MINNESOTA DEPARTMENT OF TRANSPORTATION
Engineering Services Division
Technical Memorandum No. 12-14-B-03
December 18, 2012

To: Electronic Distribution Recipients

From: Jon M. Chiglo, P.E.
Division Director, Engineering Services

Subject: Bridge Width Standards for State Highways

Expiration
This is a new Technical Memorandum and will remain in effect until December 18, 2017 unless superseded or published in the MnDOT Bridge LRFD Manual prior to that date.

Implementation
The design guidance contained in this Technical Memorandum is effective immediately for projects in the early stages of the preliminary design phase, and may be incorporated into projects in a more advanced design phase.

It is required that final selection of the traveled lane width and design of the roadway shoulder width be thoroughly documented in the Project Design Memorandum. Documentation should be submitted to the MnDOT Preliminary Bridge Plans Unit for review and concurrence of appropriate bridge cross section elements, including all considerations leading to selection of appropriate bridge shoulder width standards as defined herein.

Introduction
Many state transportation departments have been turning to flexible design as a solution to resolving various transportation challenges. The benefits of flexible design allow for a greater sensitivity to the design needs of multiple travel modes, the local community, and the surrounding environment. This design approach also provides an opportunity to increase safety on a system-wide basis by stretching available funding to improve safety over a larger exposure area. MnDOT has been moving forward with its own flexible design initiative and this Technical Memorandum is one in a series that are being published to help support the statewide effort.

Purpose
In response to the department wide initiative to promote more design flexibility, MnDOT Bridge Width Standards were reviewed with respect to current AASHTO Standards and guidance, along with MnDOT Technical Memoranda No. 12-07-TS-02 and No. 12-12-TS-06, wherein the new design criteria represents a conceptual change in how lane and shoulder width design choices are made. The Roadway Designer is given more leeway in selecting the most appropriate standard by incorporating a multitude of design considerations. Because of this flexibility, detailed decision documentation is required.

Past practice required minimum bridge shoulder widths per singular values in accordance with the minimum MnDOT bridge shoulder width standards as published in the MnDOT Bridge LRFD Manual, or a Design Exception would be required. The revised minimum bridge shoulder width standards now are represented by a “minimum range” and will allow for more design flexibility without seeking a Design Exception for many cases where Design Exceptions were previously required. Bridge Shoulder and Lane Width Standards are now specified as “minimum range” values, with the lower most value in the range defining the Minimum Width Standard, unless a Design Exception is approved.

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Guidelines

General Design Considerations

Care must be exercised in determining widths. As with other engineering judgments, an appropriate design balances operational performance with physical, contextual, environmental, and economic considerations. Additionally, the safety and operations of the various travel modes along and across the right of way must be equitably balanced amongst themselves.

Geometric design choices can have a substantial impact on the maintainability of bridge structures. Temporary Traffic Control requirements often dictate the closure of a traffic lane if equipment setup areas and offset distances cannot be accommodated on the shoulder. This can add traffic control labor, equipment, and material cost and time to maintenance operations for the life of the facility. The responsible operations and maintenance organization must be consulted with and have the ability to provide input. This must occur before the finalization of any bridge width.

Detailed design decision documentation for bridge shoulder and lane width standards must be provided by the District Project Manager and include a checklist identifying all bridge width criteria leading to the selected standards for the project. As a minimum, the checklist must include all considerations identified in section 2.1.2 of Attachment A of this technical memorandum.

The current MnDOT Bridge LRFD Manual Section 2 Contains the following sub-sections that are being updated as defined in this Technical Memorandum:

Section 2.1 Geometrics:
Previous Roadway classification definitions are retained. No changes to this section.

Section 2.1.1 Bridge Geometrics
General Criteria revised to include consideration of revised lane and shoulder width determination approach, based on MnDOT Technical Memorandum Nos. 12-07-TS-02 and 12-12-TS-06, which require project design documentation.

Section 2.1.2 Bridge Deck Requirements
Minimum “standard ranges” are defined that allow for flexible design based on revised lane and shoulder width criteria as defined in MnDOT Tech Memo Nos. 12-07-TS-02 and 12-12-TS-06. The minimum values in the range represent the minimum shoulder width that may be used without obtaining a Design Exception.

Section 2.1.4 Geometric Details
This section includes specific geometric details for bridge decks and undercrossings, and are updated to reflect the revised shoulder widths of approach roadway criteria.

Minimum shoulder width ranges are shown in Figures 2.1.4.1 through Figure 2.1.4.6 for illustration and clarity of the “minimum ranges” applicable. The minimum value shown in the range represents the minimum value that may be used, with proper documentation in the Project Memorandum. Design Exceptions are required for bridge shoulder widths that are less than the minimum shown in the range.

Use of This Technical Memorandum:
Attachment A (pages 2-1 through 2-5.1 and pages 2-16 through 2-21) supersedes MnDOT Bridge LRFD Manual pages 2-1 through 2-5 and 2-16 through 2-21.

Formal MnDOT Bridge LRFD Manual Updates will be provided separately.

Questions
Any questions regarding the technical provisions of this Technical Memorandum can be addressed to any one of the following:

- **Michael Elle at (651) 366-4622, Project Manager, 13cc Design Flexibility Initiative Engineer**
- **Keith Molnau at (651) 366-4456, State Preliminary Bridge Plans Engineer**

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

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Attachments:
Attachment A, Pages 2-1 through 2-5.1 and 2-16 through 2-21

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2. GENERAL DESIGN AND LOCATION FEATURES

The design of a bridge typically takes place in two major phases of work: preliminary design and final design. During preliminary design, the structure type, the foundation type, the aesthetics, and the primary geometry for the bridge are determined. During final design, specific details for all of the elements of the bridge are developed and presented in the plan set. These details include material descriptions, quantities, and geometric information. Final plan sets are typically assembled in an order that roughly follows the order of construction: from the ground up.

