4.1 GENERAL

This Chapter 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 standards to the maximum extent practicable.

4.2 ROADWAY DESIGN AND TECHNICAL CRITERIA

Douglas County Engineering Division 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:

- Cul–de-sac
- Urban Local (Type I & II)
- Entry Street
- Commercial & Industrial
- Urban Collector
- Minor Arterial
- Major Arterial (4 & 6 Lane)
- Rural Local (Type I, II, III & IV)
- Rural Collector
- Rural Arterial (2 & 4 Lane)
- 35-Acre Private Rural Road

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 the most recent Douglas County Transportation Plan, a Traffic Impact Study, and the Douglas County Engineering Division.

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 effected 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, since instances may occur where certain principles conflict. The principles should, therefore, be used as guidelines for proper system layout.

- Ensure Vehicular and Pedestrian Access
- Minimize Through Trips
- Minimize/Control Access to Arterials
- Discourage Speeding
- Minimize Pedestrian - Vehicular Conflicts
- Relate Street to Topography
- Provide Parking where applicable
- Increase life cycle / reduce maintenance costs of roads

TABLE 4-1
SUMMARY OF ROADWAY CONSTRUCTION STANDARDS
Page 1 of 4

	URBAN LOCAL			SPECIAL USE	
	Cul-de-Sac	**Urban Local (Type I)**	**Urban Local (Type II)**	**Entry Street**	**Commercial & Industrial**
Posted Speed (mph)	25	25	25	25	25
Design Speed (mph)	25	30	30	30	30
Maximum Design Traffic Volume (Vehicles per Day)	400	1,500	1,500	1,500	2,500
Min. Right-of-Way (feet)	50 Single family (SF) 60 multi family (MF)	50 (SF) 60 (MF)	50	60 70 for Median	60
Travel Lanes	2	2	2	2	2
Curb & Walks	SF-Mountable with 4' walk	SF- Mountable with 4' walk	Mountable curb with 4' walk	Vertical curb with 5' walk	Vertical curb with 5' walk
	MF – Vertical with 5' walk	MF – Vertical with 5' walk			
Street Sections	SF-30' paved width, 2-2' gutter pans, total is 34' fl-fl	SF-30' paved width, 2-2' gutter pans, total is 34' fl-fl	24' paved width, 2-2' gutter pans, total is 28' fl-fl	36' paved width, 2-2' gutter pans, total is 40' fl-fl	36' paved width, 2-2' gutter pans, total is 40' fl-fl
	MF – 34' paved width, 2-2' gutter pans, total is 38' fl-fl	MF – 34' paved width, 2-2' gutter pans, total is 38' fl-fl		34' paved, 16' median, 2-1' median pans, 2-2' gutter pans, total is 56' fl-fl	
HORIZONTAL CRITERIA					
Min. Centerline Curve Radii	175'	225'	225'	225'	225'
Curb Return Radii @ Arterial	N/A	N/A	N/A	35'	N/A
Curb Return Radii @ Collector	35'	35'	35'	35'	35'
Curb Return Radii @ Local	20'-25'	20'-25'	20'-25'	20'-25'	N/A
VERTICAL CRITERIA					
K-Value Crest	19	19	19	19	19
K-Value Sag	26	37	37	37	37
Min. VCL Crest	50'	50'	50'	50'	50'
Min. VCL Sag	50'	50'	50'	50'	50'
Vertical Gradient	1% to 6% 7% Mountainous	1% to 6% 7% Mountainous	1% to 6% 7% Mountainous	1% to 6% 7% Mountainous	1% to 6% 7% Mountainous
Max Int. Gradient	See Figure 4-8	See Figure 4-8	See Figure 4-8	See Figure 4-8	See Figure 4-8

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

TABLE 4-1
SUMMARY OF ROADWAY CONSTRUCTION STANDARDS
Page 2 of 4

	URBAN COLLECTOR	URBAN ARTERIALS		
	Urban Collector	**Minor Arterial**	**Major Arterial 4-Lane**	**Major Arterial 6-Lane**
Posted Speed (mph)	30	40 Minimum	40 Minimum	40 Minimum
Design Speed (mph)	45	55	60	60
Maximum Design Traffic Volume (Vehicles per Day)	7,000	15,000	15,000	35,000
Min. Right-of-Way (feet)	60	125	140	160
Travel Lanes	2	4	4	6
Street Sections	34’ paved width, 2-2’ gutter pans, total is 38’ fl-fl	48’ paved, 16’ median, 2-1’ median pans 2-2’ gutter pans, total is 70’ fl-fl	48’ paved, 28’ median, 2-1’ median pans 2-2’ gutter pans, total is 82’ fl-fl	72’ paved, 28’ median, 2-1’ median pans, 2-2’ gutter pans, total is 106’ fl-fl
Curb & Walks	Vertical curb and 5’ detached walk	Vertical curb and 10’ detached walk	Vertical curb and 10’ detached walk	Vertical curb and 10’ detached walk
HORIZONTAL CRITERIA				
Min. Centerline Curve Radii	700’	1200’	1500’	1500’
Curb Return Radii @ Arterial	50’	50’	50’	50’
Curb Return Radii @ Collector	35’	50’	50’	50’
Curb Return Radii @ Local	35’	N/A	N/A	N/A
VERTICAL CRITERIA				
K-Value Crest	29	84	84	84
K-Value Sag	49	96	96	96
Min. VCL Crest	50’	70’	110’	110’
Min. VCL Sag	50’	60’	90’	90’
Vertical Gradient	2% to 6%; 7% Mountainous	2% to 6%	2% to 6%	2% to 6%
Max Int. Gradient	See Figure 4-8	See Figure 4-8	See Figure 4-8	See Figure 4-8

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

TABLE 4-1
SUMMARY OF ROADWAY CONSTRUCTION STANDARDS
Page 3 of 4

	RURAL LOCAL ROADS				
	Rural Local Type I	**Rural Local Type II**	**Rural Local Type III**	**Rural Local Type IV**	**35-Acre Private Rural Road**
Posted Speed (mph)	25	25	25	25	25
Design Speed (mph)	30	30	30	30	25
Max. Design Traffic Volume (Vehicles Per Day)	1,500	1,500	400	100	N/A
Min. Right-of-Way (feet)	60	50	50	50	50
Travel Lanes	2	2	2	2	2
Curb & Walks	Curb and gutter not required	Mountable curb	Curb and gutter not required Mountable curb	Curb and gutter not required	Curb and gutter not required
Street Sections	24' paved width, 2-3' gravel shoulders, 2-roadside ditches, total is 30' roadway.	22' paved width, 2-2' gutter pans, total is 26' fl-fl	20' asphalt width, 2-3' gravel shoulders, 2-roadside ditches, total is 26' roadway. 20' asphalt width, 2-2' gutter pans, total is 24' fl-fl 20' asphalt width, composite shoulder & ditch and curb.	24' gravel width, 2-roadside ditches, total is 24' roadway.	24' gravel width, 2-roadside ditches, total is 24' roadway.
Clear Zone (feet)**	12	12	12	12	12
HORIZONTAL CRITERIA					
Min. Centerline Curve Radii	225'	225'	225'	225'	100'
Curb/Pavement Return Radii @ Arterial	N/A	N/A	N/A	N/A	25'
Curb/Pavement Return Radii @ Collector	30'	30'	30'	30'	25'
Curb/Pavement Return Radii @ Local	25'	25'	25'	25'	25'
VERTICAL CRITERIA					
K-Value Crest	19	19	19	19	12
K-Value Sag	37	37	37	37	12
Min VCL Crest	50'	50'	50'	50'	*
Min VCL Sag	50'	50'	50'	50'	*
Vertical Gradient	0.5%-6% 7% Mountainous	1%-6% 7% Mountainous	0.5%-6% 7% Mountainous	0.5%-6% 7% Mountainous	0.5%-10%
Max Int. Gradient	See Figure 4-8	See Figure 4-8	See Figure 4-8	See Figure 4-8	4%

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.
*Use equation 7 and 8 in the "Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT≤400)", AASHTO 2001.
** See section 4.16.C for definition of clear zone.
Crest curves with a K-Value higher than 167 need special review for drainage issues.
Sag curves with a K-Value higher than 167 need special review for drainage issues.

TABLE 4-1
SUMMARY OF ROADWAY CONSTRUCTION STANDARDS
Page 4 of 4

	RURAL COLLECTOR	RURAL ARTERIAL	
	Rural Collector	**Rural Arterial 2-Lane**	**Rural Arterial 4-Lane**
Posted Speed (mph)	40-45	55-60	55-60
Design Speed (mph)	60	70	70
Max. Design Traffic Volume (Vehicles Per Day)	7,000	10,000	10,000
Min. Right-of-Way (feet)	80	100	120
Travel Lanes	2	2	4
Curb & Walks	No curb, gutter or walk	No curb, gutter or walk	No curb, gutter or walk
Street Sections	24' paved width, 2-4' paved shoulders, 2-4' gravel shoulders, 2-roadside ditches, total is 40' roadway.	24' paved width, 2-6' paved shoulders, 2-4' gravel shoulders, 2-roadside ditches, total is 44' roadway.	48' paved width, 2-6' paved shoulders, 2-4' gravel shoulders, 2-roadside ditches, total is 68' roadway.
Clear Zone (feet)**	26	28	28
HORIZONTAL CRITERIA			
Min. Centerline Curve Radii	1500'	2040'	2040'
Curb Return Radii @ Arterial	35'	50'	50'
Curb Return Radii @ Collector	35'	50'	50'
Curb Return Radii @ Local	30'	N/A	N/A
VERTICAL CRITERIA			
K-Value Crest	151	247	247
K-Value Sag	136	181	181
Min VCL Crest	200'	300'	300'
Min VCL Sag	150'	150'	150'
Vertical Gradient	0.5%-6% 7% Mountainous	1%-5%	1%-5%
Max Int. Gradient	See Figure 4-8	See Figure 4-8	See Figure 4-8

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.
** See section 4.16.C for definition of clear zone.
Crest curves with a K-Value higher than 167 need special review for drainage issues.
Sag curves with a K-Value higher than 167 need special review for drainage issues.

Design Volumes shown on Table 4-1 are for the purpose of design and layout of the development and to project vehicular usage. The actual volumes on the street are dependant upon existing conditions, future changes in traffic patterns and transportation trends.

4.3 ENGINEERING DESIGN & TECHNICAL CRITERIA

A. 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 Drawing No. SP.19a and b). Certain circumstances related to, but not limited to; line of sight, traffic control devices, and pedestrian improvements may require additional Right-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.

4.3.1 CUL–DE-SAC

A cul-de-sac has no outlet, and includes an area for turn around at the end of the street. A Cul-de-sac may have a maximum length of 1200 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’ minimum Multi Family – 60’ minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	Single Family - 4” Mountable Curb with 4’ Attached Walk - Both Sides of Street Multi Family – 6” Vertical Curb with 5’ Attached Walk – Both Sides of Street.
Turnarounds	Minimum 45’ flowline radius
Knuckles	45’ flow line radius on the inside and on the outside flow lines.
Eyebrows	Eyebrows shall have a 45’ flow line radius, and a 25’ curb return radius.
Street Section	Single-Family – 34’ flowline to flowline. Multi-Family – 38’ flowline to flowline. See Standard Section
Street Grade	1% to 6%, 7% Mountainous
Minimum Centerline Curve Radii	175’
Curb Return Radii @ Arterial	N/A
Curb Return Radii @ Collector	35’
Curb Return Radii @ Local	20’-25’
K-Value Crest	19
K-Value Sag	26
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient.	See Figure 4-8

A. 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.

B. ACCESS CONDITIONS

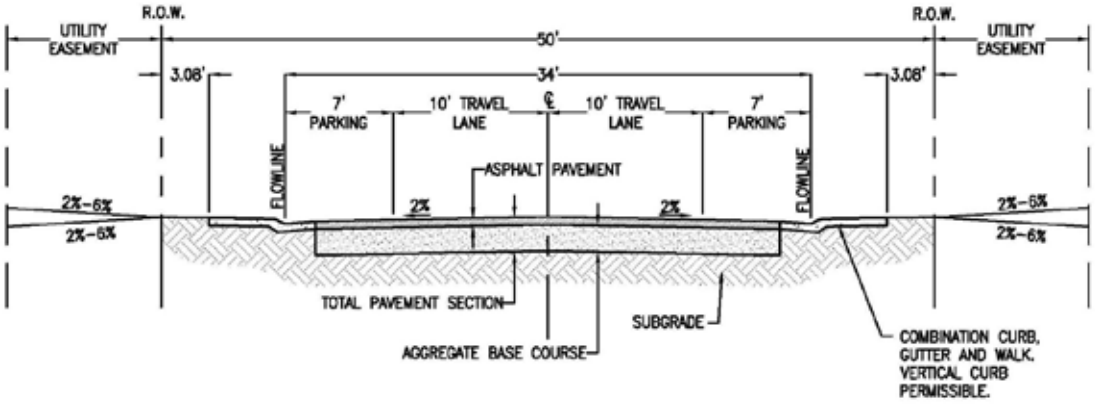
Cul-de-sacs shall only intersect with other Cul-de-sacs, Urban Local and Urban Collector roads. Direct access to abutting property is permitted. Cul-de-sacs shall not intersect Arterial streets. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*.

C. DESIGN CHARACTERISTICS

A cul-de-sac has no outlet, and includes an area for turnaround (See "Turnarounds") at the end of the street. A Cul-de-sac may have a maximum length of 1,200' and a maximum of 40 dwelling units. When a cul-de-sac is longer than 600', or has more than 25 dwelling units, sprinklering of the units per National Fire Protection Association (NFPA) may be required. 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 Multi Family Developments. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards*.

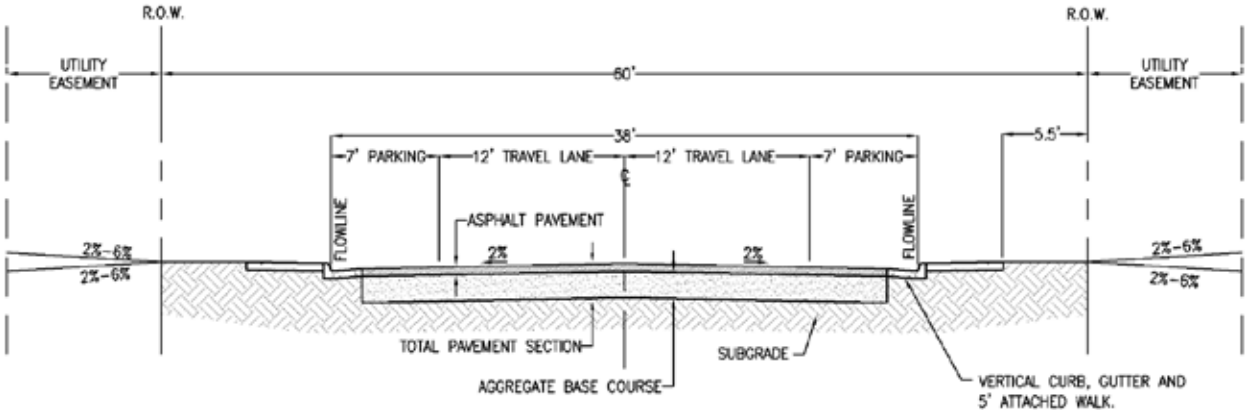
D. STREET SECTION

CUL-DE-SAC
SEE STANDARD SECTION SP.1



SINGLE FAMILY

CUL-DE-SAC
SEE STANDARD SECTION SP.1



MULTI FAMILY

4.3.2 URBAN LOCAL (TYPE I)

An Urban Local (Type I) 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.

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’ minimum Multi Family – 60’ minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	Single Family - 4” Mountable Curb with 4’ Attached Walk - Both Sides of Street Multi Family – 6” Vertical Curb with 5’ Attached Walk – Both Sides of Street.
Turnarounds	Not allowed
Knuckles	45’ flow line radius on the inside and on the outside flow lines.
Eyebrows	Eyebrows shall have a 45’ flow line radius, and a 25’ curb return radius.
Street Section	Single-Family – 34’ flowline to flowline. Multi-Family – 38’ flowline to flowline.
Street Grades	1% to 6%, 7% Mountainous
Minimum Centerline Curve Radii	225’
Curb Return Radii @ Arterial	N/A
Curb Return Radii @ Collector	35’
Curb Return Radii @ Local	20’-25’
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

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

B. ACCESS CONDITIONS

Urban Local (type I) roads shall only intersect with Urban Local and Urban Collector roads. Direct access to abutting property is permitted. Local streets shall

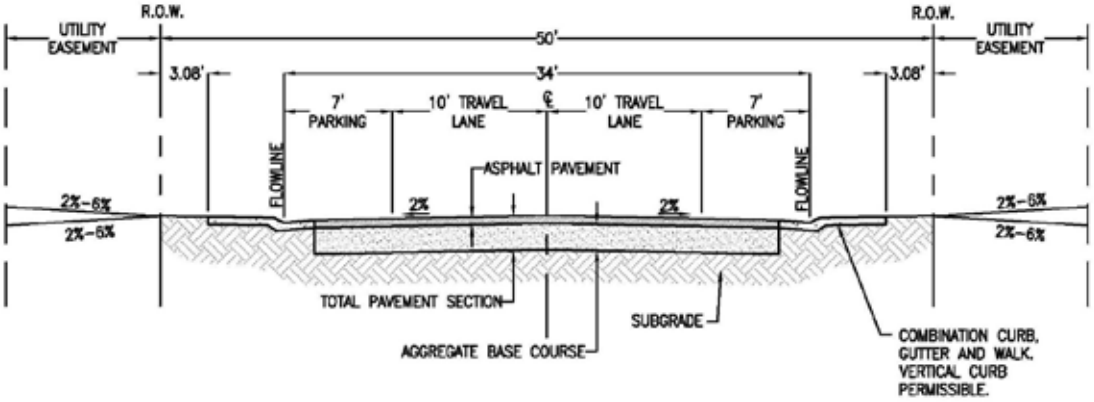
not intersect Arterial streets. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*.

C. 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 Multi Family Developments. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards*.

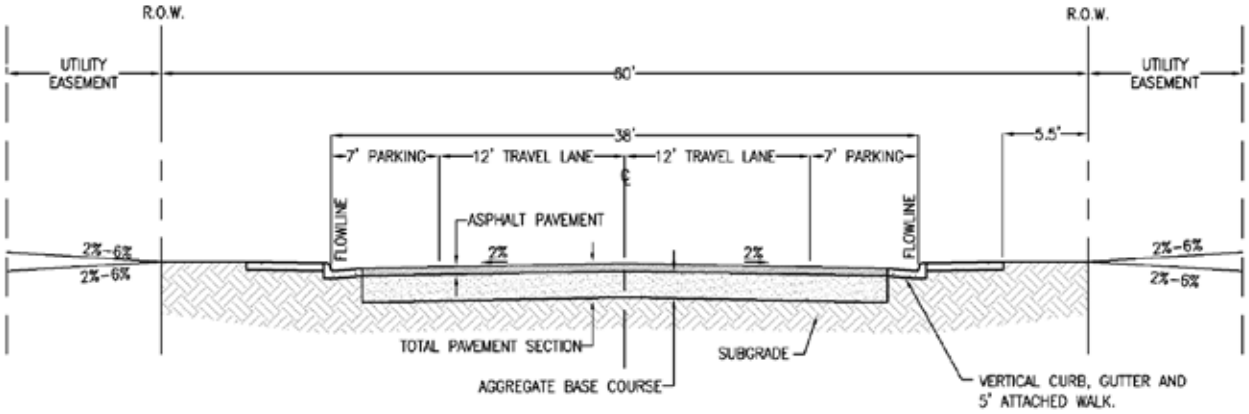
D. STREET SECTION

URBAN LOCAL (TYPE I)
STANDARD SECTION SP.1



SINGLE FAMILY

URBAN LOCAL (TYPE I)
STANDARD SECTION SP.1



MULTI FAMILY

4.3.3 URBAN LOCAL (TYPE II)

An Urban Local (Type II) road shall be for single-family residential developments with a minimum lot size of 1.5 acres. Minimum lot size is actual, and not an average of lots with other parcels such as open space areas, streets, and tracts. (This street section is narrower than the Urban Local Type I.) The street section shall include two driving lanes. Required parking spaces shall be provided on the lot, and on one side of the 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 2,500 vehicles per day is considered to be acceptable in fully established communities)
Continuity	Limited
Right-of-Way	50’ Minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	4” Mountable Curb with 4’ Attached Walk - Both Sides of Street.
Turnarounds	Minimum 45’ flowline radius
Knuckles	45’ flow line radius on the inside and on the outside flow lines.
Eyebrows	Eyebrows shall have a 45’ flow line radius, and a 25’ curb return radius.
Street Section	28’ flowline to flowline with parking restriction on one side.
Street Grades	1% to 6%, 7% Mountainous
Minimum Centerline Curve Radii	225’
Curb Return Radii @ Arterial	N/A
Curb Return Radii @ Collector	35’
Curb Return Radii @ Local	20’-25’
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

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

B. ACCESS CONDITIONS

Urban Local (type II) roads shall only intersect with Urban Local and Urban Collector roads. Direct access to abutting property is permitted. Local streets shall

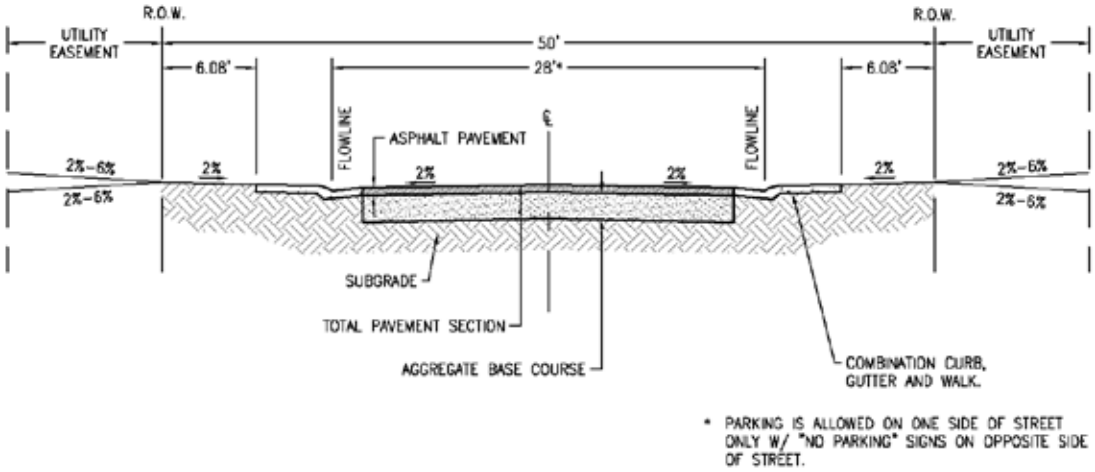
not intersect Arterial streets. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*.

