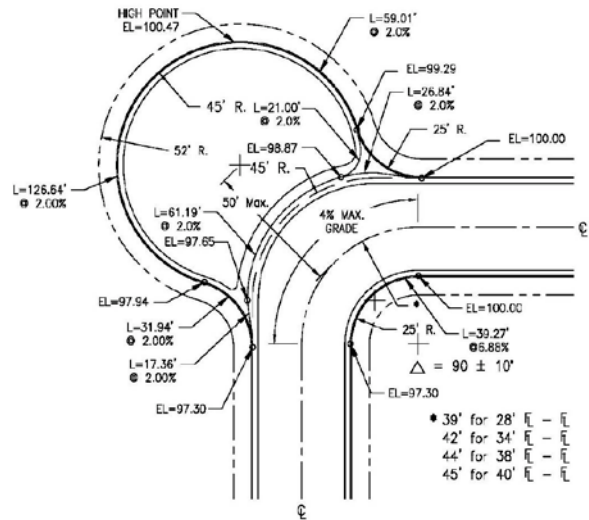
Figure 7-19. Flowline Design around Knuckles



No Bubble

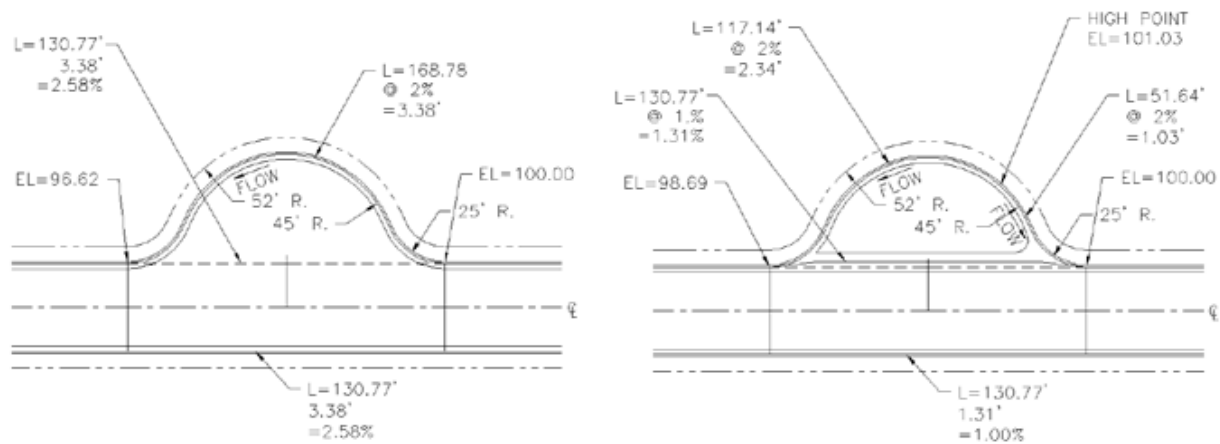


With Bubble, Grade through Entire Knuckle

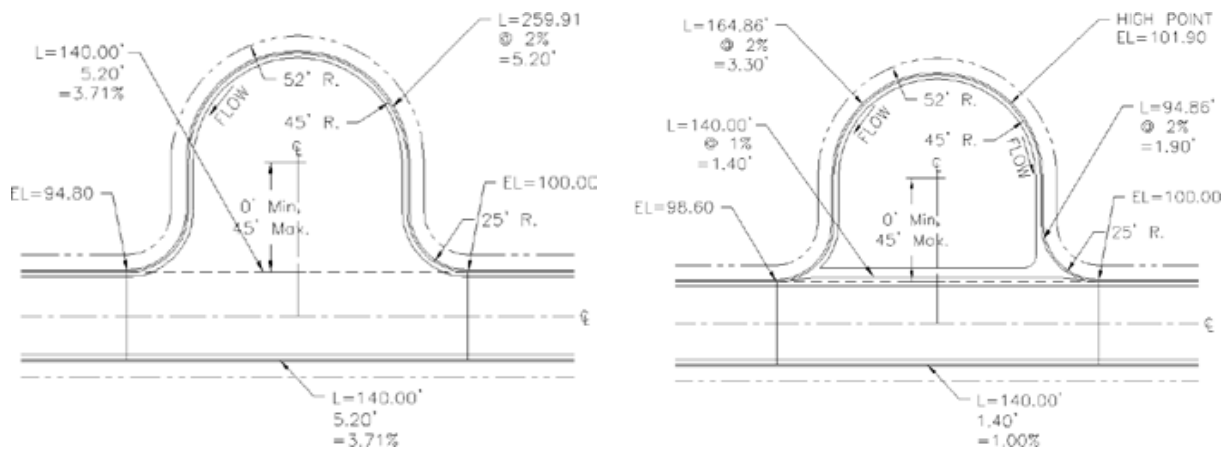


With Bubble, High Point in Bubble, 2% Grade in Both Directions

Figure 7-20. Flowline Design around Eyebrows



0-foot Offset, 2% Grade through Entire Eyebrow 0-foot Offset, High Point with 2% Grade in Both Directions



45-foot Offset, 2% Grade through Entire Eyebrow

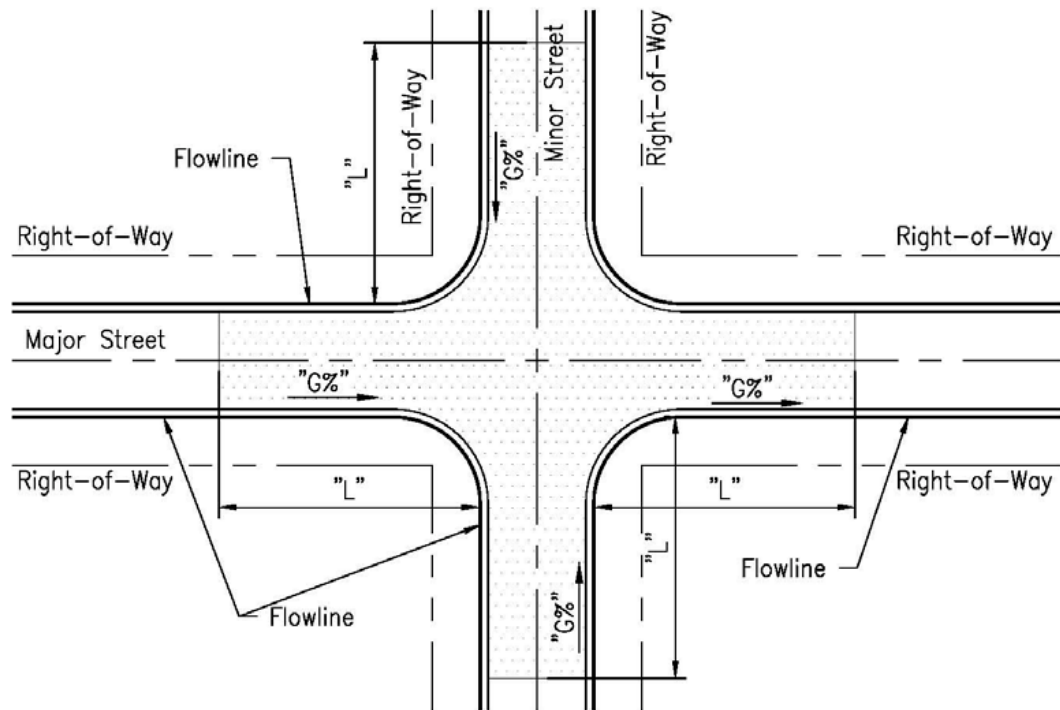
45-foot Offset, High Point with 2% Grade in Both Directions

7.8.2 Permissible Intersection Grades

The minimum length of the maximum permissible intersection grade is measured from the flowline of the through street to a point along the centerline of the intersecting street where the grade of the intersecting street does not exceed the grade shown on Figure 7-21 and Table 7-2.

The cross slope of the through street shall be maintained through intersections.

