

## CHAPTER 4 – ROADWAY DESIGN AND TECHNICAL CRITERIA

### 4.1 GENERAL

This section sets forth the minimum design and technical criteria and specifications to be used in the preparation of all roadway plans.

- 4.1.1 Within this chapter of Roadway Design and Technical Criteria, American Association of State Highway and Transportation Officials (AASHTO) "Green Book" refers to A Policy on Geometric Design of Highways and Streets-1984" or latest edition as published by the American Association of State Highway and Transportation Officials.

### 4.2 ROADWAY DESIGN AND TECHNICAL CRITERIA

The Town of Bennett has adopted a Functional Street Classification Plan based on traffic volumes, land use and expected growth. This Functional Street Classification Plan designates streets as local, entry, collector (Residential and Commercial), and arterial. The following criteria apply to each classification. Standard roadway cross sections are presented at the end of this Section.

#### 4.2.1 Planning Principles for Local Circulation Systems

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

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

Each of the following principles is an elaboration on one or more of these four factors. The principles are not intended as absolute criteria, since instances may appear where certain principles conflict. The principles should, therefore, be used as guides to proper systems layout.

#### A. Ensure Vehicular and Pedestrian Access

The primary function of local streets is to serve abutting properties. Street widths, placement of sidewalks, patterns of streets and number of intersections are related to safe and efficient access to abutting lands.

#### B. Minimize Through Trips

Through traffic on local and collector streets increases the average speed and volume and thus the accident potential, thereby reducing residential amenities. Through traffic can be discouraged by creating a circuitous route between neighborhoods and higher volume streets and by channelizing or controlling median crossings along peripheral routes.

#### C. Control Access to Arterials

Local circulation systems and land development patterns should not detract from the efficiency of peripheral arterial facilities. Ideally, land development should occur so that no local streets require direct access to arterial routes. The number of access points between the local circulation system and the arterial system should be minimized. Intersections along arterial routes should be properly spaced for efficient signalization and traffic flow. The streets that do intersect the arterial system will tend to have high volumes since they are the only exit points.

#### D. Discourage Speeding

Residential streets should be designed to discourage fast movement (more than 25 MPH), through the use of curvilinear alignment and circuitous routes in the street system.

#### E. Minimize Pedestrian-Vehicular Conflict

Pedestrian travel from within the area to points outside should require a minimum of street crossings. Sometimes this may be achieved through proper design of street patterns, land use arrangements and pedestrian routes. Typical methods include use of cul-de-sacs and loop streets, special pedestrian routes or walkways and the proper placement of high pedestrian traffic generators. In general, while vehicular flow must be outward oriented to the peripheral arterials, pedestrian travel should be inward oriented to avoid these heavier vehicular flows.

#### F. Minimize Space Devoted to Street Use

It is desirable to minimize local street mileage to reduce construction and maintenance costs as well as to permit the most economic land use. Streets should also have an appearance commensurate with their function. They should be in keeping with the residential character.

#### G. Relate Street to Topography

Local Streets will be more attractive and economical if they are constructed to closely adhere to topography. The important role that streets play in the overall storm drainage system can be enhanced by using the topography of the area.

#### H. Layout Street to Achieve Optimum Subdivision of Land

The arrangements of streets should permit economical and practical patterns, shapes and sizes of development parcels. Streets as a function of land use must not unduly hinder the development of land. Distances between streets, number of streets, and related elements all have a bearing on efficient subdivision of an area. Access to adjoining properties should also be encouraged.

### 4.2.2 Roadway Classifications and Specifications

Table 4.1 shows a summary of the minimum roadway construction requirements and other related information. Details for cross sections and other criteria are located at the end of this section.

#### 4.2.2.1 Local

- A. POSTED SPEED LIMIT – 25 MPH maximum per AASHTO “Green Book”. Posted or Prima facie speeds for the various street classifications are normally 5 MPH less than the design speed of that street.
- B. TRAFFIC VOLUMES – Less than 1,500 vehicles per day for residential roadways with backing driveway access.
- C. LIMITED CONTINUITY
- D. SAFETY - Designed for the safety of pedestrians and bicyclists, and the ease of access to adjacent parcels of land.
- E. TRAFFIC CONTROL - Stop signs, yield signs, or ROW rules for uncontrolled intersections.
- F. FUNCTION - Local streets provide direct access to adjacent property. Traffic carried by local streets should have an origin or a destination within the neighborhood. Utility line easements should be available.

- G. ROW - In single-family residential areas with monolithic rollover curb, gutter and sidewalk the minimum ROW shall be 50 feet. In single-family residential with 5.5 foot detached sidewalk the minimum ROW shall be 60 feet minimum. Any change in ROW width due to a change in street classification shall be made at intersections only. An appropriate radius of the ROW will shall be provided at all intersections to ensure the sight distance triangle will also be acceptable for the same purpose (with the shorter dimension lying parallel to the centerline of the minor street). ROW radius in cul-de-sac bubble or eyebrow shall be 55 feet. Utility line easements a minimum of 5 feet in width shall be dedicated adjacent to the ROW boundary.
- H. NUMBER OF MOVING LANES – Two
- I. ACCESS CONDITIONS – Intersections shall be at grade with direct access to abutting property permitted.
- J. PLANNING CHARACTERISTICS - Local streets should be designed to discourage through traffic from moving through the neighborhood. Local streets should not intersect arterial streets. See Chapter 13 of these regulations for intersection spacing criteria.
- K. TYPE OF CURB AND GUTTER - Vertical and mountable type permissible with an attached sidewalk.
- L. CUL-DE-SACS and KNUCKLES – Cul-de-sacs shall have a minimum flowline radius of 45 feet, knuckles shall have a minimum flowline radius of 45 feet (see Drawing No. 41, 42 & 43). Cul-de-sacs may have a maximum length of 500 feet, or a maximum of 25 dwelling units. Cul-de-sacs longer than 500 feet, or with more than 25 dwelling units, may require all units to be sprinkled per Fire Department requirements.
- M. ROADWAY WIDTHS – Single-family residential: 30 feet paved width plus two 2 foot gutter pans (34 feet flowline to flowline).
- N. MINIMUM RADIUS OF CURVATURE ON CENTER LINE (HORIZONTAL) – See Table 4.2. Knuckles, or eyebrows shall not be used as a substitute for meeting the minimum curve radius.
- O. MINIMUM LENGTH OF TANGENTS BETWEEN CURVES – (Reverse Curves Permissible) Minimum Tangent Length on Local Roadways shall be at least 25 feet.

P. MINIMUM LENGTH OF VERTICAL CURVES - See Table 4.6.

Q. STREET GRADES - A minimum longitudinal flowline grade of 1 percent shall be required on all Local streets except at curb returns, knuckles, and bubbles where the minimum flowline grade shall be 2 percent. Maximum grade shall be 6 percent. See Table 4.1 and Table 4.6.

R. CURB RETURN RADII - See Table 4.3.

S. Maximum Tangent Length – ¼ Mile.

#### 4.2.2.2 Collector

A. POSTED SPEED LIMIT - Posted or prima facie speeds shall be minimum of 35 MPH. Posed or Prima facie speeds for various street classifications are normally 5 MPH less than the design speed of that street.

B. TRAFFIC VOLUMES – Generally collectors will have 1,500 to 7,000 vehicles per day.

C. CONTINUOUS – For less than 2 miles.

D. SAFTEY – Designed to accommodate traffic volumes from and onto local, other collector, and arterial roadways.

E. TRAFFIC CONTROL – Regulations of traffic is accomplished through the use of stop signs and channelization. Traffic signals shall be used when MUTCD warrants are met.

F. 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 a collector street should have an origin or a destination within the community. Unless written approval is obtained, bike lanes shall be required on all collector classifications.

G. ROW

a. Residential Collector shall have a minimum ROW of 65 feet. An appropriate radius for the ROW will be provided at all intersections to ensure the sight distance triangle falls within the public ROW. Utility

- line easements a minimum of 5 feet in width shall be dedicated adjacent to the ROW boundary.
- b. Commercial Collector shall have a minimum ROW of 75 feet. An appropriate radius for the ROW will be provided at all intersections to ensure the sight distance triangle falls within the public ROW. Utility line easements a minimum of 5 feet in width shall be dedicated adjacent to the ROW boundary.
  - c. Additional Width may be required based on future transit needs as identified in the TIS and the Town Planning Department.
- H. NUMBER OF MOVING LANES – Two
- I. ACCESS CONDITIONS - Intersections at grade with direct access to abutting property permitted unless no access is reasonable available.
- J. PLANNING CHARACTERISTICS – Collector Streets should have continuity throughout a neighborhood but need not extend beyond the neighborhood. See Chapter 13 of these regulations for intersection spacing criteria.
- K. TYPE OF CURB AND GUTTER – 6 inch vertical curb and gutter permitted with a required detached 6 foot wide sidewalk. Suitable configurations may be required to provide bike paths where bike lanes are not provided within the flowline of the roadway.
- L. STREET WIDTHS
- a. Residential collector shall have a minimum of 34 feet of paved width plus two 2 foot gutter pans (38 feet flowline to flowline).
  - b. Commercial Collector shall have a minimum of 45 feet of paved width plus two 2 foot gutter pans (49 feet flowline to flowline)
- M. MINIMUM RADIUS OF CURVATURE ON CENTER LINE (HORIZONTAL) – See Table 4.2.
- N. MINIMUM LENGTH OF TANGENTS BETWEEN CURVES – (Reverse curves permissible) Minimum Tangent Length on Collector Roadways shall be a minimum of fifty (50) feet.
- O. MINIMUM LENGTH OF VERTICAL CURVES - See Table 4.6.

P. STREET GRADES – A minimum longitudinal grade of 1 percent shall be required along the centerline of all collector roadway classifications. The maximum grade shall be 6 percent. See Table 4.1 and Table 4.6.

Q. CURB RADII – See Table 4.3.

#### 4.2.2.3 Entry Streets

Only collectors or entry streets may connect residential neighborhoods to arterials. When collectors are not appropriate, entry streets shall be used and meet the following criteria:

- A. Entry streets shall be a maximum of 200 feet in length.
- B. No driveway access shall be allowed.
- C. Entry streets shall be posted 25 MPH.
- E. An “Entry Street” off of an arterial shall have a minimum 80 feet flowline-flowline dimension with the required 7 feet minimum median island, 25 foot minimum flowline-flowline both sides
- E. An “Entry Street” from a collector shall match the cross section of a residential collector with a minimum 36 feet flowline-flowline dimension (if median island, 24 feet minimum flowline-flowline both sides).
- F. Entry streets shall be posted “No Parking”
- G. An “Entry Street” is considered a lower classification street than a collector, but greater than a local street, therefore, for example, “Entry Street” criteria for separation between intersections along minor collector cannot be used to place a collector street within 160 feet of another intersection.

#### 4.2.2.4 Arterial

- A. POSTED SPEED LIMIT – Posted or prima facie speeds shall be minimum of 45 MPH. Actual speed shall be determined by the Town Engineer prior to submittal of construction plans. Posted or prima facie speeds for the various street classifications are normally 5-10 MPH less than the design speed of that street.

- B. TRAFFIC VOLUMES – 7,000 to 12,000 or greater vehicles per day expected traffic volume when the land, which the arterial serves, is fully developed.
- C. CONTINUITY – Continuous for several miles, generally connecting with inter-city routes.
- D. SAFETY – Designed to handle traffic volumes loading from and onto collectors, and arterial roadways.
- E. TRAFFIC CONTROL
  - a. Regulation of traffic is accomplished through traffic signs, signals, and channelization.
  - b. Parking is prohibited.
  - c. Traffic signals shall be required as MUTCD warrants are met.
- F. FUNCTION – Arterial routes permit relatively unimpeded traffic movement and area intended for use on these routes where four moving lanes and one left-turn lane are required. Unless written approval is obtained, bike lanes shall be required on all arterial classifications. Parking is prohibited.
- G. ROW
  - a. Arterial roadways shall have a minimum ROW of one hundred and ten (110) feet.
  - b. Arterial roadways at intersections shall have a minimum ROW of 115 feet.
  - c. Additional width may be required based on future transit needs as identified in the TIS and the Town Planning Department or Town Engineer.
- H. NUMBER OF MOVING LANES – Four.
- I. ACCESS CONDITIONS
  - a. Intersection at grade.
  - b. Access from Street of lower classification will be permitted but in all cases will be controlled by traffic control devices.



- c. Direct access to abutting property shall not be permitted unless no other access.
- J. PLANNING CHARACTERISTICS – Arterial should be spaced ½ to 1 mile apart and should, where possible, be continuous. Arterial should act as boundaries between neighborhood areas. See Chapter 13 of these regulations for intersection spacing criteria. Arterials should act as boundaries between neighborhood areas.
- K. TYPE OF CURB AND GUTTER – 6 inch vertical curb and gutter permitted with a required detached 8 foot wide sidewalk. Suitable configurations may be required to provide bike paths where bike lanes are not provided within the flow line of the roadway.
- L. STREET WIDTHS – four 12 foot lanes; one 12 foot left turn lane/stripped median; two 2 foot gutter pans, two 6 foot bike lanes plus acceleration/deceleration lanes at intersections (76' flowline to flowline).
- M. MINIMUM RADIUS OF CURVATURE ON CENTERLINE (HORIZONTAL) – See Table 4.2.
- N. MINIMUM LENGTH OF TANGENTS BETWEEN CURVES – (Reverse curves permissible) Minimum tangent length on arterial roadways shall be a minimum of 100 feet.
- O. MINIMUM LENGTH OF VERTICAL CURVES – See Table 4.6.
- P. STREET GRADES – A minimum longitudinal grade 1 percent shall be required along the centerline of all arterial roadway classifications. The maximum grade shall be 6 percent. See Table 4.1 and Table 4.6
- Q. CURB RETURN RADII - See Table 4.3.

### 4.3 SIDEWALKS, CURBS AND GUTTER, AND DRIVEWAYS

- 4.3.1 Roadway typical sections shall be as specified by these Roadway Standards. They are graphically summarized at the end of this section.
- 4.3.2 Sidewalks and bicycle paths, as per the configurations of Drawing No. 2, 3 and 4, shall be required on all roadways unless specifically deleted by action of the Town Board or Town Engineer.

- 4.3.3** All sidewalks shall have a minimum width of 5 feet for local roadways. Collector roadways shall have a minimum of a 6 foot wide sidewalk. All sidewalks for arterials shall have a minimum width of 8 feet and be set back from the back of curb a minimum of 5 feet.
- 4.3.4** Combination curb, gutter and walk is approved for use on local roadways only. Vertical curb, gutter and detached walk shall be used on all other roadways.
- 4.3.5** State law requires that handicap ramps be installed at all intersections and at certain mid-block locations for all new construction or reconstruction of curb and sidewalk (CRS 43-2-107[2]). Handicap ramps shall be constructed in accordance with the Standard Details found in the Appendix Section of these Regulations. Handicap ramps shall be shown at all curb returns and must be shown (located) at all "T" intersections directly opposite either curb return. Whenever referencing a handicap ramp, call out the specific Standard Detail to be used to construct that ramp. On local streets only, mid-block handicap ramps may be constructed per CDOT M- Standard M- 608 -1 "TYPE 3A-MID-BLOCK" (6' from flowline to back of ramp) or latest edition. See Standard Details 10, 11, 12 and 13 at the end of this chapter.
- 4.3.6** When the number of parking spaces serviced by the driveway exceeds 10 spaces or the curb opening is 30 feet or more then radius curb returns are required. See Table 4.3 for the minimum radius required based on the classification of the intersecting street.
- 4.3.7** Where curb cuts are allowed based on traffic considerations, concentrated storm water runoff must not be discharged across the sidewalk. These flows must be directed to a sidewalk chase section. If this is not possible due to grading restraints, radius returns and a crossspan must be used.
- 4.3.8** Curb cuts and driveways shall be constructed in accordance with the details at the end of this section.
- 4.3.9** Regional and neighborhood trails on all Town collectors and arterials shall be provided as specified in the most recently adopted Town of Bennett Regional Trail Plan.

#### **4.4 DRAINAGE**

The minor and major storm drainage systems are designed in accordance with the Town's Drainage Criteria Manual. Because safe and efficient conveyance of traffic is the primary function of roadways, the storm drainage function of the roadway (such as allowable gutter capacity and street overtopping) will be designed to the limits set forth in this Drainage Criteria Manual. In the case of a conflict caused by requirements of the Urban Storm Drainage Criteria Manual, the stricter drainage requirements shall be adhered to.

#### 4.4.1 Crosspans

Crosspans shall be constructed in accordance with the pertaining Standard Details in the Appendix Section of these Regulations. Crosspans are not permitted across entry streets, collector roadways, or arterial roadways.

On a case-by-case basis, if an excessive length of storm sewer must be constructed to comply with this requirement, causing undue financial hardship, a variance may be requested to use a 10-foot wide crossspan across a local street, an entry street, or a minor collector roadway. If there is storm sewer in the street, and within a reasonable distance, no crosspans shall be allowed.

No mid-block crosspans will be allowed.

#### 4.4.2 Inlets

Inlets shall be located to intercept the curb flow at the point curb flow capacity is exceeded by the 10 year runoff. Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevation. Inlets are not allowed in the curb return but will be located at or behind the tangent points of the curb returns. Minimum inlet length for type "R" inlets shall be 5 feet.

#### 4.4.3 Cross Slope

Except at intersections, or where superelevation is required, roadways shall be level from top of curb to top of curb (or flowline to flowline) and shall have a 2 percent crown. At or within the "L" distance shown in Figure 4.4 the maximum elevation difference between flowlines is that dictated by the allowable intersection grade (see Figure 4.4) and the actual distance between flowlines.

**4.4.3.1** Parabolic or curved crowns are not allowed. In no case shall the pavement cross slope at warped intersections exceed the grade of the through street.

**4.4.3.2** The rate of change in pavement cross slope, when warping side streets at intersections, shall not exceed 1 percent every 25 feet horizontally on a local roadway, 1 percent every thirty-seven and one-half (37.5) feet horizontally on a collector roadway, or 1 percent every 56.5 feet horizontally on arterial roadways. See Section 4.7 of this Chapter.

#### 4.4.4 Temporary Erosion 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 the pertaining section of Bennett's Storm Drainage Criteria Manual.

#### 4.4.5 Sidewalk Chases

Storm water from concentrated points of discharge shall not be allowed to flow over sidewalks but shall drain to the roadway by use of chase sections.

Sidewalk chase sections shall not be located within the curb cut or driveway. Hydraulic design shall be in accordance with the Bennett Storm Drainage Criteria Manual. Sidewalk chases will only be allowed in special situations, on a case-by-case basis, as determined by the Engineer. Sidewalk chases, when permitted, are to be used to allow surface drainage to enter into the street gutter rather than being used to avoid the use of a standard inlet.

Sidewalk chase sections are to be constructed in accordance with the Standard Details.

### 4.5 HORIZONTAL ALIGNMENT

Pavement widening required on local streets with a radius greater than 400 feet per AASHTO Section III.

#### 4.5.1 Horizontal Curves

TABLE 4.2 HORIZONTAL CURVES			
Design Speed (MPH) $f$		Maximum Curve (Degrees)	Minimum Curve Radius* (Feet)
25	0.245	32.7	200
30	0.215	22.9	325
35	0.19	14.3	500
40	0.174	10.4	700
45	0.162	8.0	1,000
50**	0.152	6.7	1,300
55**	0.146	5.7	1,650

\*Adapted from AASHTO Fig. 111-17

\*\* Superelevation may be allowed. See Section 4.5.5 of this chapter.

#### 4.5.2 Curb Return Radii

Minimum and maximum curb return radii shall be shown according to Table 4.3

TABLE 4.3 CURB RETURN RADII MINIMUM AND MAXIMUM (measured in feet along flowline)			
Through Street	Arterial	Collector	Local Service
Arterial	50 min.	35 min.	35
Collector	35 min.	30	25
Local	35	25	20

#### 4.5.3 Design Speed

Horizontal alignment design speed shall be consistent with the requirement for vertical alignment design speed. If no superelevation is required and a normal crown section exists, the horizontal curve data as shown in Table 4.2 shall be used.

#### 4.5.4 Barricades

Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required. Design and construction shall comply with the requirements of the Manual of Uniform Traffic Control Devices most recent edition. Details shall be shown on the construction drawings, and installation shall be provided by the Developer.

#### 4.5.5 Superelevation

Superelevation may be required for curves on arterial roadways and selected collector roadways. Horizontal curve radii and superelevation shall be in accordance with the recommendations of the AASHTO "Green Book", (Horizontal Alignment).

Superelevation shall not be used on roadway classifications with a design speed of 50 MPH or less. Superelevation shall not be used without prior approval by the Engineer.

##### 4.5.5.1 Definitions Regarding Superelevation

Superelevation Runoff - That length of roadway needed to accomplish the change in cross slope from a section with the adverse crown removed (flat) to the fully superelevated section, or vice versa.

Transition Points - Beginning or ending of tangent runoff, superelevation runoff or full superelevation.

Tangent Runout - That length of roadway needed to accomplish the change in cross slope from a normal (2.0) crown section to a section with the adverse crown removed (flat), or vice versa.

#### 4.5.5.2 General

One of the most important factors to consider in highway safety is the centrifugal force generated when a vehicle traverses a curve. Centrifugal force increases as the velocity of the vehicle and/or the degree of curvature increases.