C. DESIGN CHARACTERISTICS

Urban Local Type ll streets shall be designed to carry traffic that has an origin or destination within the neighborhood. This category of Urban Local Street shall be for residential developments with a minimum lot size of 1.5 acres. On street parking is restricted to one side of the street with “No Parking” signs installed per MUTCD and Douglas County criteria. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards*.

D. STREET SECTION

URBAN LOCAL (TYPE II)
STANDARD SECTION SP.2



4.3.4 ENTRY STREET

An Entry Street is generally short (160' 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 an Urban 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' Minimum 70' Minimum for median
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	6" Vertical Curb with 5' Attached Walk – Both Sides of Street.
Turnarounds	Not allowed
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	40' Flowline to Flowline 56' Flowline to Flowline for median
Street Grades	1% to 6%, 7% Mountainous
Minimum Centerline Curve Radii	225'
Curb Return Radii @ Arterial	35'
Curb Return Radii @ Collector	35'
Curb Return Radii @ Local	20'-25'
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50'
Minimum VCL Sag	50'
Maximum Int. Gradient	See Figure 4-8

A. 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.

B. ACCESS CONDITIONS

Entry Streets shall only intersect with an Urban Local on one end, and a Collector or Arterial road on the other end. Direct access to abutting property is not permitted. See Chapter 13 Access Requirements And Criteria of these *Roadway Standards*.

C. DESIGN CHARACTERISTICS

This category of street is generally short (160' 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 urban local street intersection. If accepted by the Engineering Division, up to 100 units may be allowed on an internally looped urban local road using an entry street for primary access. On-street parking is prohibited. "No Parking" signs shall be installed per MUTCD and Douglas County criteria along both sides of the road. 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. See also Chapter 12, Utility Locations of these *Roadway Standards*.

D. 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.

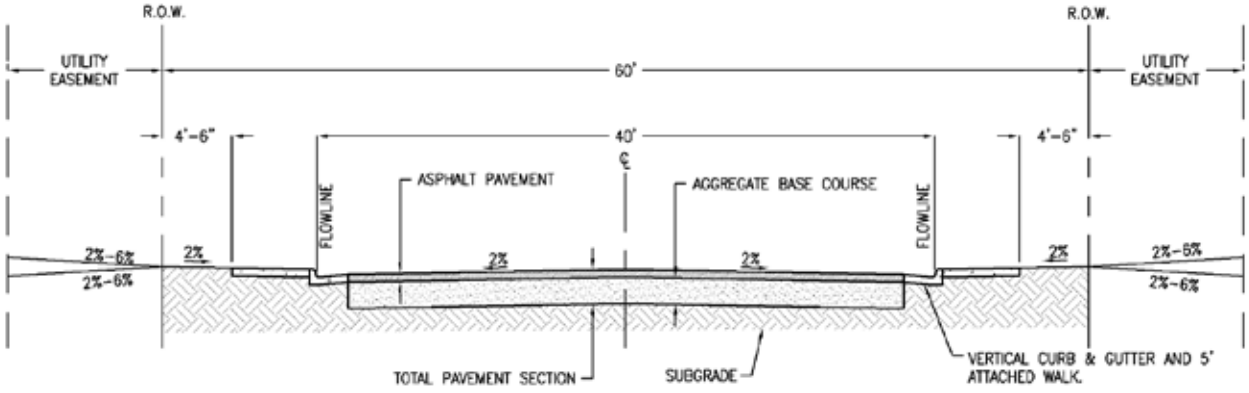
6. Traffic carried by School Access Street may have an origin or a destination outside the local neighborhood.

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.

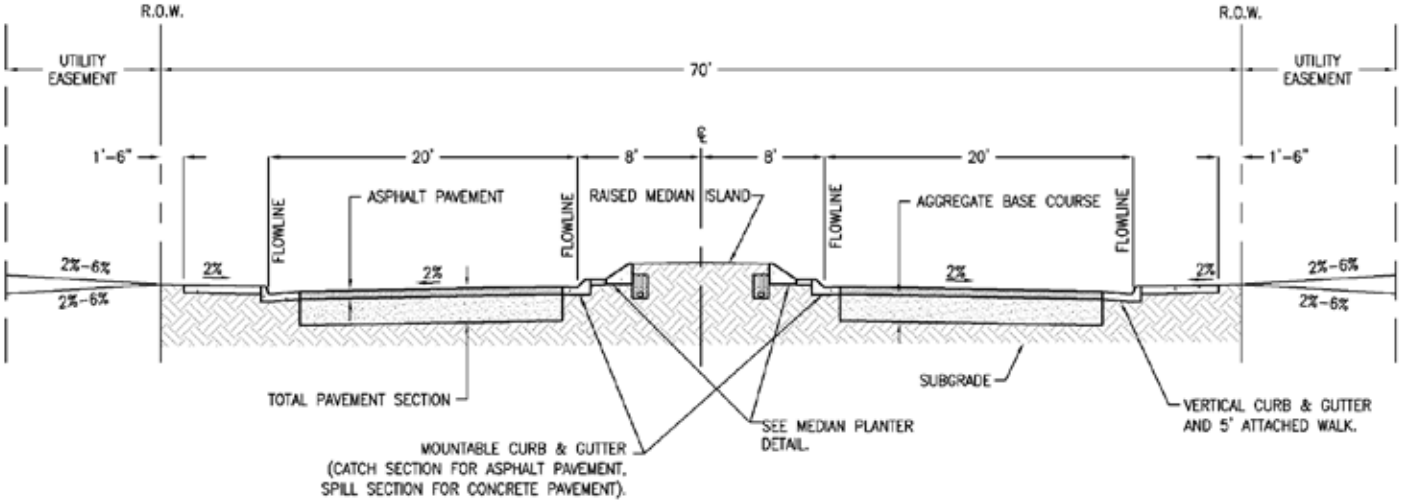
E. STREET SECTION

ENTRY STREET
STANDARD SECTION SP.3



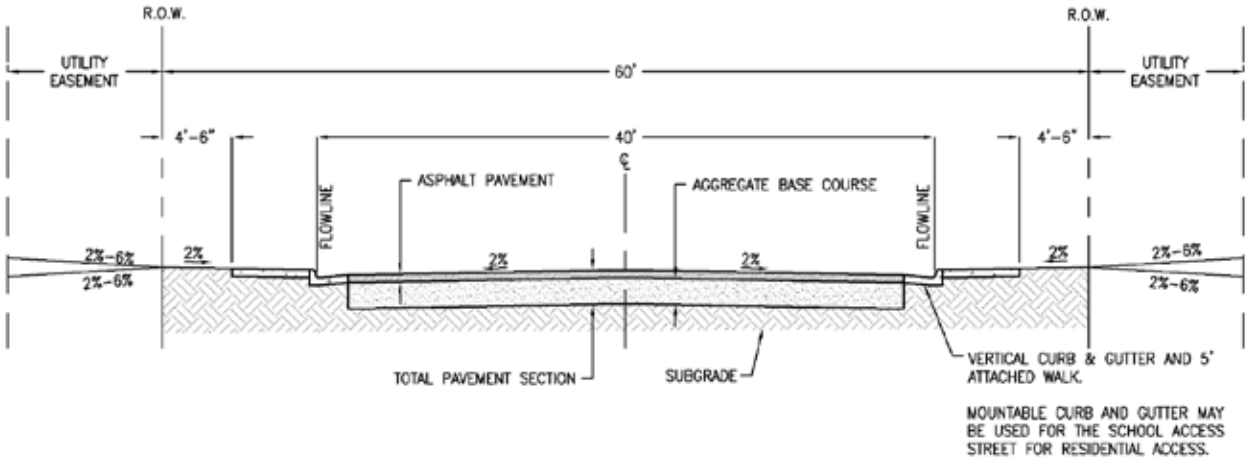
NO MEDIAN

ENTRY STREET
STANDARD SECTION SP.3



WITH MEDIAN

SCHOOL ACCESS STREET
STANDARD SECTION SP.3



4.3.5 COMMERCIAL AND INDUSTRIAL

A Commercial and Industrial street shall be design for ease of access to adjacent commercial/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’ minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	6” Vertical Curb with 5’ Attached Walk – Both Sides of Street.
Turnarounds	The addition of a turnaround on a commercial/Industrial road type creates a Commercial/Industrial Cul-de-Sac. The maximum length of Commercial/Industrial cul-de-sacs shall be 600’. However, Douglas County may impose additional restrictions on lengths based on, but not limited to, factors such as: the types and/or products related to a proposed use, number of trips generated by the proposed use(s), numbers of employees and/or customers, types of vehicles used, available capacity and/or access for emergency services. The Commercial/Industrial Turnaround shall all have a flowline radius of 50’.
Knuckles	45’ flow line radius on the inside and on the outside flow lines.
Eyebrows	Eyebrows shall have a 45’ flow line radius, and a 25’ curb return radius.
Street Section	40’ flowline to flowline
Street Grades	1% to 6%, 7% Mountainous
Minimum Centerline Curve Radii	225’
Curb Return Radii @ Arterial	N/A
Curb Return Radii @ Collector	35’
Curb Return Curb Radii @ Local	N/A
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. 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/industrial area.

B. ACCESS CONDITIONS

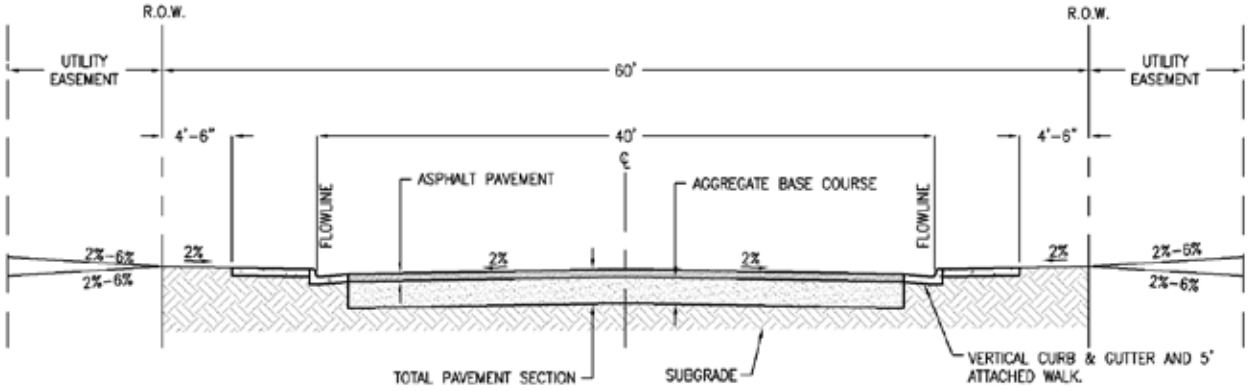
Commercial and Industrial streets shall only intersect with Collector Roads. Direct access to abutting property is permitted. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*.

C. DESIGN CHARACTERISTICS

Commercial and Industrial streets shall be designed to carry traffic that has an origin or destination within the Commercial and/or Industrial area. Commercial and Industrial streets shall not intersect arterial streets. This category of street shall be for ease of access to adjacent commercial/industrial developments. On-street parking is prohibited. “No Parking” signs shall be installed per MUTCD and Douglas County criteria along both sides of the road. Backing or loading maneuvers are NOT allowed in the street. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards*.

D. STREET SECTION

COMMERCIAL & INDUSTRIAL
STANDARD SECTION SP.3



4.3.6 URBAN COLLECTOR

Urban 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’ minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	6” Vertical Curb with 5’ Detached Walk – Both Sides of Street.
Turnarounds	Not allowed
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	38’ flowline to flowline
Street Grades	2% to 6%, 7% mountainous
Minimum Centerline Curve Radii	700’
Minimum Length of Tangents Between All Curves	50’
Curb Return Radii @ Arterial	50’
Curb Return Radii @ Collector	35’
Curb Return Radii @ Local	35’
K-Value Crest	29
K-Value Sag	49
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. 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.

B. ACCESS CONDITIONS

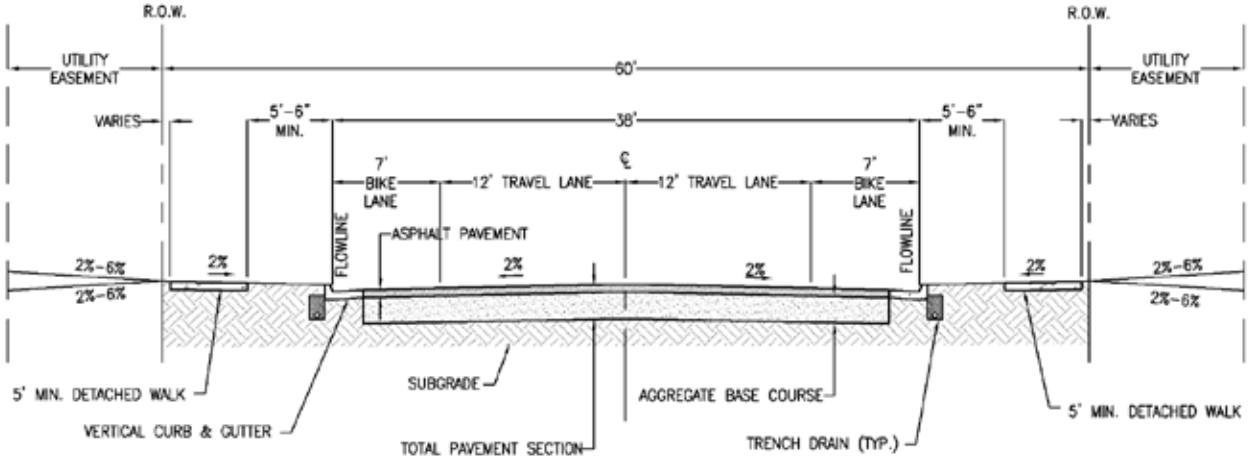
Collector streets shall only intersect with Urban Local, Collector and Arterial streets. Single Family Residential access is not permitted. Direct access to other zoned abutting property is not permitted unless another access is not reasonably available.

C. DESIGN CHARACTERISTICS

Collector streets should have continuity throughout a neighborhood but need not extend beyond the neighborhood. On-street parking is prohibited. Intersections and/or access points shall be spaced a minimum of 330’ apart. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards*.

D. STREET SECTION

URBAN COLLECTOR
STANDARD SECTION SP.4



4.3.7 MINOR ARTERIAL

Minor Arterial routes permit rapid and relatively unimpeded traffic movement throughout the County. Arterial Roadways are designed to handle traffic volumes from and onto Collector and Arterial roads and State Highways. Minor Arterial has a minimum distance of ¼-mile between intersections.

Posted Speed Limit	> and/or = 40 MPH – Determined by Douglas County Engineering Division prior to Construction Plan Submittal
Design Speed Limit	55 MPH
Traffic Volumes	Maximum Design Volume is 15,000 vehicles per day.
Continuity	Two or more miles – generally connecting intercity/intracounty routes.
Right-of-Way	125’ Minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	4
Type of Curb, Gutter and Walk	6” Vertical Curb with 10’ Detached Walk – Both Sides of Street.
Turnarounds	Not allowed
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	70’ flowline to flowline
Street Grades	2% to 6%
Minimum Centerline Curve Radii	1200’
Minimum Length of Tangents Between All Curves	100’
Curb Return Radii @ Arterial	50’
Curb Return Radii @ Collector	50’
Curb Return Radii @ Local	N/A
K-Value Crest	84
K-Value Sag	96
Minimum VCL Crest	70’
Minimum VCL Sag	60’
Maximum Int. Gradient	See figure 4-8

A. FUNCTION

Arterial routes permit 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.

B. ACCESS CONDITIONS

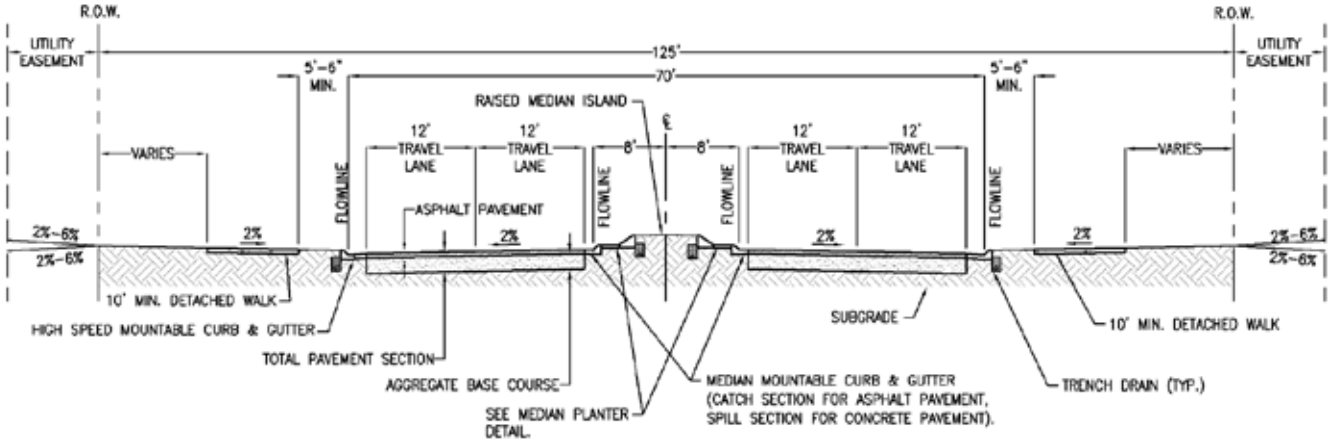
Access from Collector and Arterial streets will be allowed. Residential access is not permitted. Direct access to other abutting property is not permitted unless no other access is reasonably available.

C. DESIGN CHARACTERISTICS

Minor arterials should be spaced from ½- to1-mile apart and should be continuous. On-street parking is prohibited. Intersections and/or access points should be spaced a minimum of ¼-mile apart, see Chapter 13-Access Requirements and Criteria of these *Roadway Standards*. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12, Utility Locations of these *Roadway Standards*.

D. STREET SECTIONS

MINOR ARTERIAL
SEE STANDARD DETAIL SP.5

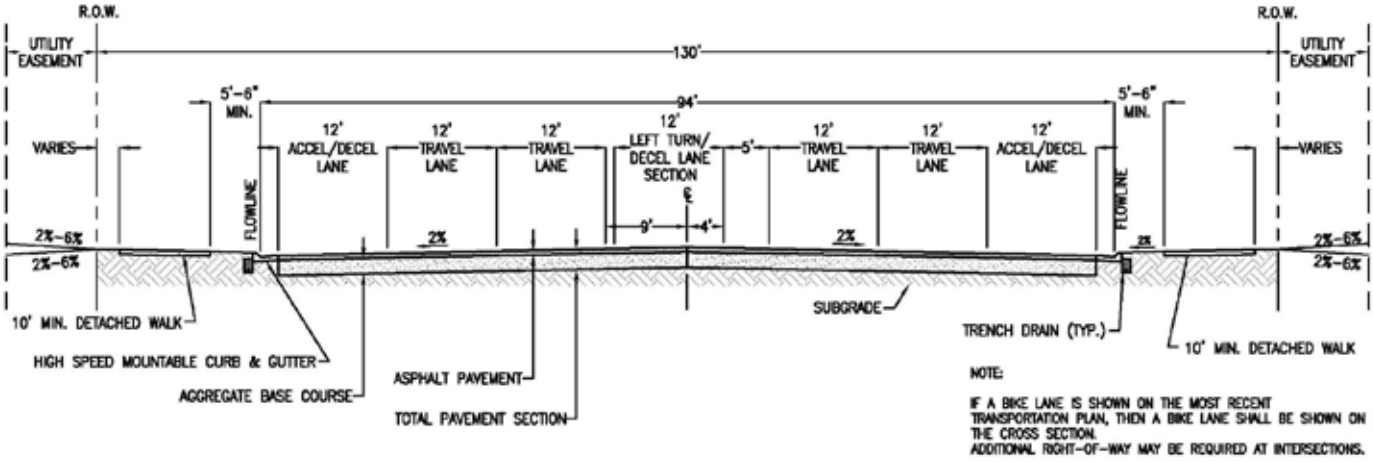


MINOR ARTERIAL ROAD SECTION

Typical Minor Arterial Road Section

- Minimum of four-12' through lanes and two-2' gutter pans.
- Minimum 16' median, measured curb face to curb face, with two-barrier curb and gutter. Note: If asphalt pavement is used, a 1' catch curb and gutter is required. A median planter may be constructed in this median.
- Two detached sidewalks, minimum 10' each. Minimum setback from the curb face is 5.5'.
- Minimum Right-of-Way is 125'.
- Size of utility easement adjacent to each Right-of-Way line will vary.