Figure 7-21. Permissible Intersection Grade Layout



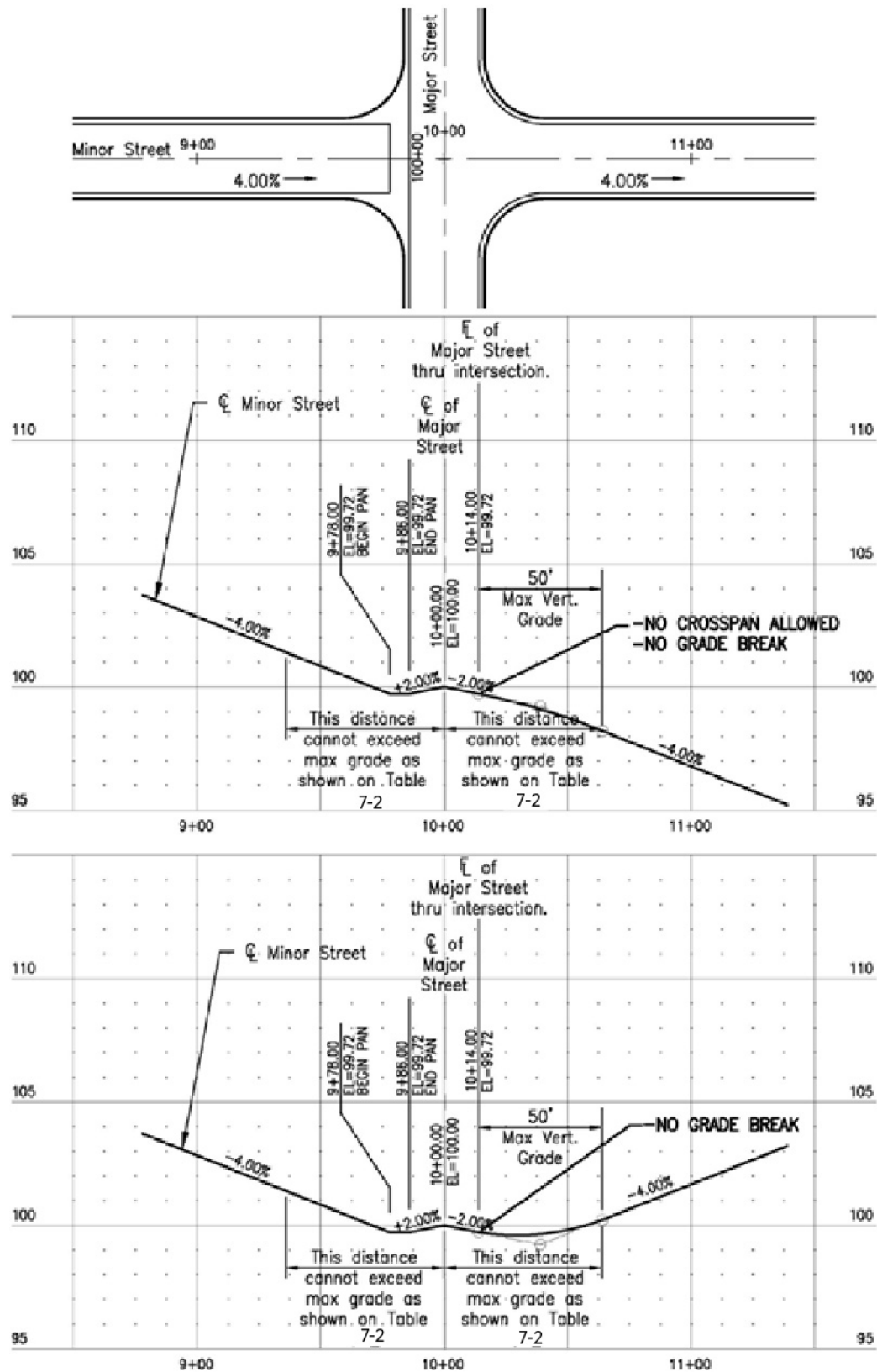
L = Minimum Length Required G = Maximum Grade Allowed See Table 7-2 for information.

The longitudinal slope of the Major Street shall continue through the intersection and may be greater than the max "G" shown in Table 7-2 except at Major Collectors and Arterials.

Table 7-2. Permissible Intersection Grades

| Major Street Minor Street | Cul-De- Sac | Local | Entry Street | School Access Street | Commercial & Industrial | Collector | Minor Arterial | Principal Arterial |
|------------------------------|-------------|------------|--------------|----------------------|-------------------------|-------------|----------------|--------------------|
| Cul-De-Sac | L=95' G=4% | L=95' G=4% | L=95' G=4% | L=95' G=4% | L=95' G=4% | N/A | N/A | N/A |
| Local | N/A | L=95' G=4% | L=95' G=4% | L=95' G=4% | L=95' G=4% | N/A | N/A | N/A |
| Entry Street | N/A | N/A | L=95' G=4% | L=95' G=4% | N/A | L=100' G=4% | L=150' G=3% | L=150' G=3% |
| School Access Street | N/A | N/A | L=95' G=4% | L=95' G=4% | N/A | L=100' G=4% | L=150' G=3% | L=150' G=3% |
| Commercial & Industrial | N/A | L=95' G=4% | L=95' G=4% | L=95' G=4% | L=95' G=4% | L=100' G=4% | L=150' G=3% | L=150' G=3% |
| Collector | N/A | N/A | N/A | N/A | N/A | L=100' G=4% | L=150' G=3% | L=150' G=3% |
| Minor Arterial | N/A | N/A | N/A | N/A | N/A | N/A | L=200' G=2% | L=200' G=2% |
| Principal Arterial | N/A | N/A | N/A | N/A | N/A | N/A | N/A | L=200' G=2% |

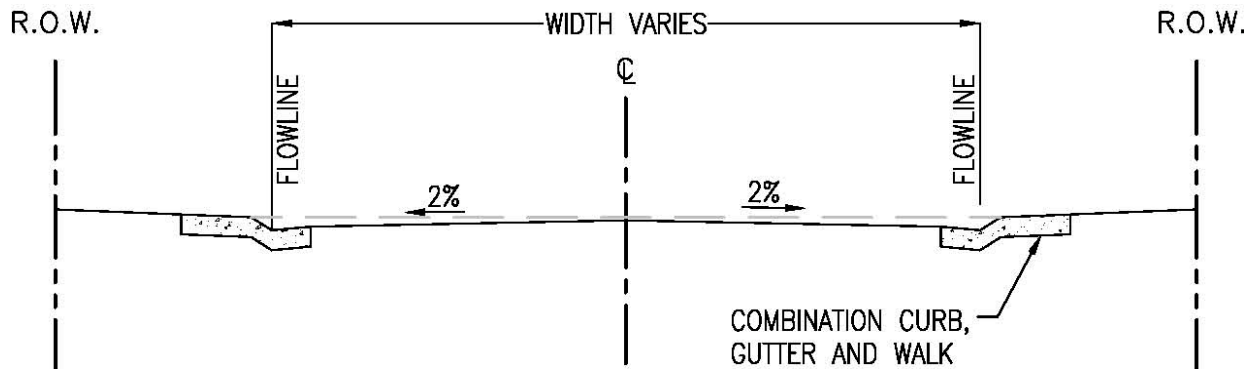
Figure 7-22. Permissible Intersection Grade Example



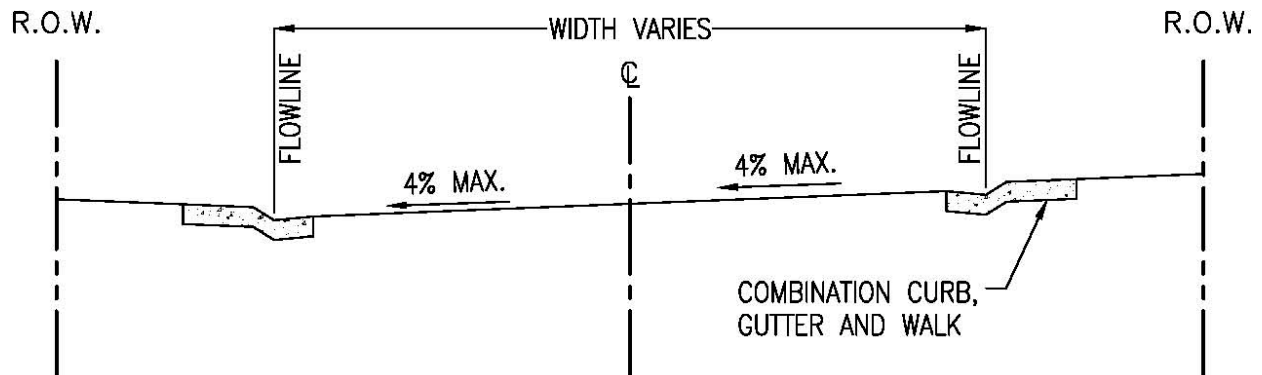
7.8.3 Cross Slope

Typically, roadways shall have a crown in the center with a minimum 2% cross slope with curbs at the same elevation at the same station. The maximum permissible cross slope is 4%. The pavement cross slope at intersections shall not exceed the grade of the through street. Parabolic or curved crowns are not allowed.