It is impossible to balance centrifugal force by superelevation alone, because for any given curve radius a certain superelevation rate is exactly correct for only one driving speed. At all other speeds there will be a side thrust either outward or inward, relative to the curve center, which must be offset by side friction.

#### 4.5.5.3 Standards for Superelevation

The Division "M" Standards (CDOT) on Superelevation give the required rate of superelevation for the various degrees of curvature.

Maximum superelevation rates of 0.04 to 0.06 foot per foot are commonly used on major streets. The lower value should be used where snow and ice are significant factors.

#### 4.5.5.4 Urban Street Conditions

Every effort should be made to maintain standard rates of superelevation. However, in urban areas, street intersections, established street grades, curbs and drainage conditions may require a reduction in the rate of superelevation, or different rates for each half of the road bed. In warping areas for drainage, adverse superelevations should be avoided.

#### 4.5.5.5 Effects of Grade

Drivers tend to travel somewhat faster in the downgrade than in the upgrade direction. This should be recognized in the designs for divided highways and ramps on steep grades

Where practical, the designer should use a higher design speed for the downgrade and a lower design speed for the upgrade. The variation of design speed will depend upon the rate and length of grade and the degree of curvature compared with other curves on the highway section.

#### 4.5.6 Railroad Crossings

All railroad crossings on arterial streets shall be steel reinforced rubber for the full width of the roadway. A timber pedestrian walk and vehicle recovery area shall be provided on both sides of the steel reinforced rubber.

Timber crossings may be used in place of steel reinforced rubber on local streets only. Minimum crossing width shall be the full width of the right-of-way to provide for pedestrians and vehicle recovery area.

All railroad crossing must be approved by the affected railroad company.

#### 4.5.7 Cul-de-sacs

Criteria for cul-de-sacs shall follow the requirements of Section 4.2.

#### 4.5.8 Sight Distance

The major considerations in alignment design are safety, grade, profile, road area, design speed, sight distance, topography, drainage and performance of heavy-duty vehicles. 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.

##### 4.5.8.1 Horizontal Alignment

###### A. Sight Distance

Horizontal alignment must provide at least the minimum stopping distance for the design speed at all points. This includes visibility at intersections as well as around curves and roadside encroachments.

###### B. 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", page 243 or latest edition. Object height is six (6) inches above road surface and viewer's height is three (3) feet six (6) inches above road surface.

Where an object off the pavement restricts sight distance, the minimum radius of curvature is determined by the stopping sight distance (see Figures 4.1A and 4.1B). In no case shall the stopping sight distance be less than as specified in Table 4.4. A likely obstruction may be a bridge

abutment or line of columns, wall, cut side slope, or a side or corner of a building. The sight distance design procedure shall assume a six (6) foot fence (as measured from actual grade) exists at all property lines except in the sight distance triangles required at all intersections.

The lateral clearance, inner edge of pavement to sight obstruction, for various radii of inner edge of pavement and design speeds, is shown graphically in Figure 4.1A and Figure 4.1B. The position of the driver's eye and the object sighted are assumed to be six (6) feet from the inner edge of pavement, with the sight distance being measured along this arc.

TABLE 4.4 STOPPING AND PASSING SIGHT DISTANCE		
Design Speed (MPH)	Stopping Sight Distance	Passing Sight Distance
15	100	500
20	125	800
25	150	1,000
30	200	1,100
35	250	1,300
40	275	1,500
45	325	1,650
50	400	1,800
55	450	1,950

From AASHTO "Green Book"  
Table III-1, Table III-5 and Table VII-3  
(For Intersection and Driveway Sight Distance, See Figure 4.2)

#### C. 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. Two lane roads should provide adequate passing zones. Required passing sight distance for given design speeds is given in Table 4.4



## D. Coefficient of Friction

The coefficient of friction (f) shall conform to the values shown in Table 4.5 for snow packed conditions rather than as stated in Figure 111-1 of the AASHTO "Green Book" or latest edition.

TABLE 4.5 COEFFICIENT OF FRICTION (Design Criteria Snowpacked)	
Design Speed (MPH)	F
30-40	0.24
40-50	0.22
50-60	0.21
60-70	0.20

## E. Intersection and Driveway Sight Distance (Sight Triangle)

There shall be an unobstructed sight distance along both approaches of both sides at an intersection within the ROW for distances sufficient to allow the operators of vehicles, approaching simultaneously, to see each other in time to prevent collisions at the intersection. The sight triangle relationship developed for use in the Town is based upon the dimensions shown in Figure 4.2.

Any object within the sight triangle more than thirty-six (36) inches above the flowline elevation of the adjacent street shall constitute a sight obstruction, and shall be removed or lowered. Such objects include: buildings, cut slopes, hedges, trees, bushes, utility cabinets or tall crops. These design criteria also require the elimination of parking (except on local streets) 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 plans. All sight distances must be within the public ROW. In order to obtain the required sight distance within the ROW, the ROW cannot be widened more than 5 feet. On local residential streets only, if the line of sight crosses the front yards of the lots, a "SIGHT DISTANCE EASEMENT" of no more than 5 feet may be dedicated on the plat to meet the required sight distance.

In no case shall any permanent object encroach into the line-of-sight of any part of the sight-distance triangle.

#### 4.5.8.3 Vertical Alignment

Both the horizontal and vertical sight distances should be checked to ensure that the sight distance along the major highway is sufficient to allow a vehicle to cross or turn left, whichever is required.

- A. By graphically determining the sight distances on the plans and recording them at frequent intervals, the designer can appraise the overall layout and effect a more balanced design by minor adjustments in the plan or profile. Methods for scaling sight distances are demonstrated in Figure 4.3. The Figure also shows a typical sight distance record that would be shown on the final plans.

Because the view of the highway ahead may change rapidly in a short distance, it is desirable to measure and record sight distance for both directions of travel at each station. Both horizontal and vertical sight distances should be measured and the shorter lengths recorded. In the case of 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 4.3).

- B. Horizontal sight distance on the inside of a curve is limited by obstructions such as buildings, hedges, wooded areas, high ground, or other topographical features. These generally are plotted on the plans. Horizontal sight is measured with a straightedge, as indicated at the upper left in Figure 4.3. The cut slope obstruction is shown on the worksheets by a line representing the proposed excavation slope at a point 2.0 feet (average of 3.50 and 0.5 feet) above the road surface for stopping sight distance and at a point about 3.75 feet above the road surface for passing sight distance. The position of this line with respect to the centerline may be scaled from the plotted roadway cross sections. The stopping sight distance should be measured between points on the one traffic lane and passing sight distance from the middle of one lane to the middle of the other lane as outlined in Figures 4.1A and 4.1B.
- C. Vertical sight distance may be scaled from a plotted profile by the method illustrated at the right center of Figure 4.3. A transparent strip with parallel edges 4.25 ft. apart and with scratched lines 6 in. and 3.50 ft. from the upper edge, in accordance with the vertical scale, is a useful tool. The 3.50 ft. line is placed on the station from which the vertical sight distance

is desired, and the strip is pivoted about this point until the upper edge is tangent to the profile. The distance between the initial station and the station on the profile intersected by the six (6) inch line is the stopping sight distance. The distance between the initial station and the station on the profile intersected by the lower edge of the strip is the passing sight distance

- D. A simple sight distance record is shown in the lower part of Figure 4.3. Sight distances in both directions are indicated by arrows and figures at each station on the plan and profile sheet of the proposed highway. To avoid the extra work of measuring unusually long sight distances that may occasionally be found, a selected maximum value may be recorded. In the example shown, all sight distances of more than 3,000 feet are recorded as 3,000+, and where this occurs for several consecutive stations, the intermediate values are omitted. Sight distances less than 1,000 feet may be scaled to the nearest 50 feet and those greater than 1,000 feet to the nearest 100 feet.
- E. The methodology of graphically determining sight distances may well require longer stopping sight distances than noted in Table 4.4 or Figure 4.1. However, in urban design, the combination of horizontal curves, vertical curves and intersections occurring at the same time is very real. The graphic solution then is a simple means to determine the controlling sight distances.

#### 4.6 VERTICAL ALIGNMENT

Design controls for vertical alignment are shown on Table 4.6 below.

TABLE 4.6 VERTICAL ALIGNMENT CONTROLS (Measured Along Flowline)						
Description	Design Speed	Maximum Grade	K-Value Ranges		Min. VCL	
			Crest	Sag	Crest	Sag
Local	30	7%	35-50	40-50	50	50
Residential Collector	35	6%	35-50	40-50	50	50
Commercial Collector	35	6%	55-65	65-80	50	50
Arterial	55	5%	65-85	80-95	70	80

\*The Design Speed is a minimum of 5 MPH over the posted speed for each classification. Arterials are design at 10 MPH over the posted speed. All vertical curves in knuckles and bubbles shall have a length of 50 feet.

#### 4.6.1 Permissible Roadway Grades

A minimum longitudinal flowline grade of 1 percent shall be required on all Local streets, except at curb returns, knuckles, bubbles and collectors where the minimum flowline grade shall be 2 percent.

A minimum longitudinal grade of 1 percent shall be required along the centerline of all Collector and Arterial streets. Variances may be granted by written approval in accordance with Chapter 1 of these regulations.

The maximum allowable grade for any roadway is shown on Table 4.1 and 4.6 of these Regulations.

#### 4.6.2 Intersection Grades (Public Rights-of-Way)

The maximum permissible grade at intersections shall be as shown in Figure 4.4. These grades are maximum instantaneous flowline grades for the stated distances (each side of the street) for the minor (intersecting) street.

Then, intersection grade of the major (through) street at the intersection may be dictated by design considerations for that street. However, if the major street intersection grade exceeds 3 percent, the type of access and access control will be dictated by the Town.

All private commercial driveways with curb return radii shall follow the standard the set forth for a local street. The length of the maximum grade for the commercial driveway shall be a minimum of 50 feet measured from the flowline intersection of the public roadway.

#### 4.6.3 Changing Grades

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 (A) does not exceed one percent (0.01 ft. / ft.) along the roadway, the grade break will be permitted.

The maximum grade break allowed at the point of tangency at a curb return for local and collector roads shall be two percent, and for arterial roadways a maximum of one percent.

#### 4.6.4 Cross Fall Slope

Except at intersections, or where superelevation is required, roadways shall be 'level from top of curb to top of curb (or flowline to flowline). The distance from intersections with which "cross-fall" will be permitted shall be determined by criteria in Section 4.4.3, Cross-Slope.

#### 4.6.5 Vertical Curves

When the algebraic difference in grade (A) is at or exceeds one percent (0.01 ft. / ft.), a vertical curve is to be used. Design criteria for vertical curves is found in Table 4.6 of these Regulations. Minimum length of a vertical curve is shown in Table 4.6. All vertical curves shall be labeled, in the profile, with length of curve (L) and K (L/A) values and H.P. or L.P. elevations.

### 4.7 INTERSECTIONS

The following criteria shall apply at intersections:

- 4.7.1.1 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 Town Engineer, shall have this precedence. The design should warp side streets to match through streets with as short a transition as possible.
- 4.7.1.2 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. Permissible grade in the stop/start lane (See Section 4.6.2).
  - B. Pavement cross slope at the PCR's on the side street and permissible warp in pavement cross slope. (Section 4.4.3)
  - C. Normal vertical curve criteria. (Section 4.6.5)
  - D. Vertical controls within the curb return itself. (See Section 4.7.3)
- 4.7.1.3 The elevation at the PCR on the through street is always set by the grade of the through street in conjunction with normal pavement cross slope (2.0%).
- 4.7.1.4 Carrying the crown at a side street into the through street is permitted only when drainage considerations warrant such a design. Refer to Section 4.4.3.2 for street cross slope allowances.
- 4.7.1.5 Dipping the flowline to the extent that the lip of gutter is dipped is not permitted. Dipping the flowline is only permitted as specified by Standard Details concerning curb opening inlets. Tipping an inlet for the benefit of drainage is also not permitted.

- 4.7.1.6** A more detailed review shall be performed for arterial-arterial intersections to maximize drivability. Few arterial intersections will have a uniform 2% cross slope, the majority of them having one or more sides warped. (See Sections 4.4.3 and 4.7.1.2 of this Chapter for rates of pavement warp allowed).
- 4.7.1.7** Whenever possible, intersections shall be made at right angles or radial to a curve. No intersecting angle of less than 80 degrees will be allowed. (See Figure 4.5).
- 4.7.1.8** Intersection sight distances shall conform to the requirements of Section 4.5.8.2.e and Figure 4.2 of this Chapter which have been taken from Table V-II (Page 468) and the formula on page 781 of AASHTO "Green Book", latest edition.

#### **4.7.2 Curb Returns**

Minimum fall around all curb returns along the flowline shall be 2 percent.

#### **4.7.3 Curb Return Profiles**

Curb return profiles are required for radii equal to or greater than 30 feet within the public ROW. A midpoint elevation along the arc length of the curb return shall be shown in the plan view for radii equal to or greater than 25 feet. Curb return design shall be set in accordance with the following design procedure. General standards for flowline control and profiles within the curb returns shall be as follows:

- 4.7.3.1** The point of tangency at each curb return shall be determined by the projected tangent grade beginning at the point of Intersection (PI) of the flowlines.
- 4.7.3.2** The arc length and external distance of the curb return shall be computed and indicated on the drawing.
- 4.7.3.3** Show the corresponding flowline (or top of curb) grade for each roadway beyond the PCR
- 4.7.3.4** Design the flowline of the curb return such that the maximum slope along the flowline does not exceed 8 percent. Grade breaks at the PCR's will not exceed 2 percent for local and collector streets and 1 for arterials. Maximum vertical curves will equal the arc length of the curb return. The elevation and location of the high or low point within the return, if applicable, is to be called out in the profile. Warp of the side streets shall match across the street within the "L" distance shown on Figure 4.4. No more than 1 foot vertical difference in elevation across the street at the P.C.R. is allowed.

**4.7.3.5** Scale for the curb return profile is 1 foot =10 feet horizontally and 1 inch = 1 foot vertically.

**4.7.3.6** Curb return radii, existing and proposed, shall be shown.

#### **4.7.4 Connection with Existing Roadways**

**4.7.4.1** Connection with existing roadways shall be smooth transitions conforming to normal vertical curve criteria (See Section 4.6) if the algebraic difference in grade (A) between the existing and proposed grade exceeds one (0.01 ft. / ft.) percent. When a vertical curve is used to make this transition, it shall be fully accomplished prior to the connection with the existing improvement, and also comply with the grade requirements at intersection approaches.

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

**4.7.4.3** Previously approved designs for the existing improvement are not an acceptable means of establishing existing grades, however, they are to be referenced on the construction plan, where they occur.

**4.7.4.4** The basis of the as-built elevations shall be the same as the design elevations (either flowlines or both top of curbs, etc.) when possible. All elevations shall be based on USGS.

#### **4.8 OFF-SITE DESIGN**

The design grade, and existing ground at that design grade, 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, for at least 500 feet or to intersection with an arterial roadway. This limit shall be extended to 1,000 feet when arterial roadways are being designed.

- 4.8.1** 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. The following formula shall be applied to the taper of lane change necessary for this transition:

$$L = WS^2/60$$

Where

L = Length of transition in feet

W = Width of offset in feet

S = Speed limit of 85th percentile speed

- 4.8.2** The developer shall provide a written request for a variance from these transition criteria. If approved by The Town, a variance may be issued in writing by the Town Engineer stating the variance and the purpose of the variance.

#### **4.9 ACCELERATION/DECELERATION LANES**

The design of the arterial street system depends upon the proper control of access to developments. The location and design of access points must minimize traffic hazards and interference to through traffic movements. Acceleration/Deceleration lanes shall be designed using Section 400 and 500 of the CDOT Road Design Manual or Access Code, latest edition. The need for acceleration or deceleration lanes shall be established by the approved traffic impact study for the final plat or final development plan.

#### **4.10 CONSTRUCTION TRAFFIC CONTROL**

##### **4.10.1 Pedestrian Traffic**

Every precaution shall be taken to ensure that construction work does not interfere with the movement of pedestrian traffic, which shall be maintained on the sidewalk at all times. Flagmen shall be provided for guidance as necessary.

Where an excavation interrupts the continuity of the sidewalk, the contractor shall provide suitable bridge or deck facilities, to be supplemented by the use of such proper devices and measures as prescribed in the MUTCD most recent edition, for the safe and uninterrupted movement of pedestrian traffic. The edges or ends of the pedestrian bridge or decking shall be beveled or chamfered to a thin edge to prevent tripping.

Temporary diversion walkways shall be hard surfaced and electric lighting shall be provided and kept continuously burning during hours of darkness, when required by the Town Engineer.



Unless otherwise authorized by the Town Engineer, pedestrians shall not be channeled to walk on the traveled portion of a roadway.

Under certain conditions, it may be necessary to divert pedestrians to the sidewalk on the opposite side of the street. Such crossings shall only be made at intersections or marked pedestrian crossovers.

Facilities satisfactory to the Engineer shall to divert pedestrians to the sidewalk on the opposite side of the street. Such crossings shall only be made at intersections or marked pedestrian crossovers.

#### 4.10.2 Vehicular Traffic

Construction work zone traffic shall be controlled by signs, barricades, detours, etc., which are designed and installed in accordance with the Manual of Uniform Traffic Control Devices most recent edition, and applicable Town Traffic Regulations. A Traffic control plan shall be submitted and accepted by the Engineer, or his designate, prior to start of any construction.

During construction of new facilities, traffic control should strive to keep the motorist from entering the facility. The primary means to accomplish this are by use of temporary barricades, located in advance of the point where new construction joins existing and by appropriate signing. New construction shall not be opened to traffic, and thus the construction traffic control removed, without the approval of the Town Engineer.

In general terms, a construction traffic control plan must be drawn on a map. The traffic control plan should be super-imposed on as-built drawings, construction plan drawings or other detailed maps.

The Manual on Uniform Traffic Control Devices shall be the basis upon which the construction traffic control plan is designed, in concert with proper, prudent, and safe engineering practice. All necessary signing, striping, channelization devices, barricading, flagging, etc., shall be shown on the plan.

In concept, Town streets shall not be closed overnight, and work shall not force road or lane closures before 8:30 a.m. or after 3:30 p.m. If exceptions to this are required, this shall be so noted on the construction traffic control plan and must be specifically approved by the Engineer.

Directional access on roadways may be restricted (minimum travel lane width in construction area is 10 feet), but proper controls including flagging must be indicated. Removal of on-street parking should be considered and noted where applicable.

#### 4.11 MEDIAN ISLANDS

Median islands shall be designed per the AASHTO "Green Book", latest edition. No permanent structures (trees, poles, large rocks, etc.) shall be placed within 10 feet of the traveled lane (unless median is design variance is approved) or in any location that would obstruct sight distance.

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

Landscaping on median islands shall have a mature height of 24 inches or less above the traveled way in areas around intersections to facilitate adequate sight distance and will preferably be dry land or native vegetation. If irrigation is planned for a median island, mitigation will be provided to protect the subgrade under the pavement from being saturated by using the median island.

A minimum flowline-flowline dimension of 24 feet must be maintained on both sides of all median islands.

When median islands are constructed/designed for concrete streets and the island is hardscape, the Developer shall install two thickness of expansion material on each side of the median between the back of curb and "hardscape" and seal the expansion material.

Median islands 4 feet wide or less may not be landscaped and must be designed as stamped concrete or exposed aggregate concrete.

#### 4.12 TWO POINTS OF ACCESS

A minimum of two (2) points of access shall be required to a development. The number of dwelling units with a single access shall be specified by the Town Fire Protection District. Emergency access may only be permitted on a case by case basis by the Town Fire Protection District.

#### 4.13 FIRE LANES

Any secondary access not constructed as part of the dedicated public street system shall meet the following design criteria in addition to the roadway design criteria within these Regulations. Fire lanes shall be required when safe access to structures within a Project is limited. The requirement for fire lanes shall be determined in the plat process by the Fire Department and/or Planning Department.

**4.13.1** The slope of fire lanes shall be a minimum of 1 percent and a maximum of 7 percent.

**4.13.2** The cross slope of the fire lanes shall be a minimum of 1 percent and a maximum of 4 percent.

- 4.13.3 The lane width shall be a minimum of 20 feet from the edge of asphalt to edge of asphalt and shall be in an access easement. The lane widths may be required to be increased through horizontal curves to accommodate fire truck passage.
- 4.13.4 There shall be a minimum of 18 feet of vertical clearance over the entire fire lane.
- 4.13.5 The fire lane may have a gate, but it must be approved by the Fire Department.
- 4.13.6 The surface of the roadway must be paved or approved otherwise by the Town Engineer. All pavement design shall meet the requirements of Chapter 5 of these Regulations.