MINOR ARTERIAL
SEE STANDARD DETAIL SP.5



MINOR ARTERIAL ROAD SECTION AT INTERSECTION

Typical Minor Arterial Road Section at Intersection

- Minimum of four-12' through lanes and two 2' gutter pans.
- Minimum 12' left turn lane
- Minimum one 12' acceleration, and one 12' deceleration lane
- Minimum 1' painted median.
- Two detached sidewalks, minimum 10' each. Minimum setback from the curb face is 5.5'.
- Minimum Right-of-Way is 130'.
- Sizes of utility easement adjacent to each Right-of-Way line will vary.

4.3.8 MAJOR ARTERIAL (4-LANE AND 6-LANE)

Major Arterials should be spaced approximately one-mile apart and should traverse an entire city and/or county. Major Arterial streets should not bisect neighborhoods but should act as boundaries between them. Arterial routes permit rapid and relatively unimpeded traffic movement throughout the County. Arterial Roadways are designed to handle traffics volumes from and onto collectors, arterial roads and State Highways. Major Arterials have a minimum distance of 1/4-mile between intersections.

Posted Speed Limit	> and/or = 40 MPH – Determined by Douglas County Engineering Division prior to Construction Plan Submittal
Design Speed Limit	60 MPH
Traffic Volumes	Design Volume is generally over 15,000 vehicles per day for 4 lane roadway and 35,000 vehicles per day for 6 lane roadway. (phasing of laneage requirements may be considered based on Traffic Impact Analysis)
Continuity	Several miles, generally connecting inter and intra county routes
Right-of-Way	140’ 4-Lane minimum 160’ 6-Lane minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	4 or 6
Type of Curb, Gutter and Walk	6” barrier curb and gutter with 10’ detached sidewalk on both sides.
Turnarounds	Not allowed
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	82’ flowline to flowline – 4 lane. 106’ flowline to flowline – 6 lane.
Street Grades	2% to 6%
Minimum Centerline Curve Radii	1500’
Minimum Length of Tangents Between All Curves	100’
Curb Return Radii @ Arterial	50’
Curb Return Radii @ Collector	50’
Curb Return Radii @ Local	N/A
K-Value Crest	84
K-Value Sag	96
Minimum VCL Crest	110’
Minimum VCL Sag	90’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

Major Arterial routes permit rapid and relatively unimpeded traffic movement throughout the County, connecting major land uses.

B. ACCESS CONDITIONS

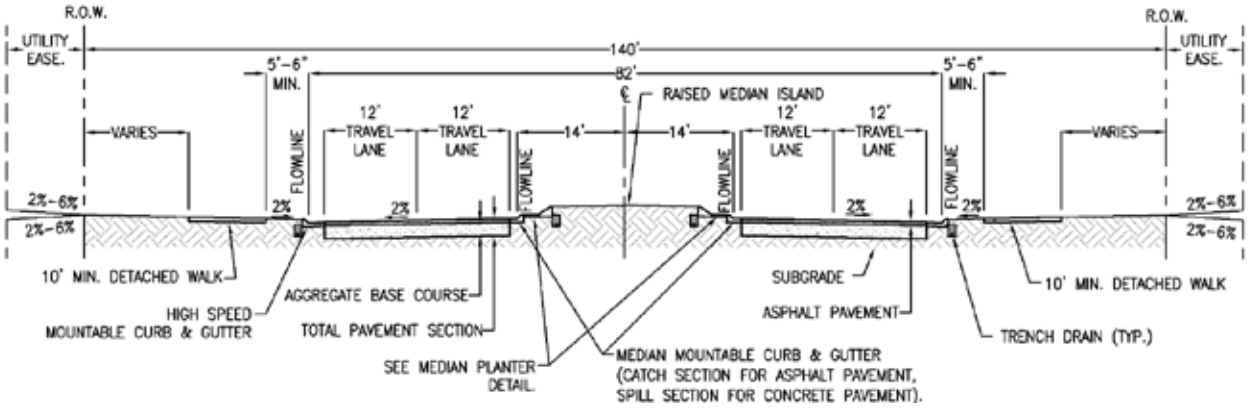
Access from Collector and Arterial streets will be allowed. Direct access to abutting property is not permitted.

C. DESIGN CHARACTERISTICS

Major Arterials should be spaced approximately one-mile apart and should traverse an entire city and/or county. On-street parking is prohibited. Intersections and/or access points should be spaced a minimum of 1/4-mile apart. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards*.

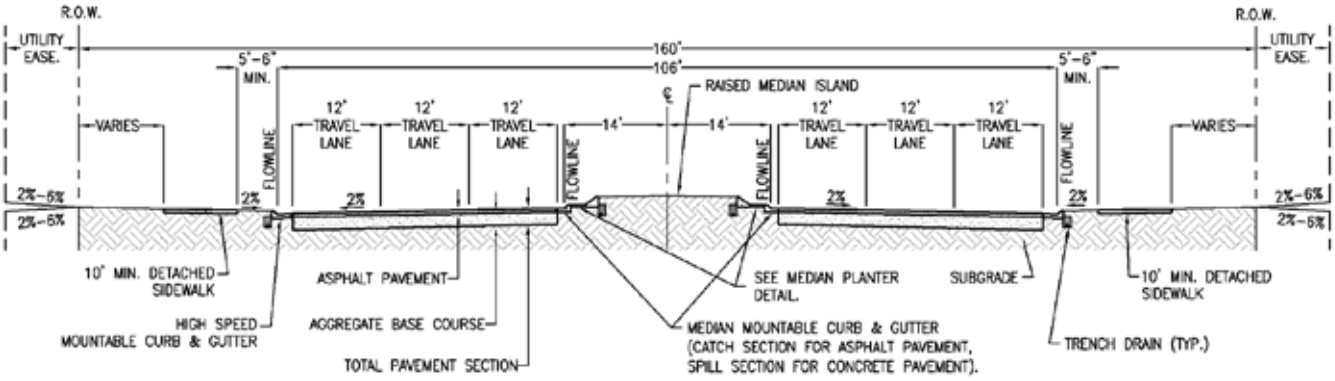
D. STREET SECTION

MAJOR ARTERIAL
SEE STANDARD DETAIL SP.6



FOUR LANE ROAD SECTION

MAJOR ARTERIAL
SEE STANDARD DETAIL SP.7

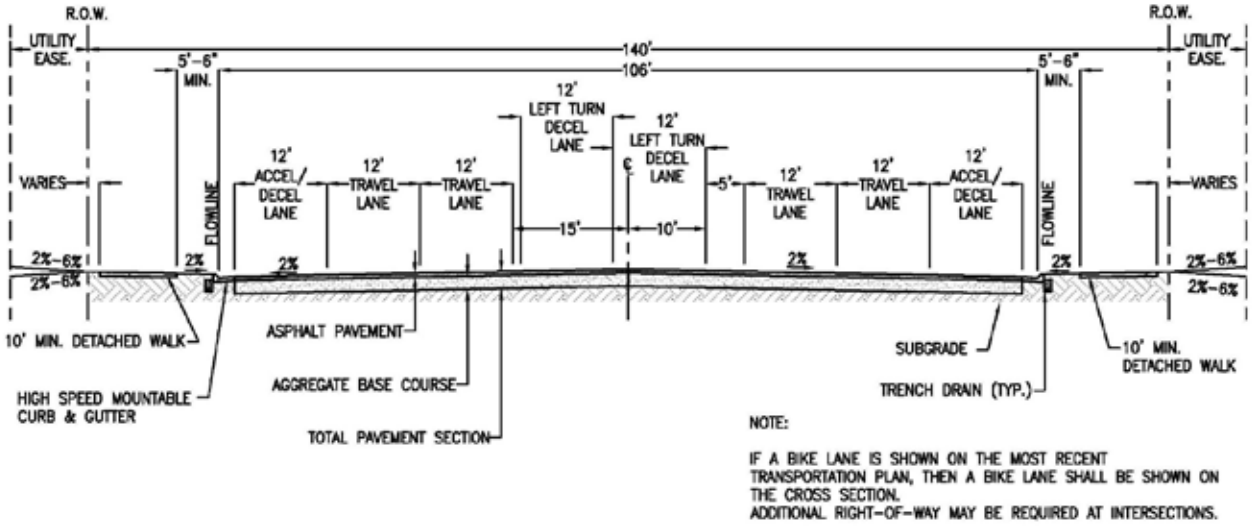


SIX LANE ROAD SECTION

Typical Major Arterial Road Section

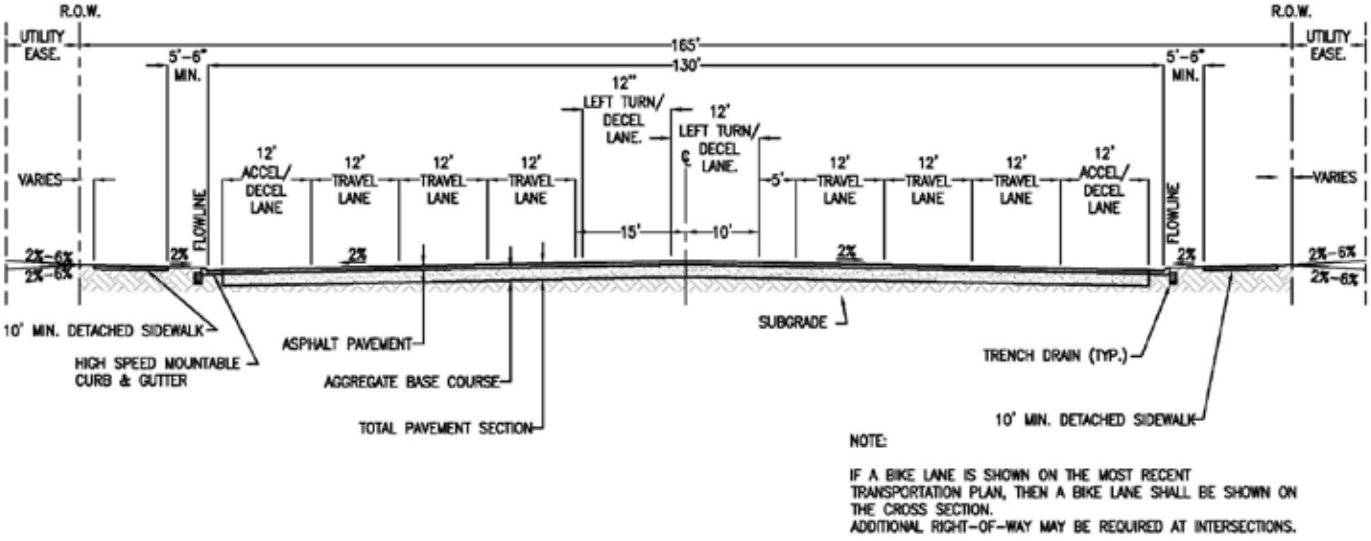
- For a **four lane arterial**, Minimum of four-12' through lanes and barrier curb and gutter.
- For a **six lane arterial**, Minimum of six-12' through lanes and two-barrier curb and gutters. Minimum one-12' acceleration, and one-12' deceleration lane
- Minimum 28' median, measured curb face to curb face, with two-barrier curb and gutters. Note: If asphalt pavement is used, a 1' catch curb and gutter is required. A median planter may be constructed in this median.
- Two detached sidewalks, minimum 10' each. Minimum setback from the curb face is 5.5'.
- Minimum **four lane arterial** Right-of-Way is 140'.
- Minimum **six lane arterial** Right-of-Way is 160'
- Size of utility easement adjacent to each Right-of-Way line will vary.

MAJOR ARTERIAL
SEE STANDARD DETAIL SP.6



FOUR LANE AT INTERSECTION

MAJOR ARTERIAL
SEE STANDARD DETAIL SP.7



SIX LANE AT INTERSECTION

Typical Major Arterial Road Section at Intersections

- For a **four lane arterial**, Minimum of four-12‘ through lanes and two-barrier curb and gutters.
- For a **six lane arterial**, Minimum of six-12’ through lanes and two-barrier curb and gutters.
- Minimum two-12’ left turn lanes
- Minimum one-12’ acceleration, and one-12’ deceleration lane
- Minimum 4’ median, measured curb face to curb face, with two-barrier curb and gutters. Note: If asphalt pavement is used, a 1’ catch curb and gutter is required. A median planter may be constructed in this median.
- Two detached sidewalks, minimum 10’ each. Minimum setback from the curb face is 5.5’.
- Minimum **four lane arterial** Right-of-Way is 141’.
- Minimum **six lane arterial** Right-of-Way is 165’.
- Size of utility easement adjacent to each Right-of-Way line will vary.

4.3.9 RURAL LOCAL (TYPE I)

The Rural Local (Type I) road type permits ditches adjacent to the paved road section, and shall be used in Estate Residential developments (as defined in the Douglas County Zoning Resolution) having a minimum net lot size of 2.5-acres and 8 parking spaces required on each lot. Rural Local roads provide direct access to adjacent property. Traffic carried by local roads should have an origin or a destination within the neighborhood

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	60’ Minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	Not required
Turnarounds	47’ radius with 3’ gravel shoulder
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	24’ paved width 2-3’ gravel shoulders 2-roadside ditches.
Street Grades	0.5% to 6%, 7% mountainous
Minimum Centerline Curve Radii	225’
Pavement Return Radii @ Arterial	N/A
Pavement Return Radii @ Collector	30’
Pavement Return Radii @ Local	25’
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

Rural Local roads provide direct access to adjacent property. Traffic carried by local roads should have an origin or a destination within the neighborhood.

B. ACCESS CONDITIONS

Rural Local (Type I) roads shall only intersect with Rural Local and Rural Collector roads. Direct access to abutting property permitted. Rural Local roads shall not

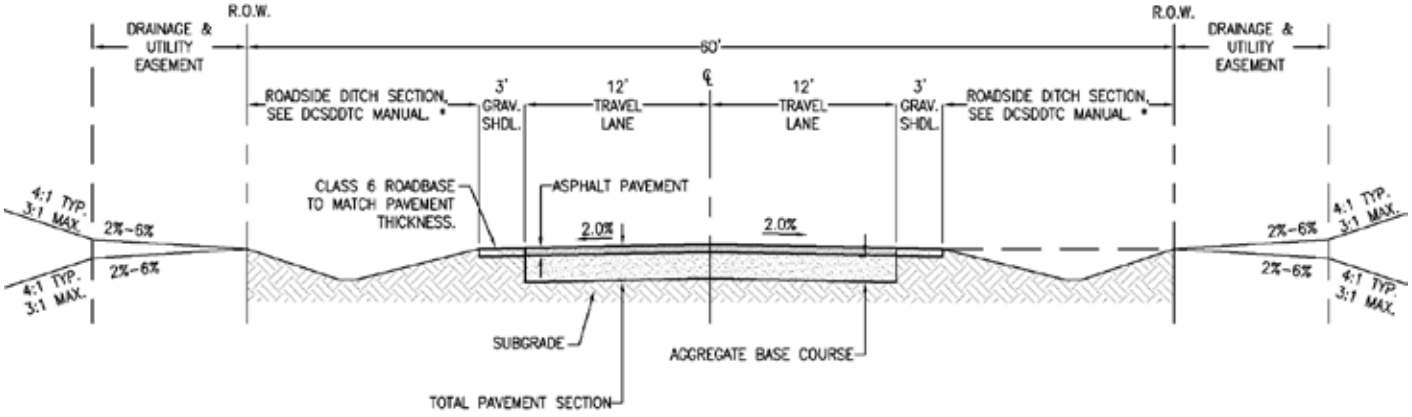
intersect major collectors or arterial roads.

C. DESIGN CHARACTERISTICS

Rural Local roads should be designed to carry traffic that has an origin or destination within the neighborhood. Rural Local roads should not intersect Arterial roads. This category of Rural Local roads shall be for residential developments with a minimum net lot size of 2.5-acres. No on-street parking shall be allowed. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards.*

D. STREET SECTION

RURAL LOCAL TYPE I (GRAVEL SHOULDERS)
SEE STANDARD DETAIL SP.8



* ROADSIDE DITCH MAY NOT BE REQUIRED IF THERE ARE NO CUT SLOPES ALONG THE ROADWAY.

4.3.10 RURAL LOCAL (TYPE II)

The Rural Local (Type II) road permits mountable type curb and gutter adjacent to the paved road section, and shall be used in Estate Residential developments (as defined in the Douglas County Zoning Resolution) having a minimum net lot size of 2.5-acres and 8 parking spaces required on each lot. Rural Local roads provide direct access to adjacent property. Traffic carried by local roads typically has an origin or a destination within the neighborhood.

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	50’ Minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	Mountable curb, no sidewalk required
Turnarounds	Minimum 45’ flowline radius
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	26’ flowline to flowline
Street Grades	1% to 6%, 7% mountainous
Minimum Centerline Curve Radii	225’
Curb Return Radii @ Arterial	N/A
Curb Return Radii @ Collector	30’
Curb Return Radii @ Local	25’
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

Rural Local (Type II) roads provide direct access to adjacent property. Traffic carried by local roads typically has an origin or a destination within the neighborhood.

B. ACCESS CONDITIONS

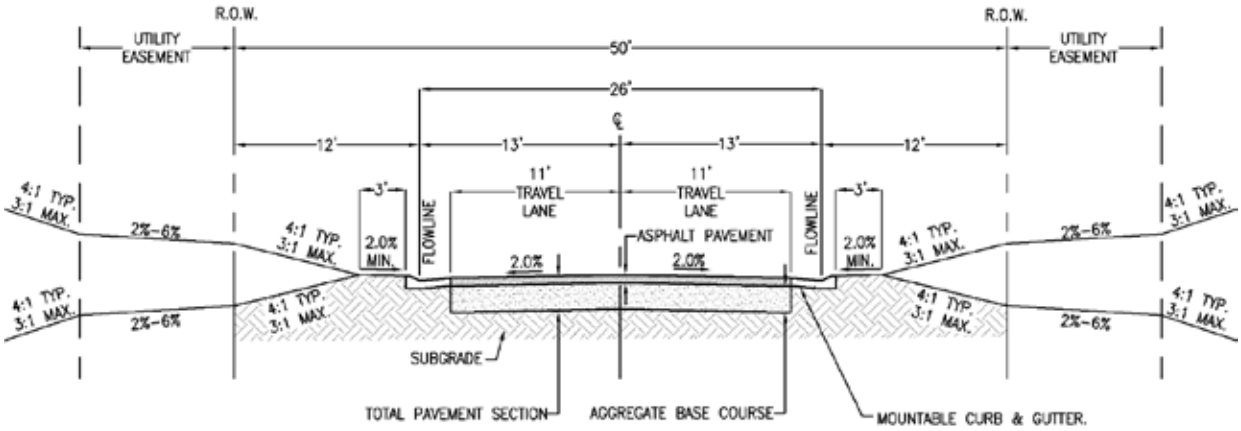
Rural Local (Type II) roads shall only intersect with Rural Local and Rural Collector roads. Direct access to abutting property permitted.

C. DESIGN CHARACTERISTIC

Rural Local roads should be designed to carry traffic that has an origin or destination within the neighborhood. Rural Local roads should not intersect Arterial roads. This category of Rural Local road shall be for residential developments with a minimum net lot size of 2.5-acres. On-street parking is prohibited. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards.*

D. STREET SECTION

RURAL LOCAL TYPE II (MOUNTABLE CURB & GUTTER)
SEE STANDARD DETAIL SP.9



4.3.11 RURAL LOCAL (TYPE III)

The Rural Local (Type III) road type permits a narrow paved road and may be used only in the Large Rural Residential (LRR), Rural Residential (RR) or Estate Residential (ER) zone districts having a minimum net lot size of 2.5-acres and 8 parking spaces required on each lot. Rural Local roads provide direct access to adjacent property. Traffic carried by local roads should have an origin or a destination within the neighborhood.

Posted Speed Limit	25 MPH
Design Speed Limit	30 MPH
Traffic Volumes	Maximum Design Volume is 400 vehicles per day.
Continuity	Limited
Right-of-Way	50’ Minimum
Traffic Control	Signage per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	Roadside Ditch or Mountable Curb acceptable; no sidewalk required
Turnarounds	47’ radius with 3’ gravel shoulder.
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	20’ asphalt surface, 2-3’ gravel shoulders, 2-roadside ditches. 20’ asphalt surface, Mountable curb, no sidewalk required. Combination allowed.
Street Grades	0.5% to 6%, 7% Mountainous
Minimum Centerline Curve Radii	225’
Curb or Pavement Return Radii @ Arterial	N/A
Curb or Pavement Return Radii @ Collector	30’
Curb or Pavement Return Radii @ Local	25’
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

Rural Local roads provide direct access to adjacent property. Traffic carried by local roads should have an origin or a destination within the neighborhood.