Figure 7-23. Cross Slope Example



Typical Roadway Cross Slope



Maximum Roadway Cross Slope

The rate of change for roadway cross slope, when warping side streets at intersections, shall not exceed the following criteria:

- Local Streets: 1% every 25 feet horizontally along the roadway
- Collector Streets: 1% every 37.5 feet horizontally along the roadway
- Arterial Streets: 1% every 56.5 feet horizontally along the roadway

7.8.4 Grade Breaks and Vertical Curves

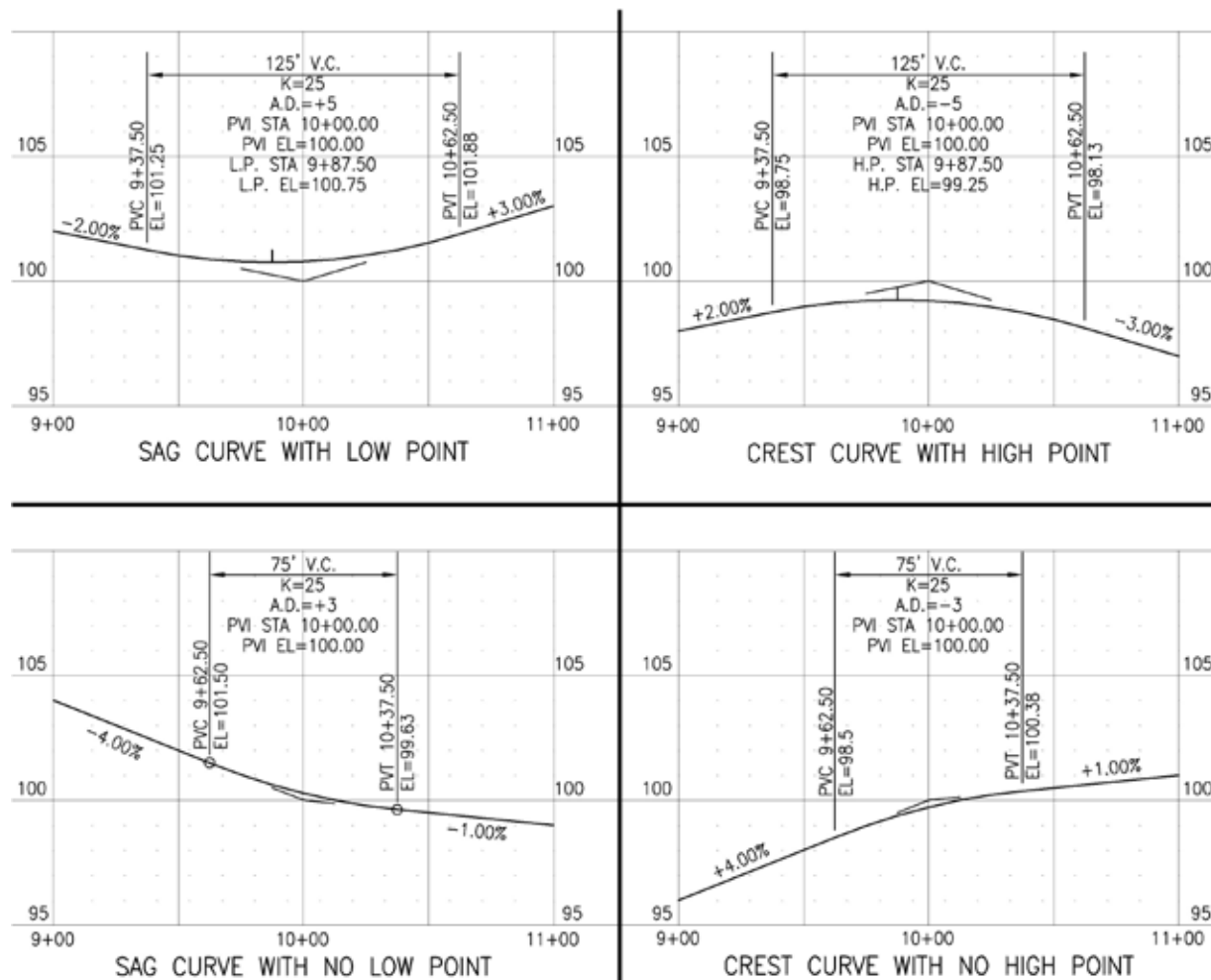
The use of grade breaks in lieu of vertical curves is discouraged. However, if a grade break is necessary, and the algebraic difference in grade does not exceed 0.5% along the roadway flowline, the grade break may be permitted.

When the algebraic difference in grade (A) is at or exceeds 0.5%, a vertical curve shall be used. Design criteria for vertical curves are found in Table 7-1 of these Roadway Standards. Minimum length of a vertical curve is also shown in Table 7-1. All vertical curves shall be labeled, in the profile, with length of curve (L) and $K = (L/A)$ values.

The maximum grade break allowed at the PT at a curb return for local and collector roads shall be 2%; for arterial roadways, it shall be a maximum of 1%.

All flowline vertical curves in Knuckles and Bubbles shall have a maximum length of 50 feet.

Figure 7-24. Vertical Curve Examples



7.9 Intersections

The grade of the through street shall take precedence at intersections. At intersections of roadways with the same classification, the more important roadway, as determined by the City, shall have precedence. The design should warp side streets to match through streets with as short a transition as possible. Refer to Section 7.8.3 for the rate of change in pavement cross slope when warping side streets at intersections.

The key criteria for determining the elevation of the curb return on the side street and the amount of warp needed on a side street transitioning to a through street are as follows:

- Pavement cross slope at the point of curb return (PCRs) on the side street and permissible warp in pavement cross slope (refer to Section 7.8.3).
- The maximum permissible cross slope is 4% between the PCRs.
- Normal vertical curve criteria (refer to Section 7.8.4).
- Vertical controls within the curb return itself (refer to Section 7.9.1).

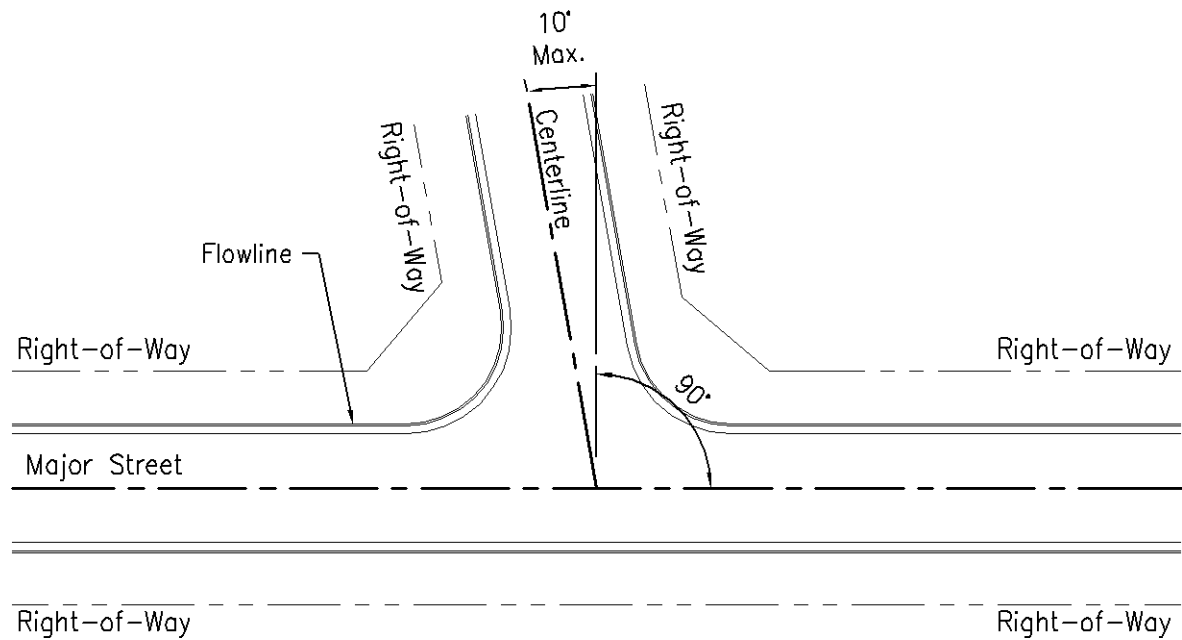
The elevation at the PCR of the curb return on the through street is always set by the grade of the through street in conjunction with a normal pavement cross slope of 2%. Carrying the crown at a side street into the through street is permitted only when drainage considerations warrant such a design. Refer to Section 7.8.3 for street cross slope allowances.

A more detailed review shall be performed for Arterial-Arterial intersections to maximize drivability. Few Arterial intersections will have a uniform 2% cross slope, the majority of them having one or more sides warped (refer to Sections 7.8.3 of these Standards for rates of pavement warp allowed). A plan view drawing of all Arterial-Arterial intersections will be required showing spot elevations on a 10-foot-by-10-foot grid.