#### 4.14 BIKEWAYS/TRAILS

- 4.14.1 All projects shall optimize pedestrian and bicycle travel within the Town by providing bikeways, trails and pathways in all new developments in accordance with the Town's Master Plan.
- 4.14.2 Offsite improvements may also be required to provide residents with access to schools, and local commercial and community facilities. The bikeway and pathway system shall make use of, but not be limited to, the drainage and open space system.
- 4.14.3 Bicycle paths, lanes or routes, where required by applicable Town ordinances, approved site plans or development agreements, shall be shown on the approved construction plans and shall meet, at a minimum, these Regulations.
- 4.14.4 The materials used in the construction of bike paths and bikeways shall be in conformance to the Materials Chapter of these Regulations.
- 4.14.5 In locations where trails or bikeways cross private land or coincide with private access facilities, the Developer shall be required to provide a public access easement. This will ensure that trails and bikeways or other access facilities become part of the overall Town bikeway/trails plan.
- 4.14.6 When trails/bikeways are to be constructed, maintenance and operation responsibility will be determined during the site/subdivision plan approval process. Public access/trail easements shall be conveyed to the Town. The easement width shall be clearly indicated on the site plan or construction plans.
- 4.14.7 No manholes or other appurtenances shall be located in bikeways or trails.

#### 4.15 BIKE PATH STANDARDS AND CRITERIA

In order to plan and construct bikeways and trails in a consistent, usable and orderly fashion, it is necessary to establish basic standards and criteria. The standards and criteria in this chapter and in the construction section shall be used in the design and review of Bikeways and Trails, development, site and subdivision plans.

##### 4.15.1 Bikeway/Trail Use

- A. Bikeway/Trail type, width and surface shall be approved by the Director after recommendations from staff. This recommendation will be based on site conditions and expected usage.
- B. Generally, for trails an 8' minimum trail width is allowed. Bikeway widths shall have a minimum finished surface width of 8'. See Drawing No.'s 35, 36, 37, 38, 39 and 40.

##### 4.15.2 Bikeway/Trail Location

- A. Bikeway/Trail location shall be based on safety, circulation and access considerations. Trails designated on the Town plan generally parallel to existing or proposed roadways shall be constructed wholly within the road ROW. These Bikeway/Trails shall be constructed in the general location designated as sidewalk on the typical road section.
- B. Where the typical road section does not include sufficient width to meet the minimum required Bikeway/Trail easements specified in the following table, the deduction of additional land adjacent to the street ROW will be necessary. The minimum easement width required for bike, walkways and equestrian trails shall be 20 feet.

##### 4.15.3 Clearing

- A. Where possible, trails and bikeways shall be located so as to minimize the loss of trees and disruption of natural environmental conditions. A minimum of 2 feet is required between the Bikeway/ Trail edge and any vertical obstructions such as trees, utility poles, signs or other obstacles.
- B. Regardless of trail surface, all vegetative material within a clearing envelope of 10' wide shall be removed prior to trail construction. This requirement is to be verified by the Consultant Engineer and specified on the approved plans.
- A. For trails greater than 8 feet wide, a width of 4 feet greater than the width of trail shall be cleared.
- D. All trails shall have a minimum of 10 feet clear vertical distance above the path. Equestrian trails shall have a minimum clearance of 12 feet above the path. See Drawing No. 38.

#### 4.15.4 Grade

- A. A profile of the proposed trail construction shall be included in the construction plans or site plan. Typical cross sections shall be provided for all critical points along the length of the trail.
- B. Minimum Allowable-A minimum grade of 1 percent is recommended except in sags where proper drainage is provided by cross slope.
- C. Maximum Allowable-A maximum grade of 6 percent is recommended. However, staff will consider on a case by case basis grades up to 10 percent. At no time will short dips or excessively long grades be approved.

#### 4.15.5 Cross Slope

- A. Minimum allowable-1/4 inch per foot of width (2 percent slope).
- B. Maximum allowable-1/2 inch per foot of width (4 percent slope).
- C. All design shall conform to the ADA requirements.

#### 4.15.6 Turning Radius

Minimum Allowable-20 feet are recommended however, the actual minimum allowable should be computed by the Consultant Engineer based on expected use and site conditions.

#### 4.15.7 Drainage

- A. All trail designs shall be in accordance with the general storm drainage requirements of the Town's Drainage Criteria Manual.
- B. Trails located within the State ROW shall meet CDOT standards.
- C. As a general guide, where a trail is cut into a hillside, a ditch shall be placed along the high side of the path to prevent sheet flow across the walkway.
- D. Appropriate drainage improvements shall be provided along slopes exceeding 6 percent.

#### 4.15.8 Safety Considerations

- A. The safety of potential pedestrians, and others who may use or travel on a trail, shall be a prime consideration in the trail design.

- B. A utility strip is required between the edge of the trail, and the back edge of curb and gutter. 2 feet is the minimum requirement. The actual separation should be a safety consideration by the Consultant Engineer and shall be a consideration in the approval process. No trail shall be constructed directly adjacent to street curb or street pavement.
- C. Trails which are to be located adjacent to roads with speed limits exceeding 25 MPH, and which have slopes greater than six 6 percent may require special safety measures such as the installation of barriers or other safety devices, or an increase in the distance between the trail and highway.
- D. Standard signing and markings shall be included in the design and construction of the trail to alert trail users of potential hazards and to convey regulatory messages.
- E. The Consultant Engineer shall address stopping and intersection sight distance at all trail intersections, curves and particularly where steep grades are proposed at trail/roadway intersections, Obstructions to the visibility of motorists or trail users shall be removed or the trail aligned around the obstruction to maximize visibility.
- F. Standard handicapped ramps will be provided at all trail curb crossings to allow continuity of trail use by bicyclists and the handicapped. For trails equal to or greater than six (6) feet in width, curb depressions equaling the trail width shall be used, with the trail surface sloping to the pavement at one (1) foot for every inch of curb height.

#### 4.15.9 Pedestrian Bridges

- A. Pedestrian bridges shall be prefabricated using a standardized steel truss design with pressure treated timber decking.
- B. The minimum bridge width shall be ten (10) feet. Bridge widths shall be two (2) feet greater than the trail width for trails greater than six (6) feet.
- C. All trails require either a bridge or a fair weather crossing.

### 4.16 STREETSCAPE DESIGN CRITERIA

#### 4.16.1 General

This chapter provides a framework for the Developers in which to design streetscaping within the Town ROW and public areas. This criterion is not intended to direct the Developer in development of private landscaping within site plans or other onsite development, however, the same water conservation methodologies used for public ways should be considered in the design of irrigation and landscaping on private property. The Developer should refer to Chapter 12 for additional plantscape design criteria.

#### 4.16.2 Intent

The intent of this design criteria is to beautify the Town and its many common areas through the planting of trees, shrubs and other plantings and the appropriate use of hardscape while practicing water conservation through drip irrigation and drought resistant plants.

The Town is committed to the reduction of water consumption in landscape irrigation and encourages the application of Xeriscape design and maintenance principles. This includes the required use of drip irrigation and the use of drought resistant and native plants.

#### 4.16.3 Requirements

##### A. Local Streets

For all residential local streets the adjacent homeowner shall be responsible for planting and maintaining the right of way behind the walk. The homeowner shall install plantings and irrigation within the guidelines for these Regulations.

##### B. Local Streets-Commercial

For all local Commercial local streets, the adjacent property owner shall be responsible for designing, planting and maintaining the ROW behind the curb. This design shall include the sidewalk as required by these Regulations. The property owners shall install plantings and irrigation (if necessary) within the guidelines of these Regulations. All non-hardscape areas within the ROW shall be seeded, planted or covered within the guidelines of this Chapter. All on sight landscaping shall be designed in accordance with the Town Planning Department Guidelines.

##### C. Arterials, Collectors, and Entry Streets

For all arterials, collectors and entry streets within the Town including medians, the Developer shall be responsible for plans and construction of Streetscape within the Project. The plans shall be submitted as an integral part of the Plans as defined in the Policy and Procedure Section of these Regulations. The cost of such improvements shall be included in the Opinion of Costs for Public Improvements as required in the pertaining chapter of these Regulations. The HOA, District or Town as determined by the Town, may require the maintenance of these improvements. All non-hardscape within the ROW shall be seeded, planted or covered within the design criteria of this section.

##### D. Medians

All medians shall be constructed as shown on Drawings No.'s within the applicable section of these Regulations.

1. All medians or sections of medians that are less than 4 feet wide must be completed in a hardscape, including stamped concrete, brick flagstone or exposed aggregate concrete. No landscaping will be allowed within the medians that are narrower than 4 feet. If a median is between 4 feet and 10 feet, it shall be at the Towns discretion whether the median is hardscaped or irrigated and landscaped.

2. All medians or sections of medians over 4 feet are allowed to use drought resistant plantings as shown in this chapter. However, only drip irrigation systems will be allowed. No pop-up sprinklers will be allowed in medians to minimize wastewater that occurs with pop-up sprinklers.

E. Tree Lawn

On arterials, all sidewalks shall be set back from the curb a minimum of 5 feet. Pop-up sprinklers may be approved in tree lawns over 8 feet in width.

#### 4.16.4 Plantings

Refer to Chapter 12 for plantscape design criteria.

#### 4.16.5 Street Trees

Design for street trees should respond to the uses on the street. The following factors are guidelines for determining how and when trees should be used within the streetscaping areas:

1. Trees should have the same characteristics on both sides of the street. If mixing species, alternate them in a regular pattern.
2. Plant only one species unified. Avoid random changes in species.
3. Select trees that will fit when they are mature. Narrow areas suggest a narrow tree and open areas suggest a wide one.
4. Where tree lawns do not exist, tree grates or pavers are recommended to protect tree roots and pedestrians. Ground covers may be considered for use in low traffic areas.
5. Use tree grates where pedestrian traffic is high.
6. Trees may be grouped in areas upon approval of the Town.

All existing trees must be protected during construction. The Town's Parks Department must approve any existing trees being removed from the ROW prior to removal.

#### 4.16.6 Location

The Developer shall consider the mature trees shape and size during the design and before planting so that the tree has room to grow. Where signs, lights, overhead or underground utilities, utility poles and fire hydrants would limit mature tree size, adjustment in species or location should be considered to minimize excessive pruning. The following items are suggestions or guidelines in the design of trees:



1. Plant trees with regular spacing in straight rows to create a continuous street edge. Adjust spacing only slightly for driveways and lights. On the arterials, the plant trees may be varied for visual appeal.
2. Locate trees in a straight line midway between curb and detached walk even where the width of the tree lawn varies.
3. Plant trees 35 to 45 feet apart on center for most species. The spacing shall be related to species and age of trees.
4. When replacing trees in an existing row, select new trees of similar characteristics of those being replaced, including form, scale, texture, and color.

The following items are requirements to be followed in the design of trees and their locations:

1. Trees shall not be planted closer than 30 feet from the curb face at intersections and street corners within the sight distance triangle.
2. Within the Sight Distance Triangle, no non-plant materials over 32 inches or plant materials over 6 inches high are permitted.
3. Maintain the minimum sight distance triangle and corner triangle distances for safe view of on-coming traffic and pedestrians.
4. Trees must not interfere with the visibility of traffic control devices especially at intersections.
5. Trees should be located a minimum of 42 inches from the face of the curb.
6. For commercial areas, the minimum distance from streetlights is 20 feet.
7. Trees shall be designed to ensure the driver visibility of all regulatory signs.
8. Create a clear walking zone between trees and fences or buildings. In the downtown area this shall be a minimum of 10 feet.
9. No trees shall be planted within 5 feet of a utility

#### 4.16.7 Tree Size

Trees should be large enough when planted to add substantial shade and to reach a height appropriate to the surrounding vicinity.

1. Street trees in grades should be a 3-inch caliper, minimum with high branching where pedestrians will be passing under the tree canopy. This high branching shall be a minimum of 8 feet high. This size is recommended so that adequate branching height is achievable without severe pruning.
2. Trees planted in tree lawn should be 2 inch caliper, minimum.
3. The branching height of a tree on the traffic side of the street shall be no less than 13 feet and -6 inches above the street.
4. The branching height of a mature tree on the pedestrian side of the street should be no less than 8 feet above the sidewalk.
5. Small varieties of thornless and fruitless trees may be used only in median areas or traffic islands where lower branching habits will not interfere with pedestrians, vehicles or driver visibility.
6. Smaller trees shall be used where power lines overhead would not allow a large street tree to reach maturity without severe pruning.

#### 4.16.8 Tree Selection

All trees should fit the microclimate, soils, sun, moisture, budget and maintenance environment in which they are planted. This is a major concern in areas with high levels of pollution, salt, snow storage or automobile or pedestrian damage. Trees selected for urban streets should be able to endure pollution, compacted soils, minimal water and low maintenance.

1. Trees near walks should be thornless and fruitless to minimize maintenance and to reduce pedestrian hazards. They must be strong wooded, resistant to most diseases and insects, single trunked, with upright growth and a medium to long life expectancy. Branches should resist breaking.
2. Trees and irrigation techniques that require minimal water are necessary. Drip irrigation must be installed for street trees in all commercial streets. Irrigation must be designed to provide the appropriate amount of water to each tree with minimal waste. Easily adjustable, automatic irrigation systems are recommended.
3. Along commercial streets, trees should be selected that will minimize the obstruction of views to retail signs. Use trees with the appropriate forms and character. Utilize tree spacing that supports this concept.

#### 4.16.9 Ground Covers

Ground covers provide seasonal color and serve as a buffer between people and cars. Groundcover plantings provide functional and aesthetic benefits, however maintenance is extremely important.

Plantings other than trees in the streetscape may include turf, ground covers or shrubs. In commercial streetscapes with a large area between the sidewalk and the street or low pedestrian volume, a tree lawn of grass may be most appropriate. This area helps soften the street environment along the street edge. Certain ground covers are recommended because they require moderate to low amounts of water and have been proven successful in the region.

Specific site conditions must be fully understood prior to plant selection. Local microclimates and soils are key factors that determine which plants will thrive. Where possible, low water requiring plants should be selected. Trees and shrubs will require less water and will thrive better if placed in planting beds rather than turf beds.

1. Tree lawns should be at least 8 feet wide to accommodate irrigation system and to provide adequate room for healthy tree root systems. Turf should be provided where the average width of the tree lawn is 8 feet or more. In medians, turf should be limited to median areas greater than 10 feet.
2. For tree lawn areas less than 8 feet wide, turf is difficult to irrigate efficiently and ground cover such as shrubs, etc. should be considered. In median areas, any width less than 4 feet shall be hardscaped.
3. Tree lawns should be planted with sod or low ground covers (below 6-inches in mature height) in residential areas and in commercial areas where pedestrian traffic does not warrant hardscape.
4. Very narrow tree lawns or those in high traffic areas may be paved with brick, flagstone or concrete pavers and/or colored or scored concrete. All tree lawn areas designated by the Town as high commercial or downtown shall be hardscaped.
5. Tree lawns may not be elevated.
6. Medians shall be elevated through use of a concrete median planter.

#### 4.16.10 Recommended Turf Grasses

Turf should be planted on prepared soil from seed or sod. Seeding allows a greater turf selection but requires approximately six months and regular maintenance to become established. Newly seeded areas require protection from pedestrians and must be kept moist until seeds germinate. All irrigated turf areas require organic soil amendments at the rate of at least 3 cubic yards per 1,000 square feet.

Alternatives to bluegrass are required. They are as follows:

1. Mixed Fine Fescue, Rye Grass and Bluegrass

This mix works in sun and shade, suits a number of climate and soil conditions and provides improved shade, disease, and moisture stress tolerance over pure bluegrass.

2. Tall Fescue-Turf Type

Deep green color, shade and salt tolerant, and drought resistant because of its deep root system. Include at least 3 improved varieties of turf type tall fescue in the blend.

#### 4.16.11 Recommended Ground Covers (other than turf)

Where ground covers are used, the intent should be to create a consistent carpet of plant material similar to the affect achieved by turf. Mixed uses of species that create a planting display are not desirable except at corners of entry streets or in medians. Ground covers provide more seasonal variety, require less water and, once established, usually require lower maintenance than most turf species. For ground covers to be successful, they must create a tight, dense planting.

Ground covers are not as dependable as turf when required to grow with poor soil preparation and maintenance and should only be planted in areas that will receive minimal foot traffic. They require adequate water and weeding until established.

The species listed are preferred for their dependability, low maintenance and drought resistance.

### 4.17 ALLEY DESIGN CRITERIA

- 4.17.1 All alleys shall be paved in concrete, asphalt or pavers. Pavers use must have prior approval from Town Engineer or Public Works Director and are not eligible for Town acceptance.

Alleys shall meet the requirements of the Town Roadway Design and Construction Standards.

All alleys shall be constructed prior to issuance of a building permit for any residential, commercial, or industrial structures. A subdivision improvements agreement and appropriate collateral shall be required for all alley improvements.

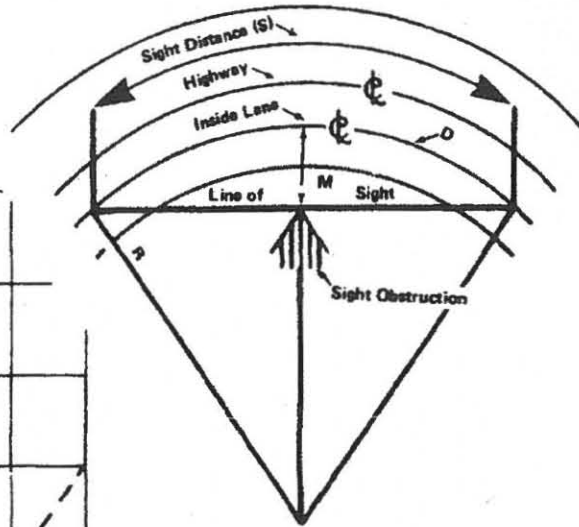
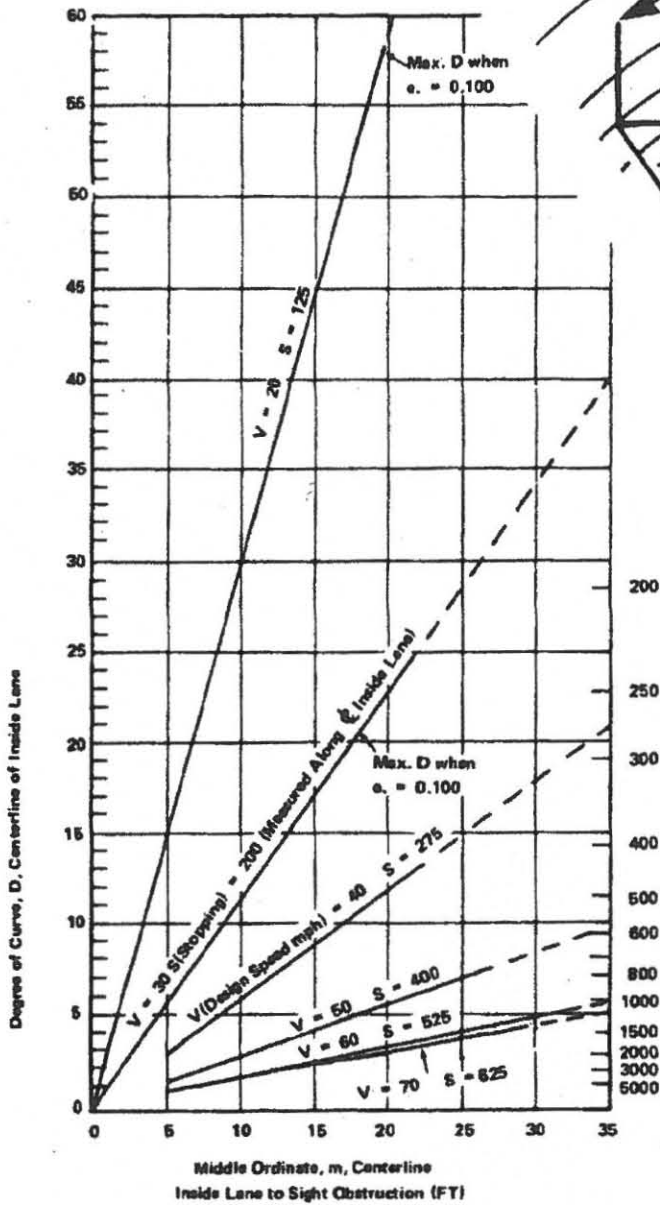
- 4.17.2 Pavement sections shall be in conformance with Chapter 5 of these regulations.
- 4.17.3 Residential alleys shall be a minimum of 20 feet in width.
- 4.17.4 Commercial and Industrial alleys shall be a minimum of 20 feet in width.
- 4.17.5 Reductions to minimum alley widths shall be submitted to Town Engineer and Bennett Fire Protection District for review of fire protection standards and Town Code compliance and approval.
- 4.17.6 Designers are encouraged to avoid grades less than 0.7% to minimize maintenance and icing problems. The minimum allowable grade for any alley is 0.5%.
- 4.17.7 All alleys shall be contained within public ROW or easements approved by subdivision plat or separate document.
- 4.17.8 Alleys shall not be used for major utility corridors.
- 4.17.9 Width of alley having a Town utility is 20 feet for single utility, 30 feet for two utilities, and 40 feet for three or more utilities.
- 4.17.10 Design of any alley less than 20 feet in width must have prior Town Engineer, Director of Public works, or Bennett Fire Protection District approval and contain no Town utility. Dry utility with alley is acceptable.
- 4.17.11 Dead-end alleys are prohibited. All alleys, when permitted by Town, shall be paved to a full width and shall provide paved access to a paved street at both ends.
- 4.17.12 All trees located on a lot shall be kept trimmed to a clear height of twelve (12) feet above the alley surface when the branch extends into the established ROW or easement.
- 4.17.13 Setbacks for auxiliary structures from alleys shall comply with applicable zone district standards.