B. ACCESS CONDITIONS

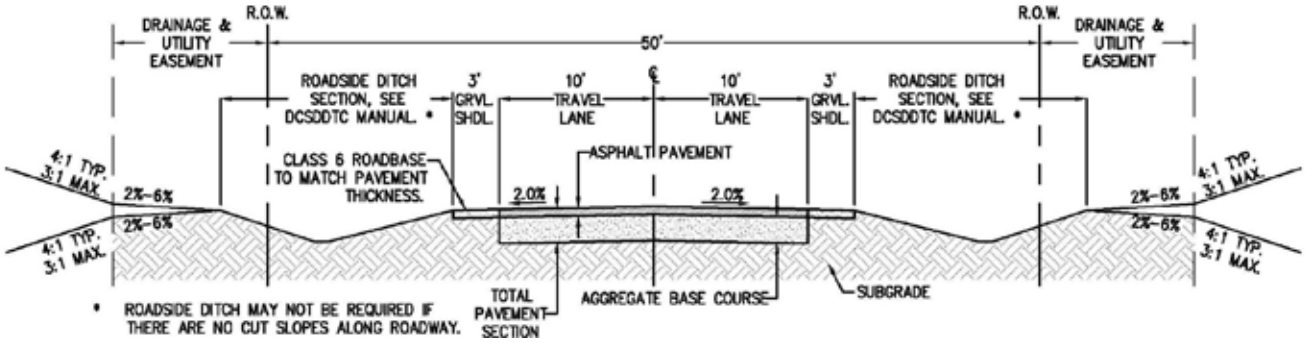
Rural Local (Type III) roads shall only intersect with Rural Local and Rural Minor Collector roads. Direct access to abutting property permitted. Rural Local roads shall not intersect Major Collectors or Arterial roads.

C. DESIGN CHARACTERISTICS

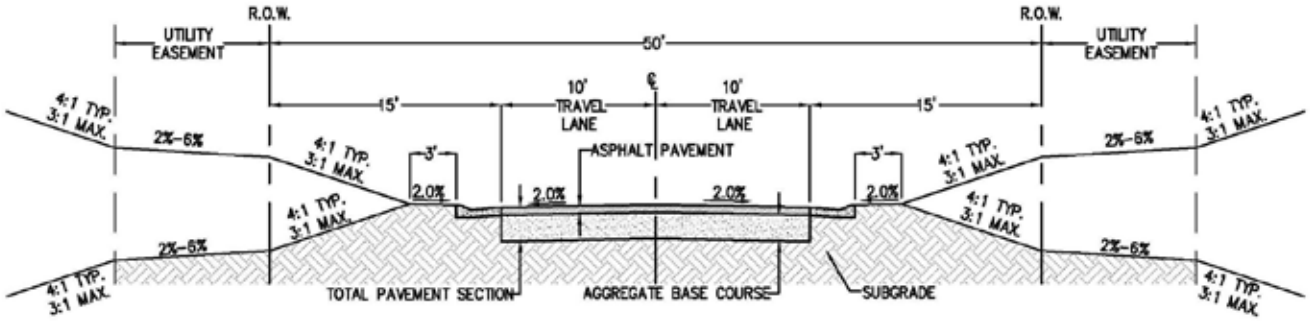
Rural Local roads should be designed to carry traffic that has an origin or destination within the neighborhood. Rural Local roads should not intersect Arterial roads. This category of Rural Local road shall be for residential developments with a minimum net lot size of 2.5-acres. On-street parking is prohibited. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards.*

D. STREET SECTION

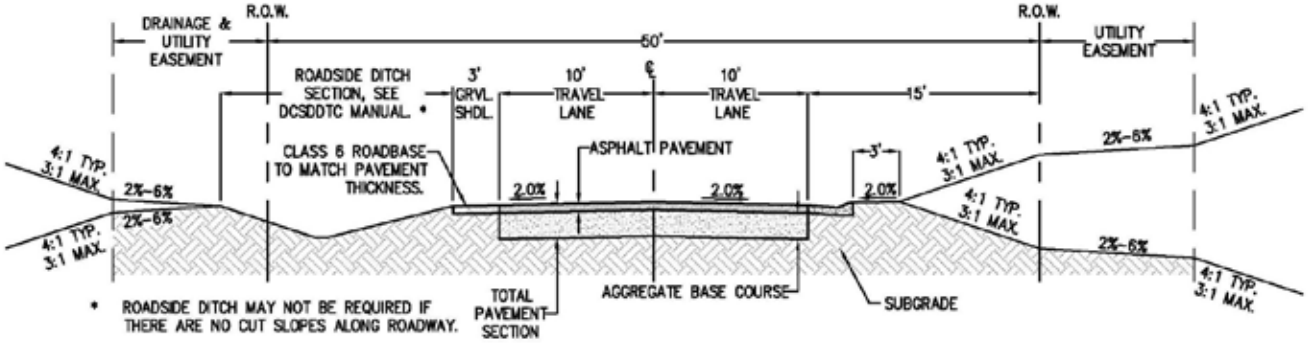
RURAL LOCAL TYPE III (Maximum Design Volume is 400 Vehicles Per Day)
SEE STANDARD DETAIL SP.10



GRAVEL SHOULDER WITH ROADSIDE DITCH



MOUNTABLE CURB AND GUTTER



COMBINATION

4.3.12 RURAL LOCAL (TYPE IV)

The Rural Local (Type IV) road type permits a gravel surfaces and may be used only in the Large Rural Residential (LRR), Rural Residential (RR) or Estate Residential(ER) zone districts having a minimum net lot size of 2.5-acres and 8 parking spaces required on each lot. Rural Local roads provide direct access to adjacent property. Traffic carried by local roads should have an origin or a destination within the neighborhood.

Posted Speed Limit	25 MPH
Design Speed Limit	30 MPH
Traffic Volumes	Maximum Design Volume is 100 Vehicles Per Day.
Continuity	Limited
Right-of-Way	50’ Minimum
Traffic Control	Signage per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	None
Turnarounds	47’ radius with 3’ gravel shoulder.
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	24’ gravel surface, 2-roadside ditches
Street Grades	0.5% to 6%, 7% Mountainous
Minimum Centerline Curve Radii	225’
Pavement Return Radii @ Arterial	N/A
Pavement Return Radii @ Collector	30’
Pavement Return Radii @ Local	25’
K-Value Crest	19
K-Value Sag	37
Minimum VCL Crest	50’
Minimum VCL Sag	50’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

Rural Local roads provide direct access to adjacent property. Traffic carried by local roads should have an origin or a destination within the neighborhood.

B. ACCESS CONDITIONS

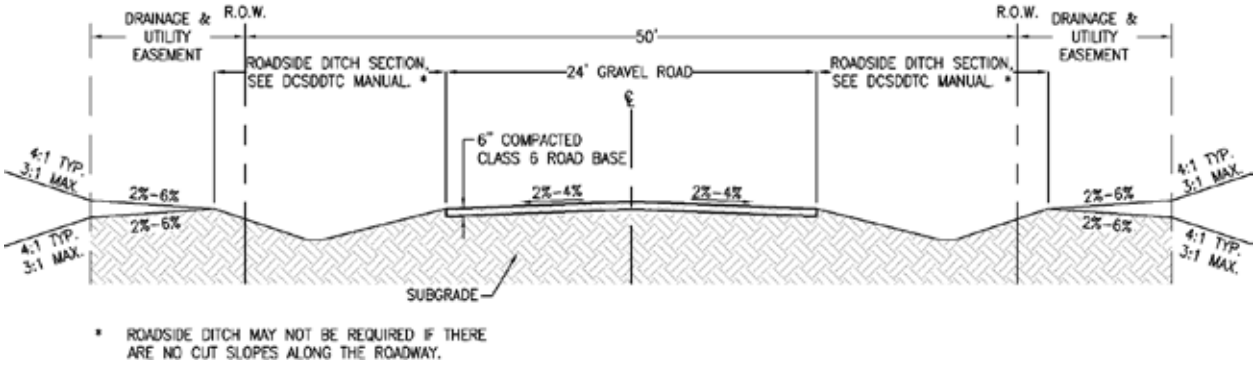
Rural Local (Type IV) roads shall only intersect with Rural Local and Rural Minor Collector roads. Direct access to abutting property permitted. Rural Local roads shall not intersect Major Collectors or Arterial roads.

C. DESIGN CHARACTERISTICS

Rural Local roads should be designed to carry traffic that has an origin or destination within the neighborhood. Rural Local roads should not intersect Arterial roads. This category of Rural Local road shall be for residential developments with a minimum net lot size of 2.5-acres. On-street parking is prohibited. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards.*

D. STREET SECTION

RURAL LOCAL (TYPE IV)
(Max. 100 Vehicles per day)
SEE STANDARD DETAIL SP.11



* ROADSIDE DITCH MAY NOT BE REQUIRED IF THERE ARE NO CUT SLOPES ALONG THE ROADWAY.

4.3.13 RURAL COLLECTOR

The Rural Collector road type permits a paved road with shoulders, and may be used only in Estate Residential developments (as defined in the Douglas County Zoning Resolution), having a minimum net lot size of 2.5-acres. Collector roads collect and distribute traffic between Arterial and Local roads and serve as main connectors within communities, linking one neighborhood with another. Traffic carried by collector roads typically have an origin or a destination within the community. Direct access and parking are not permitted on a Collector road.

Posted Speed Limit	40-50 MPH
Design Speed Limit	60 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	2 or more miles
Right-of-Way	80’ Minimum
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	None
Turnarounds	Not allowed
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	24’ paved width 2-4’ paved shoulders, 2-4’ gravel shoulders, 2-roadside ditches .
Street Grades	0.5% to 6%, 7% mountainous
Minimum Centerline Curve Radii	1500’
Minimum Length of Tangents Between All Curves	100’
Pavement Return Radii @ Arterial	35’
Pavement Return Radii @ Collector	35’
Pavement Return Radii @ Local	30’
K-Value Crest	151
K-Value Sag	136
Minimum VCL Crest	200’
Minimum VCL Sag	150’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

Rural Collector roads distribute traffic between Arterial and Local roads and serve as main connectors within communities, linking one neighborhood with another. Traffic carried by collector roads typically has an origin or a destination within the community.

B. ACCESS CONDITIONS

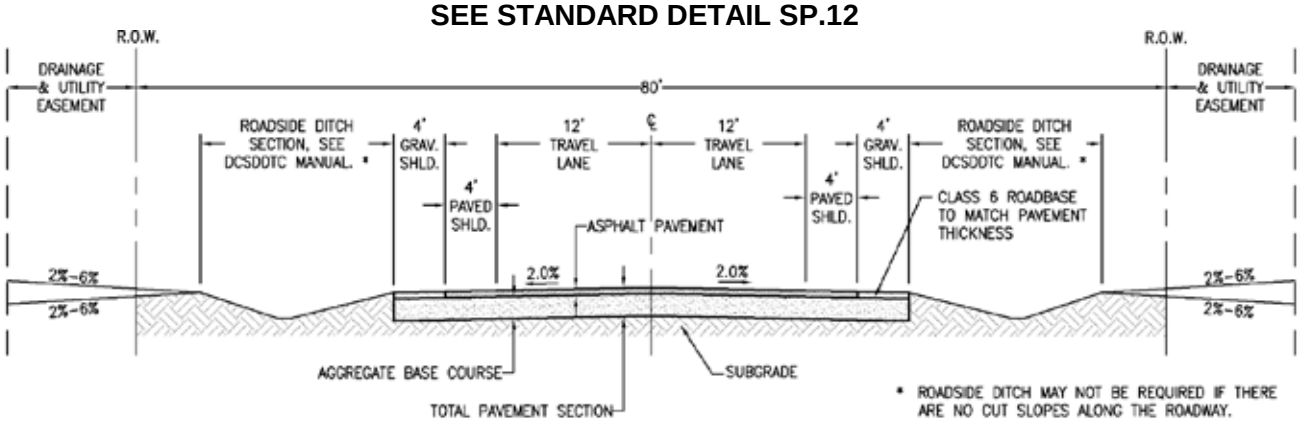
Single family residential access is not permitted. Direct access to other abutting property is not permitted unless another access is not reasonably available as determined by Douglas County Engineering Division.

C. DESIGN CHARACTERISTICS

Rural Collector roads typically will be designed to discourage cut-through traffic from moving through the neighborhood. Rural Collector roads typically will be for residential developments with a minimum net lot size of 2.5-acres. On-street parking is prohibited. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12, Utility Locations of these *Roadway Standards*. Intersections and/or access points should be spaced a minimum of 660' apart. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*.

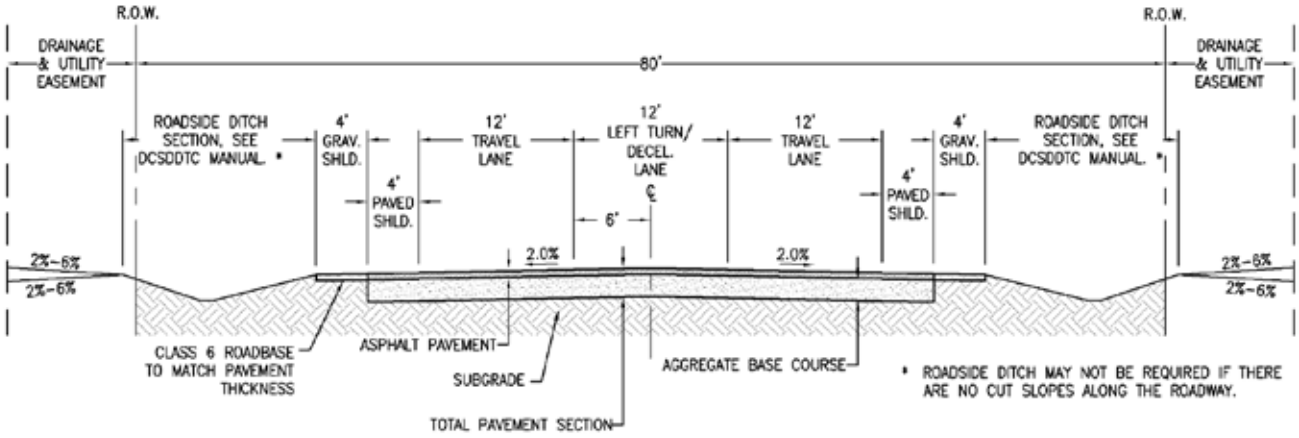
D. STREET SECTION

RURAL COLLECTOR
SEE STANDARD DETAIL SP.12



ROAD SECTION

RURAL COLLECTOR
SEE STANDARD DETAIL SP.12



AT INTERSECTION

4.3.14 RURAL ARTERIAL (2 LANE AND 4 LANE)

The Rural Arterial road type permits a paved road with shoulders. Rural Arterials typically will be spaced approximately one-mile apart and typically will traverse an entire city and/or county. Rural Arterial roads should not bisect neighborhoods but should act as boundaries between them. Arterial routes permit rapid and relatively unimpeded traffic movement throughout the County. Arterial Roadways are designed to handle traffic volumes from and onto collector and arterial roads. Arterials have a minimum distance of 1/4 –mile between intersections. Direct access and parking are not permitted on an arterial road.

Posted Speed Limit	55-60 MPH
Design Speed Limit	70 MPH
Traffic Volumes	Maximum Design Volume is generally 10,000 vehicles per day. (Typically capacity up to 20,000 vehicles per day is considered to be acceptable in fully established communities)
Continuity	2 or more miles
Right-of-Way	100’ 2-Lane 120’ 4-Lane
Traffic Control	Signage and pavement markings per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2 or 4
Type of Curb, Gutter and Walk	None
Turnarounds	Not allowed
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	24’ paved width, 2-6’ paved shoulders, 2-4’ gravel shoulders, 2-roadside ditches (2-Lane) 48’ paved width, 2-6’ paved shoulders, 2-4’ gravel shoulders, 2-roadside ditches (4-Lane)
Street Grades	0.5% to 5%
Minimum Centerline Curve Radii	2040’
Minimum Length of Tangents Between All Curves	100’
Pavement Return Radii @ Arterial	50’
Pavement Return Radii @ Collector	N/A
Pavement Return Radii @ Local	N/A
K-Value Crest	247
K-Value Sag	181
Minimum VCL Crest	300’
Minimum VCL Sag	150’
Maximum Int. Gradient	See Figure 4-8

A. FUNCTION

Rural Arterial roads permit relatively unimpeded traffic movement and are intended for use on those routes where two through lanes are required but where a larger classified road is not warranted.

B. ACCESS CONDITIONS

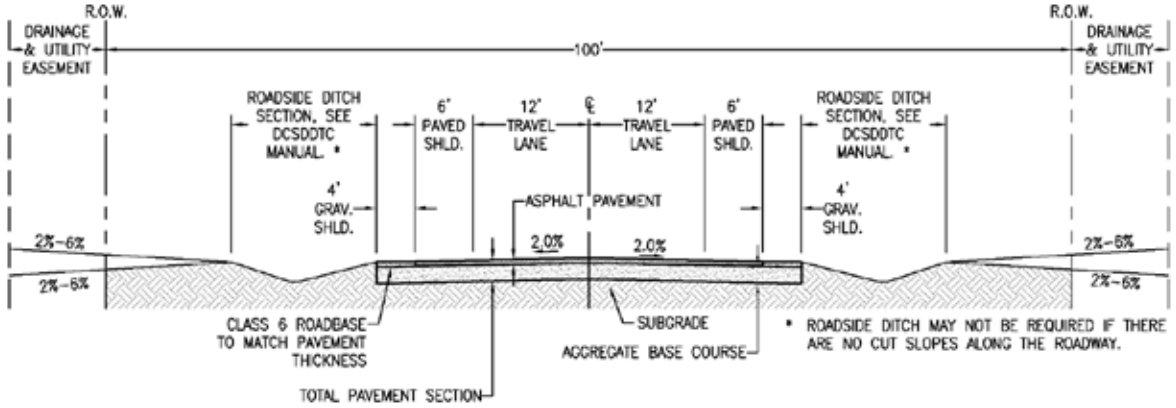
Access from roads of lower classifications will be permitted. Residential access is not permitted. Direct access to other abutting property is not permitted unless another access is not reasonably available as determined by Douglas County Engineering Division.

C. DESIGN CHARACTERISTICS

Rural Arterial roads typically are employed where traffic demands dictate. Landscaping elements are encouraged (Trees, open space, etc.). On-street parking is prohibited. Intersections and/or access points should be spaced a minimum of ¼-mile apart. See Chapter 13 Access Requirements and Criteria of these *Roadway Standards*. Public easements for utilities are required along both sides of the Right-of-Way. See also Chapter 12 Utility Locations of these *Roadway Standards.*

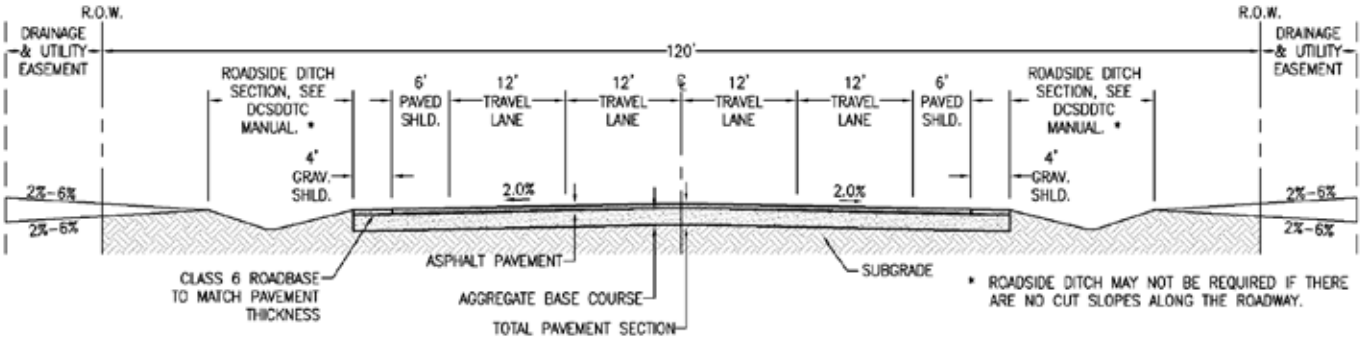
D. STREET SECTIONS

RURAL ARTERIAL
SEE STANDARD DETAIL SP.13



TWO LANE ROAD SECTION

RURAL ARTERIAL
SEE STANDARD DETAIL SP.14

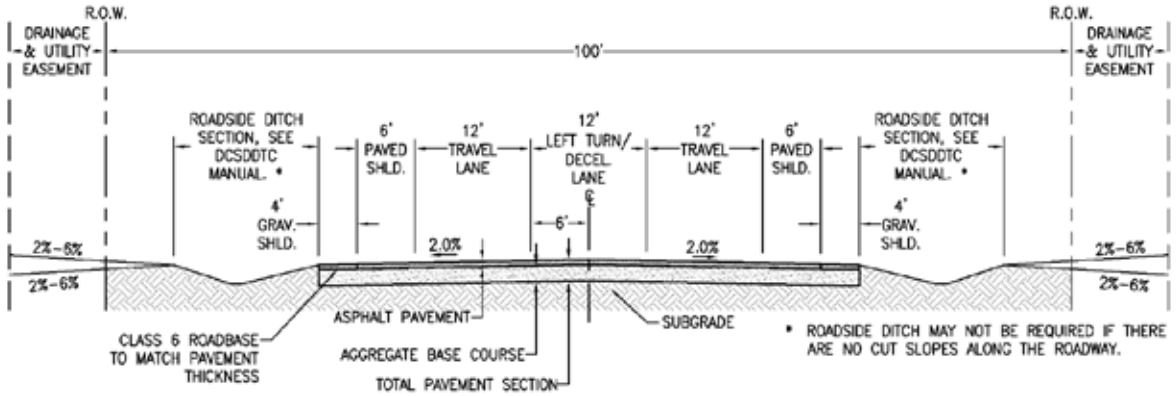


FOUR LANE ROAD SECTION

Typical Rural Arterial Road Section

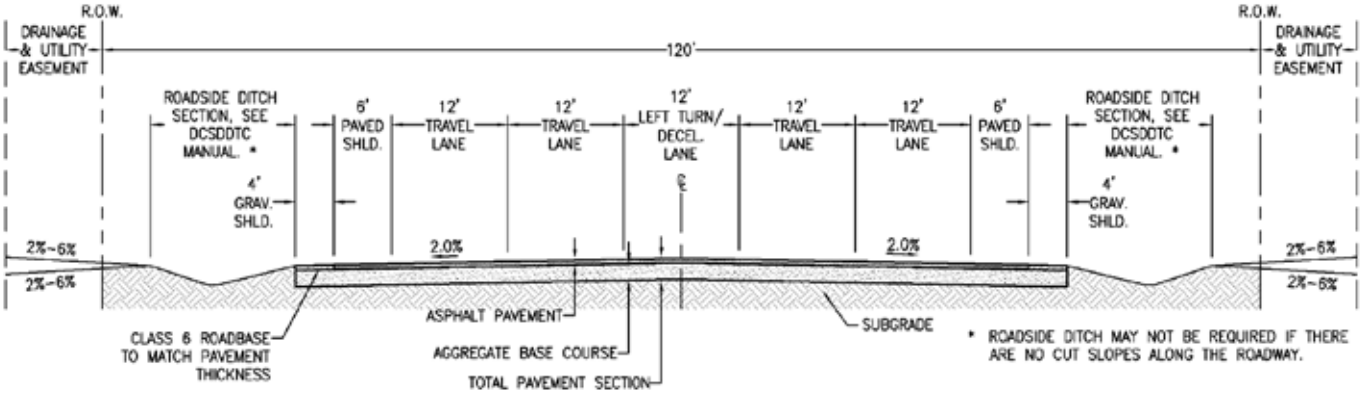
- For a **two lane arterial**, Minimum of two-12' through lanes and shoulders.
- For a **four lane arterial**, Minimum of four-12' through lanes and shoulders.
- Two roadside ditches, minimum 15' each.
- Minimum **two lane arterial** Right-of-Way is 100'.
- Minimum **four lane arterial** Right-of-Way is 120'
- Size of utility easement adjacent to each Right-of-Way line will vary.

