Chapter 1 – SCDOT ORGANIZATION

DEPUTY DIRECTOR OF CONSTRUCTION, ENGINEERING AND PLANNING	1.3(7)

Chapter 4 – ROAD DESIGN COORDINATION

PRECONSTRUCTION DIVISION	4.2(8)

Chapter 9 – BASIC DESIGN CONTROLS

ADHERENCE TO GEOMETRIC DESIGN CRITERIA	9.2(2-5)

Chapter 10 – SIGHT DISTANCE

STOPPING SIGHT DISTANCE	10.1(2)

Chapter 12 – VERTICAL ALIGNMENT

VERTICAL CURVES	12.5(2) 12.5(6)

Chapter 17 – SPECIAL DESIGN ELEMENTS

TABLE OF CONTENTS	17ii
RETAINING WALLS	17.2(1-3)

Chapter 19 – FREEWAYS

TABLES OF DESIGN CRITERIA	19.3(2)

Chapter 20 – RURAL HIGHWAYS

TWO-LANE HIGHWAYS	20.1(4-5) 20.1(10) 20.1(12)

Chapter 22 - LOCAL ROADS AND STREETS

DESIGN ELEMENTS	22.2(4)
TABLES OF DESIGN CRITERIA	22.3(2)

Chapter 34 – PLAN DEVELOPMENT

- developing cross sections and plotting templates, and
- finalizing the road plans.

2. CADD Support. CADD Support is responsible for assisting designers in the use of the Department's computer-aided drafting and design packages (i.e., MicroStation and GEOPAK). This includes:

   - developing uniform conventions for the use of CADD,
   - providing technical support to all CADD users,
   - upgrading the CADD package as necessary, and
   - maintaining the *SCDOT Road Design CADD Users Guide*.

3. Roadway Structures Design Group. The Roadway Structures Design Group is responsible for all in-house roadway structural designs and related construction issues. The Group produces engineering designs for roadway and hydraulic structures that are required due to roadway design. The Roadway Structures Design Group is responsible for requesting roadway geotechnical design information and using these recommendations to design roadway and drainage structures. Typical roadway structures would include the structural design and analysis of retaining walls, roadside barriers, temporary shoring, embankments, roadway cuts and subgrade improvements. Typical hydraulic structures would include box culverts, rectangular precast concrete boxes and special and modified drainage structures. The Group prepares plans and computes bid quantities of these specific roadway and hydraulic structures. The Group reviews shop drawings, engineering design drawings and structural engineering calculations of all submittals from contractors, consultants and manufacturers to insure conformance with SCDOT design standards and policies. The Group is responsible for all structural designs required in the *Standard Drawings*.

4. Letting Preparation Group. The Letting Preparation Group consists of the following:

   a. Operations Center/Specifications and Estimates Group. The Operations Center and the Specifications and Estimates Group are responsible for preparing the bid proposal documents for letting. This includes:

      - receiving the road plans from the Road Design Groups and other Units (e.g., Bridge Design, Traffic Engineering, Consultants);
      - insuring the road plans have been reviewed by the applicable Units and have all the necessary signatures;
      - requesting and submitting necessary prints to other agencies;
      - calculating the road plan cost for letting;
      - preparing the Engineer's Estimate;
      - calculating the contract completion date;

Contract Documents Unit renamed to Letting Preparation Group – Revised: 10-2005

- preparing Bid Proposals;
- developing uncommon Special Provisions; and
- assembling all the documents for printing.

b. Engineering Reproductions Services/Plans Storage. Engineering Reproductions Services is responsible for any printing required by the Road Design Section (e.g., Field Review Plans, Bid Proposals) or other Sections. The Plans Storage Unit is responsible for cataloging and storing the design plans after they have been forwarded to the Contract Administration Office for letting.

5. Engineering/Consultant Services Unit. For projects where a consultant does the road design work, this Unit is involved at all stages, beginning with the advertising of the proposed contract to the final review of the submitted plans. The Engineering Consultant Services Group:

- evaluates consultant's qualifications;
- makes recommendations to the Selection Committee as to a consultant's qualifications and suitability for a particular project;
- assists in the preparation of consultant agreements;
- reviews proposal for road design services from consultants for other SCDOT sections;
- prepares man-hour estimates for comparisons and negotiations of contracts;
- provides consultants with necessary information to design projects; and
- reviews consultant plans for accuracy, completeness and compliance with Department criteria.

The Engineering/Consultant Services Unit also contains the following Units:

a. Engineering Support. Engineering Support is responsible for day-to-day support of Road Design by:

- researching technical manuals and advisory materials,
- coordinating the development and updating of engineering reference materials,
- creating and reviewing standard drawings for road construction,
- presenting training classes,
- providing daily on-call assistance with standard road design applications, and
- making field inspections when called upon.

b. Engineering Visualization. Engineering Visualization is responsible for creating public hearing maps and other displays for public meetings.

placed on the plans in a form that can be easily found and understood by those charged with the task of constructing the project.

4.2.7 Utilities Office

The Utilities Office is responsible for coordinating with utility and railroad companies impacted by highway improvement projects. The following describes the coordination between the Utilities Office and the Road Design Groups:

1. Utility Coordination. After the Right of Way Plans are complete, the Road Design Group will provide the Utilities Office with a set of plans with the existing utilities plotted as determined from the survey. The Road Design Group will list the utility conflicts by station and offset from the centerline and place the subsurface utility locations on the cross sections. The Utilities Office will work with any impacted utility companies to implement the utility coordination process.

2. Railroad Coordination. The Utilities Office will work with the Road Design Group and other Department Units to prepare plans that incorporate railroad requirements and criteria and are acceptable to all parties.

4.2.8 Road Design Section

The Road Design Groups must coordinate the development of the Road Design Plans with the various Units within the Road Design Section. The following describes this coordination.

4.2.8.1 Roadway Structures Design Group

The Roadway Structures Design Group will prepare the design for small structures (e.g., retaining walls, box culverts and noise barrier walls). The Road Design Group will insure that these designs are compatible with the overall project design. The Roadway Structures Design Group will prepare the necessary contract plans and quantities for direct insertion into the overall set of construction plans and quantity estimates.

4.2.8.2 CADD Support

The Road Design Group is responsible for using the Department’s computer-aided drafting and design packages (e.g., MicroStation, GEOPAK) in project development. CADD Support is available to assist the Road Design Group in their use.

4.2.8.3 Plans, Specifications and Estimates Group

The following describes the coordination between the Road Design Groups and Plans, Specifications and Estimates Group:

1. Bid-Proposal Documents. Once the Road Design Group has completed the final construction plans, quantities, Special Provisions and specifications, the Plans, Specifications and Estimates Group will transfer these to the Letting Preparation Group for assembly within the bid-proposal documents.

2. Reproduction. When the Road Design Group requires major printing efforts (e.g., Design Field Review Plans), the Road Design Group will coordinate with the Engineering Reproduction Services for the printing.

3. Plans Storage. The Plans Storage Unit is responsible for cataloging and storing the Final Construction Plans after they have been forwarded to the Contract Administration Office for letting. When needed, the Road Design Group will contact the Plan Storage Unit to retrieve the Final Construction Plans. The Final Plans Section stores the As-Built Plans.

4.2.8.4 Engineering/Consultant Services Unit

The following describes the coordination between the Road Design Groups and Engineering/Consultant Services Unit:

1. *SCDOT Standard Drawings*. Engineering Support maintains the *SCDOT Standard Drawings.* The Road Design Group will coordinate with Engineering Support to pose questions or to recommend revisions.