**TABLE 4.1**

**Roadway Construction Standards**

	Local		Collector		Arterial		
	Attached Sidewalk	Detached Sidewalk	Residential	Commercial	Entry Street	Travel Ways	At Intersections
Cross Section	Refer to Detail Drawings						
Design Speed (MPH)	30			35			55
Posted Speed (MPH)	25			30			45
Maximum Design Traffic Volume (VPD)	1500			7000			12000
Right and Left Turn Lanes	Required at all access along arterials. May be required at accesses along collectors but shall be determined at time of development by Town Planning Department. Minimum dimensions: 150 storage, 100' taper. On the arterial classification the minimum storage shall be 200 feet for storage with a 100 foot taper.						
On Street Parking	Permitted		Not Permitted				Not Permitted
Minimum Right of Way (Feet)	50'	60'	65'	75'	80'	110'	115'
Flow Line to Flow Line (Feet)	34'		38'	49'	55'	76'	81'
<b>Horizontal Criteria</b>							
Curb Return Minimum Radii							
Intersection with Arterial	Not Permitted			35'			50'
Intersection with Collector	25'			30'			35'
Intersection with Local	20'			25'			Not Permitted
Min. Centerline Curve Radii	200'			500'			1000'
Min. Tangent Length Between Reverse Curves	25'			100'			100'
<b>Vertical Criteria</b>							
Maximum Intersection Grade	See Figure 4.4						
Minimum Street Grade	1%			1%			1%
Maximum Street Grade	7%	7%	6%	6%	6%	6%	6%
Vertical Alignment Control (K-Values)							
Sag	40-50	40-50	40-50	65-80	65-80	80-95	80-95
Crest	35-50	35-50	35-50	55-65	55-65	55-65	68-85
Minimum VCL							
Sag (Feet)	50	50	50	50	50	80	80
Crest (Feet)	50	50	50	50	50	70	70
Minimum Pavement Section	See Table 5.4						

\* At Curb Returns, bubbles, eyebrows and knuckles the minimum grade shall be 1%



$$M = \frac{5730}{D} \left( 1 - \cos \frac{SD}{200} \right)$$

$$R = \frac{5730}{D} \text{ and } \theta = \frac{SD}{200}$$

$$M = R (1 - \cos \theta)$$

$$M = R \left[ 1 - \cos \frac{28.65S}{R} \right]$$

where

S = Stopping Sight Distance (FT)

D = Degree of Curve

M = Middle Ordinate (FT)

R = Radius (FT)



ROADWAY DESIGN & CONSTRUCTION STANDARDS

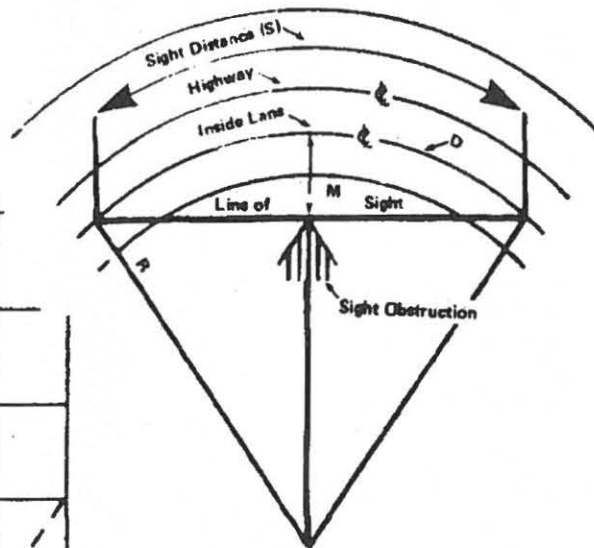
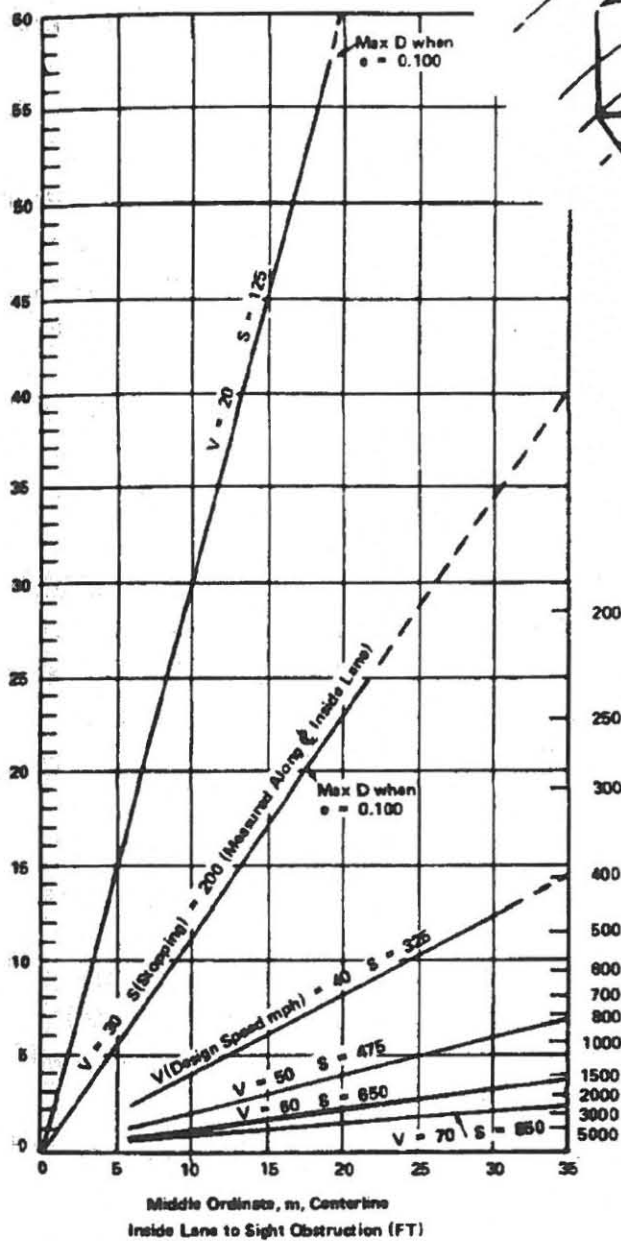
# SIGHT DISTANCE NOMOGRAPH

Scale: N.T.S

Issued: 01/23/16

Revised:

Figure No. 4.1A



$$M = \frac{5730}{D} \left( 1 - \cos \frac{SD}{200} \right)$$

$$R = \frac{5730}{D} \text{ and } \theta = \frac{SD}{200}$$

$$M = R (1 - \cos \theta)$$

$$M = R \left[ 1 - \cos \frac{28.65 S}{R} \right]$$

where

S = Stopping Sight Distance (FT)

D = Degree of Curve

M = Middle Ordinate (FT)

R = Radius (FT)



ROADWAY DESIGN & CONSTRUCTION STANDARDS

# SIGHT DISTANCE NOMOGRAPH

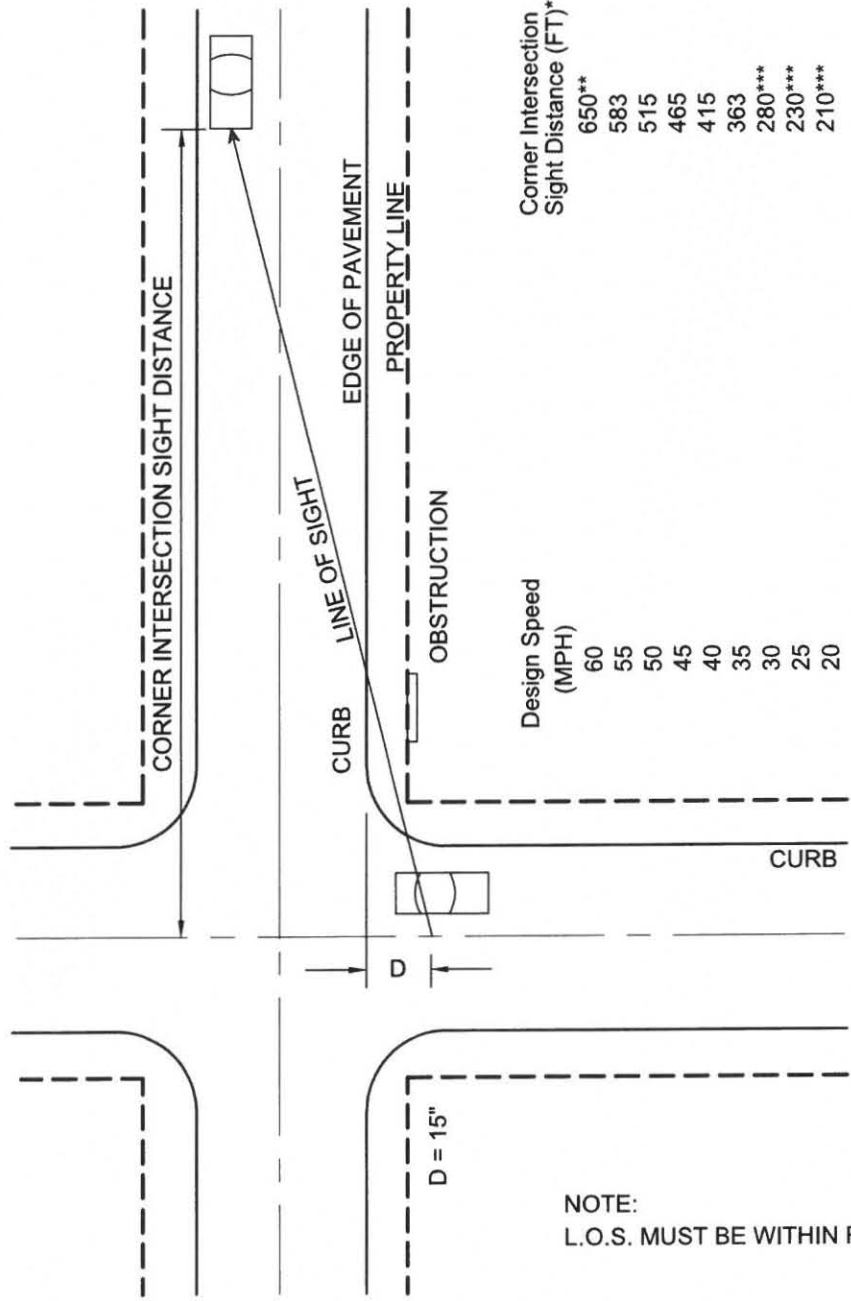
Scale: N.T.S

Issued: 01/23/16

Revised:

Figure No. 4.1B





Design Speed (MPH)	Corner Intersection Sight Distance (FT)*
60	650**
55	583
50	515
45	465
40	415
35	363
30	280***
25	230***
20	210***

NOTE:  
L.O.S. MUST BE WITHIN ROW

- \* CORNER SIGHT DISTANCE MEASURED FROM A POINT ON THE MINOR ROADWAY AT 15 FEET BACK FROM THE EDGE OF THE MAJOR ROAD PAVEMENT (FLOWLINE) AND MEASURED FROM A HEIGHT OF EYE OF 3.50 FEET ON THE MINOR ROAD TO A HEIGHT OF OBJECT OF 4.25 FEET ON THE MAJOR ROAD
- \*\* AT 60 MPH, STOPPING SIGHT DISTANCE GOVERNS
- \*\*\* AT LOCAL-LOCAL STREET INTERSECTIONS ONLY THE "D" DISTANCE SHALL BE TEN FEET (10') AND THE SIGHT DISTANCE SHALL BE MEASURED TO THE CENTERLINE OF THE STREET

SIGHT DISTANCE DEVELOPED FROM AASHTO "GREEN BOOK"



ROADWAY DESIGN & CONSTRUCTION STANDARDS

INTERSECTION SIGHT DISTANCE (SIGHT TRIANGLE)

Scale:	N.T.S
Issued:	01/23/16
Revised:	-
Figure No.	4.2

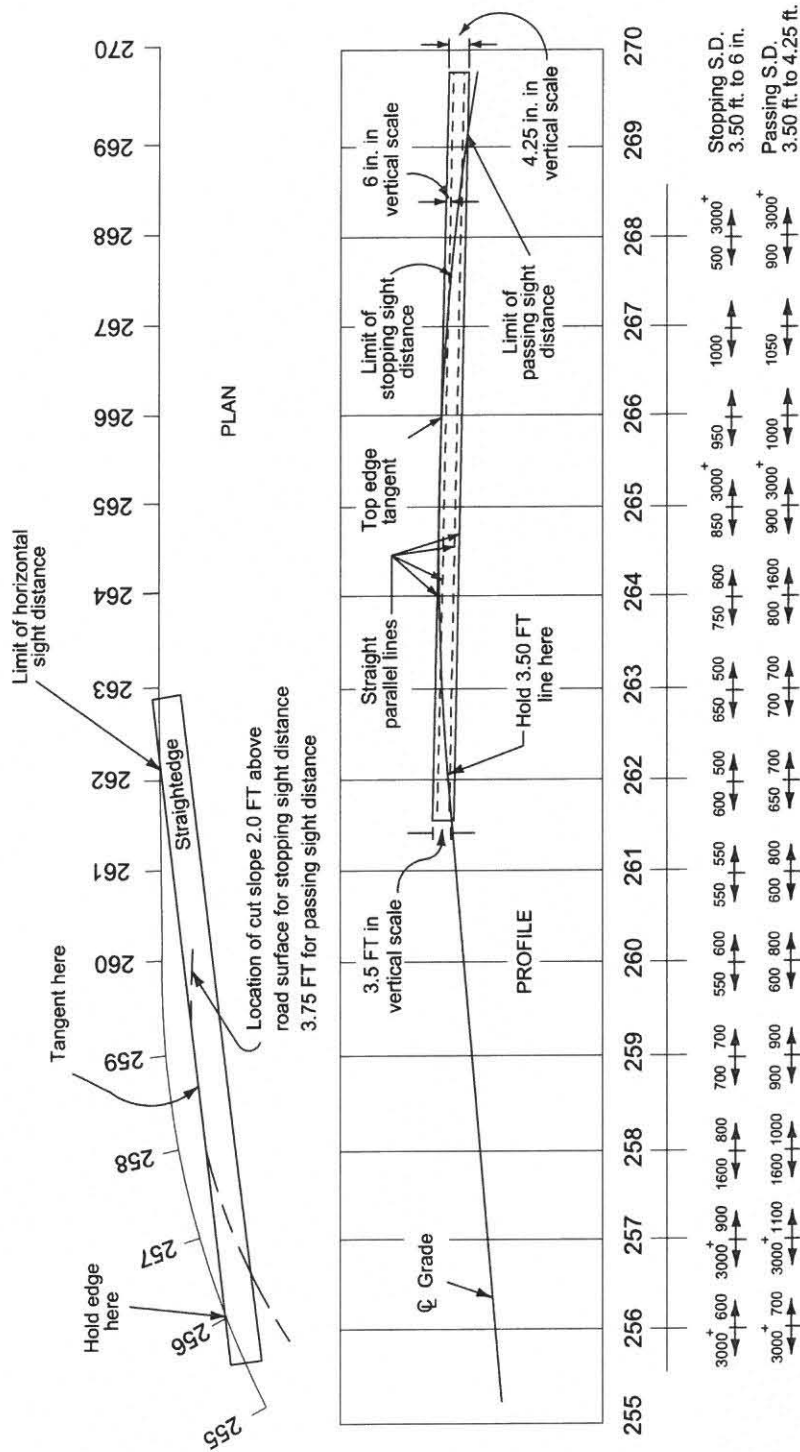


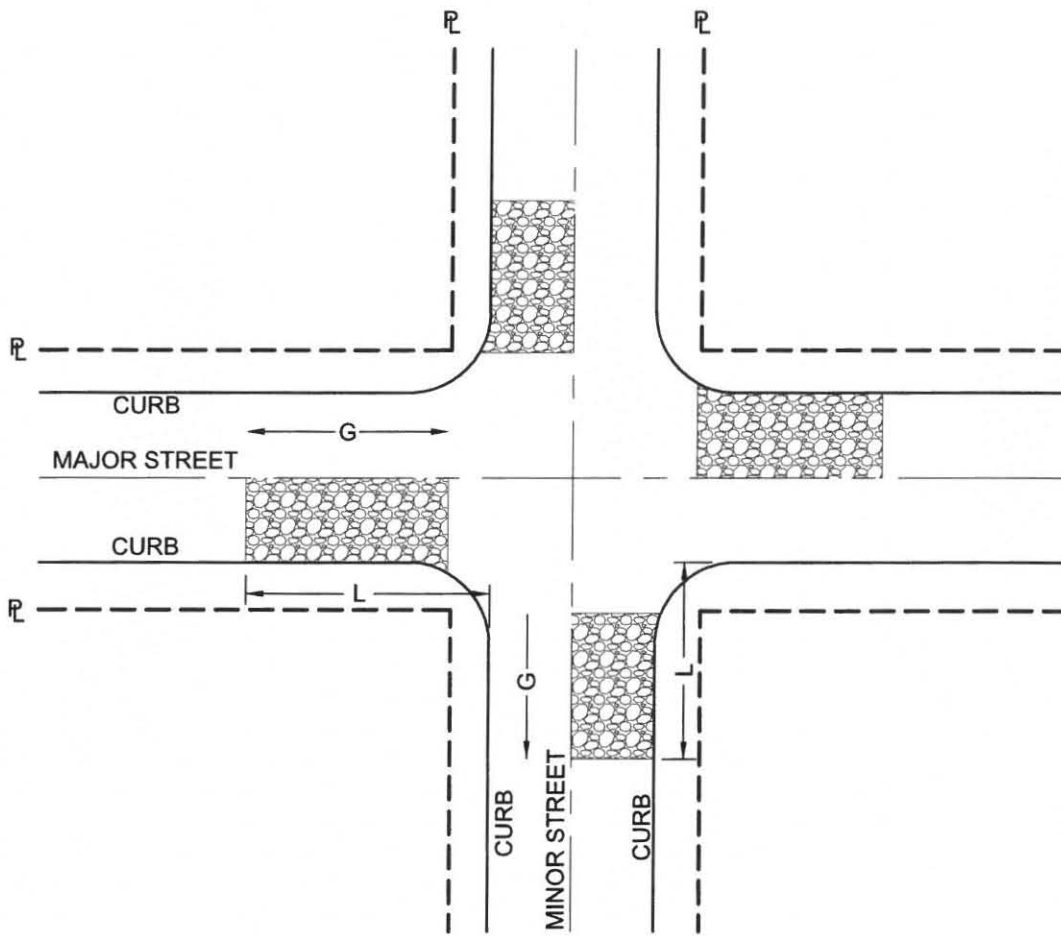
Figure III-3. Scaling and recording sight distance plans



ROADWAY DESIGN & CONSTRUCTION STANDARDS

SCALING AND RECORDING SIGHT DISTANCE ON PLANS

Scale: N.T.S  
 Issued: 01/23/16  
 Revised: -  
 Figure No. 4.3



NOTE: THE LONGITUDINAL SLOPE OF THE MAJOR STREET SHALL CONTINUE THROUGH THE INTERSECTION AND MAY BE GREATER THAN THE MAX "G" SHOWN IN THE TABLE EXCEPT AT MAJOR COLLECTORS AND ARTERIALS.