RURAL ARTERIAL
SEE STANDARD DETAIL SP.13



TWO LANE AT INTERSECTION

RURAL ARTERIAL
SEE STANDARD DETAIL SP.14



FOUR LANE AT INTERSECTION

Typical Rural Arterial Road Section at Intersections

- For a **two lane arterial**, Minimum of two-12’ through lanes and shoulders.
- For a **four lane arterial**, Minimum of four-12’ through lanes and shoulders.
- One-12’ left turn lane.
- Two roadside ditches, minimum 15’ each.
- Minimum **two lane arterial** Right-of-Way is 100’.
- Minimum **four lane arterial** Right-of-Way is 120’.
- Size of utility easement adjacent to each Right-of-Way line will vary.

4.3.15 35-ACRE PRIVATE RURAL ROAD

The 35-Acre Private Rural road type permits gravel surfaces and may be used only in the A-1 zone district where each parcel is 35-acres or larger. Private Rural Local Roads provide direct access to adjacent property.

The following design criterion represents the MINIMUM allowable criteria. In all cases, the road shall be designed to these criteria, or the criteria required for the largest apparatus that may use the road, whichever is greater.

Posted Speed Limits	The posted speeds shall be determined case-by-case, by Douglas County, based upon the horizontal and vertical geometry, road surface, the number of average daily trips, and any other factors that may influence the allowable speed.
Design Speed Limits	25 MPH
Traffic Volumes	Maximum Design Volume is undefined. NOTE: these roads may require regular dust suppression applications particularly as the number of average daily trips increase. It is the owner's responsibility to satisfy all environmental regulations as required by every level of jurisdiction including the EPA.
Continuity	Limited
Right-of-Way	50' Minimum
Traffic Control	Signage per MUTCD and Douglas County Signage and Striping Standards as amended.
Number of Travel Lanes	2
Type of Curb, Gutter and Walk	Not required
Turnarounds	50' radius. The length of the "Cul-de-sac" road type shall not exceed 1200 lineal feet, however, Douglas County may further restrict the accepted allowable length based on, but not limited to, factors such as number of structures, available water and/or access for emergency services.
Knuckles	Not allowed
Eyebrows	Not allowed
Street Section	24' gravel travel lane, 2-roadside ditches
Street Grades	0.5% to 10%
Minimum Centerline Curve Radii	100'
Pavement Return Radii @ Arterial	25'
Pavement Return Radii @ Collector	25'
Pavement Return Radii @ Local	25'
K-Value Crest	12
K-Value Sag	12
Minimum VCL Crest	Use equation 7 in the "Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT≤400)", AASHTO 2001.

Minimum VCL Sag	Use equation 8 in the "Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT≤400)", AASHTO 2001.
Maximum Int. Gradient	4%

A. FUNCTION

35-Acre Private Rural Roads provide direct access to adjacent property. Traffic carried by 35-Acre Private Rural Roads should have an origin or a destination within the neighborhood.

B. RIGHT-OF-WAY

All 35-Acre Private Rural Roads shall be legally defined or located in an easement with a minimum width of 50'. An appropriate intersection design shall ensure the line of sight falls within the defined easement. When other design criteria are being used, "easement" is synonymous with Right-of-Way. See also "Sight Distance" in this Chapter.

C. ACCESS CONDITIONS

Intersects with Rural Local and Rural Collector roads. Direct access to abutting property permitted. Private Rural Roads shall not intersect major collectors or arterial roads (unless specifically accepted by Douglas County). Formal access permits are required for each intersection with a public road.

D. DESIGN CHARACTERISTICS

1. GENERAL

35-Acre Private Rural Roads should be designed to discourage through traffic in the neighborhood. This category of Private Rural Road shall be for residential developments with a minimum lot size of 35-acres. On-street parking is prohibited. Public easements for utilities are required along both sides of the Right-of-Way, the utility easements may be added to the access easement to form a single combined easement.

The design of these roads must be accomplished by a Professional Engineer Registered in the State of Colorado; then reviewed and accepted by Douglas County. The owner/developer is responsible to obtain and submit construction inspection reports to the Douglas County Engineering Division for review and acceptance. The Douglas County Building Division will not issue building permits for any proposed structures located within the development until the inspection test reports have been accepted. If the information in the submitted reports and data are determined to be unacceptable, the developer is responsible to correct the discrepancy(s) and resubmit new data for acceptance.

2. SURFACE

The minimum depth is 6-inches of compacted Class Six Road base material. The sub-grade section for the 35-Acre Private Rural Road must conform to the Douglas County Pavement Design and Technical criteria. The structural section of the road must meet Fire District requirements.

3. GATES

Any gate on any road shall be located a minimum of 30' from the outside edge of the through lane of the intersecting road. The opening of the gate must be a minimum of 2' wider than the gated road. Minimum gate dimension is: 24' minimum road width, plus 2' = 26'.

4. CULVERTS

Ditch culverts must be installed wherever necessary to provide continuous transport of drainage flows. The minimum size shall be 15" diameter. Minimum culvert cover is 1'. The maximum ditch slope at each end of the culvert is 3' horizontal and 1' vertical (3:1). The Horizontal alignment of the ditch and depth may vary from the typical road section to facilitate these design criteria. Please reference the *Douglas County Storm Drainage Design and Technical Criteria Manual* for additional standards for roadside/driveway ditch culverts.

5. STREET SECTION

The minimum road width must be adequate for simultaneous evacuation and emergency response operations in opposite directions. Minimum width is 24' gravel surface. Ditches shall be constructed as necessary.

35-ACRE PRIVATE RURAL ROAD
SEE STANDARD DETAIL SP.15

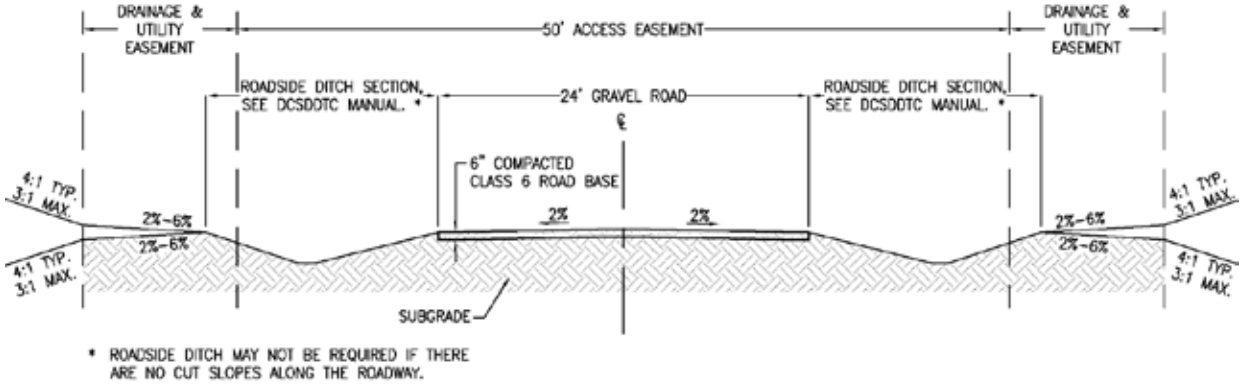
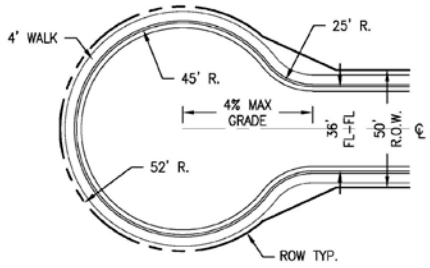
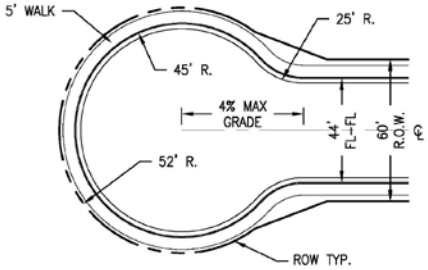


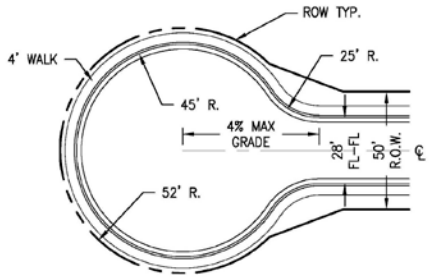
FIGURE 4-1
URBAN TURNAROUNDS



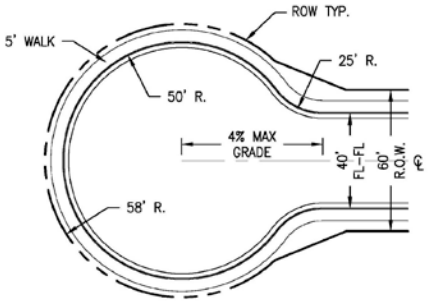
Cul-De-Sac (SF)



Cul-De-Sac (MF)

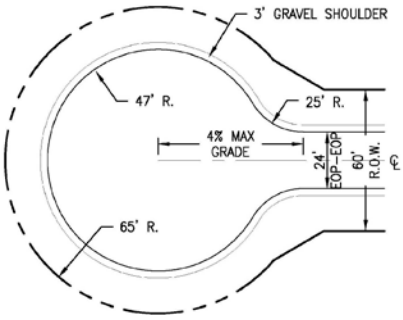


Urban Local (Type II)

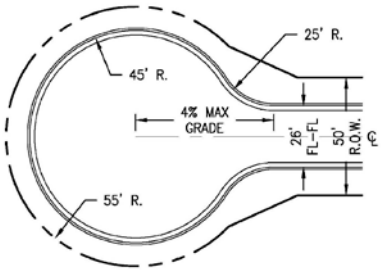


Commercial & Industrial

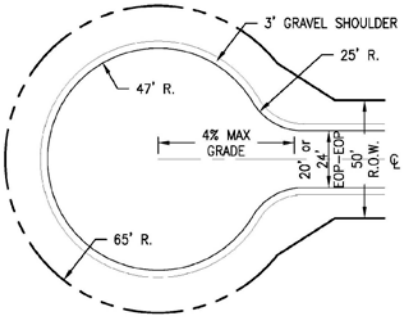
FIGURE 4-2
RURAL TURNAROUNDS



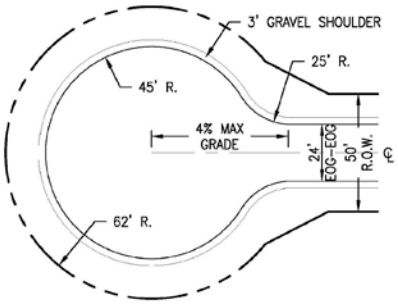
Rural Local (Type I)



Rural Local (Type II)

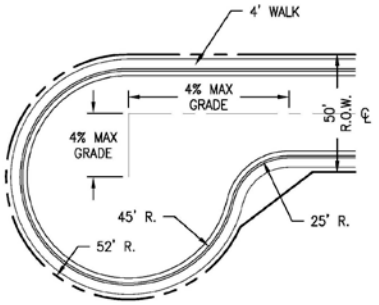


Rural Local (Type III)

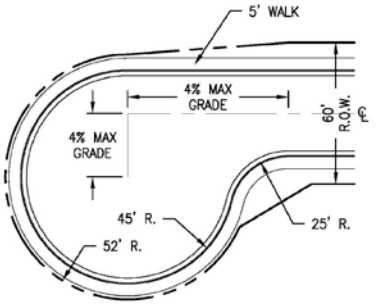


Rural Local (Type IV) and Private Rural Road

FIGURE 4-3
OFFSET TURNAROUNDS

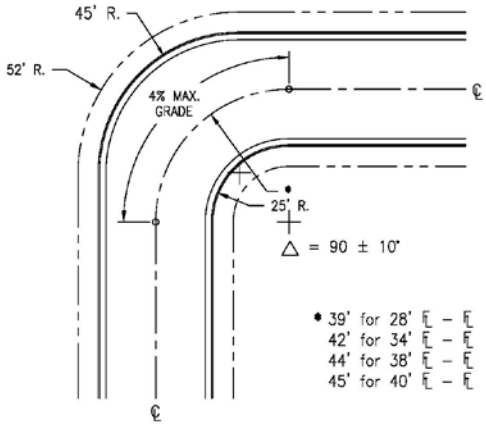


50' Right-of-Way

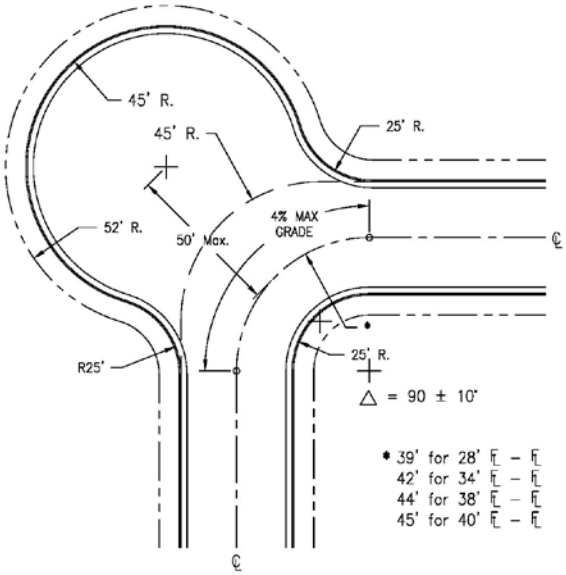


60' Right-of-Way

FIGURE 4-4
KNUCKLES

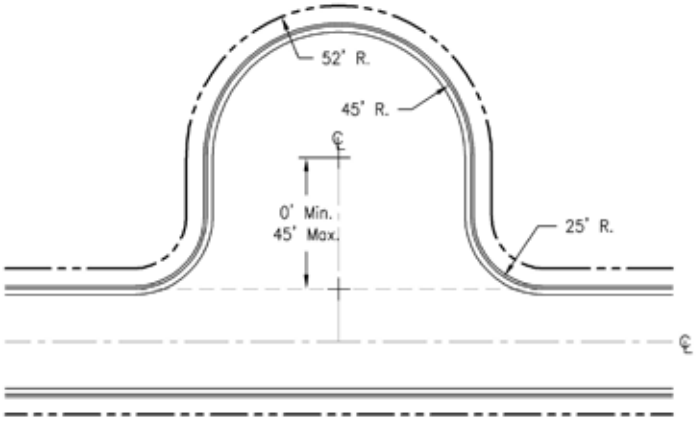


Without Bubble



With Bubble

FIGURE 4-5
EYEBROWS



4.4 SIDEWALKS, TRAILS & CURB RAMPS

A. All sidewalks that run parallel with the public street shall be located within the County right-of-way. If a sidewalk meanders outside of the County 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 4.6.3)

B. 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 curb and sidewalk. Curb ramps shall be constructed in accordance with Douglas County 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 Douglas County Standard Detail to be used to construct that ramp. Special consideration for ramp design may be necessary due to site specific issues such as cross slope, drainage, etc. with acceptance by Douglas County.

C. Grade separated pedestrian crossings at collector and arterial roads, shall be constructed whenever possible for regional/neighborhood trails, golf cart crossings, and equestrian crossings.

D. Contact the Engineering Division to determine if there are planned designated Douglas County Bicycle Facilities and/or existing or planned designated School Routes that need to be considered in the design.

4.5 CURB CUTS & DRIVEWAYS

Curb cuts and driveways shall be constructed in accordance with Douglas County Standard Details found in Appendix A of these Roadway Standards. See Chapter 13 for additional curb cut and driveway criteria.

4.6 DRAINAGE

The minor and major storm drainage systems are designed in accordance with the DCSDDTC Manual. In the case of a conflict caused by requirements of other Criteria Manuals, the most restrictive shall govern.

4.6.1 Crosspans

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

B. Crosspans shall be constructed in accordance with the Douglas County Standard Details. Crosspans are not permitted across Arterial Roadways.

C. Local road intersections require a minimum 8’ wide crosspan.

D. Minor Collector road intersections require a minimum 10’ wide crosspan.

E. Arterial road intersections do not allow a crosspan.

F. See Section 7.6.4 of the DCSDDTC Manual for crosspan capacities.

4.6.2 Inlets

A. Inlets shall be constructed in accordance with the Douglas County Standard Details. Type R Inlets are required along roadways owned and maintained by Douglas County. Type R inlets shall be 5', 10' or 15' in length. 20' Type R inlets may be allowed on a case by case basis. Inlets exceeding 20' in length are not acceptable.

B. Inlets shall be located to intercept the curb flow at the point the allowable curb flow capacity is exceeded by the storm runoff. Refer to Chapter 8 in the DCSDDTC Manual for curb capacity. Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevations.

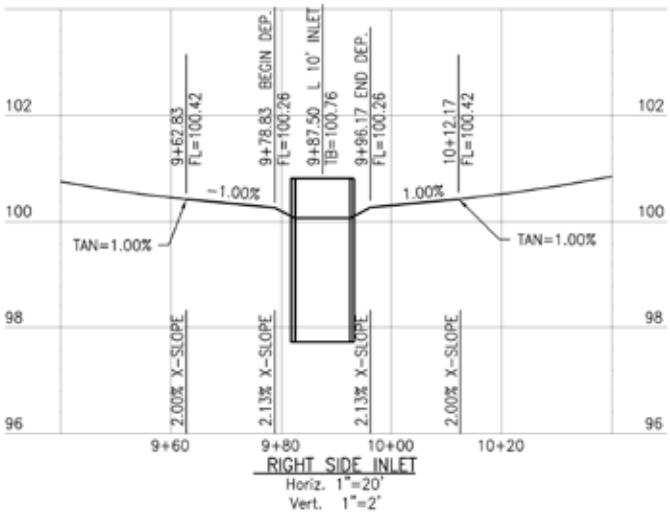
C. For all streets with raised medians constructed with asphalt, the median shall be constructed with a "catch" curb and gutter with inlets required along the median to reduce ponding at curb and gutter low points and to eliminate concentrated flow crossing over the lanes of traffic at the nose of the median. The final design and construction drawings must address inlet sizing, dimensions, and required curb and gutter transitions. Refer to Figure 8-1 of the DCSDDTC Manual, Special Median Inlet Details, which presents conceptual representations of options available for placing median nose inlets. See Section 4.15 for additional information.

D. Due to 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.

E. Refer to Chapter 8 of the DCSDDTC Manual and Douglas County Standard Details located in Appendix A of these Criteria for inlet types allowed.

F. Douglas County requires a minimum 1% flowline grade into all sump inlets. See Figure 4-6.

FIGURE 4-6
SUMP INLET PROFILE



G. An eight-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 Douglas County standard Details for criteria.

4.6.3 Sidewalk Chases

A. 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 Engineering Division. Sidewalk Chases, when permitted, 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:

- Cost of future maintenance.
- Excessive ice build-up in the gutter/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.