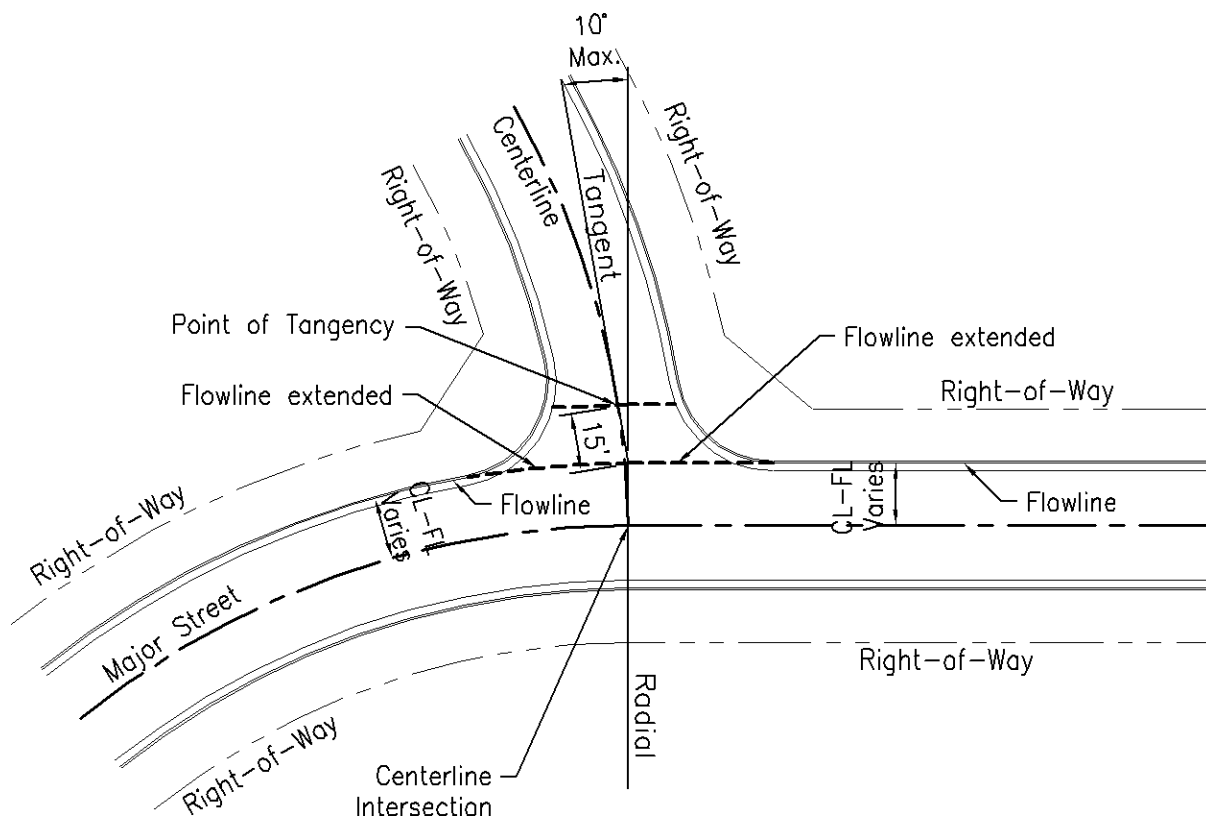
Whenever possible, intersections shall be made at right angles or radial to a curve. An intersecting deflection angle of more than 10% will not be allowed (refer to Figure 7-25). Intersection sight distances shall conform to the requirements of these Roadway Standards or the AASHTO Green Book, or both.

Refer to Figure 7-22 for an example of the Permissible Intersection Grade.

Figure 7-25. Permissible Intersection Angle



Intersection of a Straight Street to a Straight Street



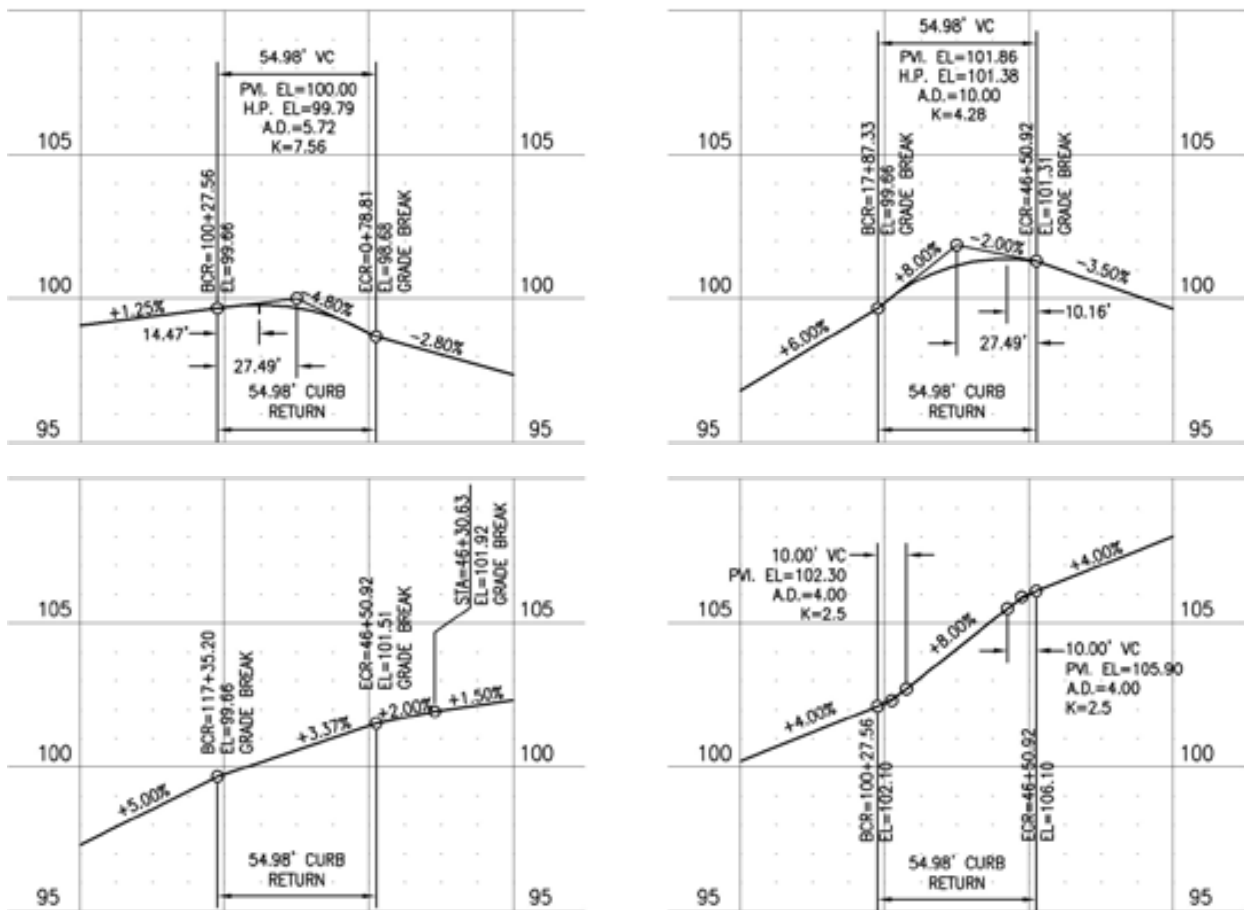
Intersection of a Curve Street to a Curve or Straight Street

7.9.1 Curb Returns

Curb return profiles are required for all curb returns within the public right-of-way. An elevation along the arc length of the curb return shall be shown in plan view at both sides of handicap ramps. Curb return profiles shall be extended 100 feet in each direction to create an adequate design with impacted roadways. General standards for flowline control and profiles within the curb returns shall be as follows:

- The point of tangency at each curb return shall be determined by the projected tangent grade beginning at the point of intersections of the flowlines.
- Design the flowline of the curb return such that the maximum slope along the flowline does not exceed 8%.
- Grade breaks at the PCRs shall not exceed 2% for Local and Collector streets and 1% for Arterials.
- Maximum vertical curve length will equal the arc length of the curb return.
- The elevation and location of the high or low point within the return, if applicable, is to be called out in the profile.
- Warp of the side streets shall not exceed criteria set in Section 7.8.3.

Figure 7-26. Curb Return Examples



Rules to follow for designing curb return profiles:

- 1) Grade break at PCR only.
- 2) Minimum grade around a curb return is 2%; maximum grade is 6%.
- 3) Roadway cross slope cannot exceed 4%.

7.9.2 Connection with Existing Roadways

If the algebraic difference in grade between the existing and proposed grade exceeds 0.5%, a vertical curve will be required to make this transition (refer to Section 7.8.4). The vertical curve shall end prior to the connection with the existing improvement and also comply with the grade requirements at intersection approaches.

Existing grade shall be shown for at least 300 feet, with field-verified as-builts showing stations and elevations at 25-foot intervals. In the case of a connection with an existing intersection, these as-builts are to be shown within a 300-foot radius of the intersection. This information will be included in the plan and profile for the proposed roadway.

Limits and characteristics of the existing improvement are the primary concern in the plan view. Such characteristics include horizontal alignment, offsite intersections, and limits of the improvement, among others.

The vertical datum of the as-built elevations shall be the same as the design elevations.

7.9.3 Intersection Warping

Refer to Section 7.8.3. for the rate of change in pavement cross slope.

7.10 Roundabouts

7.10.1 General Guidelines

The City may allow Roundabouts to replace other types of intersection traffic control, such as two-way or all-way STOP signs or traffic signals. They may be considered at any location where a Roundabout is shown to operate as well or better than a signal if the Roundabout can be constructed to meet City standards. Roundabouts are limited to roadways with no more than two approach lanes (4- to 5-lane roadways).

All Roundabout designs shall require a two-step process: (1) a preliminary design and feasibility analysis initially submitted to the City Public Works Department, and (2) a construction design where specific design criteria and standards are reviewed.

All proposed Roundabouts fall within three categories: (1) mini-Roundabouts, which are small, one-lane Roundabouts that can be used as traffic-calming devices and are limited to Local roads only; (2) single-lane Roundabouts, which are often used to replace four-way STOP control or traffic signals on all classifications of roadways with two travel lanes; and (3) multi-lane Roundabouts, which are used to replace a traffic signal on four-lane roadways.

Roundabouts may have three, four, or five approaches. Approach roadways may be single lane, single lane with a flare out to provide an added left-only or right-only lane at the circulating roadway, single lane with a by-pass right-turn lane, or two lanes without added lanes. The configuration must be based on turning movement volumes and provide balanced lane use.