2. Visual Displays. When needed for public presentations, the Road Design Group will contact Engineering Visualization to prepare the maps, displays, etc.

3. Quality Control Review. The Design Services Group is responsible for conducting a quality control review of the Final Construction Plans prepared by the Road Design Groups.

9.2 ADHERENCE TO GEOMETRIC DESIGN CRITERIA

The *South Carolina Highway Design Manual* presents numerous criteria on road design for application on individual road design projects. In general, the designer is responsible for making every reasonable effort to meet these criteria in the project design. However, this will not always be practical. This Section discusses the Department's procedures for identifying, justifying and processing exceptions to the geometric design criteria in the *Highway Design Manual*.

9.2.1 Department Intent

The general intent of the South Carolina Department of Transportation is that all road design criteria in this *Manual* should be met and, wherever practical, the proposed design should exceed the minimum criteria. The Department's intent is to provide a highway system that meets the transportation needs of the State while insuring an acceptable level of safety, comfort and convenience for the traveling public.

9.2.2 Design Exceptions

Recognizing that meeting the minimum criteria may not always be practical, the Department has established a process to identify, evaluate and approve exceptions to geometric design criteria. This Section presents those design elements that require a design exception when the proposed design does not meet the applicable criteria. The "controlling" design criteria are highway elements that are judged to be the most critical indicators of a highway's overall safety and serviceability.

The designer must seek a FHWA and/or SCDOT design exception when the proposed design includes any of the following elements that do not meet the following criteria:

- design speeds;
- horizontal alignment elements:
  - minimum radii, and
  - sight distance at curves based on level stopping sight distance (SSD);
- vertical alignment elements:
  - K-values based on level SSD for crest and sag vertical curves,
  - maximum grades, and
  - vertical clearances (without clearance for future overlay);
- travel lane and shoulder widths;
- cross slopes for travel lanes and shoulders;

- superelevation rates;
- clear roadway bridge widths;
- structural capacity of bridges;
- horizontal clearances to obstructions; and
- stopping sight distances.

9.2.3 Project Application

The design exception process applies to all capital improvement projects considered new construction and reconstruction. It does not apply to spot improvement projects. Note that, for both new construction and reconstruction, the list of design elements that require an exception when not met (Section 9.2.2) is identical. However, the numerical threshold will vary accordingly to the project scope of work.

As noted in Section 9.9, requests for design exceptions will be submitted by the Director of Preconstruction to FHWA for all new construction/reconstruction projects on Interstates and for projects on NHS routes that exceed $50 million. The request for design exceptions will be processed internally within SCDOT for all other projects. See Section 9.2.5.

9.2.4 Documentation

The type and detail of the documentation needed to justify a design exception will be determined on a case-by-case basis. The following lists potential factors that may be addressed in the documentation for a specific design exception:

- amount and character of the current and design year traffic;
- serviceability impacts (e.g., traffic level of service);
- number and type of crashes, fatal crash rate and fatal crash rate on a comparable system;
- project's compatibility with adjacent sections of roadway (e.g., comparisons of lane widths, shoulder width, slopes, curvature);
- probable timing for scheduled future improvements within the proposed project limits;
- cost analysis (maximum service and safety benefits for dollars invested);
- environmental considerations;
- right of way costs and impacts; and
- assessment of the structural and functional adequacy of existing bridges.

9.2.5 **Procedures**

A design exception may be identified at any time during the development of the project. The project development process specifies opportunities when design exceptions should be identified. Identification of design exceptions is, also, included in the quality control review of the project plans.

When a design exception is identified by the Program Manager or any Project Development Team member, the Program/Project Manager or the Engineer of Record will first seek to eliminate the exception to design. If the design exception cannot be removed, then either the Program/Project Manager or the Engineer of Record will initiate the formal design exception approval process. The request for approval of the design exception will be submitted to the Program/Project Manager. The Design Exception Request will include the request form (see Figure 9.2A) and any support data needed to justify the reason why the exception cannot be eliminated through the design process including design alternatives. The request for approval will be prepared for a design exception to AASHTO guidelines and/or for a design exception from standard SCDOT procedures.

Request for Approval of Design Exceptions can be approved only by the Director of Preconstruction. On projects requiring oversight approval by the Federal Highway Administration, the Director of Preconstruction submits the approved Design Exception Request to FHWA for their concurrence.

Submitted By: _______________ Date: __/__/__ Recommended: _________________ Date: __/__/__
Engineer of Record

To: ________________________
Program / Project Manager

BASIS OF DESIGN EXCEPTION

- ☐ Request for Approval of Design Exceptions to AASHTO Guidelines
- ☐ Request for Approval of Design Exceptions from Standard SCDOT Procedures

PROJECT CHARACTERISTICS

County: ______________________ Rd./Route: _______________ Const. Pin: _________________________
From: ________________________ To: ______________________
Length: _________ (miles) MPO/COG ________________
Work Type: ____
Functional Classification: ____

Group Designation: (1 / 2 / 3 / 4) (if applicable)

Type of Terrain: (Level / Rolling / Mountainous)

Design Speed: _________(mph)

_______ ADT _______
_______ ADT _______
Trucks ______________%

CRASH ANALYSIS

(Attach additional sheets with accident history data)

TOTAL PROJECT ESTIMATE **($)_________________**

CHECK APPROPRIATE BOX(ES) FOR DESIGN EXCEPTION(S)

- ☐ Design Speed
- ☐ Horizontal Alignment
  - ❑ Minimum Radii
- ☐ Vertical Alignment
  - ❑ Level SSD K-Values
- ☐ Maximum Grade
- ☐ Vertical Clearance
- ☐ Bridge Width
- ☐ Structural Capacity
- ☐ Superelevation Rate
- ☐ Cross Slope
  - ❑ Travel Lanes
  - ❑ Shoulders
- ☐ Travel Lane Width
- ☐ Shoulder Width
- ☐ Horizontal Clearances
- ☐ Stopping Sight Distance

DESCRIBE ELEMENT(S) FOR DESIGN EXCEPTION(S)

(Attach additional Sheets as needed)____
____
____

DESIGN EXCEPTION FORM

Figure 9.2A

JUSTIFICATION FOR DESIGN EXCEPTION(S)

(Attach additional Sheets as needed) ____
____
____
____

DESCRIBE STEPS TO ELIMINATE DESIGN EXCEPTION(S), INCLUDE COST

(Attach additional Sheets as needed)____
____
____

HOW WILL FUTURE CONSTRUCTION IMPACT DESIGN EXCEPTION(S)?

(Attach additional sheets as needed) ____
____
____
____
____

RECORD OF DECISION

☐ For	☐ For	☐ Approved
☐ Against	☐ Against	☐ Denied
____________________ __/__/__	____________________ __/__/__	____________________ __/__/__
(Section Head/DEA)	(Project Development Engineer)	(Director of Preconstruction)

☐ Concur

____ __/__/__
FHWA (NHS Routes > $50 million & All Interstate)

cc:
Director of Preconstruction
FHWA
Program Development Engineer
Road Design Engineer
Bridge Design Engineer
District Engineering Administrator
Central File

DESIGN EXCEPTION FORM
(Continued)

Figure 9.2A

Chapter Ten
SIGHT DISTANCE

Sight distance is the length of the roadway ahead that is visible to the driver. This Chapter discusses stopping, passing, decision and intersection sight distances.