B. Storm water from concentrated points of discharge (i.e. sump pumps and roof drains) shall not be allowed to flow over sidewalks. Sidewalk Chase sections will not be allowed where home owners 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.

C. 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 Douglas County 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.

4.6.4 Trench Drains

A. 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 road-side 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.

B. 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 be included on the plan, a concrete collar (3" minimum around pipe and 6" thick) with a minimum of 2' by 6' pad of type L rip-rap placed over filter fabric is required. A drainage easement is required for trench drain outside of public right of way. The plan also needs to call for a marker post to identify the discharge point of the trench drain.

C. 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 in to the storm sewer or discharge point to a natural drainageway.

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

- If soils in the area are non-expansive (A-6 & A-7-6 are expansive) the applicant may submit a Variance Request (signed and stamped by a Colorado registered Geotechnical Professional Engineer) 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 Douglas County Engineering Division, 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' from the back of curb or walk, a trench drain may not be required.

4.6.5 Rural Roadside Ditches

Roadside ditches should be constructed in accordance with Section 7.8 of the DCSDDTC Manual. Roadside ditches may not be required if there are no cut slopes along the roadway.

4.6.6 Temporary Erosion and Sediment Control

Temporary erosion control is required along and at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with Douglas County Grading, Erosion and Sediment Control (GESC) Manual.

4.7 HORIZONTAL ALIGNMENT

4.7.1 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.

4.7.2 Horizontal Curves

See Table 4-1.

4.7.3 Intersection Curb Return Radii

See Table 4-1.

4.7.4 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 below the design speed. Posted speed limits may be adjusted by Douglas County to reflect actual roadway conditions and circumstances.

4.7.5 Superelevation

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

Superelevation shall not be used without prior acceptance by the Douglas County Engineering Division. If a superelevated design is applied for, the AASHTO design standards shall be used.

4.7.6 Railroad Crossings

Railroad crossings are not permitted unless Douglas County, the affected railroad company, and the Public Utilities Commission (PUC) accept them.

4.8 VERTICAL ALIGNMENT

4.8.1 Permissible Roadway Grades(See also “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 4-1 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 4-7
FLOWLINE GRADE AROUND CURVES

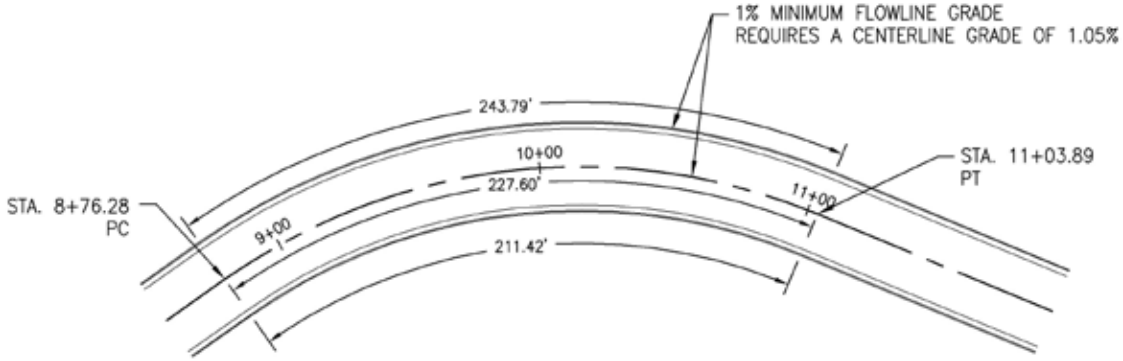
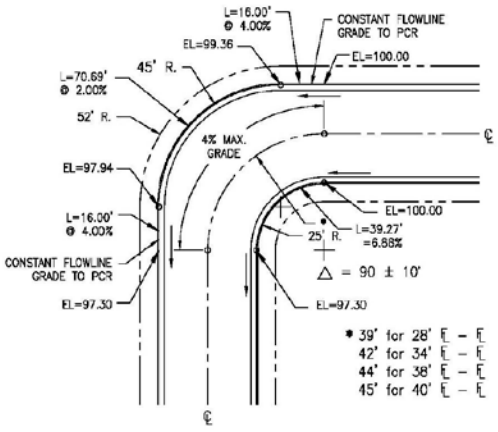
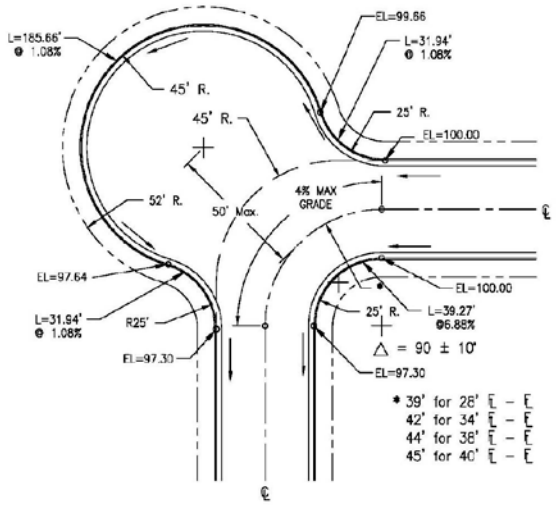


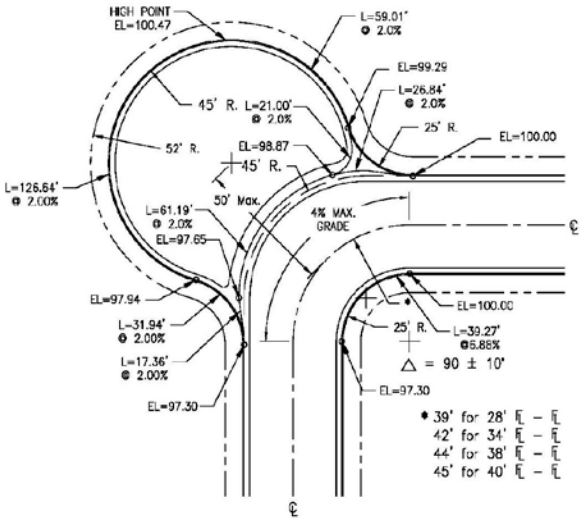
FIGURE 4-7a
FLOWLINE DESIGN AROUND KNUCKLES



No Bubble

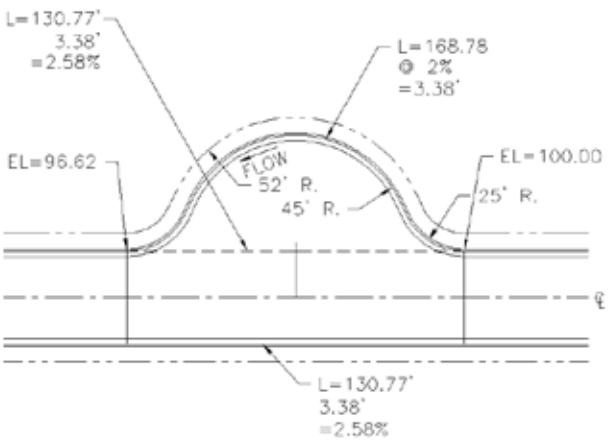


With Bubble, Grade Thru Entire Knuckle

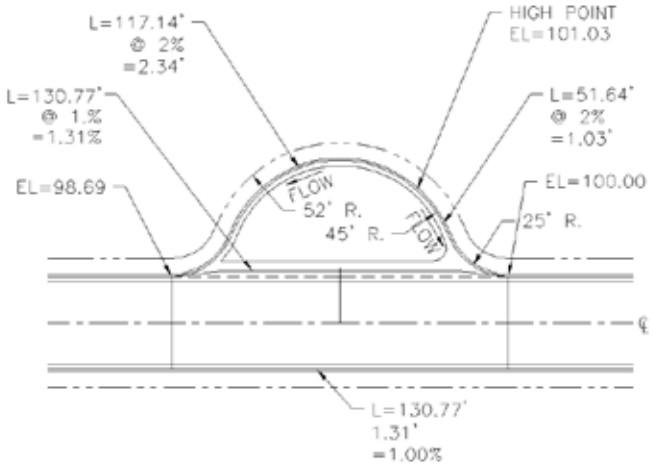


With Bubble, High Point in Bubble, 2% Grade in both directions

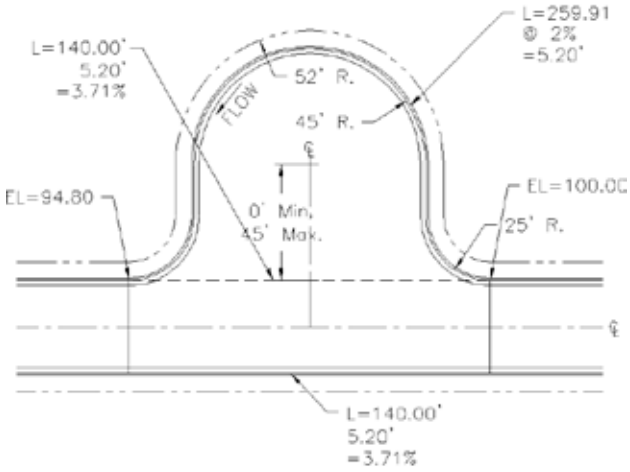
FIGURE 4-7b
FLOWLINE DESIGN AROUND EYEBROWS



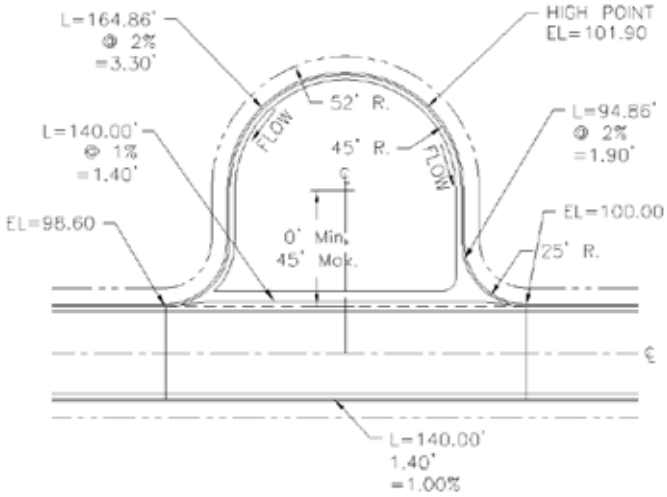
0' Offset, 2% Grade Thru Entire Eyebrow



0' Offset, High Point with 2% Grade in both Directions



45' Offset, 2% Grade Thru Entire Eyebrow



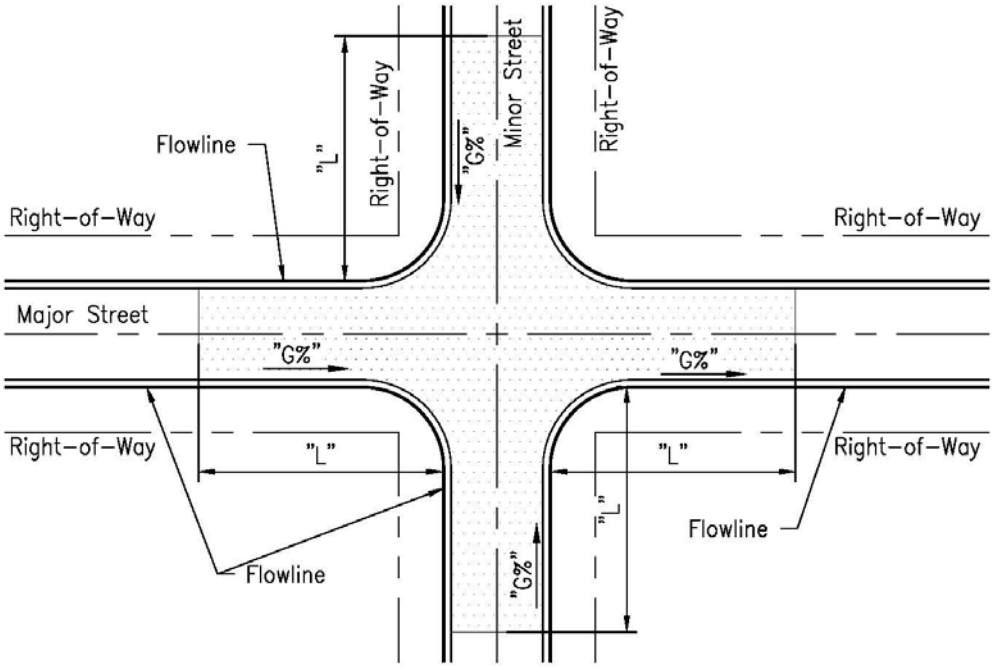
45' Offset, High Point with 2% Grade in both directions

4.8.2 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 4-8 and Table 4-2.

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

FIGURE 4-8
PERMISSIBLE INTERSECTION GRADE LAYOUT



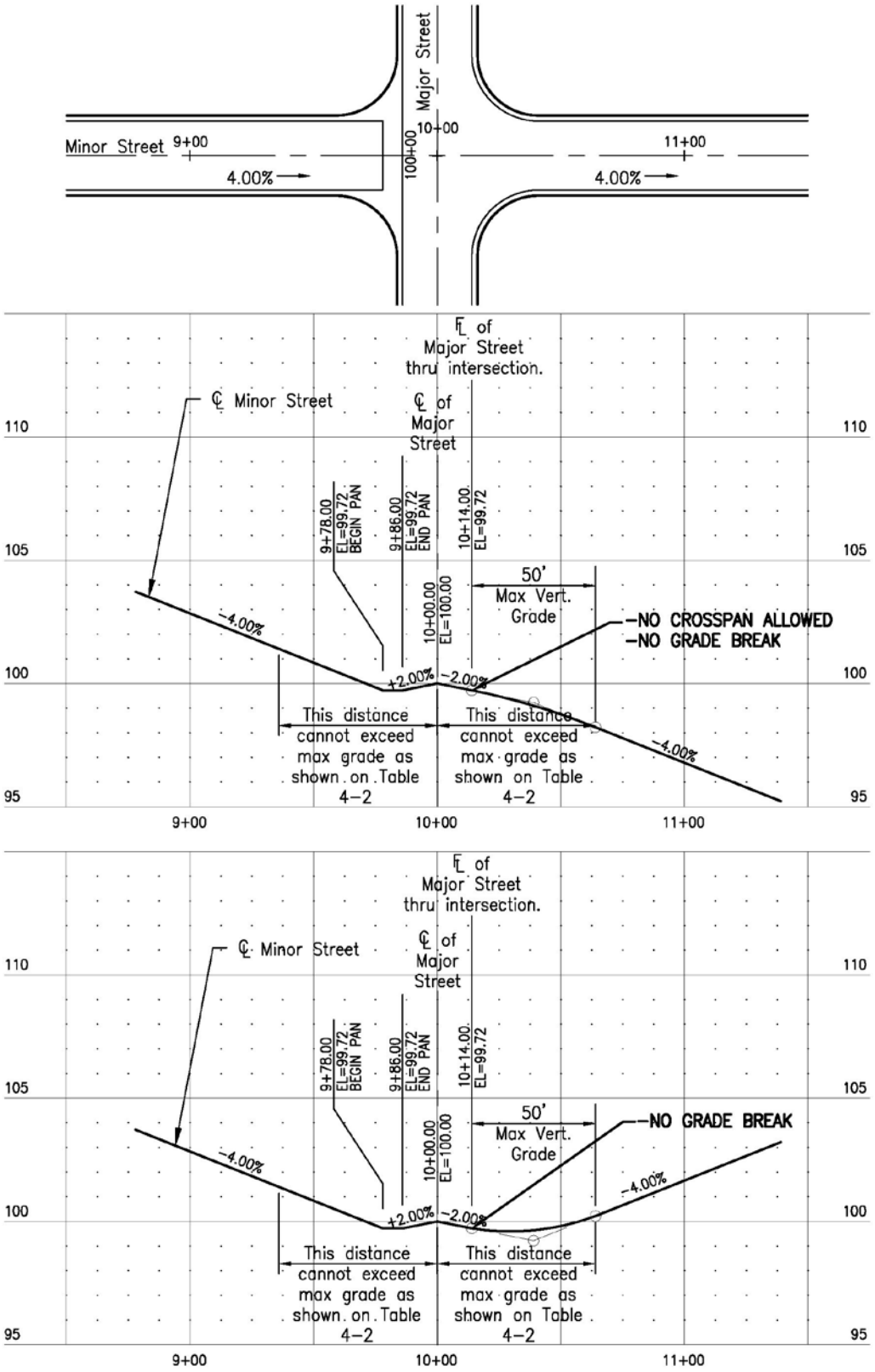
L=Minimum Length Required
G=Maximum Grade Allowed
See Table 4-2 for information.

The longitudinal slope of the Major Street shall continue through the intersection and may be greater than the max “G” shown in TABLE 4-2 except at Major Collectors and Arterials.

TABLE 4-2
PERMISSIBLE INTERSECTION GRADE TABLE

Major Street / *Minor Street*	Cul-De-Sac	Urban Local (Type I)	Urban Local (Type II)	Entry Street	School Access Street	Commercial & Industrial	Rural Local (Type I)	Rural Local (Type II)	Rural Local (Type III)	Rural Local (Type IV)	Urban Collector	Rural Collector	Minor Arterial	Major Arterial	Rural Arterial
Cul-De-Sac	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	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	N/A	N/A
Urban Local (Type I)	N/A	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	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	N/A	N/A
Urban Local (Type II)	N/A	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	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	N/A	N/A
Entry Street	N/A	N/A	N/A	L=95' G=4%	L=95' G=4%	N/A	N/A	N/A	N/A	N/A	L=100' G=4%	L=120' G=3%	L=150' G=3%	L=150' G=3%	L=150' G=3%
School Access Street	N/A	N/A	N/A	L=95' G=4%	L=95' G=4%	N/A	N/A	N/A	N/A	N/A	L=100' G=4%	L=120' G=3%	L=150' G=3%	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=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=100' G=4%	L=120' G=3%	L=150' G=3%	L=150' G=3%	L=150' G=3%
Rural Local (Type I)	N/A	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	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	N/A	N/A
Rural Local (Type II)	N/A	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	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	N/A	N/A
Rural Local (Type III)	N/A	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	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	N/A	N/A
Rural Local (Type IV)	N/A	L=95' G=4%	L=95' G=4%	L=95' G=4%	L=95' G=4%	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	N/A	N/A
Urban Collector	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L=100' G=4%	L=120' G=3%	L=150' G=3%	L=150' G=3%	L=150' G=3%
Rural Collector	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L=120' G=3%	L=150' G=3%	L=150' G=3%	L=150' G=3%
Minor Arterial	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L=200' G=2%	L=200' G=2%	L=200' G=2%
Major Arterial	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L=200' G=2%	L=200' G=2%
Rural Arterial	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L=200' G=2%	L=200' G=2%	L=200' G=2%

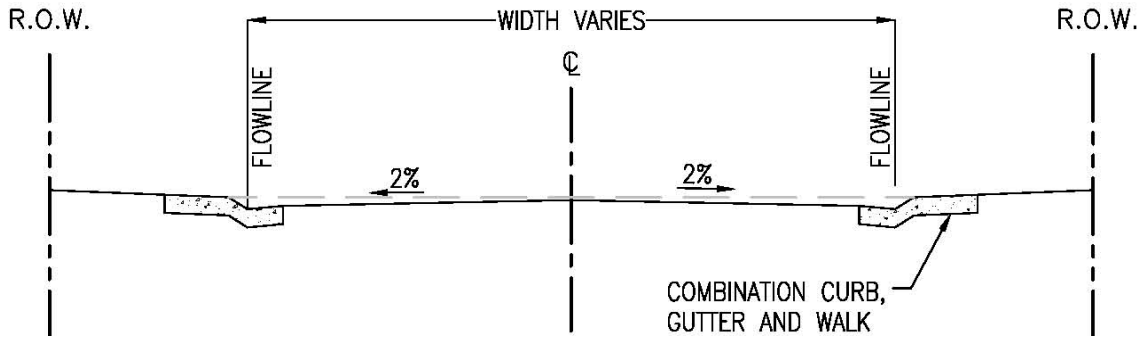
FIGURE 4-9
PERMISSIBLE INTERSECTION GRADE EXAMPLE



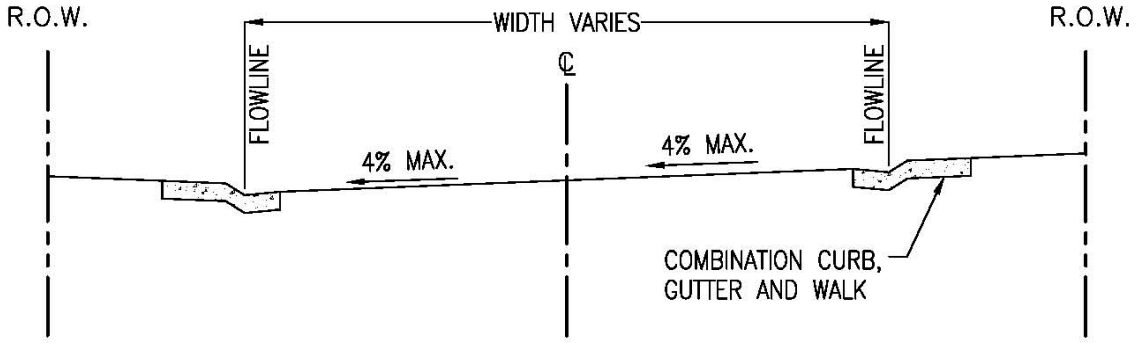
4.8.3 Cross Slope

Typically roadways shall have a crown in the center of the roadway 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 4-10
CROSS SLOPE EXAMPLE



STA. 10+00
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' horizontally along the roadway.
Collector Streets	1% every 37.5' horizontally along the roadway.
Arterial Streets	1% every 56.5' horizontally along the roadway.