MINOR STREET \ MAJOR STREET	LOCAL	RESIDENTIAL COLLECTOR	COMMERCIAL COLLECTOR	ARTERIAL
LOCAL	L 95' G 4%	100' 4%	100' 4%	125' 4%
RESIDENTIAL COLLECTOR	L -- G --	100' 4%	120' 3%	150' 3%
COMMERCIAL COLLECTOR	L -- G --	-- --	120' 3%	150' * 3%
ARTERIAL	L -- G --	-- --	-- --	200' * 2%

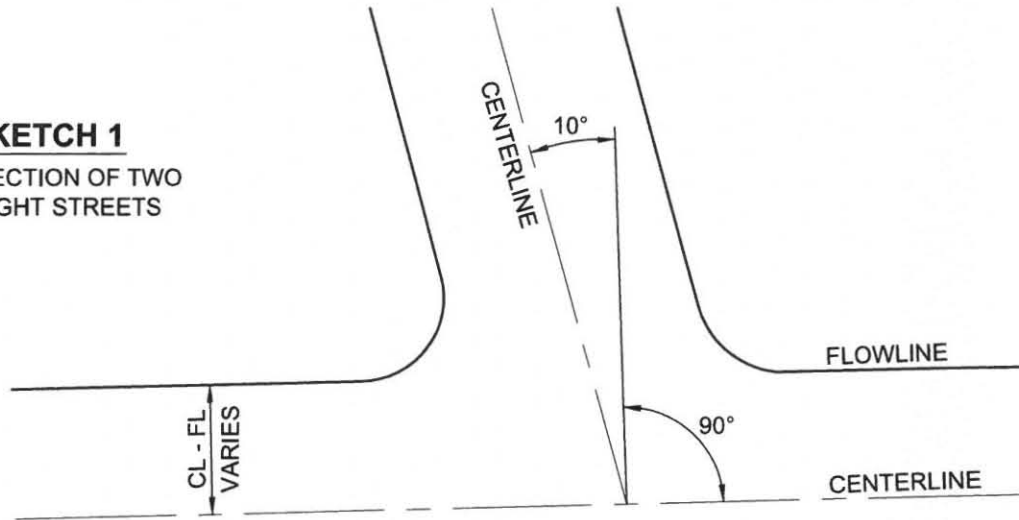


ROADWAY DESIGN & CONSTRUCTION STANDARDS

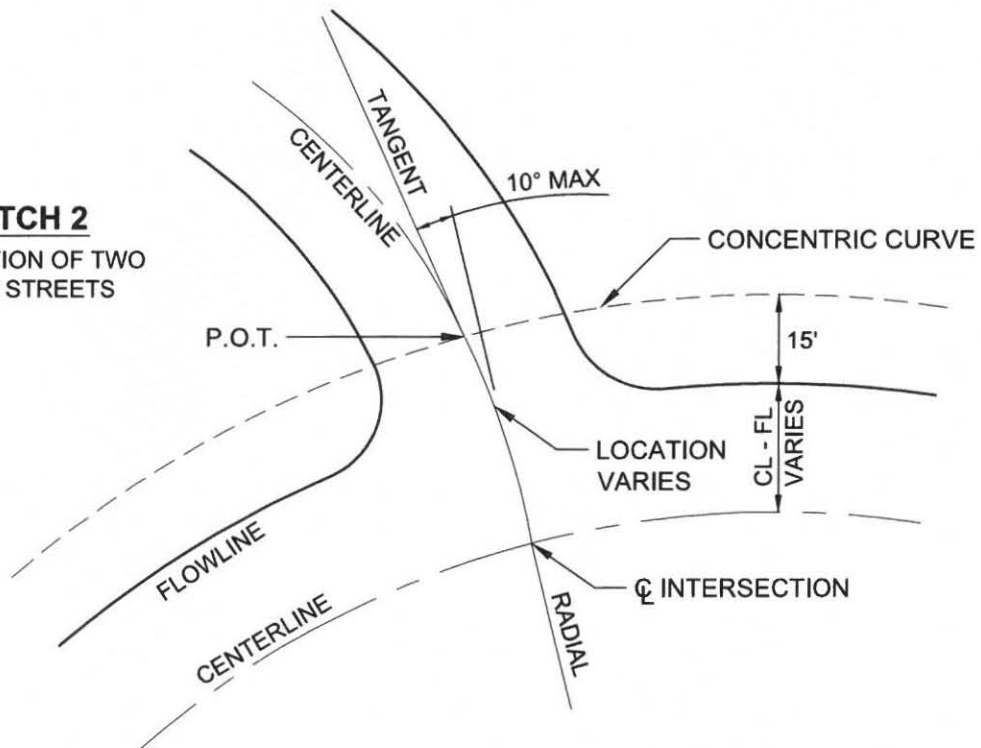
PERMISSIBLE INTERSECTION GRADES

Scale: N.T.S  
 Issued: 01/23/16  
 Revised: -  
 Figure No. 4.4

**SKETCH 1**  
INTERSECTION OF TWO  
STRAIGHT STREETS



**SKETCH 2**  
INTERSECTION OF TWO  
CURVED STREETS



ROADWAY DESIGN & CONSTRUCTION STANDARDS

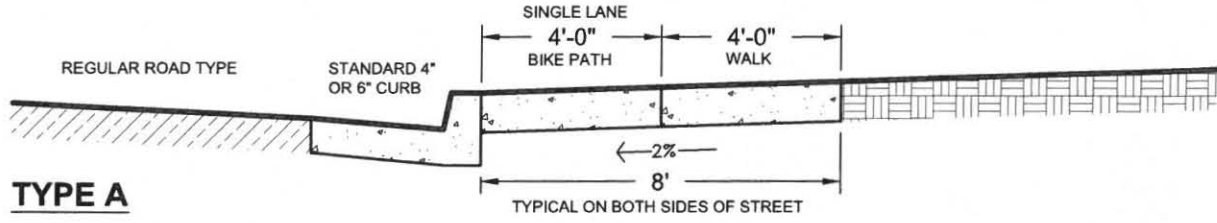
**PERMISSIBLE INTERSECTION  
ANGLES**

Scale: N.T.S

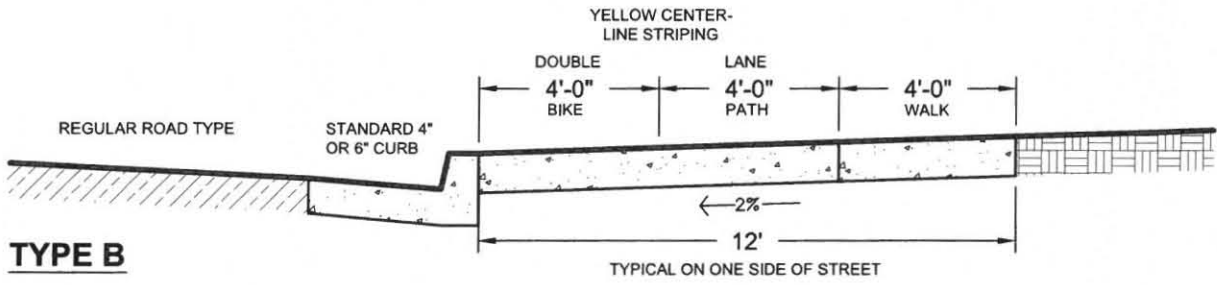
Issued: 01/23/16

Revised: -

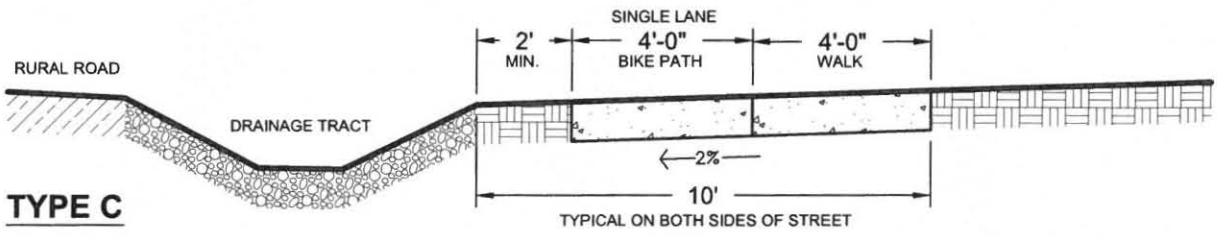
Figure No. 4.5



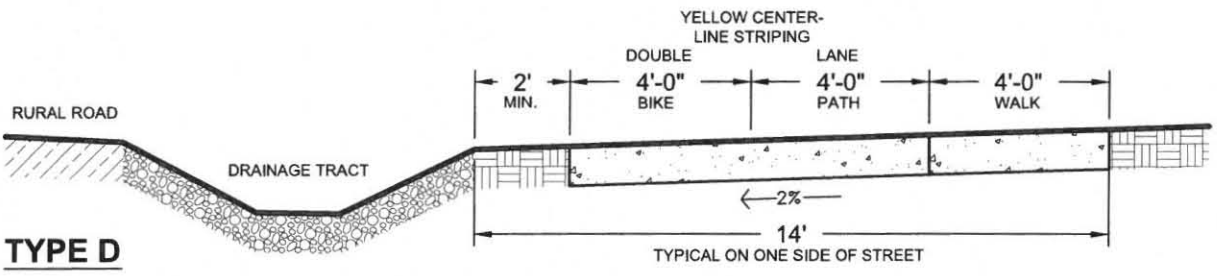
**TYPE A**



**TYPE B**



**TYPE C**



**TYPE D**

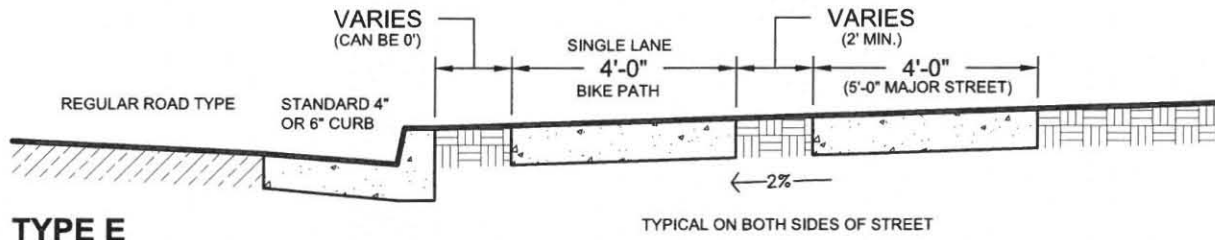
NOTE: ALL ROAD SIDEWALKS AND BIKE PATHS SHALL BE 6" THICK CONCRETE



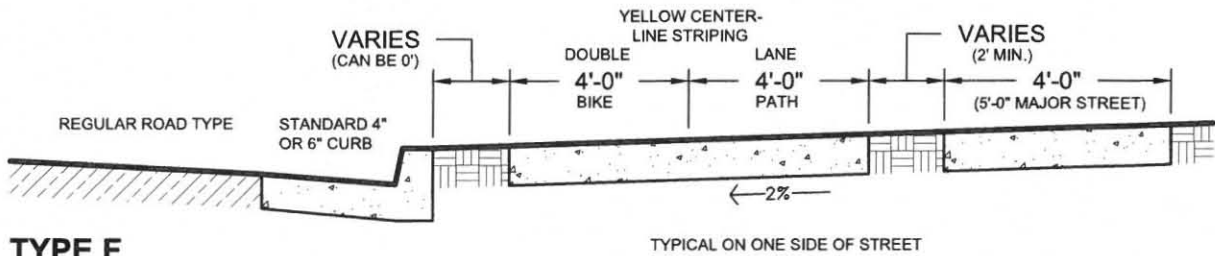
ROADWAY DESIGN & CONSTRUCTION STANDARDS

STANDARD SIDEWALK & BIKE PATH CONFIGURATIONS

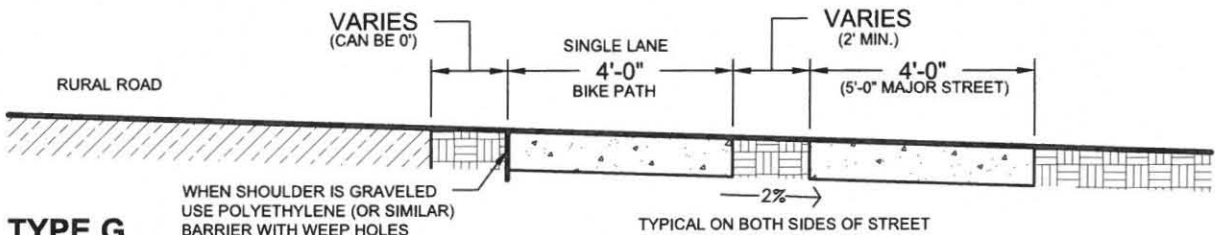
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Issued:	01/23/16
Revised:	-
Drawing No.	4-2



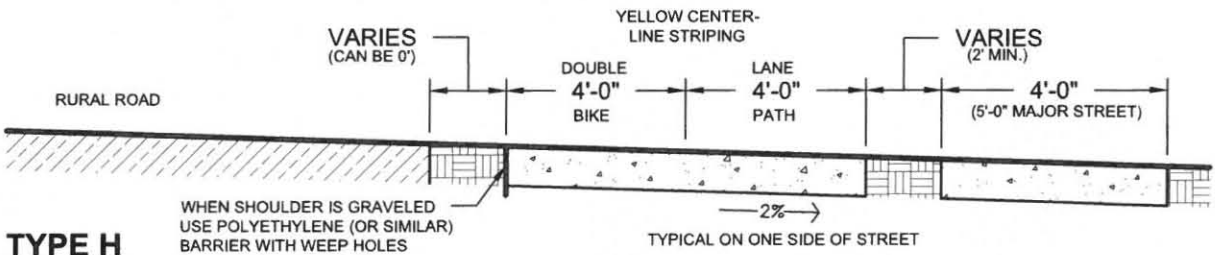
**TYPE E**



**TYPE F**



**TYPE G**



**TYPE H**

WHEN SHOULDER IS GRAVELED USE POLYETHYLENE (OR SIMILAR) BARRIER WITH WEEP HOLES

WHEN SHOULDER IS GRAVELED USE POLYETHYLENE (OR SIMILAR) BARRIER WITH WEEP HOLES

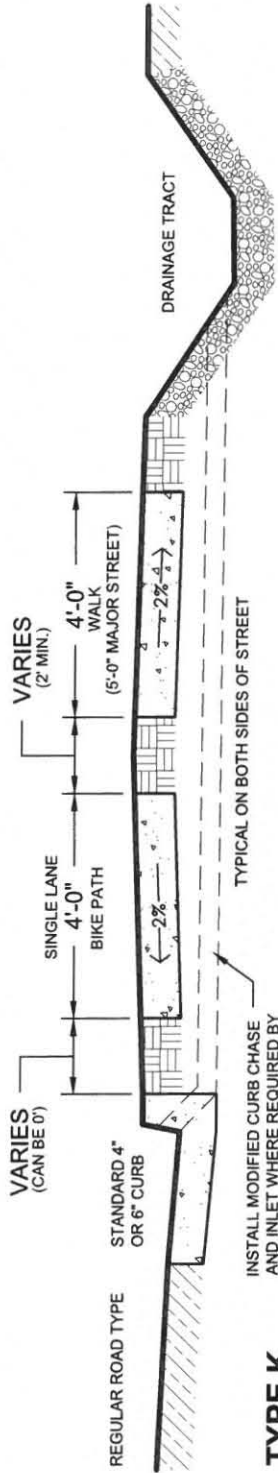
NOTE: ALL ROAD SIDEWALKS AND BIKE PATHS SHALL BE 6' THICK CONCRETE



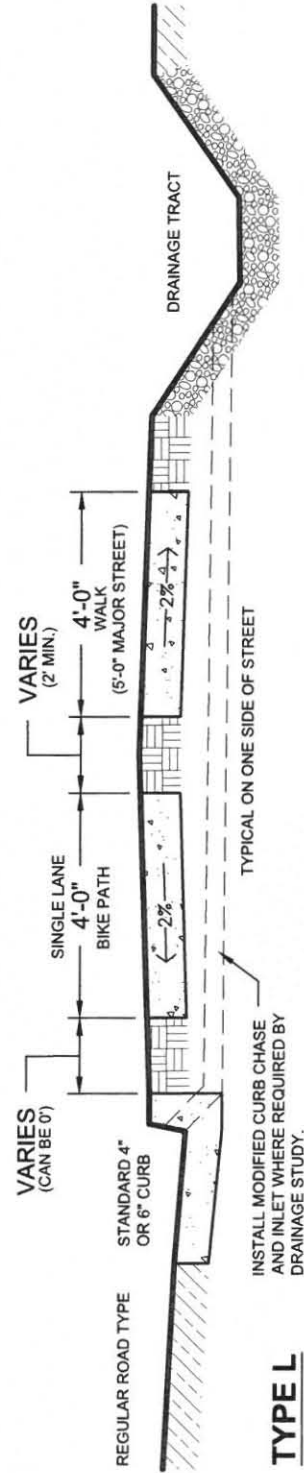
ROADWAY DESIGN & CONSTRUCTION STANDARDS

STANDARD SIDEWALK & BIKE PATH CONFIGURATIONS

Scale:	N.T.S
Issued:	01/23/16
Revised:	-
Drawing No.	4-3



**TYPE K**



**TYPE L**

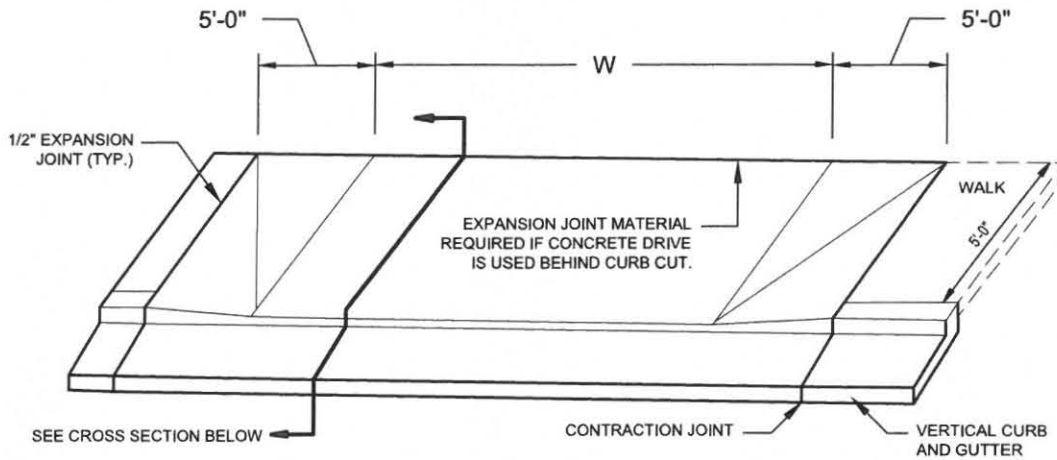
NOTE: ALL ROAD SIDEWALKS AND BIKE PATHS SHALL BE 6" THICK CONCRETE



ROADWAY DESIGN & CONSTRUCTION STANDARDS

STANDARD SIDEWALK & BIKE PATH CONFIGURATIONS

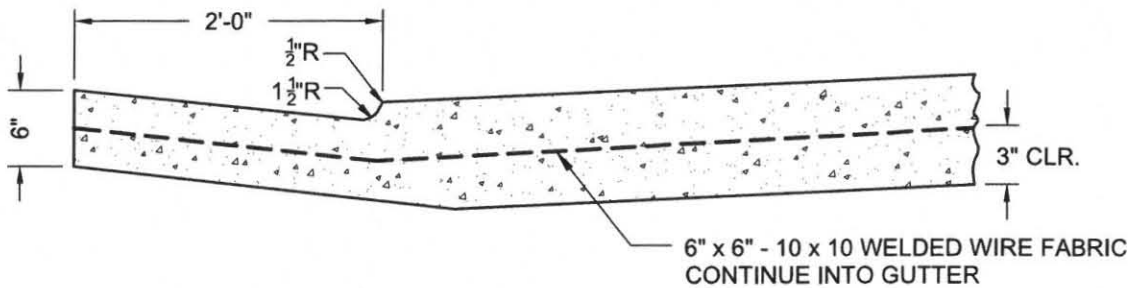
Scale:	N.T.S
Issued:	01/23/16
Revised:	-
Drawing No.	4-4



**NOTES:**

1. BACK OF CURB CUT EXTENDS TO BACK OF WALK. IF NO WALK IS PRESENT, EXTEND BACK OF CURB CUT TO 5'-0" BEHIND FLOW LINE.
2. TOWN SHALL APPROVE LOCATION OF CURB CUT BEFORE CONSTRUCTION.
3. CURB OPENINGS OF 30' OR MORE MUST BE CONSTRUCTED AS RADIUS CURB RETURN.

W= WIDTH OF CURB OPENING



**CROSS-SECTION THROUGH CURB CUT**

**WIDTH OF CURB OPENING (From Table 13.1)**

	RESIDENTIAL SF	MF	COMMERCIAL	SERVICE STATION	INDUSTRIAL
ARTERIAL	IF ALLOWED UNDER CHAPTER 4 DESIGN AS COLLECTOR				
COLLECTOR	N/A	N/A	30-40	30-40	30-40
LOCAL	30-35	30-35	30-40	30-40	30-40

**NOTES:**

1. CURB OPENINGS OF 30" OR MORE MUST BE CONSTRUCTED AS A RADIUS CURB RETURN.
2. IF A RADIUS CURB RETURN IS USED, THE WIDTH OF THE ALLOWED DRIVEWAY IS MEASURED BY NOT COUNTING THE TWO (2) 20' RADII, OR IN OTHER WORDS, IT IS MEASURED AT THE THROAT EXTENDED TO FLOWLINE.