10.1 STOPPING SIGHT DISTANCE

The available sight distance on a roadway should be long enough to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Although greater lengths of visible roadway are desirable, the sight distance at every point along a roadway should be at least that needed for a vehicle to stop. Stopping sight distance (SSD) is the sum of the distance traveled during a driver's perception/reaction or brake reaction time and the distance traveled while braking to a stop.

10.1.1 Assumptions

The AASHTO *A Policy on Geometric Design of Highways and Streets* presents the basic equations for determining SSD. The following briefly discusses the basic assumptions within the SSD model:

1. Brake Reaction Time. This is the time interval between when the obstacle in the road can be physically seen and when the driver first applies the brakes. Based on several studies of observed driver reactions, the assumed value is 2.5 seconds. This time is considered adequate for approximately 90 percent of drivers in simple to moderately complex highway environments.

2. Braking Action. The braking action is based on the driver's ability to decelerate the vehicle while staying within the travel lane and maintaining steering control during the braking maneuver. A deceleration rate of 11.2 feet/second/second is considered to be comfortable for 90 percent of the drivers.

3. Speed. Use the highway's design speed to determine the initial driver speed.

10.1.2 Level Grade

Figure 10.1A provides stopping sight distances for passenger cars on grades less than 3 percent. Wherever conditions permit, use values that exceed the required stopping distance for design. When applying the SSD values, the height of eye is assumed to be

3.5 feet and the height of object 2 feet. Figure 10.1B provides a graphical representation of SSD criteria.

10.1.3 Grade Adjustment

The longitudinal gradient of the roadway impacts the distance needed for vehicles to brake to a stop. Figure 10.1C presents the grade-adjusted SSD. The designer should make every effort to meet these SSD values where downgrades are 3 percent or greater.

Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance On Level Grade (ft)	Stopping Sight Distance	
			Calculated (ft)	Design (ft)
15	55.1	21.6	76.7	80
20	73.5	38.4	111.9	115
25	91.9	60.0	151.9	155
30	110.3	86.4	196.7	200
35	128.6	117.6	246.2	250
40	147.0	153.6	300.6	305
45	165.4	194.4	359.8	360
50	183.8	240.0	423.8	425
55	202.1	290.3	492.4	495
60	220.5	345.5	566.0	570
65	238.9	405.5	644.4	645
70	257.3	470.3	727.6	730
75	275.6	539.9	815.5	820
80	294.0	614.3	908.3	910

Note: These SSD values assume a minor road approach grade less than or equal to 3 percent. For grades greater than 3 percent, see Figure 10.1C.

STOPPING SIGHT DISTANCE
(Level Grade)

Figure 10.1A

12.5 VERTICAL CURVES

12.5.1 Crest Vertical Curves

12.5.1.1 Equations

Crest vertical curves are in the shape of a parabola. The basic equations for determining the minimum length of a crest vertical curve are:

$$L = \frac{AS^2}{200\left(\sqrt{h_1} + \sqrt{h_2}\right)^2} \quad \text{(Equation 12.5.1)}$$

$$K = \frac{S^2}{200\left(\sqrt{h_1} + \sqrt{h_2}\right)^2} \quad \text{(Equation 12.5.2)}$$

$$L = KA \quad \text{(Equation 12.5.3)}$$

where:

- L = length of vertical curve, feet
- A = absolute value of the algebraic difference between the two tangent grades, percent
- S = sight distance, feet
- h_1 = height of eye above road surface, feet
- h_2 = height of object above road surface, feet
- K = horizontal distance needed to produce a 1 percent change in gradient

The length of a crest vertical curve will depend upon "A" for the specific curve and upon the selected sight distance, height of eye and height of object. Equation 12.5.1 and the resultant values of K are predicated on the sight distance being less than the length of vertical curve. However, these values can also be used, without significant error, where the sight distance is greater than the length of vertical curve. The following Sections discuss the selection of K-values. For design purposes, round the calculated length up to the next highest 50-foot increment.

12.5.1.2 Stopping Sight Distance

The principal control in the design of crest vertical curves is to insure that minimum stopping sight distance (SSD) is available throughout the vertical curve. The following discusses the application of K-values for various operational conditions:

1. Passenger Cars (Level Grade). Figure 12.5A presents K-values for passenger cars on a level grade. Level conditions are assumed where the grade on the far side of the vertical curve is less than 3 percent. The minimum values are calculated by assuming h_1 = 3.5 feet, h_2 = 2 feet and S = SSD in the basic equation for crest vertical curves (Equation 12.5.1).

2. Passenger Cars (Grade Adjusted). For crest vertical curves, consider grade adjustments where the downgrade is 3 percent or greater. However, every effort should be made to provide stopping sight distances greater than the design values in Figure 10.1A where horizontal sight restrictions occur on downgrades, even when the horizontal sight obstruction is a cut slope. No adjustment is necessary for grades less than 3 percent. Use Equation 12.5.1 and the grade adjusted SSD's from Figure 10.1C to determine the length of vertical curve.

3. Minimum Length. The minimum length of a crest vertical curve in feet should be 3V, where V is the design speed in miles per hour.

4. Minimum Values. Designs should be made to values as high as are commensurate with conditions. Minimum values should be used only where the use of higher value will result in unacceptable social, economic or environmental consequences.

12.5.1.3 Passing Sight Distance

At some locations, it is desirable to provide passing sight distance in the design of crest vertical curves. Section 10.2 discusses the application and design values for passing sight distance on two-lane, two-way highways. Passing sight distance values are used as the "S" value in the basic equation for crest vertical curves (Equation 12.5.1). In addition, the following will apply:

1. Height of Eye (h_1). For passenger cars, h_1 = 3.5 feet.

2. Height of Object (h_2). Passing sight distance is predicated upon the passing driver being able to see a sufficient portion of the top of the oncoming car. Therefore, h_2 = 3.5 feet.

3. K-Values. Figure 12.5B presents the K-values for passenger cars using the passing sight distances presented in Figure 10.2B.

Bullet 2 - Revised: 10-2005

Bullet 2, Figure 10.1B changed to Figure 10.1C – Revised: 10-2004

12.5.1.4 Drainage

Proper drainage must be considered in the design of crest vertical curves. Typically, drainage problems will not be experienced if the vertical curvature is sharp enough so that a minimum longitudinal gradient of at least 0.3 percent is reached at a point about 50 feet from either side of the apex. To insure that this objective is achieved, determine the length of the crest vertical curve assuming a K-value of 167 or less. Where the maximum drainage K-value is exceeded, carefully evaluate the drainage design near the apex. With the use of proper cross slopes, drainage generally should not be a problem on crest vertical curves.

12.5.2 <u>Sag Vertical Curves</u>

12.5.2.1 Equations

Sag vertical curves are in the shape of a parabola. Typically, they are designed to allow the vehicular headlights to illuminate the roadway surface (i.e., the height of object = 0.0 feet for a given distance "S." The light beam from the headlights is assumed to have a 1° upward divergence from the longitudinal axis of the vehicle. These assumptions yield the following basic equations for determining the minimum length of sag vertical curves:

$$L = \frac{AS^2}{200[h_3 + S(\tan 1°)]} = \frac{AS^2}{200h_3 + 3.5S} \qquad \text{(Equation 12.5.4)}$$

$$K = \frac{S^2}{200h_3 + 3.5S} \qquad \text{(Equation 12.5.5)}$$

$$L = KA \qquad \text{(Equation 12.5.6)}$$

where:

- L = length of vertical curve, feet
- A = absolute value of the algebraic difference between the two tangent grades, percent
- S = sight distance, feet
- h_3 = height of headlights above pavement surface, feet
- K = horizontal distance needed to produce a 1 percent change in gradient

The length of a sag vertical curve will depend upon "A" for the specific curve and upon the selected sight distance and headlight height. Equation 12.5.4 and the resultant values of K are predicated on the sight distance being less than the length of vertical curve. However, these values can also be used, without significant error, where the sight distance is greater than the length of vertical curve. The following Sections discuss the selection of K-values.