7.10.2 Feasibility Analysis

Prior to beginning design of the Roundabout, a feasibility analysis must be prepared that includes at a minimum the following:

- Traffic Operations Study consisting of daily volumes, vehicle classification, and a.m./p.m. peak hour turning movement counts for existing site buildout and a 20-year forecast. Where the Roundabout is near a school, shopping center, or other major traffic generator, the peak hour for local traffic with the traffic generator fully developed shall be used.
- Location and category of the proposed Roundabout, including roadway widths, speeds, and classifications for intersecting roadways.
- Preliminary dimensions of the Roundabout, including inscribed circle and circulating roadway, number of lanes for each approach and departure, existing and planned pedestrian and bicycle facilities in the immediate area, and right-of-way.
- Preliminary approach grades.
- Identification and proposed method of correcting any restrictions to visibility on each approach caused by vertical or horizontal alignment design or other sight-distance restrictions.
- LOS analysis from RODEL, SIDRA, or ARCADY (minimum LOS C or better at 85% confidence level) and comparison with alternatives (signal, four-way, or two-way STOP, using Synchro or Highway Capacity Software) at initial construction and with 20-year projections.
- Identification of impact on any nearby intersections, driveways, or traffic signals caused by queuing.
- Identification of any expected construction or phasing problems and proposed mitigation.

7.10.3 Design

The design shall include the following:

- A location map and details of the approach roadways (such as width, grades, number of lanes, drainage patterns, lighting, and typical Roundabout design criteria).
- Sight-distance lines for Decision Sight Distance. The approach roadways must provide drivers with adequate visibility of the Roundabout from a distance that shall allow approaching drivers to see and identify the Roundabout, both day and night. The Decision Sight Distance is the minimum distance required to allow deceleration from the 85th percentile travel speed (or posted speed limit, whichever is greater) to the maximum entry speed of 20 mph (single lane) or 25 mph (multi-lane) without exceeding a deceleration rate of 10 feet per second squared. This is generally the same distance as the "intersection sight distance" noted in AASHTO standards and is variable by approach speed.
- Stopping Sight Distance lines and restricted sight areas for each approach.
- A separate drawing showing turning templates for large vehicles and fastest path lines.
- Drainage patterns on the approaches and within the Roundabout.
- Signage and pavement markings for vehicles and pedestrians.
- Where bike lanes exist or are planned, provision of ramps for bicyclists to enter sidewalk and navigate Roundabout as a pedestrian.
- Location of existing and proposed utilities.

See Appendix A for specific design details regarding alignment, grades, and other Roundabout-specific design criteria.

7.11 Sight Distance

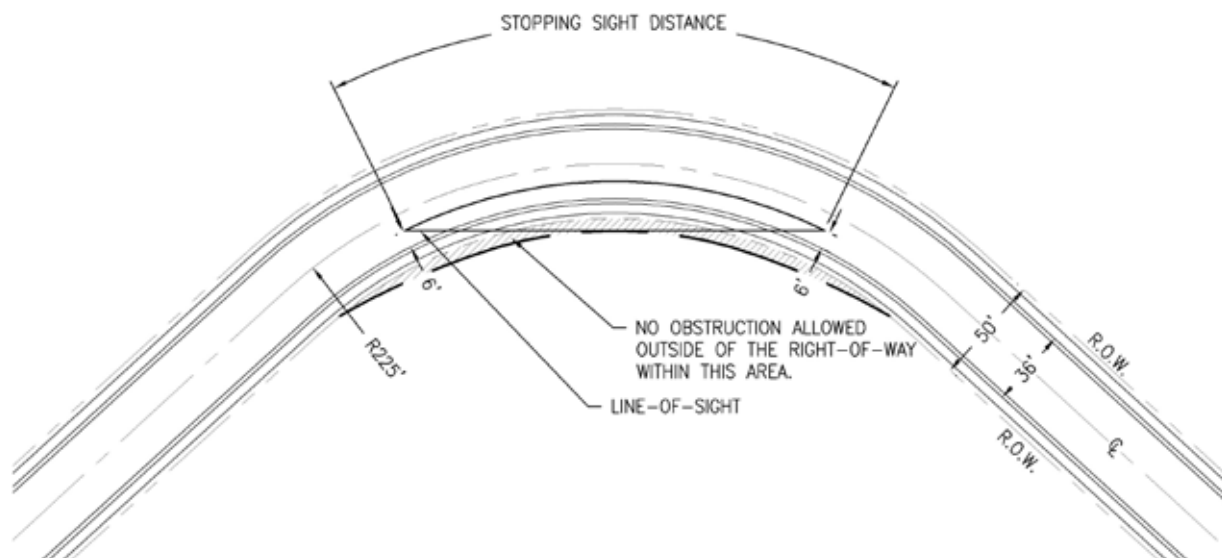
The horizontal and vertical alignment must provide at least the minimum sight distance for the design speed at all points. This includes visibility at intersections as well as along all horizontal and vertical curves. All sight distance lengths shall be adjusted for any grade 3% or higher per AASHTO.

7.11.1 Sight Distance on Horizontal Curves

Horizontal sight distance on the inside of a curve can be limited by obstructions, such as buildings, hedges, wooded areas, high ground, and utility boxes. These obstructions shall be shown on the plans. Horizontal sight is measured as indicated on Figure 7-27.

Cut slope obstructions shall be shown on the plans by a line representing the proposed excavation slope at a point 2.75 feet above the road surface for stopping sight distance and at a point 3.5 feet above the road surface for passing sight distance. The position of this line with respect to the centerline may be scaled from the plotted roadway cross sections. The stopping sight distance shall be measured between points on the same traffic lane and passing sight distance from the middle of one lane to the middle of the other lane.

Figure 7-27. Lateral Clearance to Sight Obstruction inside of Horizontal Curves Providing Stopping Distance for Turning Roadways



7.11.2 Stopping Sight Distance

The minimum stopping sight distance is the distance required by the driver of a vehicle traveling at the design speed to bring the vehicle to a stop after an object on the road becomes visible. Stopping sight distance is calculated in accordance with the AASHTO Green Book. Object height is 2 feet above road surface and viewer's height is 3.5 feet above road surface.

In no case shall the stopping sight distance be less than as specified in Table 7-3. A likely obstruction may be a bridge abutment or line of columns, wall, cut-side slope, landscaping, or the side or corner of a building. The sight distance design procedure shall assume a 6-foot fence (as measured from actual finished grade) exists at all property lines except in the line of sight required at all intersections (Refer to Figure 7-27).

The position of the driver's eye and the object sighted are assumed to be 6 feet from the inner edge of pavement, with the sight distance being measured along this arc.

7.11.3 Passing Sight Distance

Passing sight distance is the minimum sight distance that must be available to enable the driver of one vehicle to pass another safely and comfortably without interfering with oncoming traffic traveling at the design speed. Required passing sight distance for given design speeds is shown in Table 7-3.

Table 7-3. Stopping and Passing Sight Distance

| Design Speed (mph) | Stopping Sight Distance (feet) | Passing Sight Distance (feet) |
|--------------------|--------------------------------|-------------------------------|
| 20 | 115 | 400 |
| 25 | 155 | 450 |
| 30 | 200 | 500 |
| 35 | 250 | 550 |
| 40 | 305 | 600 |
| 45 | 360 | 700 |
| 50 | 425 | 800 |
| 55 | 495 | 900 |
| 60 | 570 | 1,000 |
| 65 | 645 | 1,100 |
| 70 | 730 | 1,200 |

Source: AASHTO Green Book

7.11.4 Intersection and Driveway Sight Distance

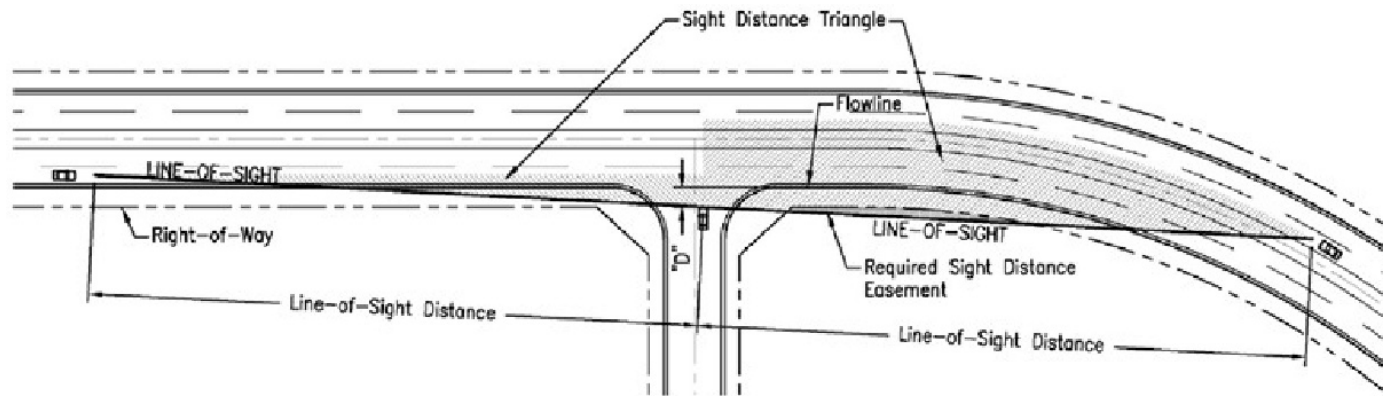
There shall be an unobstructed line-of-sight along both sides of all stopped approaches at an intersection within the right-of-way to provide the entering vehicle adequate sight distance to enter or cross the roadway. Refer to Figure 7-28.