4.8.4 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.

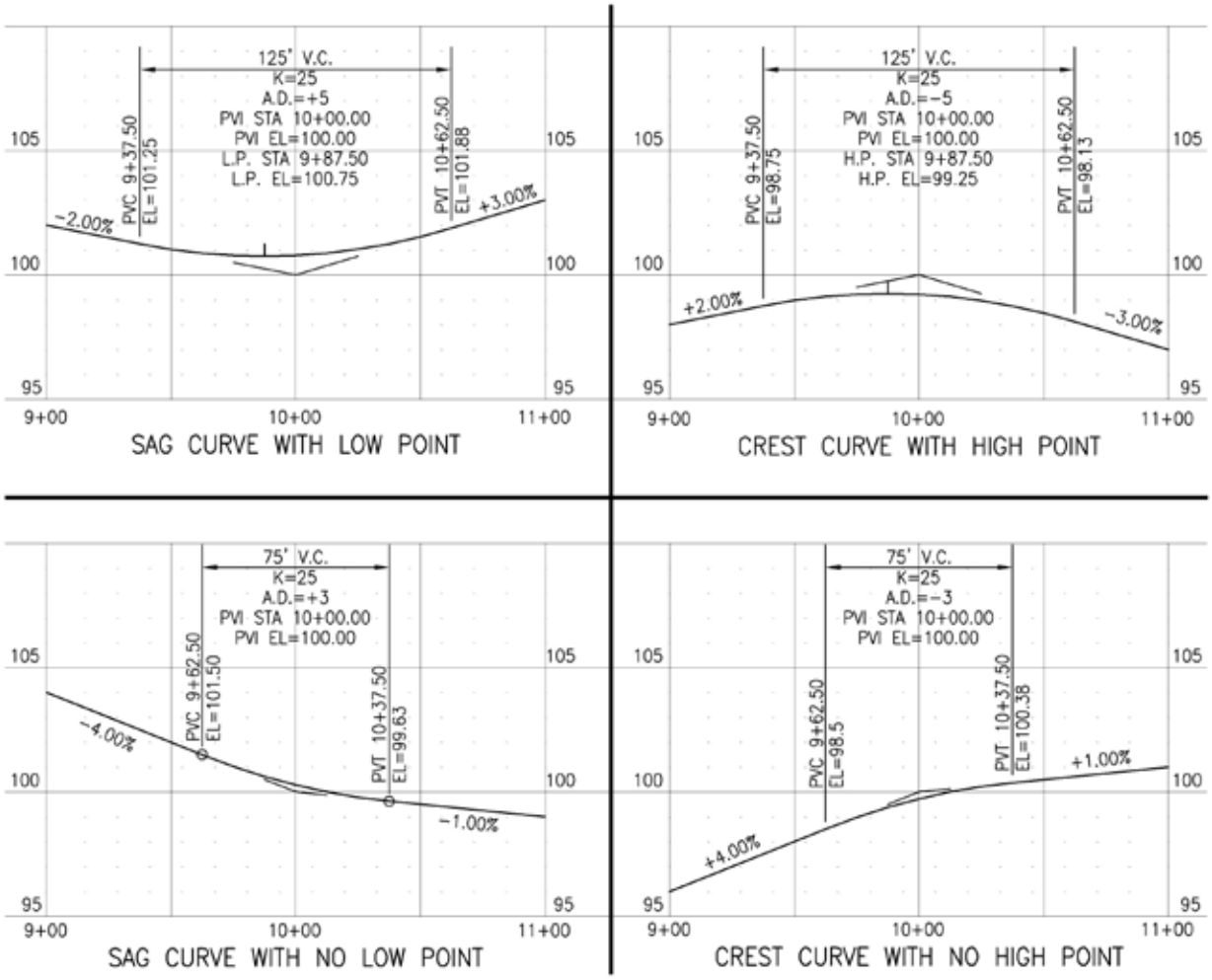
When the algebraic difference in grade (A) is at or exceeds 0.5%, a vertical curve shall be used. Design criteria for vertical curves are found in Table 4-1 of these *Roadway Standards*. Minimum length of a vertical curve is shown in Table 4-1. All vertical curves

shall be labeled, in the profile, with length of curve (L) and K= (L/A) values.

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

All flowline vertical curves in knuckles and bubbles shall have a maximum length of 50'.

FIGURE 4-11
VERTICAL CURVE EXAMPLES



4.9 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 Douglas County Engineering Division, shall have precedence. The design should warp side streets to match through streets with as short a transition as possible. See Section 4.8.3. 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:

- **A.** Pavement cross slope at the PCR's on the side street and permissible warp in pavement cross slope. (See Section 4.8.3).
- **B.** The maximum permissible cross slope is 4% between the PCR's.
- **C.** Normal vertical curve criteria. (See Section 4.8.4).
- **D.** Vertical controls within the curb return itself. (See Section 4.9.1).

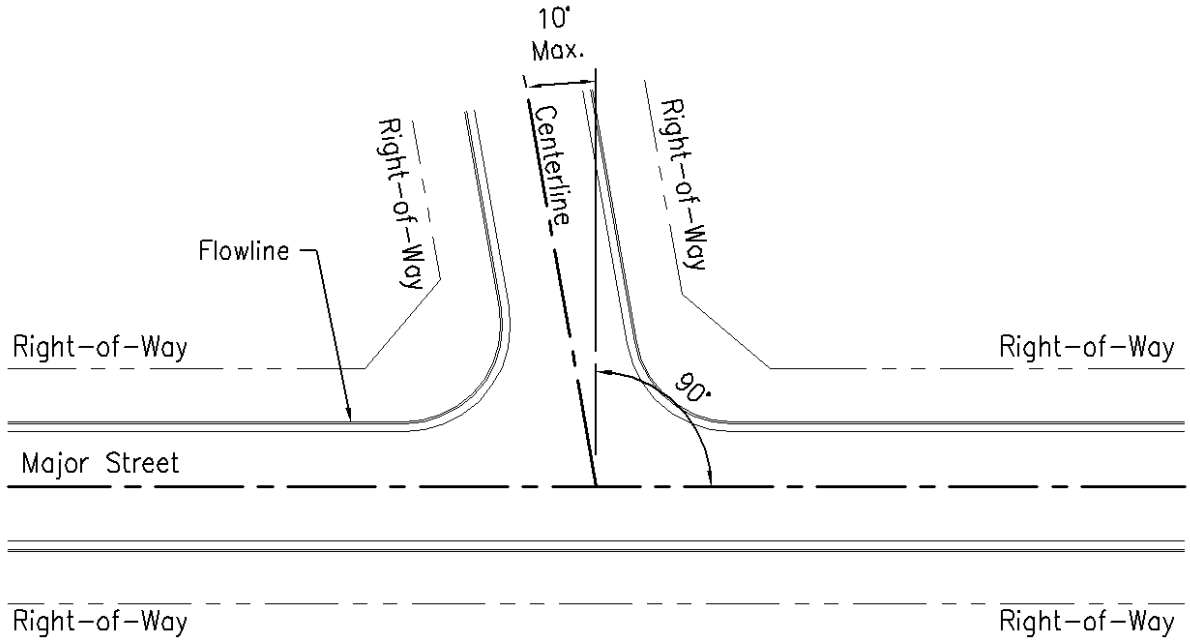
The elevation at the PCR of the curb return on the through street is always set by the grade of the through street in conjunction with normal pavement cross slope of 2%. Carrying the crown at a side street into the through street is permitted only when drainage considerations warrant such a design. Refer to Section 4.8.3 for street cross slope allowances.

A more detailed review shall be performed for arterial-arterial intersections to maximize driveability. Few arterial intersections will have a uniform 2% cross slope, the majority of them having one or more sides warped (See Sections 4.8.3 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' by 10' grid.

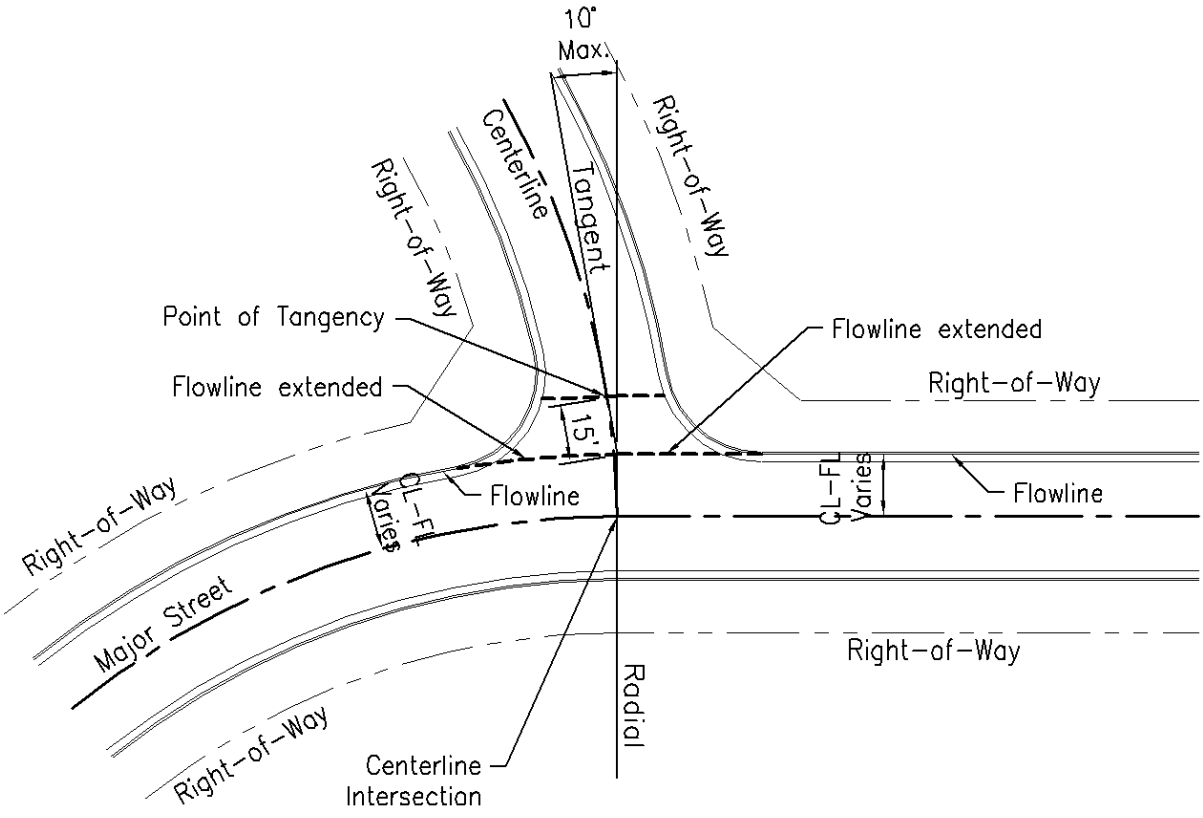
Whenever possible, intersections shall be made at right angles or radial to a curve. An intersecting deflection angle of more than 10% will not be allowed (See Figure 4-12). Intersection sight distances shall conform to the requirements of Section 4.11.4 and/or the AASHTO Green Book.

See Figure 4-9 for an example of the Permissible Intersection Grade.

FIGURE 4-12
PERMISSIBLE INTERSECTION ANGLE



INTERSECTION OF A STRAIGHT STREET TO A STRAIGHT STREET



INTERSECTION OF A CURVE STREET TO A CURVE OR STRAIGHT STREET

4.9.1 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' in each direction to ensure adequate design with impacted roadways. General standards for flowline control and profiles within the curb returns shall be as follows:

A. The point of tangency at each curb return shall be determined by the projected tangent grade beginning at the point of intersections (PI) of the flowlines.

B. Design the flowline of the curb return such that the maximum slope along the flowline does not exceed 8%.

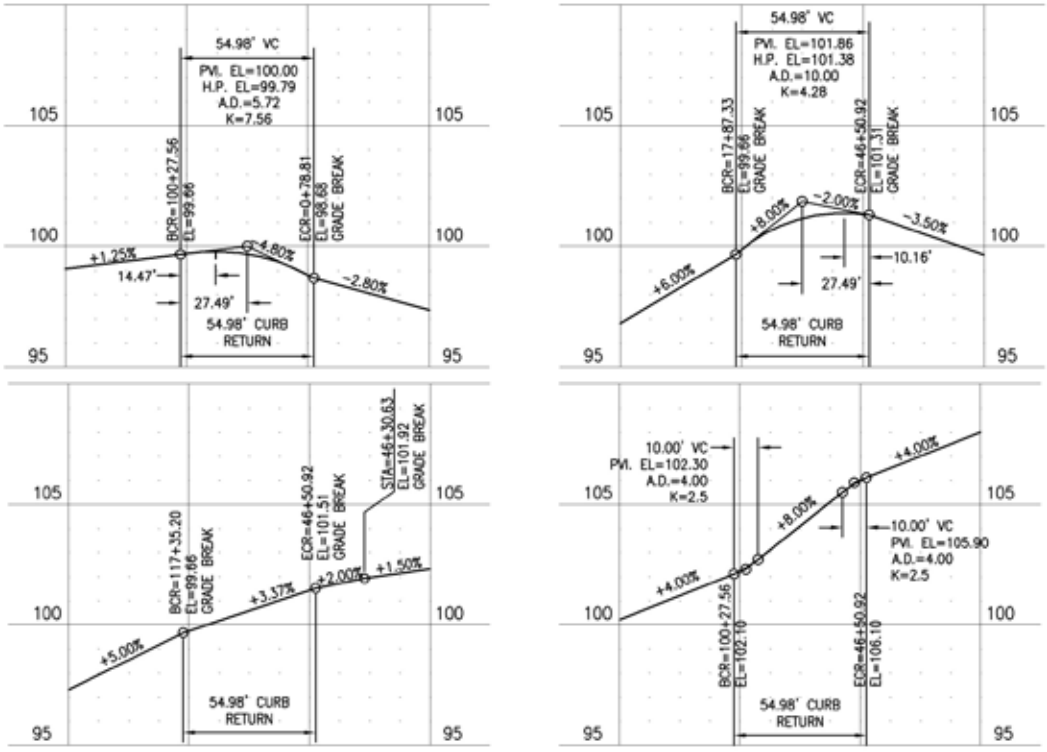
C. Grade breaks at the PCR's shall not exceed 2% for local and collector streets and 1% for arterials.

D. Maximum vertical curve length will equal the arc length of the curb return.

E. The elevation and location of the high or low point within the return, if applicable, is to be called out in the profile.

F. Warp of the side streets shall not exceed criteria set in Section 4.8.3.

FIGURE 4-13
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 8%.
3. Roadway cross slope cannot exceed 4.0%.

4.9.2 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 (See Section 4.8.4). 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' with field verified as-builts showing stations and elevations at 25' intervals. In the case of a connection with an existing intersection, these as-builts are to be shown within a 300' 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, off-site intersections, limits of the improvement, etc.

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

4.9.3 Intersection Warping

See Section 4.8.3. for the rate of change in pavement cross slope.

4.10 ROUNDABOUTS

4.10.1 General Guidelines

Douglas County may allow roundabouts as a substitute or to replace other types of intersection traffic control, such as 2-way or all-way STOPs 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 Douglas County standards. Roundabouts are limited to roadways with no more than two approach lanes (4-5 lane roadways).

All roundabout designs shall require a two step process: a preliminary design and feasibility analysis initially submitted to the Department of Public Works Engineering, Traffic Division, and a construction design where specific design criteria and standards are reviewed.

All proposed roundabouts fall within three categories - mini-roundabouts, which are small, one-lane roundabouts that can be used as traffic calming devices, and are limited to local roads only, single lane roundabouts which are often used to replace 4-way STOP control or traffic signals on all classifications of roadways with 2 travel lanes, and multi-lane roundabouts, which are used to replace a traffic signal on 4 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.

4.10.2 Feasibility Analysis

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

A. Traffic Operations Study consisting of daily volumes, vehicle classification, and AM / PM peak hour turning movement counts for existing, site build out 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.

B. Location and category of the proposed roundabout, including roadway widths, speeds and classifications for intersecting roadways.

C. 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.

D. Preliminary approach grades.

E. Identification and proposed method of correcting any restrictions to visibility on each approach due to vertical or horizontal alignment design or other sight distance restrictions.

F. Level of Service analysis from RODEL or ARCADY (min LOS C or better at 85% confidence level) and comparison with alternatives (signal, 4-way or 2-way STOP using Synchro or HCS) at initial construction and with 20-year projections.

G. Identification of impact on any near-by intersections, driveways, or traffic signals caused by queuing.

H. Identification of any expected construction or phasing problems and proposed mitigation.

4.10.3 Design

The design shall include:

A. A location map and details of the approach roadways (width, grades, number of lanes, drainage patterns, lighting, typical roundabout design criteria, etc).

B. Sight distance lines for Decision Sight Distance (DSD). 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 daytime and nighttime. The DSD 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 (multilane) without exceeding a deceleration rate of 10 ft/s/s. This is generally the same distance as the “intersection sight distance” noted in AASHTO standards, and is variable by approach speed.

C. Stopping Sight Distance (SSD) lines and restricted sight areas for each approach.

D. A separate drawing showing turning templates for large vehicles and fastest path lines.

E. Drainage patterns on the approaches and within the roundabout.

F. Signage and pavement markings.

G. Location of existing and proposed utilities.

See appendix for specific design details regarding alignment, grades and other roundabout specific design criteria.

4.11 SIGHT DISTANCE

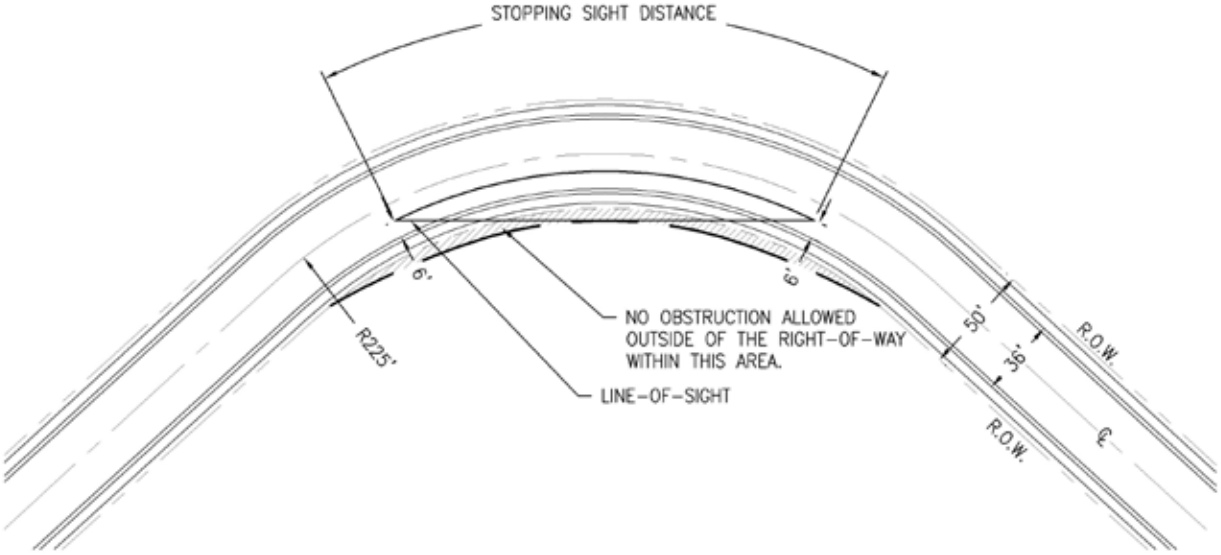
The horizontal and vertical alignment must provide at least the minimum sight distance for the design speed at all points. This includes visibility at intersections as well as along all horizontal and vertical curves. All sight distance lengths shall be adjusted for any grade 3% or higher per AASHTO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

4.11.1 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, utility boxes, etc. These obstructions shall be shown on the plans. Horizontal sight is measured as indicated in Figure 4-14.

Cut slope obstructions shall be shown on the plans by a line representing the proposed excavation slope at a point 2.75' above the road surface for stopping sight distance and at a point 3.5' 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 4-14
LATERAL CLEARANCE TO SIGHT OBSTRUCTION INSIDE OF HORIZONTAL CURVES PROVIDING STOPPING DISTANCE FOR TURNING ROADWAYS



4.11.2 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' above road surface and viewer's height is 3.5' above road surface.

In no case shall the stopping sight distance be less than as specified in Table 4-3. A likely obstruction may be a bridge abutment or line of columns, wall, cut side slope, landscaping, or a side or corner of a building. The sight distance design procedure shall assume a 6' fence (as measured from actual finished grade) exists at all property lines except in the line of sight required at all intersections. See Figure 4-14.

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

4.11.3 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. Rural two-lane roads should provide adequate passing zones. Required passing sight distance for given design speeds is shown in Table 4-3.