12.5.2.2 Stopping Sight Distance

The principal control in the design of sag vertical curves is to insure minimum stopping sight distance (SSD) is available for headlight illumination throughout the sag vertical curve. The following discusses the application of K-values for various operational conditions:

1. Passenger Cars (Level Grade). Figure 12.5C presents K-values for passenger cars. These are calculated by assuming h_3 = 2 feet and S = SSD in the basic equation for sag vertical curves (Equation 12.5.4). The minimum values represent the lowest acceptable sight distance on a facility. Use longer than the minimum lengths of curves to provide a more aesthetically pleasing design.

2. Passenger Cars (Grade Adjusted). For sag vertical curves, consider grade adjustments where the downgrade is 3 percent or greater. No adjustment is necessary for grades less than 3 percent. However, ever effort should be made to provide stopping sight distances greater than the design values in Figure 10.1A where horizontal sight restrictions occur on downgrades, even when the horizontal sight obstruction is a cut slope. Use Equation 12.5.4 and the grade adjusted SSD from Figure 10.1C to determine the length of vertical curve.

3. Minimum Length. The minimum length of a sag vertical curve in feet should be 3V, where V is the design speed in miles per hour.

4. Minimum Values. Designs should be made to values as high as are commensurate with conditions. Minimum values should be used only where the use of higher value will result in unacceptable social, economic or environmental consequences.

Bullet 2 and 3 - Revised: 10-2005
Bullet 4 - Added: 10-2005

Table of Contents

Table of Contents
(Continued)

Section **Page**

Page 17.2(3) Intentionally Left Blank – Revised: 10-2005

17.2 RETAINING WALLS

Where increasing traffic requires a new roadway or the addition of lanes, retaining systems are often necessary (e.g., where existing or proposed slopes are unstable and flattening of the slope is not feasible). This Section addresses the general requirements in the selection of retaining systems.

For information regarding right of way issues and retaining systems, see Chapter 30.

17.2.1 Selection Process

When selecting a retaining system, the following process will be used:

1. Identify Needs. The Program Manager and the Plan Production Team are responsible for identifying the need for a retaining system (e.g., difference in grade elevations, slope stabilization, limited right of way available, environmental concerns, temporary excavation support, etc.)

2. Identify Site Constraints and Project Requirements. The Structural Engineer, Road/Bridge Design, is responsible for identifying the possible types of retaining systems based on site constraints (e.g., fill conditions, height, right of way constraints, etc.) and project requirements (e.g., time, phasing, environmental issues) provided by the Road Design Squad. The Program Manager is responsible for determining the aesthetic requirements for the wall.

   a. Functionality. The functionality of a retaining system is dependant on its intended use, and whether it is permanent or temporary. A retaining system that is in use for 5 or more years is considered permanent and its design life is typically 75 or 100 years depending on the critical nature of its use. Retaining systems can be divided further into fill and cut types based on site-specific criteria. Fill types are most appropriate when the location of the retaining system will be “built up” with borrow material to the finished grade. Cut types are most appropriate when the location of the retaining system will be “cut down” to the finished grade. The Structural Engineer is responsible for determining the appropriate retaining system based on its functionality.

b. Aesthetics. Aesthetic requirements refer to the system's appearance. Aesthetic requirements would include facing, material, color, coping, and possibly layout. The Structural Engineer will assist the Program Manager in developing a list of possible facing options available for the wall. The Program Manager, with assistance from the Environmental Management Office, identifies the aesthetic requirements based on public hearings, communications with property owners, compatibility with other walls on the project and input from the District, and notifies the Structural Engineer of the required facing.

3. Evaluate Alternatives. The Structural Engineer evaluates the alternatives based on the functionality and aesthetic requirements. The Structural Engineer, with the assistance of the Program Manager and Geotechnical Engineer, will conduct a cost analysis for the most appropriate retaining system for the site-specific criteria. The Program Manager will compare other alternatives (e.g., purchasing additional right of way, project realignment, extending bridge structures) to determine the most appropriate option for the project, and notify the Structural Engineer of the chosen option.

4. Geotechnical. Geotechnical Design will order borings based on the possible systems for the site. Geotechnical Design will provide a geotechnical report, geotechnical specifications, and the final recommendation for the retaining system based on the analysis of the borings.

5. Structural. The Structural Engineer will design and detail the retaining system, and will provide design drawings to the Road Design Squad and Geotechnical Design. The Structural Engineer will provide specifications to the Specifications Group of Road Design. Geotechnical Engineers should use the Federal Highway Administration publication, *Geotechnical Engineering Circular No. 2, Earth Retaining Systems* as a guide in selecting the appropriate wall type based on functionality.

PAGE INTENTIONALLY LEFT BLANK

19.3 TABLES OF DESIGN CRITERIA

Figures 19.3A and 19.3B present the Department's design and alignment criteria for freeway projects. The designer should consider the following when using these figures:

1. Applicability. Note that some of the cross-section elements included in the figures (e.g., flush CMB) are not automatically warranted in the project design. The values in the figures only apply after the decision has been made to include the design element in the highway cross section.

2. Manual Section References. These figures are intended to provide a concise listing of design values for easy use. However, the designer should review the *Manual* section references for more information on the design elements.

3. Footnotes. The figures include many footnotes, which are identified by a number in parentheses (e.g., (3)). The information in the footnotes is critical to the proper use of the design tables.

4. Controlling Design Criteria. The figures provide an asterisk to indicate controlling design criteria. If the designer cannot meet the criteria provided in the tables, see the Program Manager for alternatives. Section 9.2 discusses this in more detail and presents the process for approving design exceptions to controlling criteria.

Design Element				Manual Section	Rural	Urban
Design Controls	Design Forecast Year			9.6.2	20 Years	20 Years
	*Design Speed	Minimum		9.5.2	70 mph **(1)**	50 mph
	Access Control			9.8	Full Control	Full Control
	Level of Service	Desirable		9.6.4	B	C
		Minimum			C	D
Cross Section Elements	*Travel Lane Width			13.2.3	12′	12′
	*Shoulder Width	Right	Total Width	13.2.4	12′	12′
			Paved		10′ **(2)**	10′ **(2)**
		Left	Total Width		10′	10′
			Paved		4′ **(3)**	4′ **(3)**
	Auxiliary Lanes	Lane Width		13.2.5	12′	12′
		Shoulder Width	Total Width		12′	12′
			Paved		10′	10′
	Cross Slope	*Travel Lane		13.2.3.3	2.08% **(4)**	2.08% **(4)**
		Auxiliary Lane		13.2.5	2.08% **(5)**	2.08% **(5)**
		*Shoulder	Paved	13.2.4.3	4.17%	4.17%
			Unpaved		8.33%	8.33%
	Median Width	Depressed		13.4.2.3	Min.: 48′	48′ **(6)**
		Flush (CMB)		13.4.2.1	Min.: 22.5′	Min.: 22.5′ **(7)**
Roadway Slopes	Side Slopes	Cut Section	Foreslope	13.3.1	6H:1V	6H:1V
			Ditch Type		V-Ditch	V-Ditch
			Back Slope		6H:1V to 2H:1V	6H:1V to 2H:1V
			Rock Cut		0.25H:1V **(8)**	0.25H:1V **(8)**
		Fill Section			0′ – 5′: 6H:1V; 5′ – 10′: 4H:1V; > 10′: 2H:1V	
	Median Slopes			13.4.2	6H:1V	6H:1V
	Clear Zone			14.3	**(9)**	**(9)**
Bridges	New and Reconstructed Bridges	*Structural Capacity			HL-93	HL-93
		*Clear Roadway Width		13.5.1.1	**(10)**	**(10)**
	Existing Bridges to Remain in Place	*Structural Capacity			HS-20	HS-20
		*Clear Roadway Width		13.5.1.1	**(11)**	**(11)**
	*Vertical Clearance (Freeway Under) **(12a)**	New/Replaced Overpassing Bridges **(12b)**		12.6	17′-0″	17′-0″
		Existing Overpassing Bridges			16′-0″	16′-0″
		Pedestrian Bridges			18′-0″	18′-0″
		Overhead Signs			17′-6″	17′-6″
	Clearance (Freeway Over)	*Railroads		12.6	23′-0″	23′-0″
		Underpass Width		13.5.2	Traveled Way plus Clear Zone	Traveled Way plus Clear Zone