Any object within the sight triangle (Figure 7-28) more than 24 inches above the flowline or edge of pavement elevation of the adjacent street shall constitute a sight obstruction and shall be removed or lowered. Such objects include berms, retaining walls, signs, buildings, cut slopes, hedges, trees, bushes, utility cabinets, or tall crops. These Roadway Standards also require the elimination of parking (except on local streets or as otherwise permitted by the City) within the sight triangle and applies whether the intersecting roads are level or on grades. The sight distance shall be measured to the centerline of the closest through lane in both directions.

All sight-distance triangles must be shown on the street plan/profile and landscape plans. All sight distance must be within the right-of-way. Any sight distance triangle outside of the right-of-way must be accepted by the City Public Works Department and requires a sight-distance easement.

In no case shall any object encroach into the line-of-sight of any part of the sight distance triangle. Refer to Figure 7-29.

Figure 7-28. Intersection and Driveway Sight Distance (Line-of-Sight Triangle)



| City of Castle Pines Road Classification | Design Speed (mph) | Posted Speed Limit (mph) | Line-of-Sight Distance (FT) |
|--|--------------------|--------------------------|-----------------------------|
| Cul-de-Sac | 25 | 20 | 230 |
| Local | 30 | 25 | 280 |
| Entry Street | 30 | 25 | 280 |
| Commercial and Industrial | 30 | 25 | 280 |
| Major and Minor Collector | 35 | 25 | 280 |
| Minor Arterial | 50 | 40 | 583 |
| Principal Arterial | 50 | 40 | 583 |

Notes:

Line-of-Sight distance is measured from a point on the Minor road at 15 feet back from the flowline of the Major road to the closest oncoming lane.

Line-of-Sight distance is measured from a height of eye at 3.50 feet on the Minor road to a height of object of 2.00 feet on the Major road.

At Local-Local street intersections only, the "D" dimension shall be 10 feet and the sight distance shall be measured to the center of the lane.

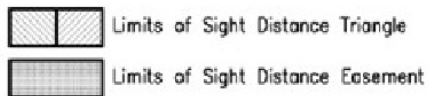
For private driveway access to a public street, use 10 feet back from the flowline (or shoulder for gravel roads).

For 60 mph Design Speed, stopping sight distance governs.

Line-of-Sight must be within the right-of-way or easement.

Sight distance developed from the AASHTO Green Book.

Line-of-Sight distances may need to be adjusted if special traffic control conditions exist per the AASHTO Green Book.



7.11.5 Sight Distance on Vertical Curves

The vertical sight distance should be checked to verify that the sight distance is sufficient to allow a vehicle to stop, pass, or enter.

Methods for scaling sight distances are demonstrated on Figure 7-29. The figure also shows a typical sight-distance record that would be shown on the final plans for Collector and Arterial roads. Both horizontal and vertical sight distances should be measured, and the shorter lengths shall be considered the critical sight distance for use in design. It is desirable to measure and record sight distance for both directions of travel at each station. In the case of rural two-lane streets, passing sight distance in addition to stopping sight distance should be measured and recorded. Once the horizontal and vertical alignments are tentatively established, the practical means of examining sight distances along the proposed street is by direct scaling on the plans. Refer to Figure 7-29.

7.12 Offsite Design

The design grade and existing ground of all roadways that dead-end as a result of project phasing, subdivision boundaries, and the like shall be continued, in the same plan and profile as the proposed design. If the offsite roadway adjacent to the proposed development is not fully improved, the developer is responsible for the design and construction of a transition for the safe conveyance of traffic from the improved section to the existing roadway.

7.13 Auxiliary Lanes

The design of the arterial street system depends on the proper control of access to developments. Auxiliary Lanes shall be designed using the CDOT Design Guide. The need for Auxiliary Lanes on two-lane roads shall adhere to the State Highway Access Code. The need for all other Auxiliary Lanes will be established by the accepted traffic impact study for the final plat or final development plan. Lane widths are a minimum of 12 feet, including the adjacent curb and gutter pans.

7.14 Bus Pullout Lanes

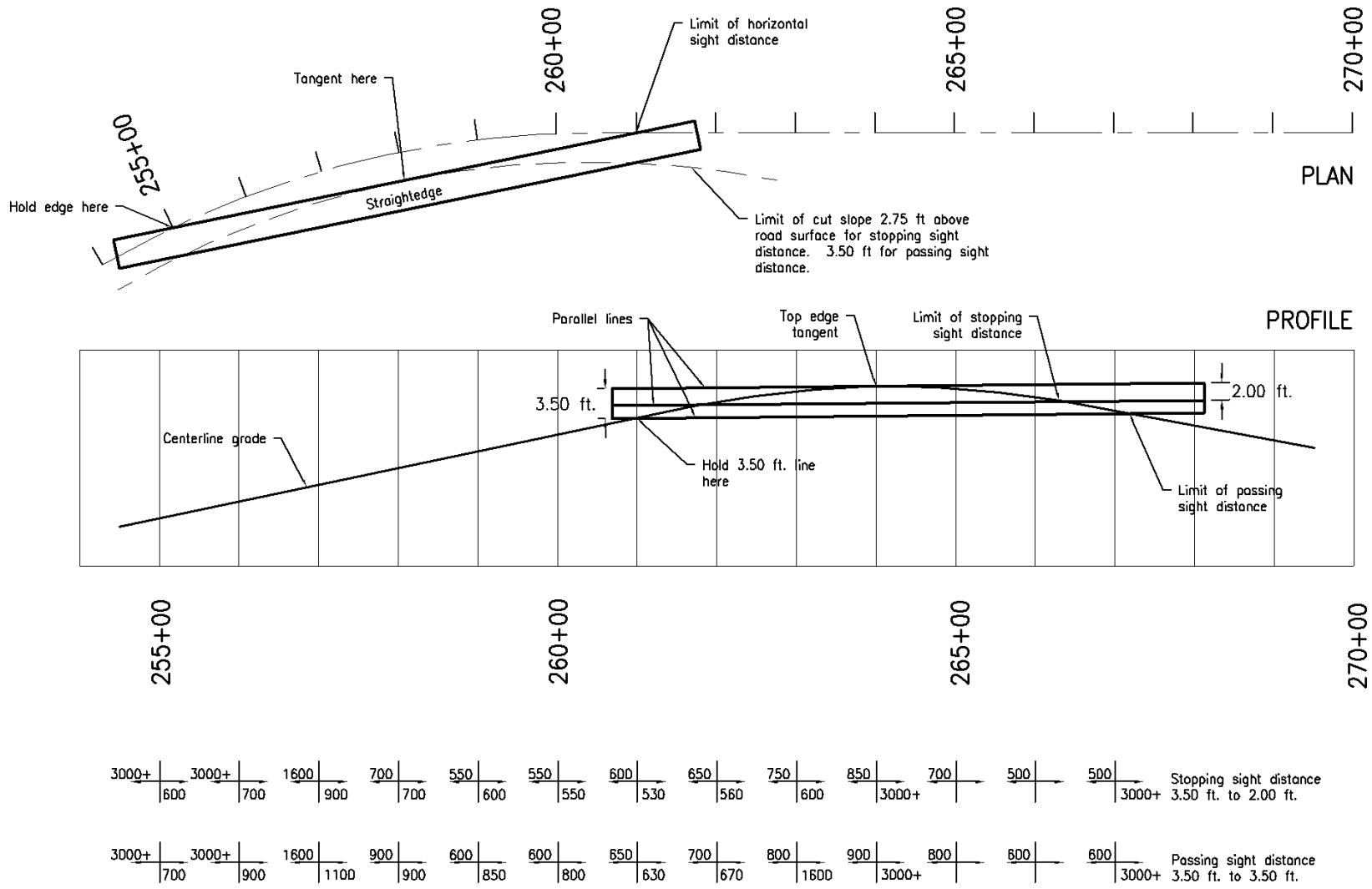
Bus Pullout Lanes shall be designed and constructed by the adjacent land developers where required. The design of the Bus Pullout Lanes will be governed by dimensions shown in Table 7-4, located on the far side of an intersection, and shall be reviewed and accepted according to procedures set forth in these Roadway Standards.