**ROADWAY DESIGN & CONSTRUCTION STANDARDS**

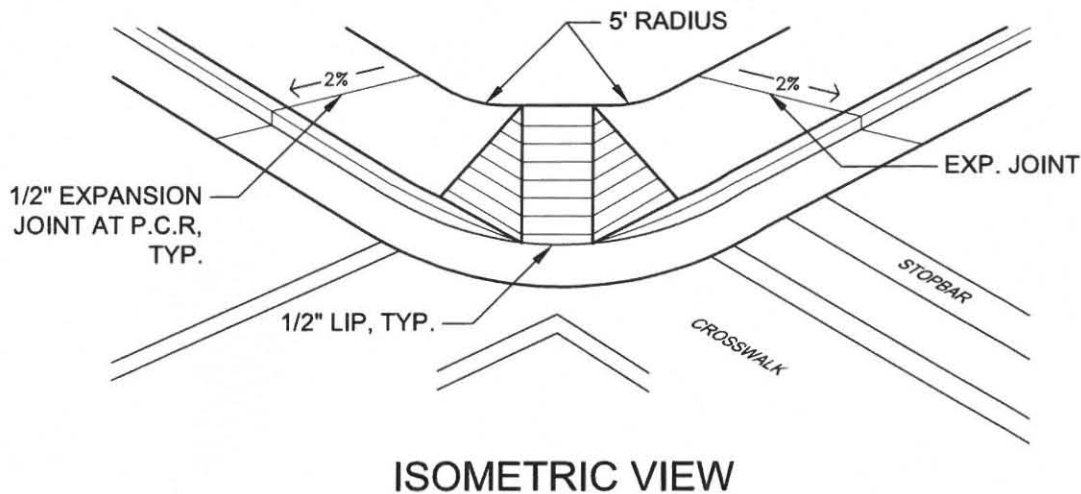
**CURB, GUTTER AND WALK  
CURB CUTS**

Scale: N.T.S  
 Issued: 01/23/16  
 Revised: -  
 Drawing No. 4-7



NOTES:

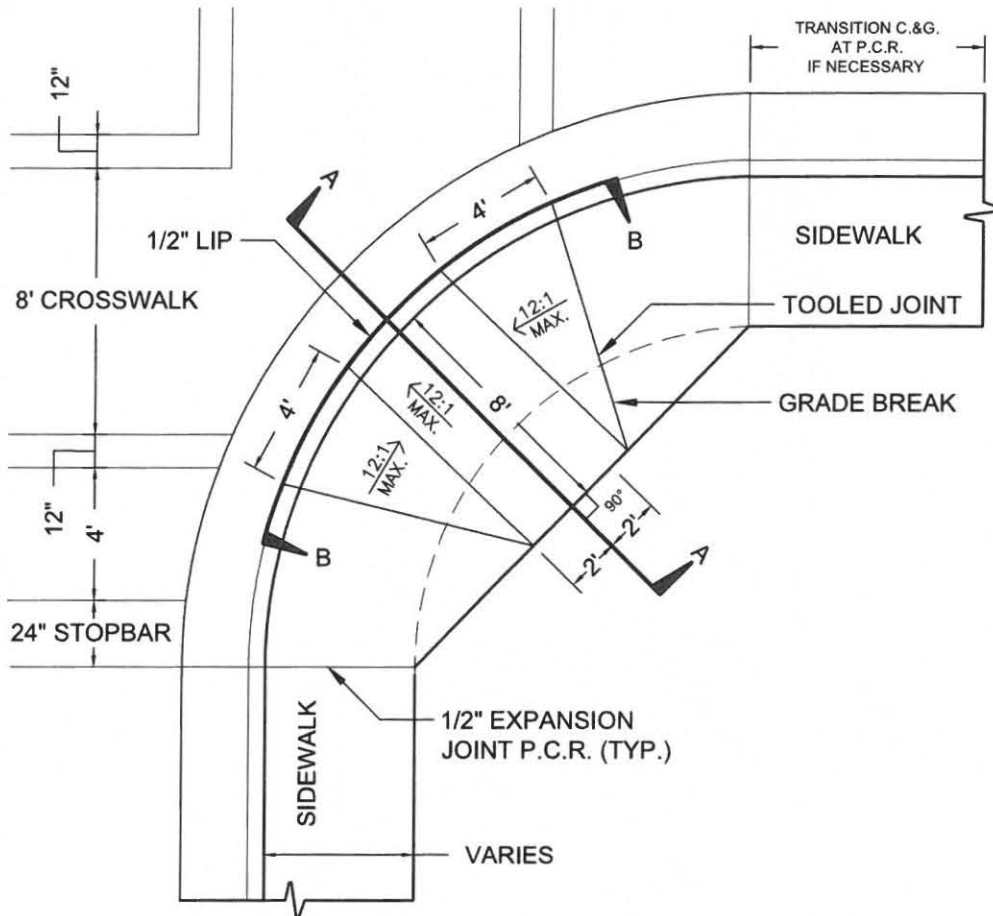
1. IN ACCORDANCE WITH CRS43-2-107(2), RAMPS SHALL BE PROVIDED AT ALL CORNERS OF STREET INTERSECTIONS WHERE THERE IS EXISTING OR PROPOSED SIDEWALK AND CURB. RAMPS SHALL ALSO BE PROVIDED AT WALK LOCATIONS IN MID-BLOCK IN THE VICINITIES OF HOSPITALS, MEDICAL CENTERS, ATHLETIC STADIUMS, AND AT "T" INTERSECTIONS DIRECTLY OPPOSITE EITHER CURB RETURN.
2. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS OF THE TOWN OF BENNETT
3. SIDEWALKS SHALL BE RAMPED WHERE A DRIVEWAY CURB IS EXTENDED ACROSS THE WALK.
4. DETAILS SHOWN IN THIS PLAN SHALL APPLY TO ALL CONSTRUCTION OR RECONSTRUCTION OF STREETS, CURBS OR SIDEWALKS.
5. SPECIAL DESIGNS ARE REQUIRED WHEN GRADES ARE OVER 4% OR WHERE THE ANGLE OF THE INTERSECTION IS LESS THAN 75 DEGREES OR MORE THAN 105 DEGREES.
6. IN NEW CONSTRUCTION , RAMP AND CURB MAY BE POURED MONOLITHICALLY.
7. RAMP AND WINGS SHALL BE POURED MONOLITHICALLY.
8. MINIMUM WIDTH OF RAMPS SHALL BE 4 FEET AND RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1.
9. MAINTAIN BACK OF WALK ELEVATION AT 2.0% ABOVE TOP OF CURB.
10. CONCRETE FOR SIDEWALK RAMPS SHALL BE CLASS "A".
11. NORMAL GUTTER FLOW LINE AND PROFILE SHALL BE MAINTAINED THROUGH THE RAMP AREA.
12. RAMP SURFACE SHALL HAVE A COURSE BROOM FINISH PERPENDICULAR TO THE DIRECTION OF RAMP SLOPE, SCORE AT 9" O.C.
13. A 1/2" EXPANSION JOINT SHALL BE REQUIRED WHERE THE CONCRETE RAMP JOINS ANY RIGID PAVEMENT OR STRUCTURE.
14. DRAINAGE STRUCTURES SHALL NOT BE PLACED IN LINE WITH RAMPS, LOCATION OF THE RAMP SHALL TAKE PRECEDENCE OVER LOCATION OF THE DRAINAGE STRUCTURE, EXCEPT WHERE EXISTING DRAINAGE STRUCTURES ARE BEING UTILIZED IN THE NEW CONSTRUCTION.
15. ALL PAVEMENT MARKING SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) FOR STREETS AND HIGHWAYS.



ROADWAY DESIGN & CONSTRUCTION STANDARDS

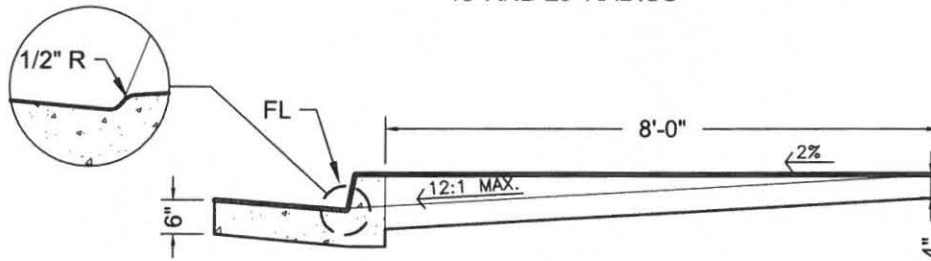
**ACCESSIBLE CURB RAMP  
ATTACHED WALK**

Scale: N.T.S  
 Issued: 01/23/16  
 Revised: -  
 Drawing No. 4-10

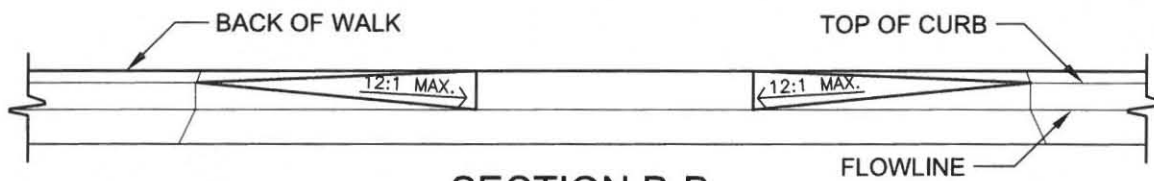


**6" VERTICAL CURB ATTACHED WALK**

15' AND 20' RADIUS



**SECTION A-A**



**SECTION B-B**



ROADWAY DESIGN & CONSTRUCTION STANDARDS

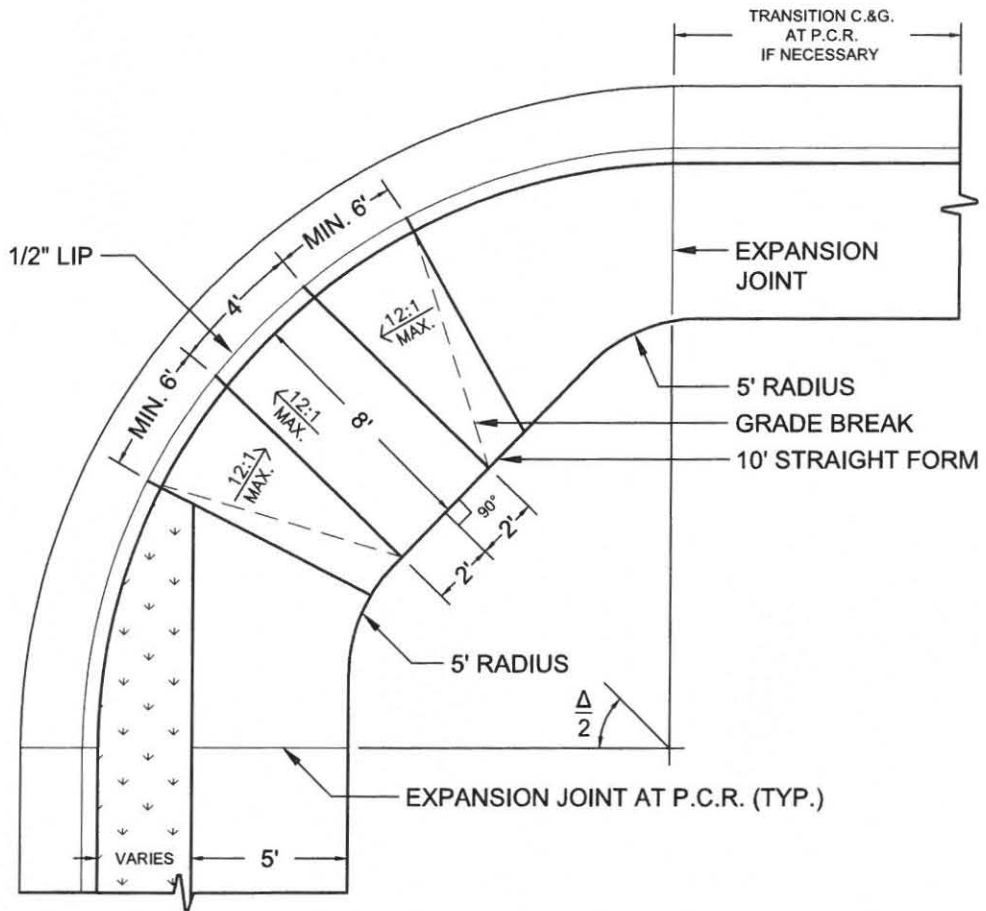
**ACCESSIBLE CURB RAMP  
ATTACHED WALK**

Scale: N.T.S

Issued: 01/23/16

Revised: -

Drawing No. 4-11



**DETACHED WALK TO ATTACHED WALK**  
 25' RADIUS OR GREATER



ROADWAY DESIGN & CONSTRUCTION STANDARDS

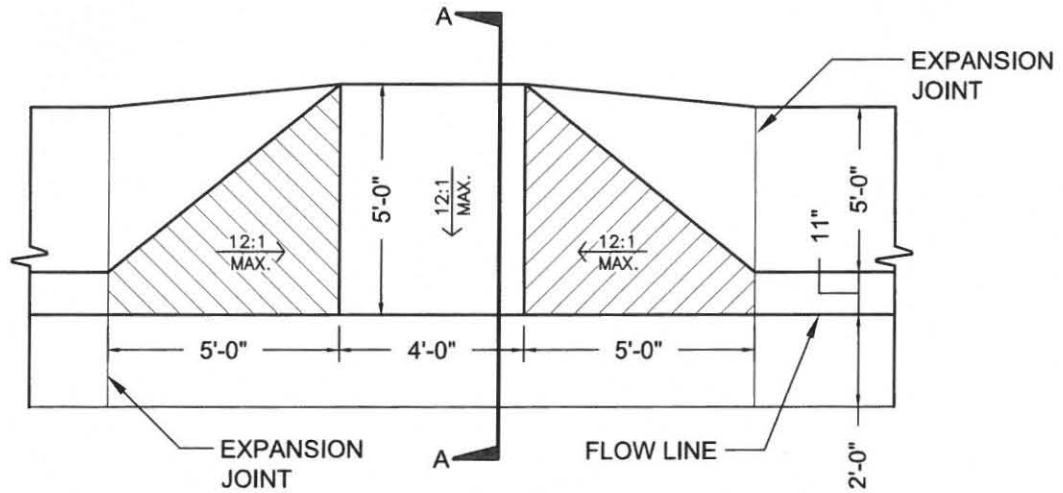
**ACCESSIBLE CURB RAMP  
 DETACHED TO ATTACHED WALK**