TABLE 4-3
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	1000
65	645	1100
70	730	1200

From AASHTO Green Book Table 3-1, Table 3-4 and Table 3-35
(For Intersection & Driveway Sight-Distance, see Figure 4-15)

4.11.4 Intersection and Driveway Sight Distance

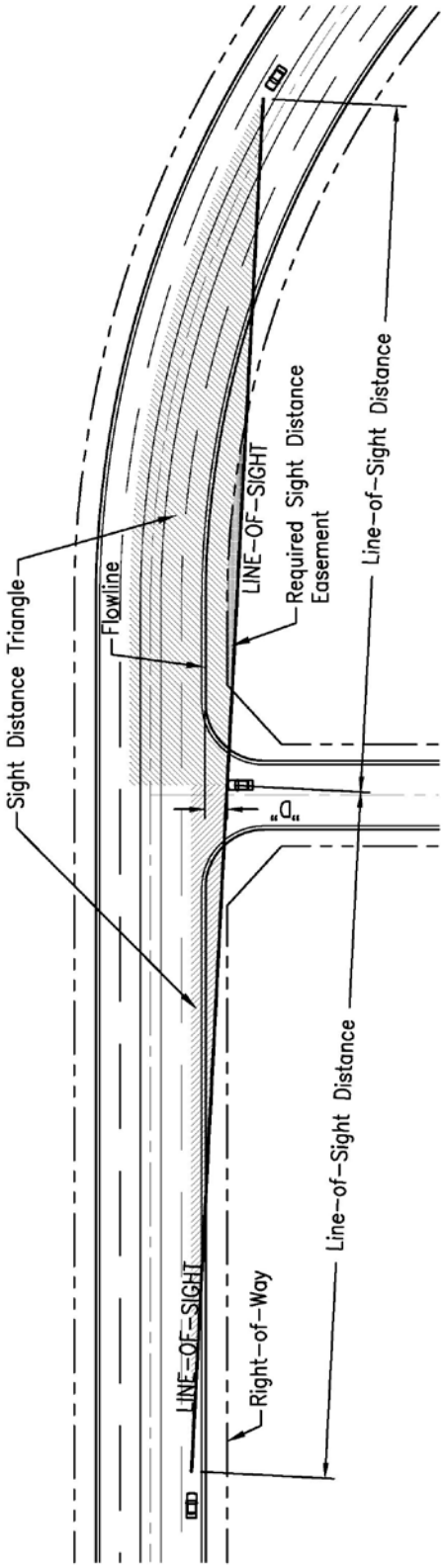
There shall be an unobstructed line of sight along both sides of all stopped approaches at an intersection within the Right-of-Way to provide the entering vehicle adequate sight distance to enter or cross the roadway. See Figure 4-15.

Any object within the “sight triangle” (refer to Figure 4-15) more than 24-inches above the flowline and/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. This design criteria also requires the elimination of parking (except on local streets or as otherwise permitted by Douglas County Engineering Division) 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 ROW. Any sight distance triangle outside of the ROW must be accepted by the Douglas County Engineering Division 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, See Figure 4-15.

FIGURE 4-15
INTERSECTION AND DRIVEWAY SIGHT DISTANCE (LINE-OF-SIGHT TRIANGLE)



Douglas County Road Classification	Design Speed (M.P.H.)	Posted Speed Limit (M.P.H.)	Line-of-Sight Distance (FT.)
Cul-De-Sac	25	20	230
Urban Local (Type I)	30	25	280
Urban Local (Type II)	30	25	280
Entry Street	30	25	280
Commercial & Industrial	30	25	280
Urban Collector	35	30	363
Minor Arterial	50	40	583
Major Arterial (4 and 6 lane)	50	40	583
Rural Local (Type I)	30	25	280
Rural Local (Type II)	30	25	280
Rural Local (Type III)	30	25	280
Rural Local (Type IV)	30	25	280
Rural Collector	60	40	575
Rural Arterial(2 and 4 lane)	70	55	730
35-Acre Private Rural Road	25	25	280

Notes:

Line-of-Sight Distance is measured from a point on the minor road at 15' 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 at 2.00 feet on the major road.

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

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

For 60 m.p.h. Design Speed, stopping sight distance governs.

Line of Sight must be within the ROW or easement.

Sight Distance developed from AASHTO "Green Book"

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

Limits of Sight Distance Triangle

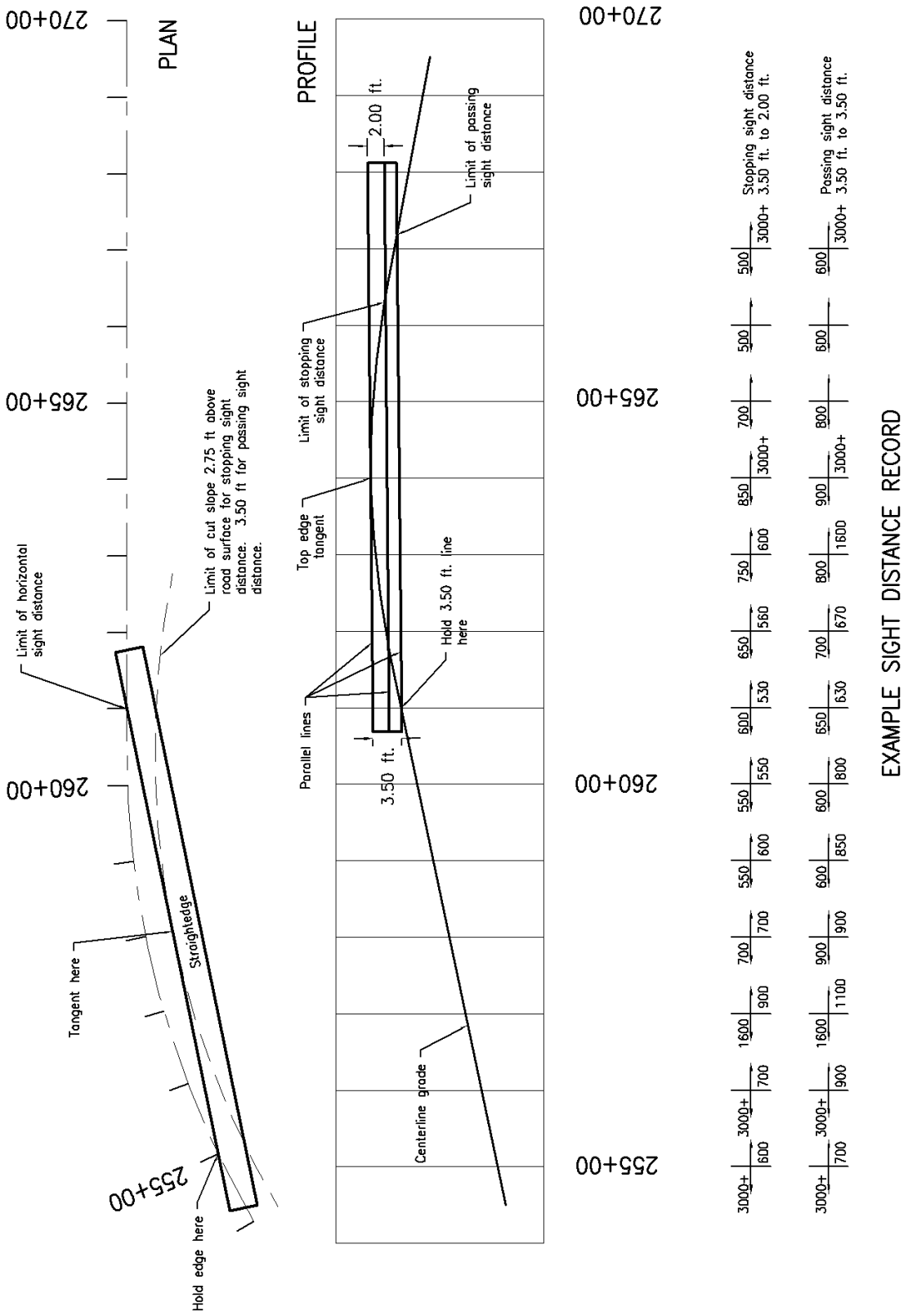
Limits of Sight Distance Easement

4.11.5 Sight Distance on Vertical Curves

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

Methods for scaling sight distances are demonstrated in Figure 4-16. 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. See Figure 4-16.

FIGURE 4-16
SCALING AND RECORDING SIGHT DISTANCE ON PLANS



4.12 OFF-SITE DESIGN

The design grade and existing ground of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued, in the same plan and profile as the proposed design. If the off-site 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.

4.13 AUXILIARY LANES

The design of the arterial street system depends upon 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' including the adjacent curb and gutter pans.

4.14 BUS PULLOUT LANES

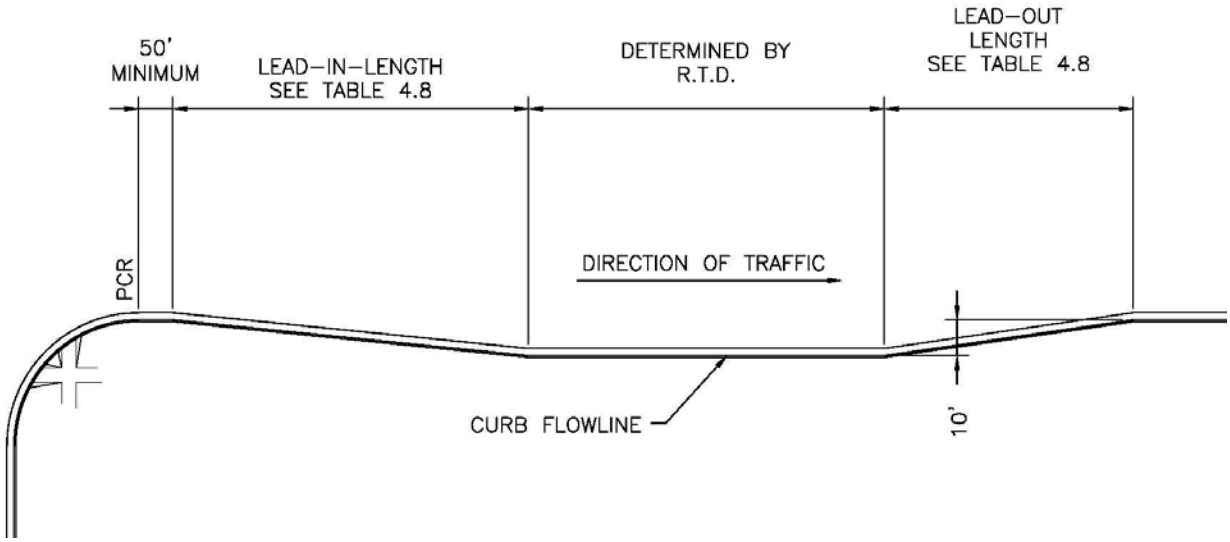
Bus Pullout Lanes shall be designed and constructed by the adjacent land developers where required. The design of the Bus Pullout Lanes will be governed by dimensions shown in Table 4-4, located on the far side of an intersection and shall be reviewed and accepted according to procedures set forth in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

TABLE 4-4
BUS PULLOUT LANES

SPEED LIMIT	LEAD-IN LENGTH	LEAD-OUT LENGTH
35 MPH & UNDER	60'	60'
40 MPH	100'	70'
45 MPH	150'	80'
50 MPH	200'	90'
55 MPH	250'	100'

Actual dimensions shall be in conformance with criteria set forth by the Regional Transportation District (RTD). The Pavement Design Soil Report (See Chapter 5 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' between an intersection curb return curve (P.C.R.) and the beginning of the lead-in taper.

FIGURE 4-17
BUS PULLOUT LANE



4.15 RAISED MEDIANS

4.15.1 Median Islands

A. No permanent structures (trees, poles, large rocks, etc.) shall be placed within 10' of the face of curb (unless the median is constructed per the Median Planter Standard Drawings of these *Roadway Standards*) or in any location that would obstruct sight distance.

B. 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.

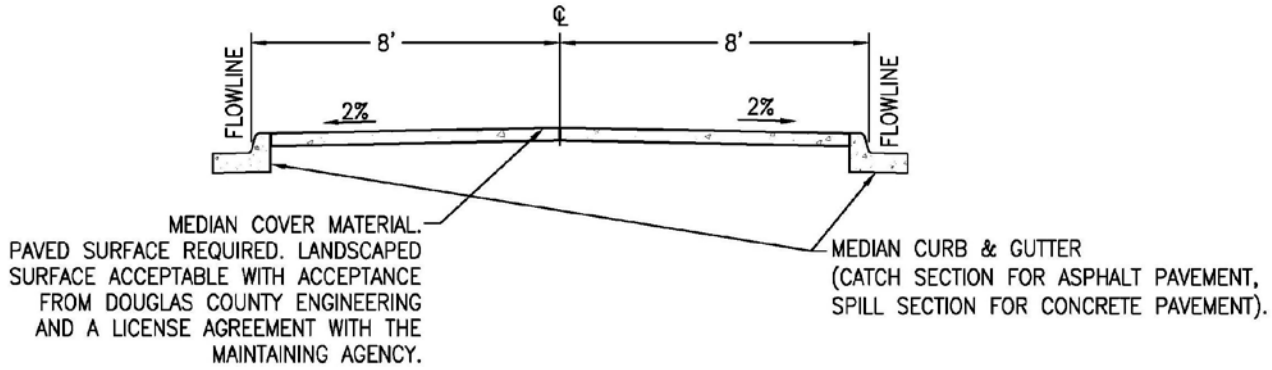
C. For all streets constructed with asphalt, the median shall be constructed with a "catch" curb and gutter. Inlets are required along the median to reduce ponding at curb and gutter low points and to eliminate concentrated flow crossing over the lanes of traffic at the nose of the median. The final 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 Figure 8-1 of the DCSDDTC Manual, Special Median Inlet Details, presents conceptual representations of options available for placing median nose inlets.

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

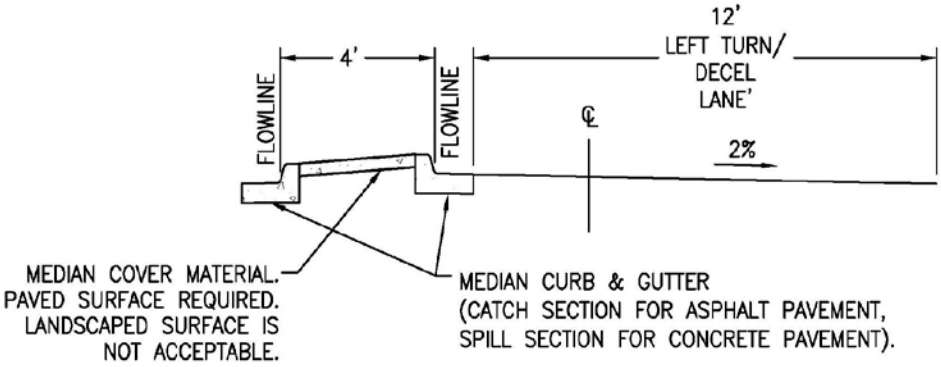
E. A minimum 20' flowline - flowline street cross section must be maintained on both sides of all median islands.

F. See Section 3.9 of these *Roadway Standards* for Landscaping requirements.

FIGURE 4-18
MEDIAN AT INTERSECTION

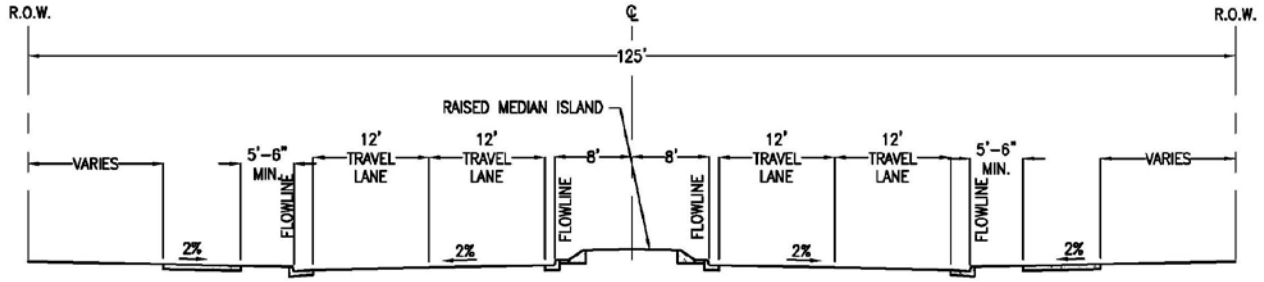


FULL WIDTH

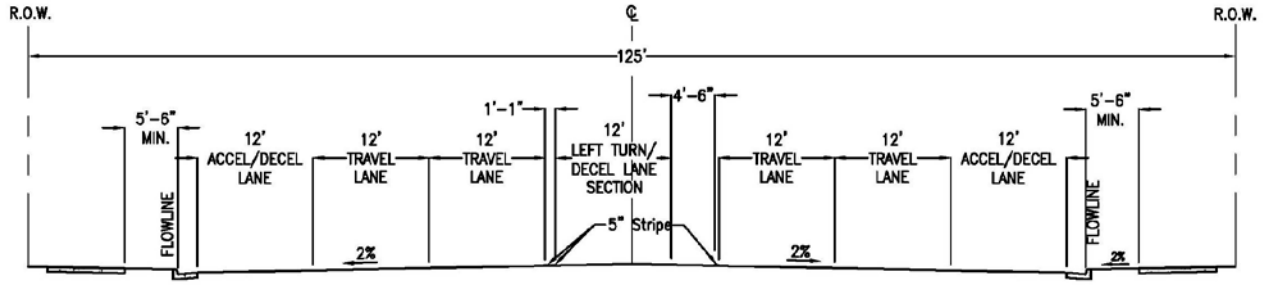


LEFT TURN LANE

FIGURE 4-19
INTERSECTION STRIPING OPTION FOR SINGLE LEFT TURN

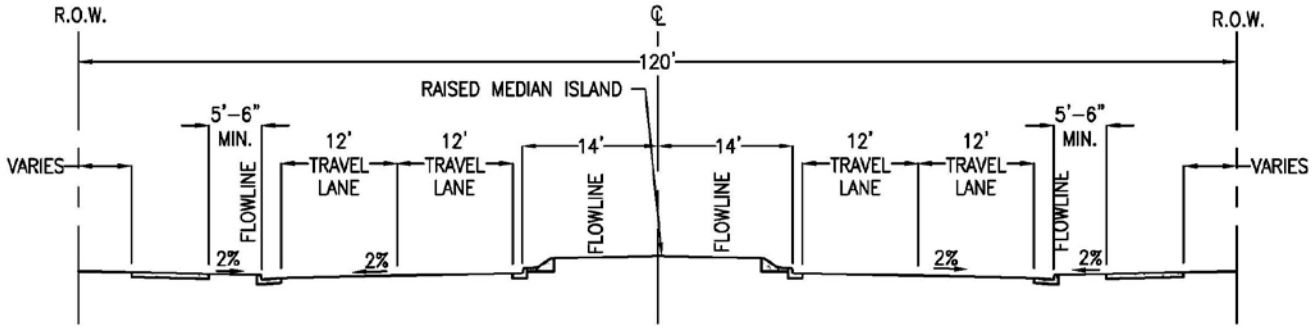


ROAD SECTION

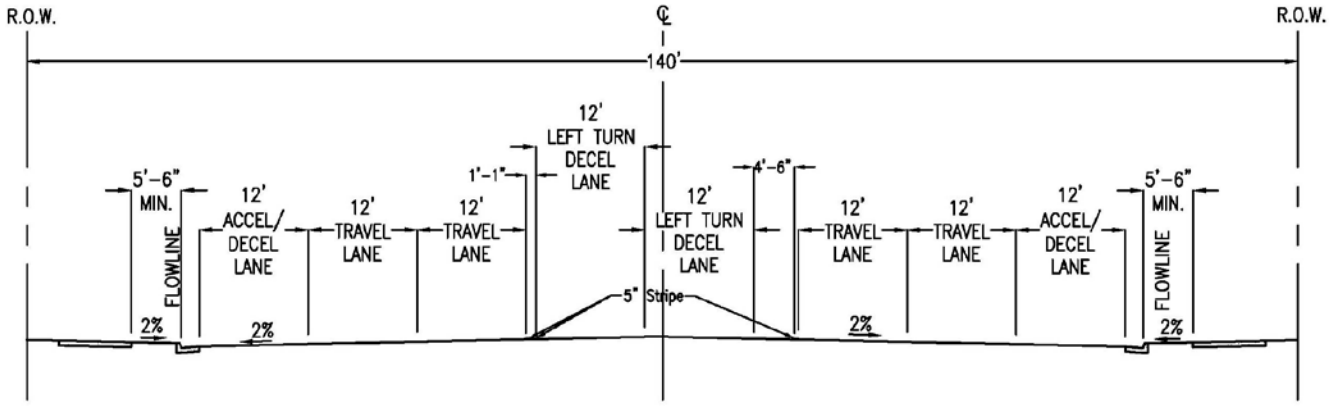


AT INTERSECTION

FIGURE 4-20
INTERSECTION STRIPING OPTION FOR DUAL LEFT TURN



ROAD SECTION



AT INTERSECTION

4.16 RIGHT-OF-WAY MAINTENANCE

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

B. Mailboxes constructed in the County ROW must conform to the standard details. Brick or stone column mailboxes are considered a vehicular obstruction and are not allowed in the County ROW unless a variance with a License Agreement is granted.

C. 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. See the AASHTO Roadside Design Guide for further guidance.

D. The Standards allow for street lighting in public right-of-way. Douglas County 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.