*Controlling design criteria (see Section 9.2)

GEOMETRIC DESIGN CRITERIA FOR FREEWAYS
(New Construction/Reconstruction)

Figure 19.3A

Revised: 10-2005

See Chapter 10 for a more detailed discussion on the various sight distances.

20.1.2.4 Typical Sections

Figures 20.1A and 20.1B illustrate typical schematic cross sections for two-lane highways. The tables in Section 20.1.4 provide the minimum criteria for lane widths, shoulder widths and other cross section elements that should be used on rural two-lane highways.

20.1.3 Alternatives to Widening

Rural two-lane highways that are not candidates for widening to four-lane facilities but are experiencing operational and safety problems or site-specific reductions in LOS may be considered for one or more of the following improvements:

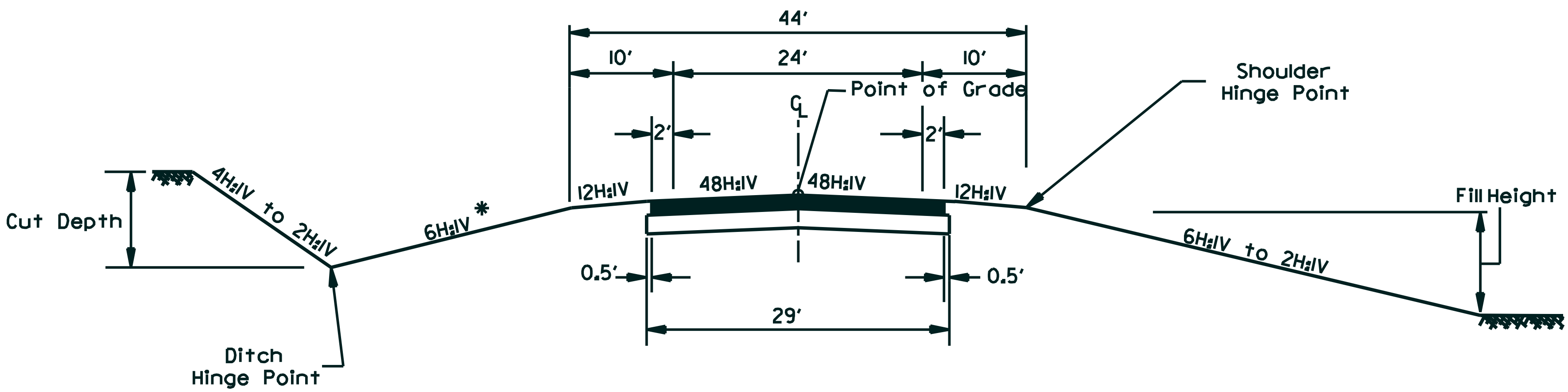
- realigning to improve passing sight distance;
- widening to provide three-lane roadway segments with two-way, left-turn lanes;
- providing a truck-climbing lane; and
- providing passing lanes.

20.1.3.1 Passing Sight Distance

Passing sight distance for two-lane rural highways is critical to the safe operation and capacity of highways. Where sections of existing two-lane highways are carrying substantial volumes of vehicles, increased crash rates or other safety problems, consideration should be given to realignment in order to improve horizontal and/or vertical geometry. This redesign inherently increases the passing sight distance. The minimum passing sight distances for two-lane highways are discussed in Section 10.2.

20.1.3.2 Three-Lane Highways –Two-Way, Left-Turn Lanes

Two-way, left-turn lanes (TWLTL) are viable alternatives where the number of left-turning vehicles is significant. Section 21.2.7 provides the guidelines and criteria for TWLTL. The use of the third or median lane for left-turning vehicles is not normally provided where posted speed limits exceed 50 miles per hour. Therefore, their applicability to rural highways is typically near suburban areas or for roads passing through small towns. This alternative eliminates the possibility for the passing maneuver.

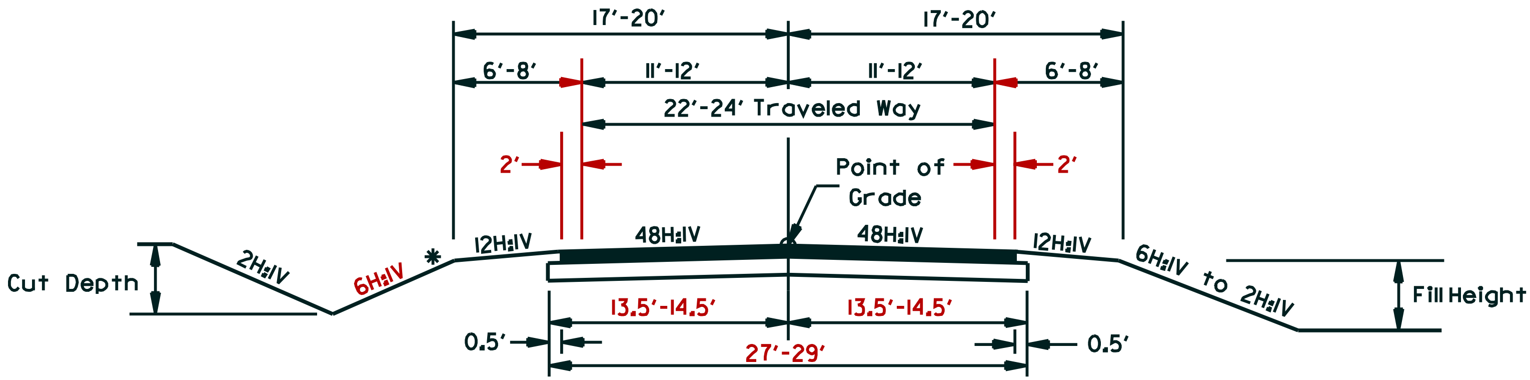


* THIS SLOPE MAY BE VARIED WHEN A DEEPER DITCH IS NECESSARY FOR DRAINAGE PURPOSES, USING A MINIMUM SLOPE OF 12:1 AND A MAXIMUM SLOPE OF 4:1. WHERE A DEEPER DITCH THAN PROVIDED BY A 4:1 IS NECESSARY, THE DITCH SHALL BE PLACED FARTHER FROM THE CL CONTINUING THE 4:1 SLOPE TO PROVIDE FOR THE NECESSARY DEPTH. SEE PROFILE FOR THE SPECIAL DITCH GRADES.