Scale: N.T.S

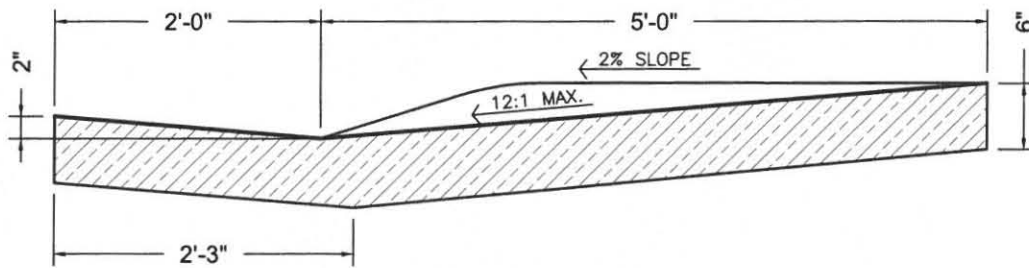
Issued: 01/23/16

Revised: -

Drawing No. 4-12



FOR LOCAL (34' FL-FL) STREETS ONLY



**SECTION A-A**  
FOR COMB. CURBWALK ONLY



ROADWAY DESIGN & CONSTRUCTION STANDARDS

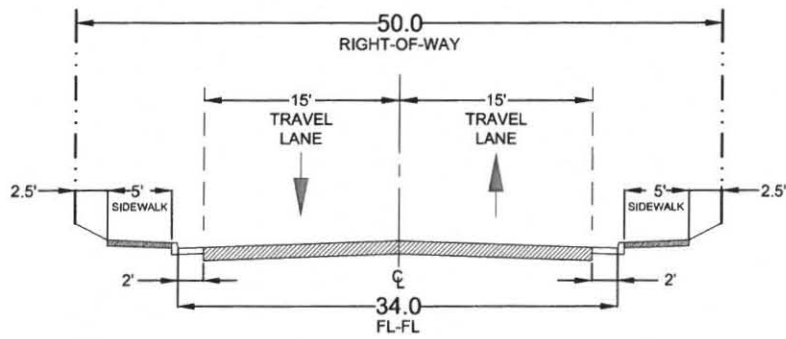
**ACCESSIBLE CURB RAMPS  
MID-BLOCK**

Scale: N.T.S

Issued: 01/23/16

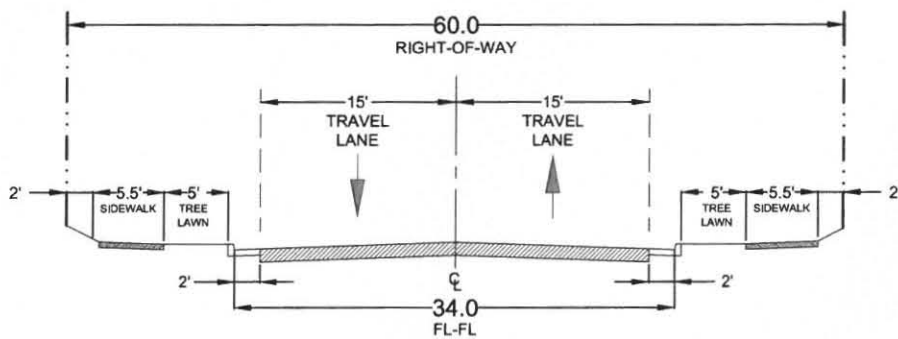
Revised: -

Drawing No. 4-13



**TYPE A**

LOCAL STREET WITH ATTACHED SIDEWALK



**TYPE B**

LOCAL STREET WITH DETACHED SIDEWALK



ROADWAY DESIGN & CONSTRUCTION STANDARDS

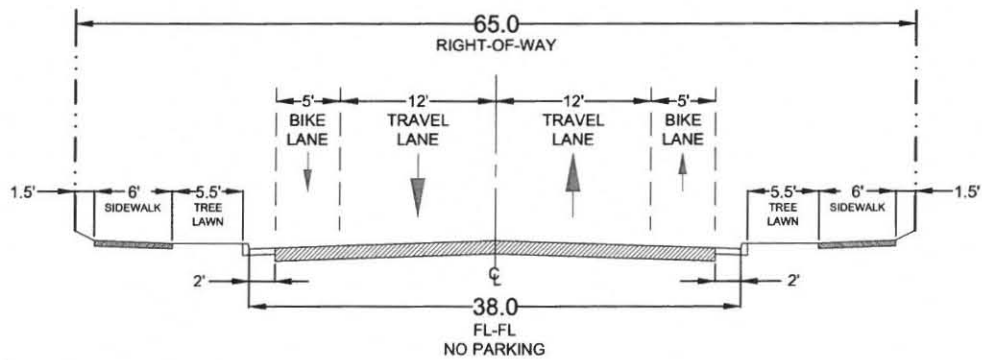
**STREET CROSS SECTIONS**

Scale: N.T.S

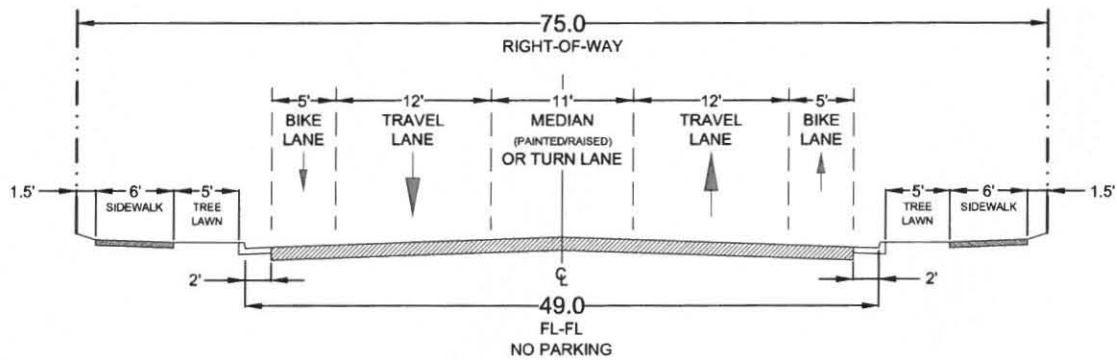
Issued: 01/23/16

Revised: -

Drawing No. 4-18



**TYPE C**  
RESIDENTIAL COLLECTOR



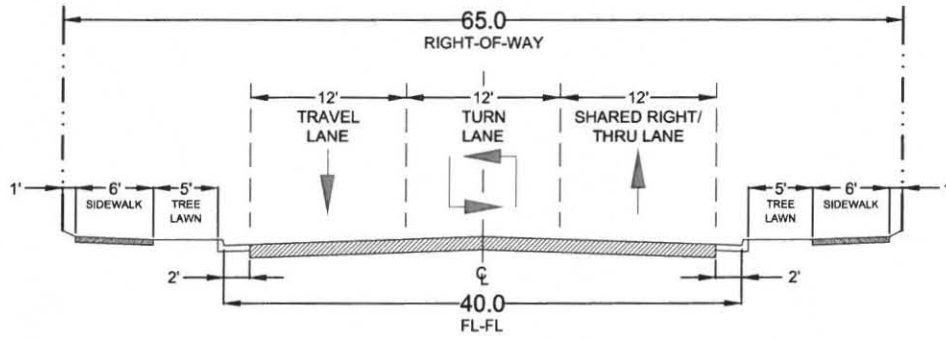
**TYPE D**  
COMMERCIAL COLLECTOR



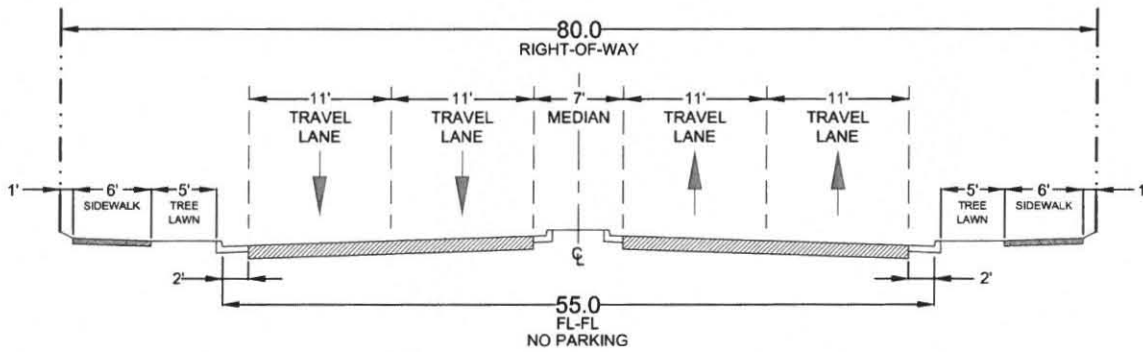
ROADWAY DESIGN & CONSTRUCTION STANDARDS

**STREET CROSS SECTIONS**

Scale: N.T.S  
 Issued: 01/23/16  
 Revised: -  
 Drawing No. 4-19



**TYPE E**  
RESIDENTIAL COLLECTOR AT ARTERIAL INTERSECTION



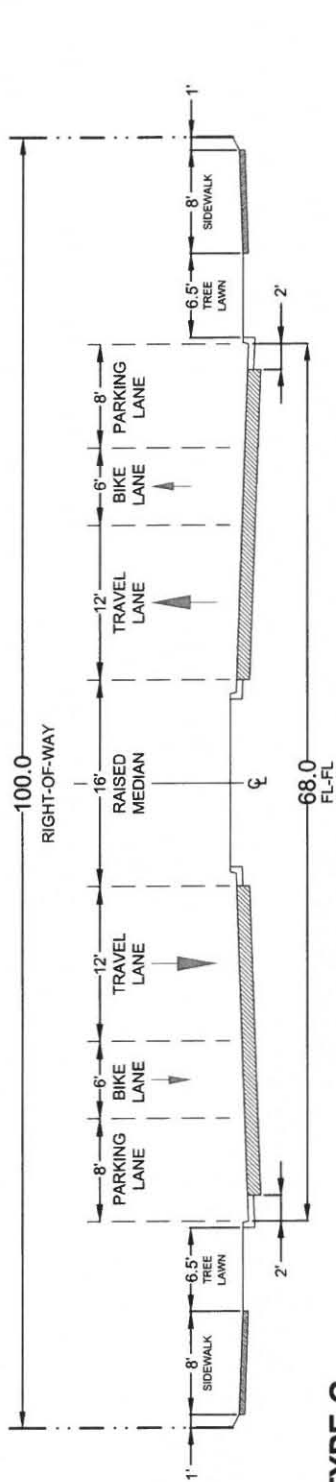
**TYPE F**  
ENTRY STREET AT ARTERIAL



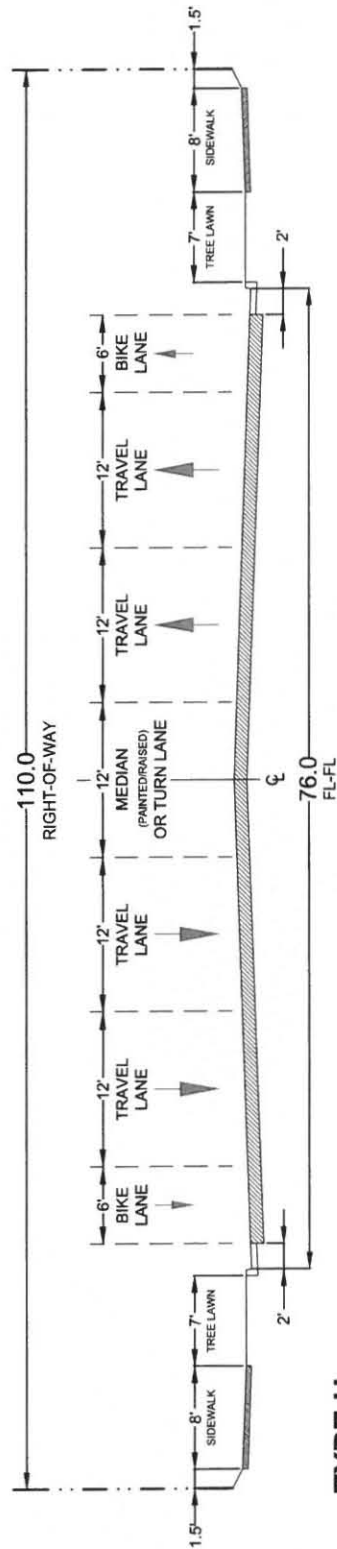
ROADWAY DESIGN & CONSTRUCTION STANDARDS

STREET CROSS SECTIONS

Scale: N.T.S  
 Issued: 01/23/16  
 Revised:  
 Drawing No. 4-20



**TYPE G**  
COLLECTOR WITH LANDSCAPE MEDIAN



**TYPE H**  
FOUR LANE ARTERIAL

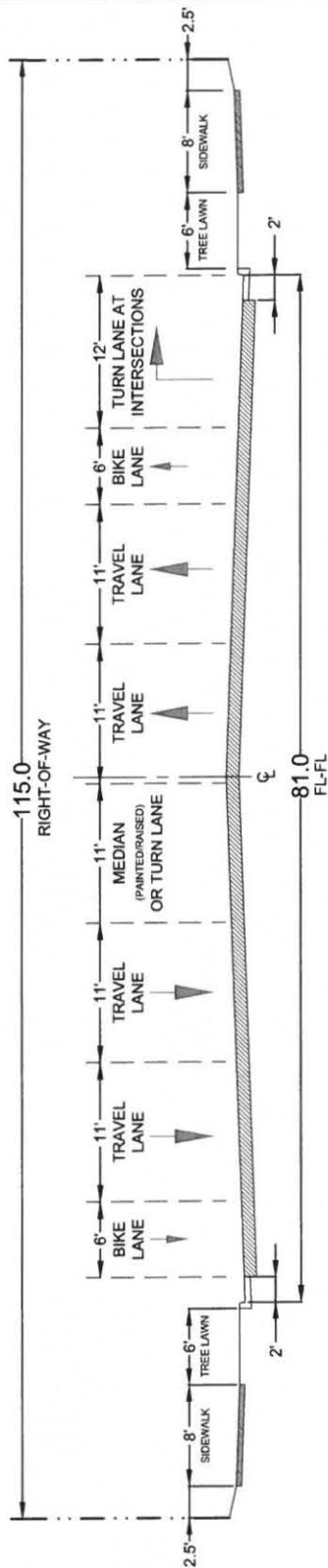


ROADWAY DESIGN & CONSTRUCTION STANDARDS

STREET CROSS SECTIONS

Scale:	N.T.S
Issued:	01/23/16
Revised:	-
Drawing No.	4-21





**TYPE I**  
FOUR LANE ARTERIAL INTERSECTION



ROADWAY DESIGN & CONSTRUCTION STANDARDS

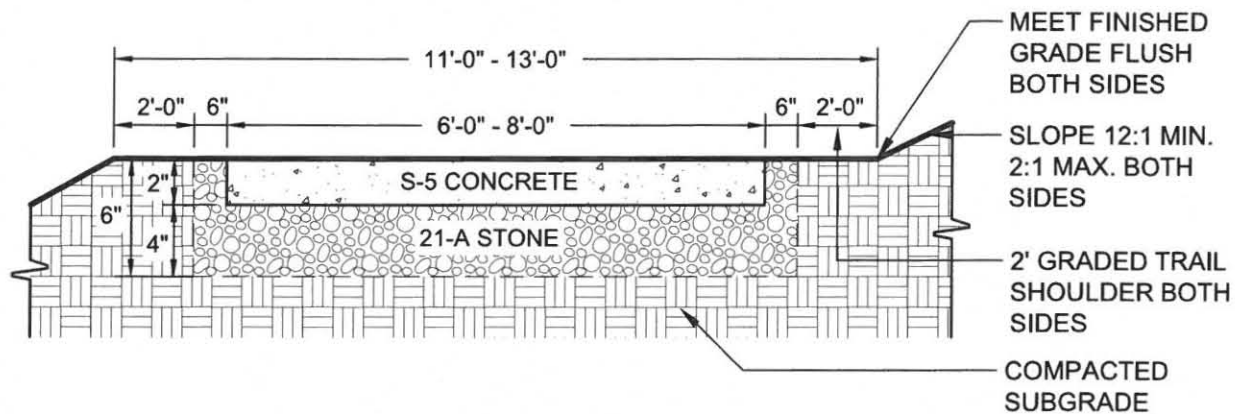
STREET CROSS SECTIONS

Scale: N.T.S

Issued: 01/23/16

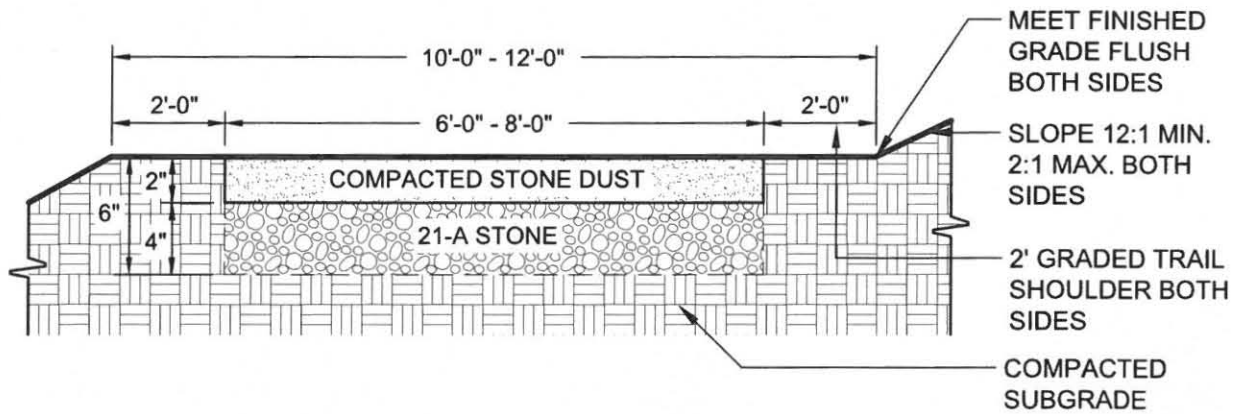
Revised:

Drawing No. 4-22



**TYPE I**

1. SUITABLE FOR BICYCLE AND GENERAL PEDESTRIAN USE. EIGHT FEET IS THE REQUIRED MINIMUM WIDTH FOR BIKEWAYS AND SIX FEET THE REQUIRED MINIMUM FOR WALKWAYS. WIDER SECTION MAY BE REQUIRED IN HEAVILY TRAVELED AREAS.
2. WHERE SOIL IS WELL DRAINED AND COMPACTABLE, THE STONE BASE MAY BE ELIMINATED AND THIS SECTION REPLACED BY A 3-1/2" FULL-DEPTH ASPHALT SECTION. CONSTRUCTION OF THIS SUBSTITUTE SECTION IS SUBJECT TO THE APPROVAL OF THE DIRECTOR.



**TYPE II**

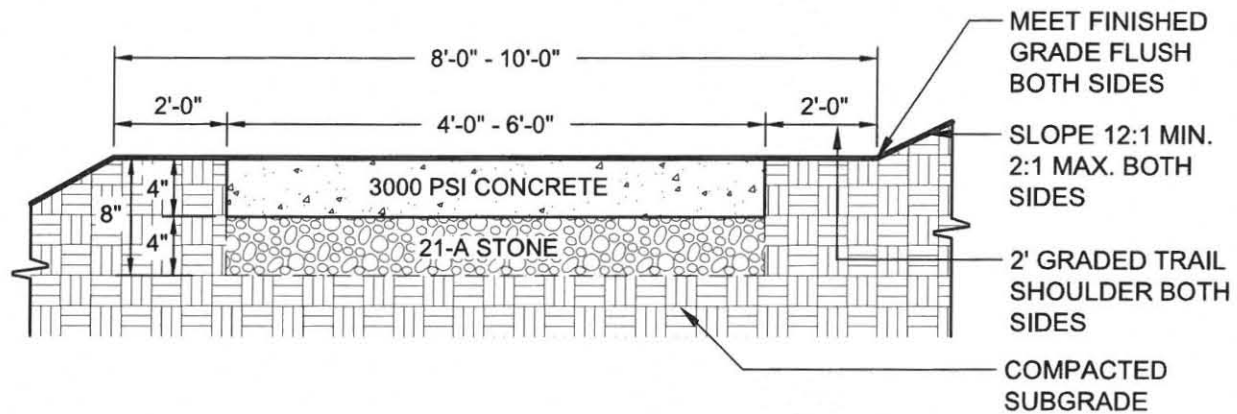
1. SUITABLE FOR EQUESTRIAN USE, HIKING AND ALL-TERRAIN (MOUNTAIN) BICYCLE USE IN GENTLY SLOPED TOPOGRAPHY. SUSCEPTIBLE TO WASHOUT AND SHEET EROSION ON SLOPES GREATER THAN 5%.
2. DEPTH OF STONE BASE DEPENDS ON SOIL TYPE, STABILITY AND DRAINAGE.



ROADWAY DESIGN & CONSTRUCTION STANDARDS

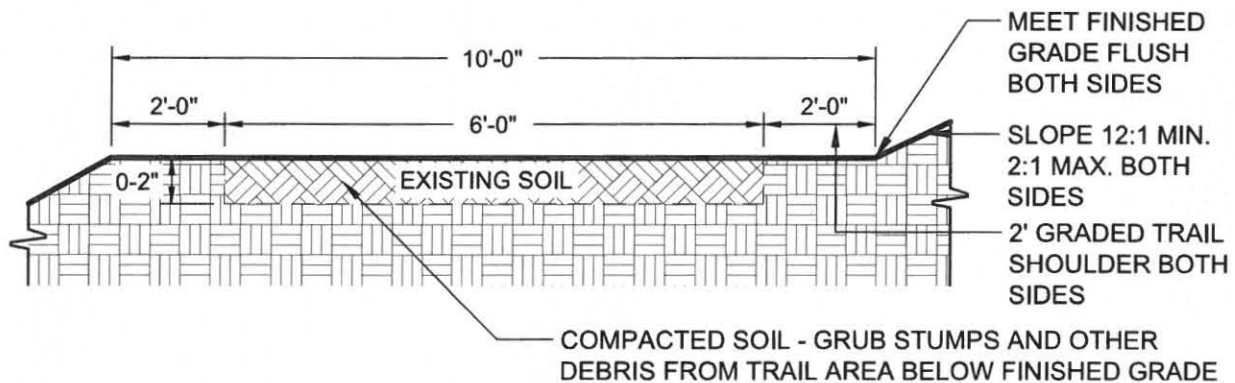
**TRAIL CROSS SECTIONS**

Scale: N.T.S.  
 Issued: 01/23/16  
 Revised:  
 Drawing No. 4-35



### **TYPE III**

1. SUITABLE FOR GENERAL PEDESTRIAN USE. UNSUITABLE FOR BIKEWAYS. ACCEPTABLE TO VDH&T MAINTENANCE.
2. SUBGRADE FRO ALL SIDEWALK SHALL BE COMPACTED TO MINIMUM 95% DENSITY AT OPTIMUM MOISTURE TO FULL WIDTH OF RIGHT-OF-WAY OR EASEMENT IN ACCORDANCE WITH AASHTO T99.



### **TYPE IV**

1. SUITABLE FOR EQUESTRIAN USE, HIKING AND ALL-TERRAIN (MOUNTAIN) BICYCLE USE IN LOW DENSITY AREAS. CONSTRUCTION OF THIS SECTION IS SUBJECT TO THE APPROVAL OF THE DIRECTOR.
2. ALIGNMENT OF THIS TRAIL SHOULD BE SUCH THAT THERE IS MINIMAL GROUND DISTURBANCE DURING CLEARING.



ROADWAY DESIGN & CONSTRUCTION STANDARDS

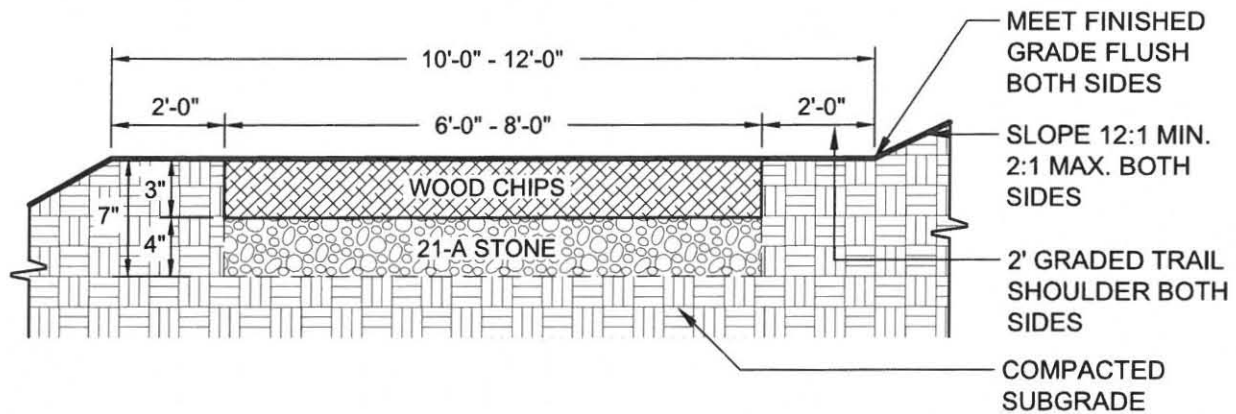
## TRAIL CROSS SECTIONS

Scale: N.T.S

Issued: 01/23/16


Revised:

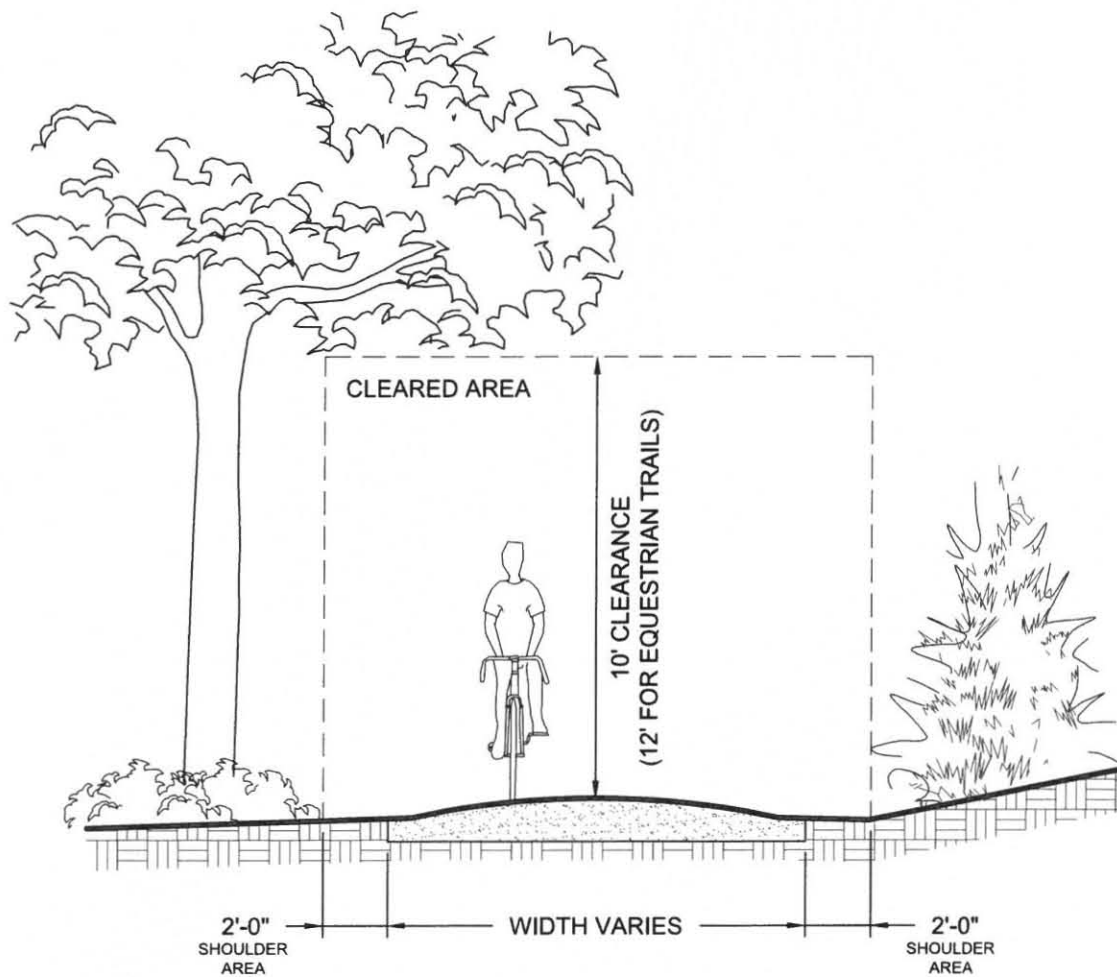
Drawing No. 4-36



**TYPE V**

1. SUITABLE FOR EQUESTRIAN USE AND HIKING.
2. DEPTH OF STONE BASE DEPENDENT ON SOIL TYPE, STABILITY AND DRAINAGE. CHIP WALKS REQUIER EDGING AS DETERMINED BY THE SITE INSPECTOR.

	ROADWAY DESIGN & CONSTRUCTION STANDARDS	Scale: N.T.S
	TRAIL CROSS SECTIONS	Issued: 01/23/16
		Revised:
		Drawing No. 4-37



NOTE: CLEAR TRAIL AND SHOULDER AREAS OF ALL VEGETATIVE MATTER AND DEBRIS.