Table 7-4. Bus Pullout Lanes

| Speed Limit (mph) | Lead-in Length (feet) | Lead-out Length (feet) |
|-------------------|-----------------------|------------------------|
| 35 and under | 60 | 60 |
| 40 | 100 | 70 |
| 45 | 150 | 80 |
| 50 | 200 | 90 |
| 55 | 250 | 100 |

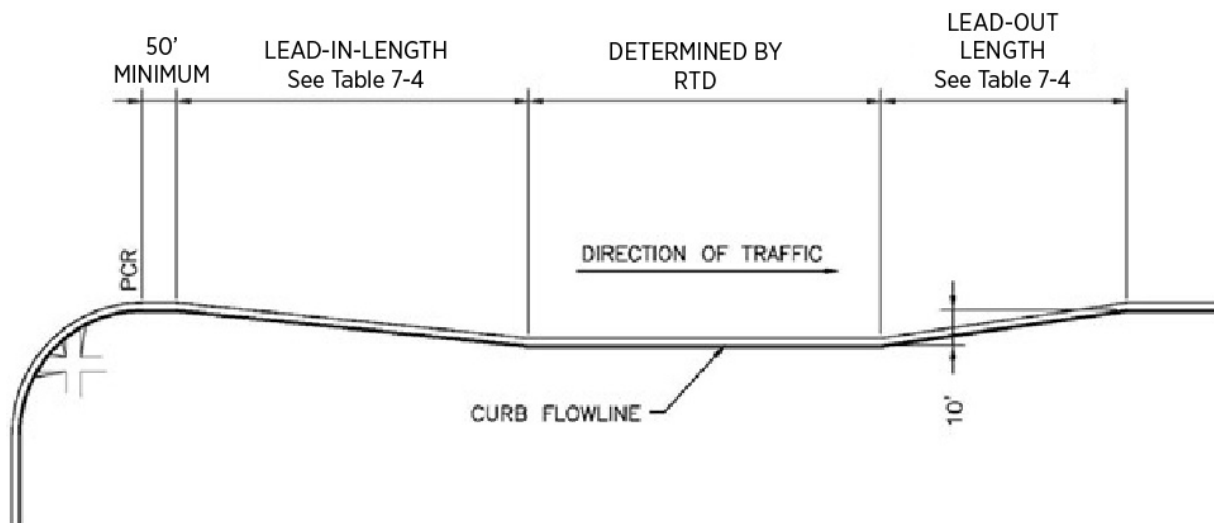
Actual dimensions shall conform with criteria set forth by the Regional Transportation District. The Pavement Design Report (See Chapter 10 of these Roadway Standards) shall consider the requirements of the Bus Pullout Lane separately from the adjacent roadway. All Bus Pullout Lanes must be concrete, which will conform to all applicable paving criteria. Bus Pullout Lanes shall be constructed with no less than 50 feet between an intersection PCR and the beginning of the lead-in taper.

Figure 7-29. Scaling and Recording Sight Distance on Plans



EXAMPLE SIGHT DISTANCE RECORD

Figure 7-30. Bus Pullout Lane



7.15 Raised Medians

7.15.1 Median Islands

No permanent structures (for example, trees, poles, and large rocks) shall be placed within 10 feet of the face of curb (unless the median is constructed in accordance with the Median Planter Standard Drawings of these Roadway Standards) or in any location that would obstruct sight distance.

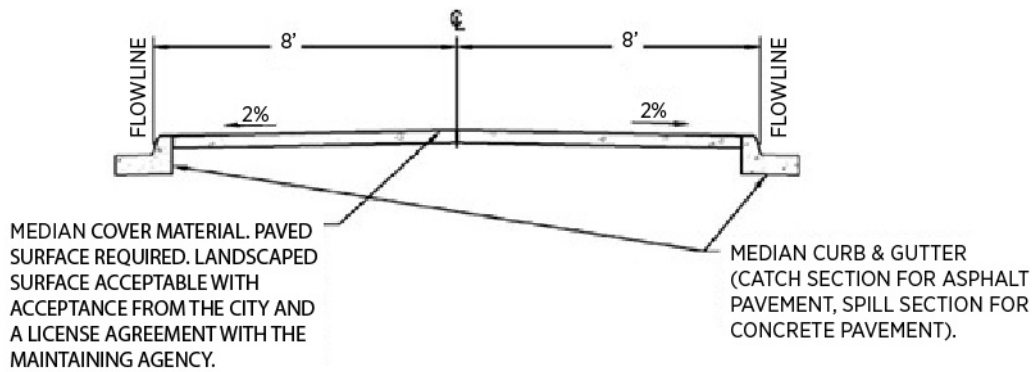
Landscaping on median islands shall have a mature height of 24-inches or less above the flowline of the adjacent street in areas around intersections to facilitate adequate sight distance and must be dry land or native vegetation. If irrigation is planned in a median island, trench drain will be provided to protect the subgrade under the pavement from being saturated by using the Median Planter detailed in Appendix A.

For all streets constructed with asphalt, the median shall be constructed with a catch curb and gutter. Inlets are required along the median to reduce ponding at curb and gutter low points and to eliminate concentrated flow crossing over the lanes of traffic at the nose of the median. The final design and construction drawings must address inlet sizing, dimensions, and required curb and gutter transitions. If a street is constructed with concrete, it is acceptable for the median curb and gutter to be constructed as a spill section. Refer to the Storm Design Manual, which presents conceptual representations of options available for placing median nose inlets.

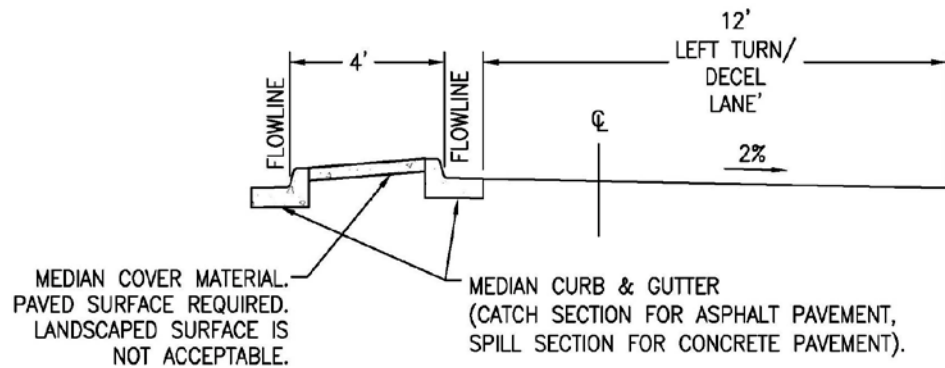
The nose of the median island shall not extend past the PCR for the curb return at any intersection.

A minimum 20-foot flowline to flowline street cross-section must be maintained on both sides of all median islands.