TYPICAL RURAL TWO-LANE ARTERIALS

Figure 20.1A

Revised: 10-2005



* THIS SLOPE MAY BE VARIED WHEN A DEEPER DITCH IS NECESSARY FOR DRAINAGE PURPOSES, USING A MINIMUM SLOPE OF 12:1 AND A MAXIMUM SLOPE OF 4:1. WHERE A DEEPER DITCH THAN PROVIDED BY A 4:1 IS NECESSARY, THE DITCH SHALL BE PLACED FARTHER FROM THE ℄ CONTINUING THE 4:1 SLOPE TO PROVIDE FOR THE NECESSARY DEPTH. SEE PROFILE FOR THE SPECIAL DITCH GRADES.

TYPICAL RURAL TWO-LANE COLLECTORS

Figure 20.1B

20.1.3.3 Intersection Treatments

Depending on the access demands for a particular two-lane facility, intersections can be a critical part of a facility's design. The use of left-turn lanes and bypass lanes to facilitate the movement and enhance the safety of through traffic at intersections is a cost-effective approach for upgrading two-lane rural highways. Detailed analyses of intersections should be performed in accordance with procedures in the *Highway Capacity Manual*.

When modifying intersections, the designer should consider the following:

- design vehicle,
- signal warrants,
- sight distance,
- crash analyses,
- turning movements/lane warrants,
- intersection alignment,
- right of way requirements,
- LOS analysis, and
- economic factors

For additional guidance, see Section 15.2.1.

20.1.3.4 Climbing Lanes

In areas with steep grades, reduced truck speeds may significantly effect the facility's capacity and safety. However, truck climbing lanes can effectively increase capacity and safety. The warrant and design criteria for truck-climbing lanes are discussed in Section 12.4.

20.1.3.5 Passing Lanes

Passing lanes, other than truck-climbing lanes, may be warranted on two-lane facilities where passing opportunities are not adequate or when an engineering study, operational experience and a capacity analysis concludes that there is a critical need. Figure 20.1C illustrates several passing lane designs. The use of a passing lane is determined on a case-by-case basis.

20.1.4 Tables of Design Criteria

Figures 20.1D through 20.1G present the Department's design and alignment criteria for rural two-lane arterials and two-lane collectors. The designer should consider the following when using these figures:

1. Functional Classification. To determine the latest functional classification of a facility, the designer should contact the Road Data Services.

2. Applicability. Note that some of the cross-section elements included in the figures (e.g., TWLTL) are not automatically warranted in the project design. The values in the figures only apply after the decision has been made to include the element in the highway cross section.

3. Manual Section References. These figures are intended to provide a concise listing of design values for easy use. However, the designer should review the *Manual* section references for more information on the design elements.

4. Footnotes. The figures include many footnotes, which are identified by a number in parentheses (e.g., (3)). The information in the footnotes is critical to the proper use of the design tables.

5. Controlling Design Criteria. The figures provide an asterisk to indicate controlling design criteria. If the values in the tables cannot be met, the designer should contact the Program Manager for alternatives. Section 9.2 discusses this in more detail and presents the process for approving design exceptions to controlling criteria.

Design Element				Manual Section	Design Criteria
Design Controls	Design Forecast Year			9.6.2	20 Years
	*Design Speed (maximum)	Level		9.5.2	70 mph
		Rolling			60 mph
		Mountainous			50 mph
	Access Control			9.8	Controlled by Regulation
	Level of Service			9.6.4	Level/Rolling: B Mountainous: C
Cross Section Elements	*Travel Lane Width **(1)**			13.2.3	12′
	*Shoulder Width **(2)**	Total Width		13.2.4	10′
		Paved			2′
	Auxiliary Lanes	Lane Width		13.2.5	12′
		Shoulder Width	Total Width		10′
			Paved		2′
	Cross Slope	*Travel Lane		13.2.3.3	2.08%
		Auxiliary Lane		13.2.5	2.08%
		*Shoulder	Paved	13.2.4.3	2.08% **(3)**
			Unpaved		8.33%
	TWLTL Width			21.2.7	15′
Roadway Slopes	Side Slopes	Cut Section	Foreslope	13.3.1	6H:1V to 4H:1V
			Ditch Type		V-Ditch
			Back Slope		4H:1V to 2H:1V
			Rock Cut		0.25H:1V
		Fill Section	0′ – 5′		6H:1V
			5′ – 10′		4H:1V
			> 10′		2H:1V
	Clear Zone			14.3	**(4)**
Bridges	New and Reconstructed Bridges	*Structural Capacity			HL-93
		*Clear Roadway Width		13.5.1.1	44′ **(5)**
	Existing Bridges to Remain in Place	*Structural Capacity			HS-20 **(6)**
		*Clear Roadway Width		13.5.1.1	44′
	*Vertical Clearance (Arterial Under) **(7a)**	New/Replaced Overpassing Bridges **(7b)**		12.6	17′-0″
		Existing Overpassing Bridges			16′-0″
		Pedestrian Bridges			18′-0″
		Overhead Signs			17′-6″
	Clearance (Arterial Over)	*Railroads		12.6	23′-0″
		Underpass Width		13.5.2	Traveled Way plus Clear Zone

*Controlling design criteria (see Section 9.2).

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE ARTERIALS
(New Construction/Reconstruction)

Figure 20.1D

Revised: 10-2005

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE PRINCIPAL ARTERIALS
(New Construction/Reconstruction)

Footnotes for Figure 20.1D

(1) Travel Lane Width. On reconstructed arterials, an existing 22-foot traveled way may be retained based on an engineering study.

(2) Shoulder (Total Width). Where guardrail is required, increase the shoulder width an additional 3.5 feet.

(3) Shoulder Cross Slopes. For paved shoulders greater than 2 feet, the shoulder cross slope should be 4.17 percent

(4) Clear Zone. The clear zone will vary according to design speed, traffic volumes, side slopes and horizontal curvature.

(5) New and Reconstructed Bridges (Clear Roadway Width). Clear roadway bridge widths are measured from face to face of parapets or rails. Bridge widths are normally defined as the sum of the approach traveled way width plus total shoulder width right and left.

(6) Existing Bridges to Remain in Place. HS-20 capacity structure may be retained if it is not deficient.

(7) Vertical Clearance (Arterial Under).

a. The clearance must be available over the traveled way, shoulders and any anticipated future widening.
b. Table value includes allowance for future overlays.