ROADWAY DESIGN & CONSTRUCTION STANDARDS

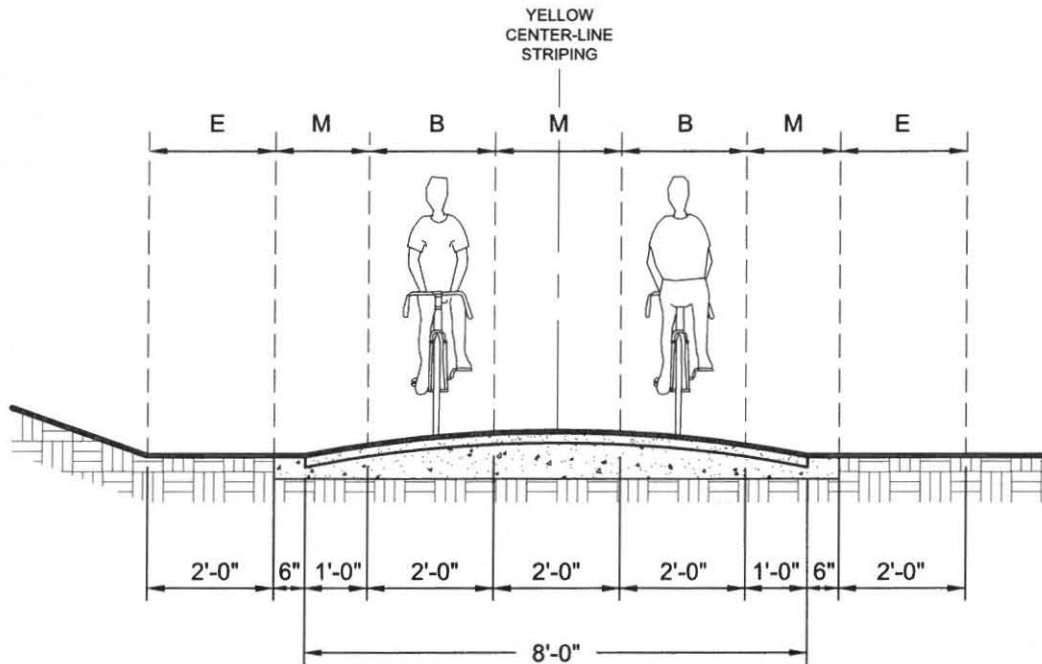
TRAIL CLEARING

Scale: N.T.S

Issued: 01/23/16

Revised:

Drawing No. 4-38



NOTE: SHOULDER IS FIRM WITH NO DROP OFF OR SUBSTANTIAL SLOPE FOR 2 FEET

**DIMENSION CODE**

- B = BICYCLE
- M = MANEUVERING CLEARANCE
- E = EDGE CLEARANCE (SHOULDER)



**ROADWAY DESIGN & CONSTRUCTION STANDARDS**

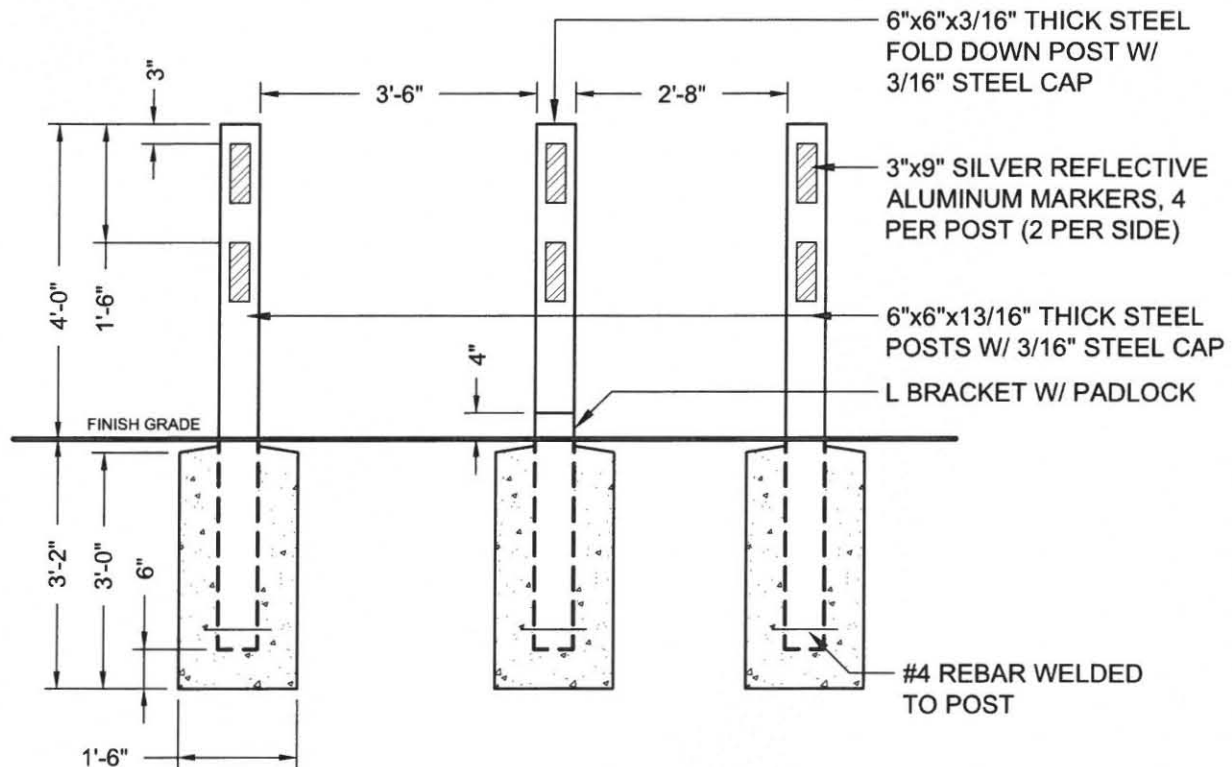
**TWO-WAY BIKE PATH IN  
OFF-STREET LOCATION**

Scale: N.T.S

Issued: 01/23/16

Revised:

Drawing No. 4-39



**NOTES:**

1. ALL FOOTINGS SHALL BE CLASS "B" CONCRETE, PITCH SURFACE.
2. INSTALL POSTS BEFORE PAVING.
3. IF WOOD POSTS, COUNTERSINK NUT AND WASHER ON 3/8" DIAMETER 6" EYE BOLTS.
4. MOUNT 3" RED REFLECTORS WITH 1/2" CABLE CLAMPS. 2 EACH SIDE OF WIRE ROPE.
5. FOLD DOWN POST WILL BE INSTALLED IN CENTER. PADLOCKS AND L BRACKETS WILL HOLD POST IN PLACE WHEN IN THE UP POSITION.
6. 3/16" STEEL CAP SHALL BE PLATE WELDED ON TOP - SMOOTH ALL ROUGH EDGES AND FINISH WITH 1 SHOP OR PRIME COAT AND 3 FIELD COATS USING AN ALKYD PAINT SYSTEM. FINISH COAT IS TO BE FLAT BLACK, ALL SURFACES OF ALL STEEL POSTS.



ROADWAY DESIGN & CONSTRUCTION STANDARDS

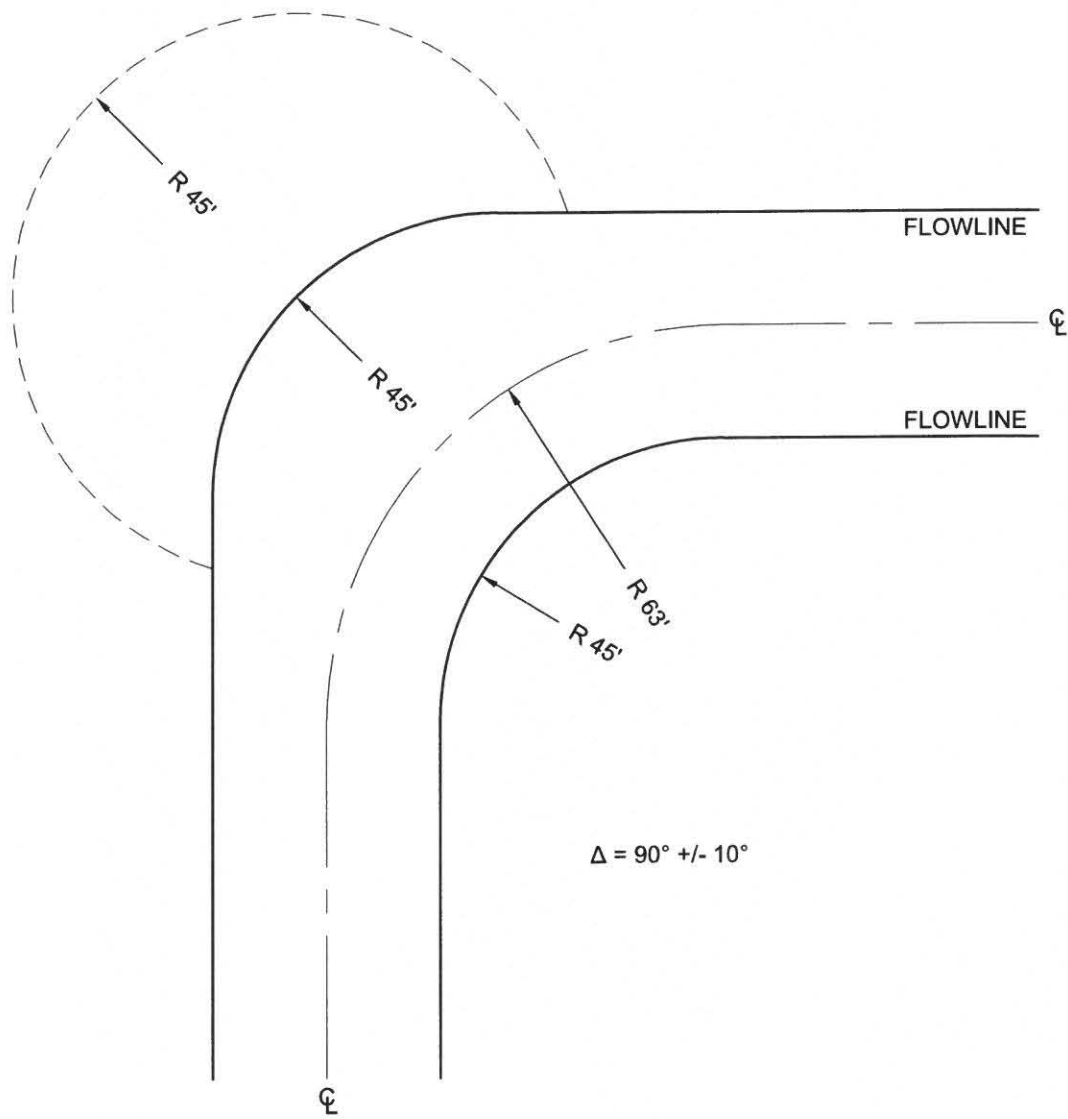
**TRAIL ACCESS THROUGH BARRICADE**

Scale: N.T.S

Issued: 01/23/16

Revised:

Drawing No. 4-40



ROADWAY DESIGN & CONSTRUCTION STANDARDS

**KNUCKLES**

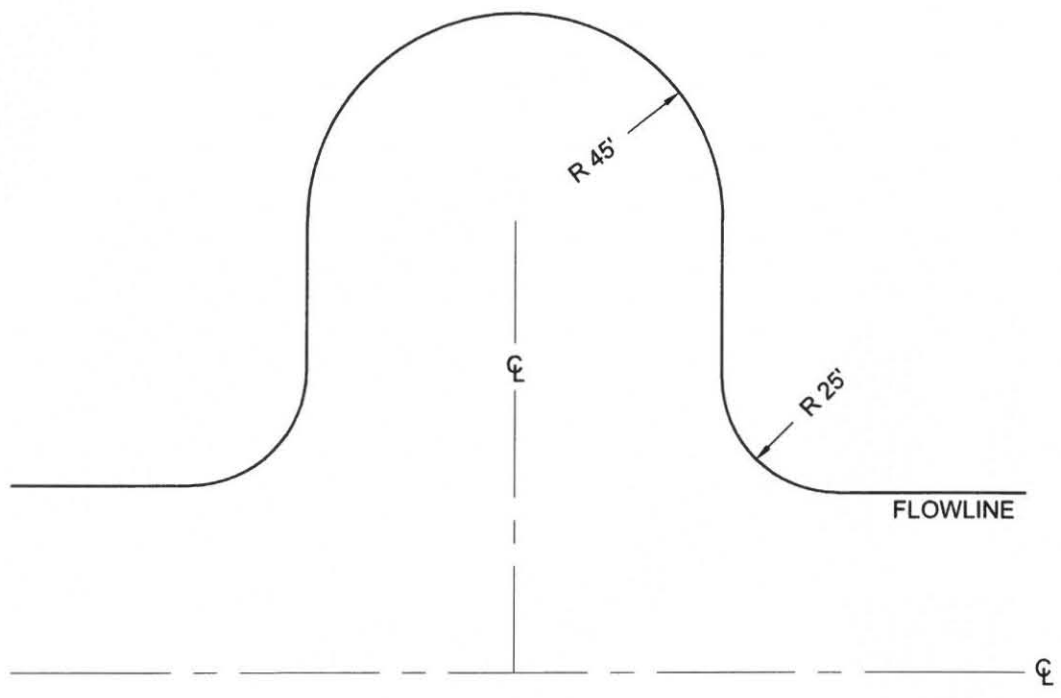
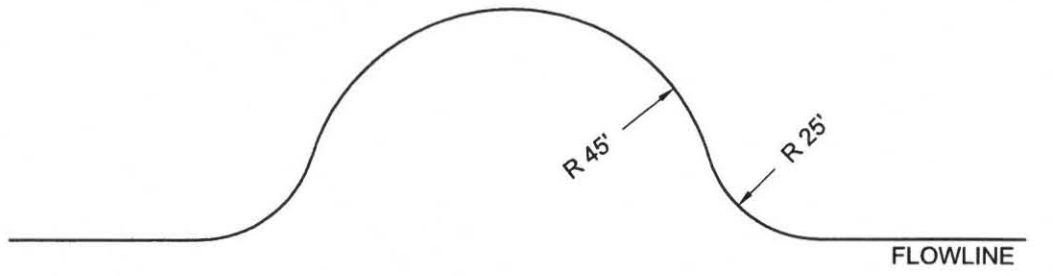
Scale:            N.T.S

Issued:            01/23/16

Revised:           

Drawing No.            4-41

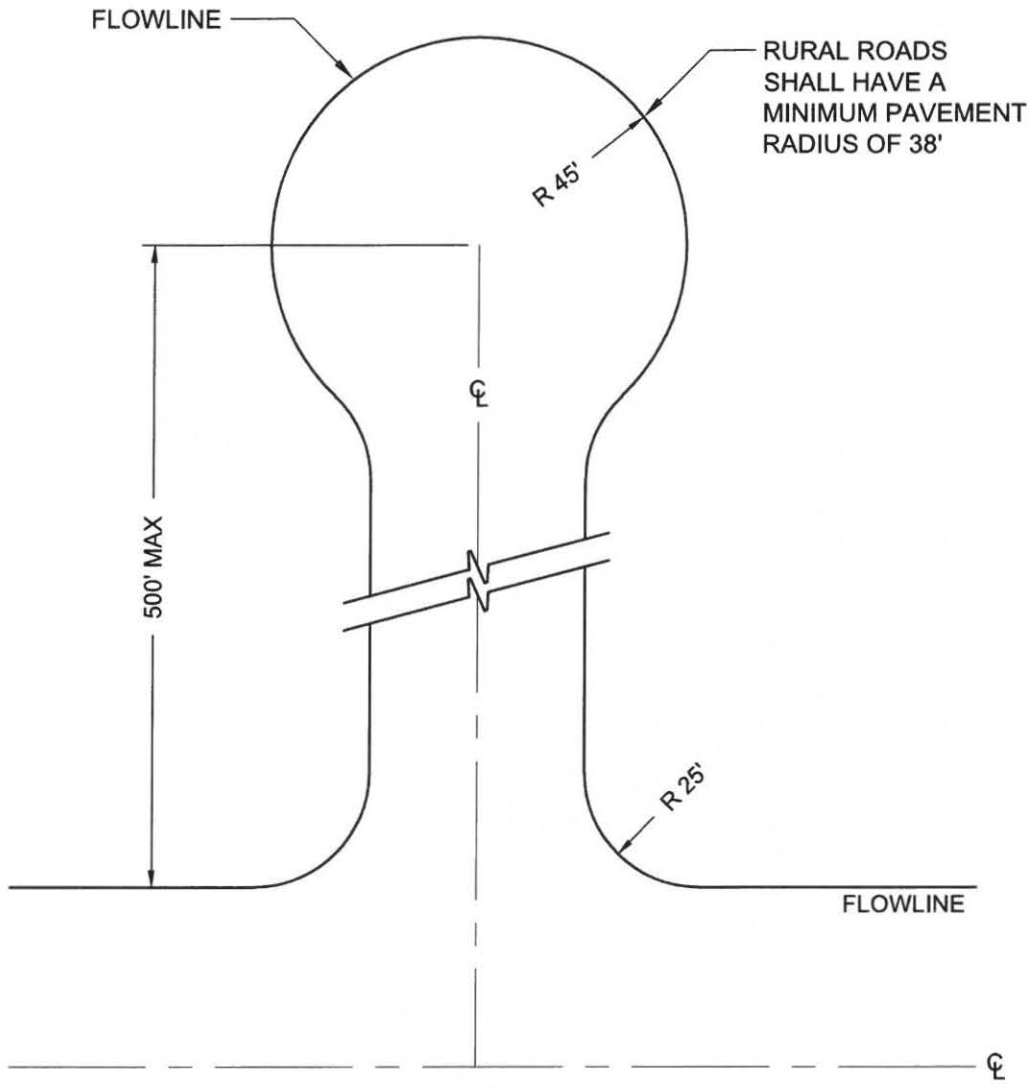




ROADWAY DESIGN & CONSTRUCTION STANDARDS

EYEBROWS

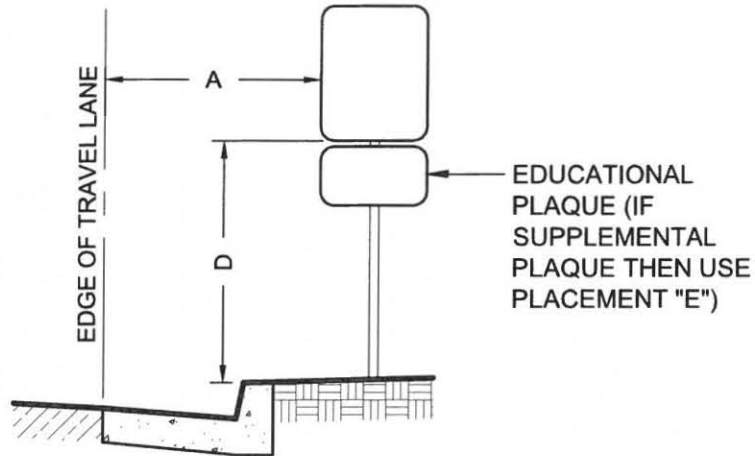
Scale: N.T.S  
 Issued: 01/23/16  
 Revised:  
 Drawing No. 4-42



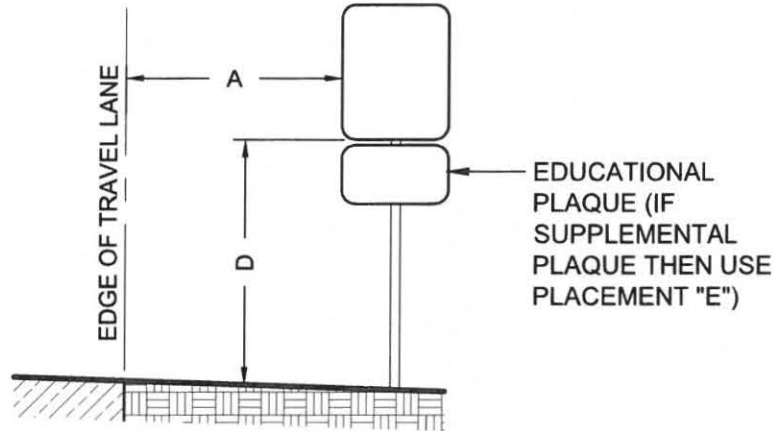
ROADWAY DESIGN & CONSTRUCTION STANDARDS

CUL-DE-SAC

Scale:            N.T.S.  
 Issued:            01/23/16  
 Revised:             
 Drawing No.            4-43



**ROADSIDE SIGN IN BUSINESS, COMMERCIAL, OR RESIDENTIAL AREA**



**ROADSIDE SIGN IN RURAL AREA**

**LATERAL PLACEMENT**

KEY	LOCAL STREETS		COLLECTORS & ARTERIALS	
	MINIMUM	NORMAL	MINIMUM	NORMAL
A	8'-0"	12'-0"	10'-0"	14'-0"

**VERTICAL PLACEMENT (MINIMUM)**

KEY	URBAN		RURAL	
	WITH SIDEWALKS	W/OUT SIDEWALKS	WITH SIDEWALKS	W/OUT SIDEWALKS
D	7'-0"	7'-0"	N/A	5'-0"
E	7'-0"	7'-0"	N/A	4'-0"



ROADWAY DESIGN & CONSTRUCTION STANDARDS

**REGULATORY SIGN PLACEMENT**

Scale: N.T.S

Issued: 01/23/16

Revised:

Drawing No. 4-50