Figure 7-31. Median at Intersection

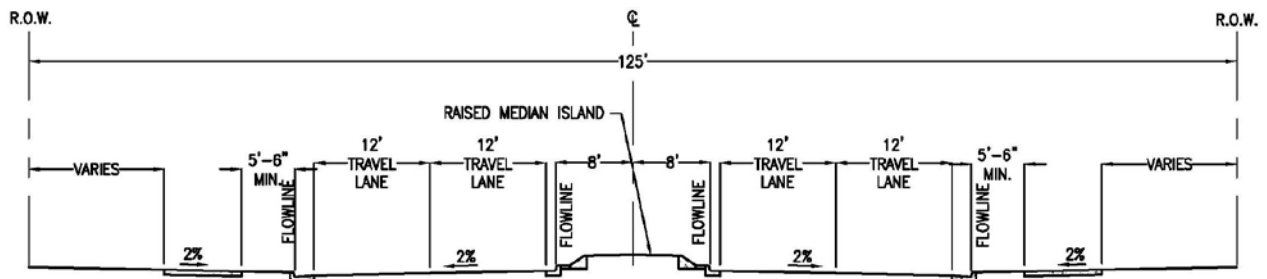


Full Width

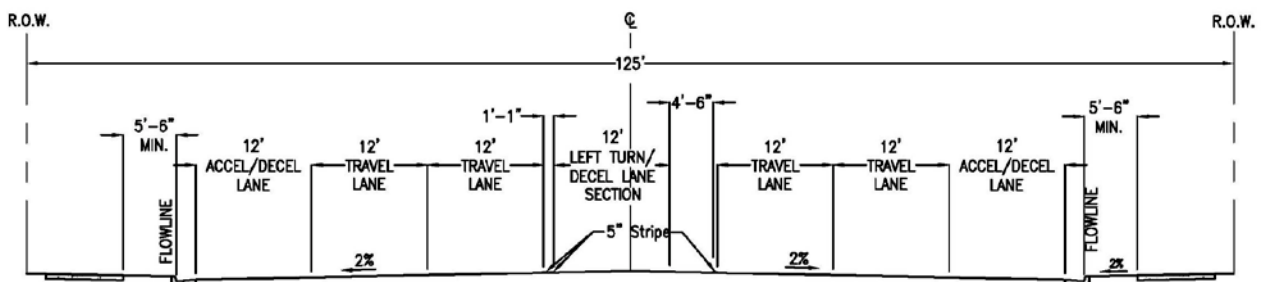


Left-Turn Lane

Figure 7-32. Intersection Striping Option for Single Left Turn

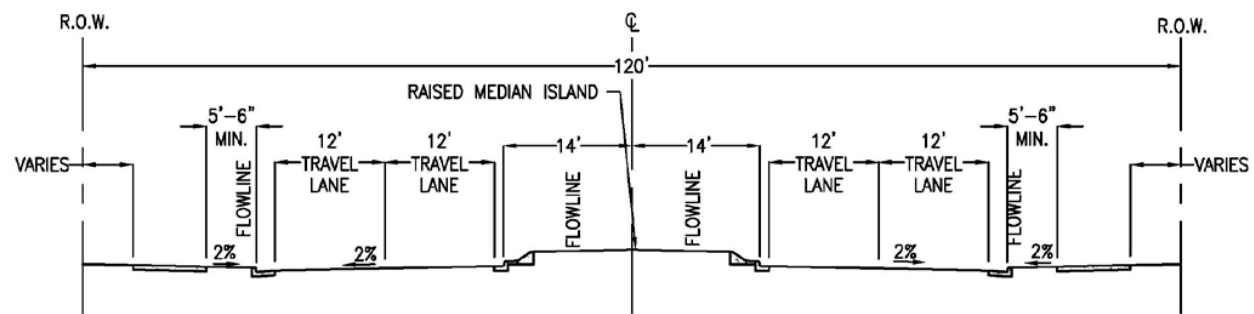


Road Section

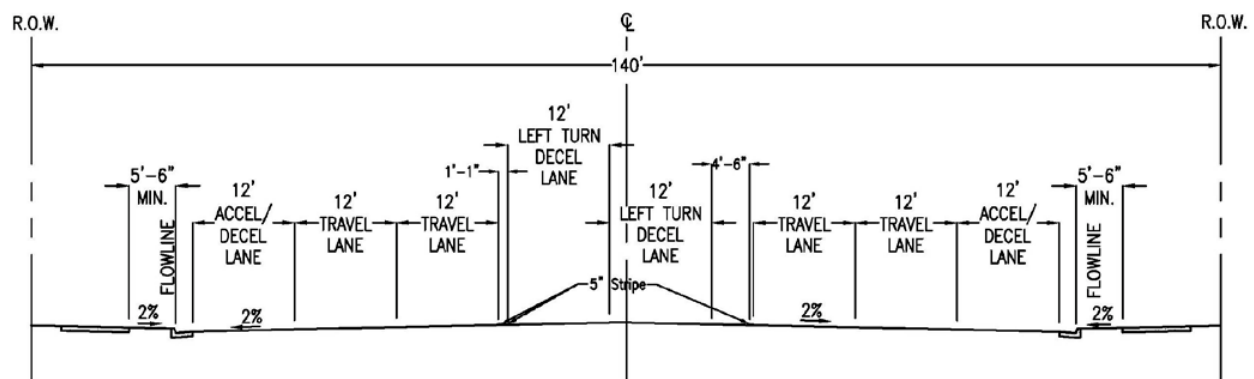


At Intersection

Figure 7-33. Intersection Striping Option for Dual Left Turn



Road Section



At Intersection

7.16 Right-of-Way Maintenance

If landscaping within, or encroaching into, the City right-of-way is restricting sight distance, is blocking a traffic control device, or is otherwise a hazard, according to City of Castle Pines criteria, the City may (by written notice sent by certified mail in accordance with CRS 42-4-114) require the owner of real property abutting the right-of-way to trim or remove, at the expense of said property owner, any tree limb, shrub, vine, hedge, or other plant on their property that projects beyond the property line into or over the public right-of-way. In the event that the property owner fails or neglects to trim or remove any such obstruction, within 10 days after receipt of said written notice, the City may remove said obstruction, and said property owner shall reimburse the City for the cost of the work performed.

Mailboxes constructed in the City right-of-way must conform to the standard details. Brick or stone column mailboxes are considered a vehicular obstruction and are not allowed in the City right-of-way unless a variance with a License Agreement is granted.

The term "Clear Zone" is used to designate the unobstructed, traversable area provided beyond the edge of the traveled way for the recovery of errant vehicles. The clear zone includes shoulders, bicycle lanes, and auxiliary lanes unless the auxiliary lane functions like a through lane. Refer to the AASHTO Roadside Design Guide for further guidance.

The Standards allow for street lighting in public right-of-way. City of Castle Pines is not responsible for installation, replacement, maintenance, removal or power costs, unless otherwise agreed to in writing. Generally, such responsibilities shall be the obligation of the adjacent development.

7.17 Private Streets

7.17.1 City Requirements

The City is required by State Statute to review all subdivision of property to confirm that the designs meet all sound planning and engineering requirements as contained in the City Subdivision Regulations. The City is further charged to guarantee the public improvements of the subdivision are constructed and that said construction is in substantial conformance with the plans and specifications. The Colorado Revised Statutes state, "All plans of streets or highways for public use, and all plans, plats, plots, and replots of land laid out in subdivision or building lots and the streets, highways, alleys, or other portions of the same intended to be dedicated to a public use or the use of purchasers or owners of lots fronting thereon or adjacent thereto, shall be submitted to the planning commission or City Council for review and subsequent approval, conditional approval, or disapproval."

7.17.2 General Application

All roadways shall be built to these Roadway Standards. If an Owner or Developer wishes to not build the roadways to City standards or with adequate rights-of-way, the Owner or Developer shall submit Private Roadway Standards for review by the City. If the Private Roadway Standards are acceptable to the City, then these roadways shall not be maintained or assumed for maintenance by the City unless they are brought to City standards at the Owner's or Developer's expense.

7.17.3 Private Improvements

Private improvements, such as roadways, driveways, or utilities, shall be clearly shown and labeled as such on each sheet of the construction plans. The following note shall appear on each sheet of the constructions plans where private improvements are shown: "City of Castle Pines shall not be responsible for the maintenance of roadway and appurtenant improvements, including storm drainage structures and pipes, for the following private streets."

When a request is made for the City to assume maintenance of any private improvement, it shall be the responsibility of the person(s) making the request to satisfactorily demonstrate that the private improvement is constructed in accordance with these Roadway Standards and that adequate right-of-way is provided.

The City will review these requests under normal review procedures as outlined previously in these Roadway Standards.

Improvements that were not constructed in accordance with the applicable design and construction standards and specifications will not be accepted for maintenance by the City.

Any gate on a private road shall be located a minimum of 30 feet from the outside edge of the closest through lane of the intersecting road. The opening of the gate must be a minimum of 2 feet wider than the gated road or greater as required by the local Fire District.

7.17.4 Private Roadway Standards

Private roadway standards, based on Sound Engineering Criteria, may be proposed for private development. These Private Roadway Standards must be certified as to their adequacy and safety by a Professional Engineer licensed in the State of Colorado. The private roadway standards must contain a list of all deviations from City criteria as well as references to all sources that support the adequacy of the proposed deviations. The standards shall be subject to acceptance by the Developer, governing Fire

District, and the City. The following statement needs to be included on the acceptance page of the private roadway standards: "Private roads shall not be maintained or assumed for maintenance by City of Castle Pines unless right-of-way is dedicated to the City in fee simple at no cost to the City, and the private roads are improved to meet the requirements of the City of Castle Pines Roadway Design and Construction Standards, as amended, at no cost to the City. Additional requirements may apply."

7.17.5 Pavement Design/Roadway Construction

All roadways constructed in the City shall be high-quality, minimum maintenance roads, that meet or exceed established City of Castle Pines specifications with respect to pavement thickness, composition, and base as set forth in these Roadway Standards.

7.17.6 Cost Estimate and Improvement Agreement

Any Developer or Applicant for Final Plat approval must provide the Community Development Department with an itemized cost estimate of all improvements (as defined by state statute) associated with the subdivision (to be titled Exhibit A). Cost estimates are to establish the amount of collateral provided by the Applicant to secure the SIA-Private. An amount equal to 15% of the total Cost Estimate shall be added to the total cost to cover construction contingencies. The Developer or Applicant shall guarantee all improvements, including those to be constructed by a District, unless an Intergovernmental Agreement has been executed between City of Castle Pines and the District, guaranteeing the construction of those Public Improvements committed to by the District. After review and acceptance of the Cost Estimate by the City Public Works Department, it is incorporated into the SIA-Private document. The SIA-Private document should be executed by the Developer or Applicant prior to the City Council hearing scheduled for the Final Plat approval. Collateral must be provided by the Developer or Applicant in the form and amount defined in the SIA-Private. Refer to Chapter 2, Submittals for additional information.

7.17.7 Inspection Requirement

During construction, a City Public Works Department Inspector may inspect private roads. Inspection or Permit fees will be charged. During construction, a City Public Works Department Inspector will inspect all erosion control measures and storm sewer facilities (that is, inlets, pipes, detention, and water quality facilities). Inspection or Permit fees will need to be collected prior to beginning work. Where utilities are installed to serve private developments and are located in easements or private street rights-of-way, those utilities will not require a Permit or associated fees from the City. Responsibility for inspection will rest with the utility company providing service, or the Developer or Applicant, or both.

7.17.8 Warranty Requirements

For subdivisions with private roads, sufficient guarantee must be given to the City in the form of test reports, field reports, and as-built drawings in conformance with the requirements in these Roadway Standards (including cores, density tests, and compaction reports) and certified by a PE licensed in the state of Colorado. Reports and as-built drawings must be submitted and accepted prior to release of securities in accordance with these Roadway Standards.