Bullets 5 and 7a – Revised: 10-2004

Design Element				Manual Section	Design Criteria		
Design Controls	Design Forecast Year			9.6.2	20 Years		
	Design Year Traffic (ADT)			9.6.3	**0 to 400**	**400 to 2000**	**Over 2000**
	*Design Speed (maximum)	Level		9.5.2	60 mph		
		Rolling			50 mph		
		Mountainous			40 mph		
	Access Control			9.8	Controlled by Regulation		
	Level of Service			9.6.4	C		
Cross Section Elements	*Travel Lane Width			13.2.3	11′ **(1a)**	11′	12′ **(1b)**
	*Shoulder Width **(2a)**			13.2.4	6′ **(2b)**	6′ **(2b)**	8′
	Auxiliary Lanes	Lane Width		13.2.5	11′	11′	12′
		Shoulder Width			6′	6′	8′
	Cross Slope	*Travel Lane		13.2.3.3	2.08%		
		Auxiliary Lane		13.2.5	2.08%		
		*Shoulder		13.2.4.3	8.33%		
	TWLTL Width			21.2.7	15′		
Roadway Slopes	Side Slopes	Cut Section	Foreslope	13.3.1	6H:1V to 4H:1V		
			Ditch Type		V-Ditch		
			Back Slope		4H:1V to 2H:1V		
			Rock Cut		0.25H:1V		
		Fill Section	0′ – 5′		6H:1V		
			5′ – 10′		4H:1V		
			> 10′		2H:1V		
	Clear Zone			14.3	**(3)**		
Bridges	New and Reconstructed Bridges	*Structural Capacity			HL-93		
		*Clear Roadway Width **(4)**		13.5.1.1	34′	34′	40′
	Existing Bridges to Remain in Place	*Structural Capacity			H-15		
		*Clear Roadway Width		13.5.1.1	22′	24′	28′
	*Vertical Clearance (Collector Under) **(5a)**	New/Replaced Overpassing Bridges **(5b)**		12.6	16′-0″		
		Existing Overpassing Bridges			16′-0″		
		Pedestrian Bridges			18′-0″		
		Overhead Signs			17′-6″		
	Clearance (Collector Over)	*Railroads		12.6	23′-0″		
		Underpass Width		13.5.2	Traveled Way plus Clear Zone		

* Controlling design criteria (see Section 9.2).

GEOMETRIC DESIGN CRITERIA FOR RURAL TWO-LANE COLLECTORS

(New Construction/Reconstruction)

Figure 20.1E

Revised: 10-2005

Design Volume (veh/day)	Minimum Clear Roadway Width[(1), (2), (3)]	Design Loading Structural Capacity
0 to 50	20 ft	H 10
50 to 250	20 ft	H 15
250 to 1500	22 ft	H 15
1500 to 2000	24 ft	H 15
> 2000	28 ft	H 15

Notes:

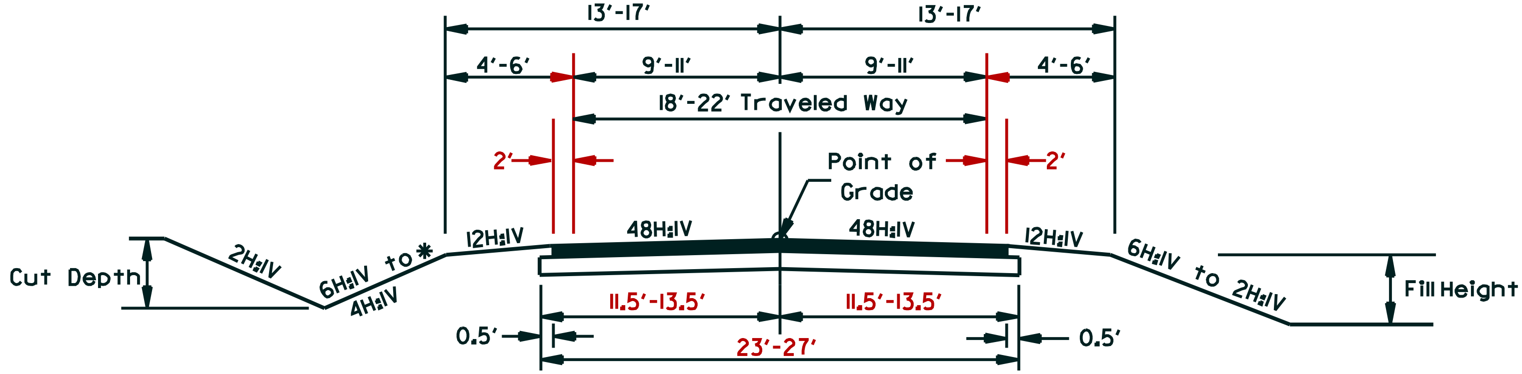
1. Clear width between curbs or rails, whichever is the lesser.

2. Minimum clear widths that are 2 feet narrower may be used on roads with few trucks. In no case should the minimum clear width be less than the approach traveled way width.

3. For single-lane bridges, use 18 feet.

MINIMUM CLEAR ROADWAY WIDTHS AND DESIGN LOADINGS FOR BRIDGES TO REMAIN IN PLACE

Figure 22.2A



✱ THIS SLOPE MAY BE VARIED WHEN A DEEPER DITCH IS NECESSARY FOR DRAINAGE PURPOSES, USING A MINIMUM SLOPE OF 12:1 AND A MAXIMUM SLOPE OF 4:1. WHERE A DEEPER DITCH THAN PROVIDED BY A 4:1 IS NECESSARY, THE DITCH SHALL BE PLACED FARTHER FROM THE ℄ CONTINUING THE 4:1 SLOPE TO PROVIDE FOR THE NECESSARY DEPTH. SEE PROFILE FOR THE SPECIAL DITCH GRADES.

Note: See Figure 22.3A for specific road group criteria.

TYPICAL LOCAL ROAD OR STREET
(With Shoulders)

Figure 22.2B

22.3 TABLES OF DESIGN CRITERIA

Figures 22.3A through 22.3C present the Department's design and alignment criteria for rural and urban local roads and streets. The designer should consider the following when using these figures:

1. Functional Classification. To determine the latest functional classification of a facility, the designer should contact Road Data Services.

2. Applicability. Note that some of the cross-section elements included in the figures (e.g., TWLTL) are not automatically warranted in the project design. The values in the figures only apply after the decision has been made to include the design element in the highway cross section.

3. Manual Section References. These figures are intended to provide a concise listing of design values for easy use. However, the designer should review the *Manual* section references for more information on the design elements.

4. Footnotes. The figures include many footnotes, which are identified by a number in parentheses (e.g., (3)). The information in the footnotes is critical to the proper use of the design tables.

5. Controlling Design Criteria. The figures provide an asterisk to indicate controlling design criteria. If the values in the tables cannot be met, the designer should contact the Program Manager for alternatives. Section 9.2 discusses this in more detail and presents the process for approving design exceptions to controlling criteria.

6. Group Designations. Figure 22.3A has been segregated according to the Group designations defined in Section 22.1.2.

Design Element				Manual Section	Design Criteria			
					Group 1	Group 2	Group 3	Group 4
Design Controls	Design Forecast Year **(1)**			9.6.2	20 years	20 years	20 years	20 years
	*Design Speed			9.5.2	**(2a)**	20 – 50 mph	30 – 50 mph	35 - 60 mph
	Access Control			9.8	Controlled by Regulation	Controlled by Regulation	Controlled by Regulation	Controlled by Regulation
	Level of Service			9.6.4	N/A	N/A	N/A	N/A
Cross Section Elements	*Travel Lane Width			13.2.3	Min: 9′	Des.: 10′ Min.: 9′	Des.: 11′ Min.: 10′	11′
	*Shoulder Width **(3)**			13.2.4	4′ or C/G	Des.: 6′ Min.: 4′ or C/G	Des.: 6′ Min.: 4′ or C/G	6′ or C/G
	Auxiliary Lanes	Lane Width		13.2.5	N/A	N/A	N/A	Min. 11′ **(4)**
		Shoulder Width			N/A	N/A	N/A	6′ or C/G
	Cross Slope	*Travel Lane		13.2.3.3	2.08%	2.08%	2.08%	2.08%
		Auxiliary Lane		13.2.5	N/A	N/A	N/A	2.08%
		*Shoulder		13.2.4.3	8.33%	8.33%	8.33%	8.33%
	Bicycle	Lane Width **(5)**		13.2.3	4′	4′	4′	4′
		Shared Roadway Width			N/A	N/A	N/A	14′ Outside Travel Lane
	Curb & Gutter (Urban)	Type		21.2.9	Vertical or Sloping			
		Width			2′			
	Sidewalk Width			21.2.10	5′	5′	5′	5′
	Median Width	TWLTL		21.2.6	N/A	N/A	N/A	15′
Roadway Elements	Side Slopes	Cut Section	Foreslope	13.3.1	6H:1V to 4H:1V	6H:1V to 4H:1V	6H:1V to 4H:1V	6H:1V to 4H:1V
			Ditch Type		V Ditch	V Ditch	V Ditch	V Ditch
			Back Slope		2H:1V	2H:1V	2H:1V	2H:1V
		Fill Section			6H:1V to 2H:1V	6H:1V to 2H:1V	6H:1V to 2H:1V	6H:1V to 2H:1V
	Median Slopes	TWLTL		21.2.7	N/A	N/A	N/A	2.08%
	Clear Zone			14.3	**(6a)**	**(6a)**	**(6a)**	**(6b)**

*Controlling design criteria (see Section 9.2)

GEOMETRIC DESIGN CRITERIA FOR SECONDARY AND STATE "C" ROADS
(New Construction/Reconstruction)

Figure 22.3A

Revised: 10-2005

Sheet Number	Description
1, 1A, etc.	Title Sheet
2, 2A, etc.	Summary of Estimated Quantities, Removal and Disposal Items, Moving Items, Reset/New Fences, etc.
3, 3A, etc.	Typical Sections and Miscellaneous Details (not covered by *Standard Drawings*)
4, 4A, etc.	Right of Way Data Sheet, Property Strip Map, Traffic Data Sheets
5, 5A, etc.	General Construction Sheets (e.g., Reference Data Sheets, Utility Data Sheets, Drainage Data Sheets, Plan Sheet Layout)
6, 7, 8, etc.	Plan and Profile Sheets (e.g., mainline, side roads, ramps)
6A, 7A, 8A, etc. *	Profile Sheets
D1, D2, D3, etc. *	Drainage Plan Sheets
12, 13, 14, etc.	Details of Plan Sheets, Geometric and Grading Plan for Intersections and Interchanges, Top of Curb Elevations (if not shown on Plan and Profile Sheets)
TC1, TC2, etc.	Traffic Control and Construction Phasing, Detour Plan and Profile Sheets
E1, E2, etc.	Electrical and Lighting Plans
L1, L2, etc.	Landscaping Plans
PM1, PM2, etc.	Pavement Marking Plans
SN1, SN2, etc.	Signing Plans
TS1, TS2, etc.	Traffic Signal Plans
S1, S2, etc.	Roadway Structure Plans (e.g., retaining walls, box culverts)
EC1, EC2, etc.	Erosion Control Data Sheets
U1, U2, etc.	Utility Relocation Sheets (For Information Only)
X1, X2, etc.	Cross Sections
BR1, BR2, etc. UC1, UC2, etc.	Bridge Plans Utility Construction Sheets

* Note that these sheets should only be used where the information cannot be combined with the Plan Sheet.

Revised: 10-2005

SHEET NUMBERING SYSTEM
Figure 34.1B

appropriate *SCDOT Standard Drawings*. The layout sheets should show all lane lines, edge lines, centerlines, markings for passing and no passing situations (the limits of which will be determined in the field by the Resident Construction Engineer), stop lines, channelizing lines, pavement arrows and pavement markers. Notes that can help clarify the Plans are encouraged. The Traffic Engineering Division is responsible for the development of the pavement marking design and associated quantities. Line item quantities for both permanent and temporary pavement markings are incorporated into the Summary of Estimated Quantities Sheet by the road designer.

34.2.13 Signing Plans (Sheets SN1, SN2, etc.)

Although signing design may be incorporated into the Final Construction Plans, a section addressing signing specifications is not presently included in the *Standard Specifications*. However, a sample Special Provision for signing may be obtained from the Traffic Engineering Division. When packaged as part of the Final Construction Plans, the designer should insure that all designs and drawings are prepared on the standard roadway sheet format. A completed signing design includes plans and quantities for bidding and specifications. If development of these plans and specifications are required, the Traffic Engineering Division is responsible for preparing these plans. However, quantities from these sheets are included on the Summary of Estimated Quantities Sheet by the road designer.

34.2.14 Traffic Signal Plans (Sheets TS1, TS2, etc.)

When incorporated in the Plans, traffic signals are developed in accordance with the *Manual on Uniform Traffic Control Devices* and all details of the design are presented on the standard roadway plan sheet. The Traffic Engineering Division is responsible for the development of the Traffic Signal Plans and all associated quantities. The road designer is responsible for incorporating traffic signal quantities in the Summary of Estimated Quantities Sheet.

34.2.15 Roadway Structure Plans (Sheets S1, S2, etc.)

Roadway structures consist of non-bridge type structures (e.g., retaining walls, footings and foundations, box culverts, pedestrian overpasses, buildings for weigh stations, rest areas). These items may appear in the Plans with or without bridge improvements and are typically included with the Final Construction Plans.

Normally, the Roadway Structures Design Group will develop these structure plans. However, if these plans are being packaged in the Final Construction Plans, design drawings are prepared on standard roadway sheets with title boxes and all work items are quantified on the Structure Summary Sheet and included on the Summary of Estimated Quantities Sheet.

34.2.15.1 Drainage Structures

The Right of Way Plans reflect the intent to which drainage impacts the proposed right of way and parcels of land to be acquired. To this extent, the major drainage items are established and documented on the Plans. It is mandatory that the structure type be determined and depicted on the Plans in cases where the roadway overpasses a creek or stream (e.g., bridge vs. box culvert). The same applies for parallel roadway drainage, ditches and channels, conveyance of storm drainage at side roads and driveways and clean out requirements of transverse ditches and streams.

Show the locations of all drainage system structures (e.g., inlets, headwalls, wingwalls, manholes, junction boxes) graphically with the location identified to the station offset and invert elevation. The pipe size and material type are also shown in the Plans by:

- labeling each location on the Plans, or
- developing a drainage tabulation box.

Where drainage structures require inlet, outlet or special treatment, not covered by the *SCDOT Standard Drawings*, prepare a special detail drawing. Show all pertinent dimensions including length, width, thickness, size and location of all concrete and reinforcing steel. Special details should reference the *Standard Specifications* pertaining to the use of materials and construction procedures to be used in the construction of special structures.

Drainage areas are to be shown for pipes 48 inches or greater. Hydrology data should be shown in the details for all culverts 48 inches or greater on Federal-aid projects.

The sectional view is a tool for setting the limits of drainage structures. Inlet and outlet structure locations and invert elevations are established and shown with respect to the roadway shoulder slopes and the existing stream profile. The sectional view should also identify headwater elevation for the appropriate design year storm. Any approach and discharge stream grading or special treatments should be shown in the sectional view along with a transverse section of the channel improvement. For the transverse approach and discharge channels, show the bottom width, side slope, design stormwater elevation, and type and thickness of lining.

Show the hydrology data on the drawings in all cases incorporating bridges/culverts conveying water through a roadway section. Data should be incorporated as recommended in the Hydraulics Engineering Section's publication, *Requirements for Hydraulic Design Studies*.

Changed from 30 inches - Revised: 10-2005