This section of the manual contains a large amount of information useful for the preparation and assembly of plans for a project. To facilitate the production of plans and standardize the content of bridge plan sets, special provisions, B-Details, standard plans, standard plan notes, and standard pay items have been prepared by the Bridge Office. Appendices to Section 2 identify the material available.

As the name of the section implies, content for this section is general in nature. Guidance for the design of specific structural elements (e.g. decks, retaining walls, etc.) is provided elsewhere in the manual.

2.1 Geometrics

2.1.1 Bridge Geometrics

Definitions

For discussion of bridge geometrics in this section, roadways are classified as Mainline Highways, Ramps, Local Roads, and Local Streets. Each of these four groups is further classified under either Urban or Rural Design.

The following definitions apply:

- Mainline Highways – Roadways that carry through traffic lanes for freeways, expressways, and primary and secondary highways.
- Local Roads – Rural roads off the trunk highway system.
- Local Streets – Urban roads off the state trunk highway system.
- Ramps – Segments of roadway connecting two or more legs at an interchange.
- Urban Design – Roadways with curbs on the right and/or left sides.
- Rural Design – Roadways without curbs.
- Median Width – The distance between the edges of opposing through traffic lanes.
- Auxiliary Lane – A lane adjoining a through traffic lane for a purpose supplementary to through traffic movement such as truck climbing, weaving, speed change or turning.

General Criteria

The width of the bridge deck and the typical section at the bridge undercrossing are determined by the classification and geometrics of the approaching roadway, together with consideration of appropriate design considerations for flexible shoulder width standards. The geometrics of the approaching roadway are to be carried over and under the bridge to the maximum extent practicable.

Bridge width requirements are a function of the lane and shoulder widths of the approaching roadway, together with assessment of pedestrian and bicycle needs, multimodal requirements, drainage requirements, staging, and other project specific considerations. The determination of the appropriate roadway and bridge shoulder width for each project will require study of specific project needs. Detailed decision documentation is required by the Roadway Designer during the preliminary layout, preliminary design phase, and should be coordinated with the Preliminary Bridge Plans Engineer for determination of the required bridge shoulder and lane widths. Bridge shoulder and lane widths should be included with project design element documentation in the district project design memo.

Rural design is considered the desirable design and will be used in all rural areas and in urban areas where sufficient right of way is available or can be obtained, provided it is not detrimental to accommodating multi-modal travel. Urban design geometrics (curbed roadways) are slightly more restrictive and are therefore used at locations where extensive right-of-way cost or other unusual conditions are controlling factors.

The discussion of geometric details included in this section describes bridge deck geometrics separately from bridge undercrossing geometrics. For side clearances at certain undercrossing situations, both a “desirable” and a minimum section are shown.

Application of Standards

The geometrics shown apply specifically to new work. However, use of these geometrics is also highly desirable when upgrading or widening existing facilities and should be incorporated in these situations. Bridge deck geometrics on the local road system must also comply with *State-Aid for Local Transportation Operations Rules*, Chapter 8820.

Responsibility

The Preliminary Bridge Plans Engineer will be responsible for assuring that the geometric standards in this section are followed. Where a deviation from the standard is necessary, a written description of the

deviation shall be prepared by the Preliminary Bridge Plans Engineer and submitted to the State Bridge Engineer when submitting the Preliminary Bridge Plan for acceptance.

2.1.2 Bridge Deck Requirements

Bridge Width Criteria

Roadway cross sections that approach bridges will normally provide a clear zone recovery area beside the travel lane for the benefit of out-of-control vehicles. It is not economical or practical to carry these full clear zone widths across bridges. Since the railing is located within the clear zone it is considered a hazard and guardrail protection is required in the approach area.

Roadway and bridge width standards have been revised to allow for more design flexibility, which in turn, will enable project designers to have greater latitude in addressing specific project requirements. Bridge shoulder width standards are now specified as "minimum range" values, with the lowest value in the range defining the Minimum Shoulder Width Standard, unless as Design Exception is approved. Detailed design decision documentation should include a checklist leading to the selected standards for the project and must include consideration of the following functions of the shoulder.

Functions of the shoulder include:

- Recovery area to regain control of a vehicle.
- Emergency parking area for stalled vehicles and escape route for stranded motorists.
- Passageway for bicycles and pedestrians.
- Passageway for emergency vehicles.
- Parking area for bridge maintenance and inspection vehicles (working area for bridge inspection snooper and lane closure requirements).
- Temporary traffic lane during deck repairs or overlay construction.
- Area for deck drainage and snow storage.
- Accommodates passing of wide oversize loads, especially farm machinery.
- On two-lane highways, the shoulders provide an escape area to avoid a head-on collision with an oncoming passing vehicle.
- Designated bus shoulders
- Staging needs during construction

The following shoulder widths for both rural and urban design apply to trunk highway bridges. In addition, these standards apply to bridges on local roads at a trunk highway freeway interchange. For local roads and streets, the bridge roadway widths are given in the *State Aid Manual*, Section 5-892.210 and the *State Aid Operations Rules*, Chapter 8820.

Long and high cost bridges should be evaluated on an individual basis and modifications to these standards are allowed based on detailed studies and judgment. In addition to these values, the bridge roadway width shall meet the additional requirements for sight distance and sharp curvature as specified in Part 4 below.

1) Rural Design
   a) Two-Lane Rural Design
      Shoulder widths are given in the table on Figure 2.1.4.1 and are dependent on the functional classification of the roadway, traffic volumes, multimodal considerations, and shoulder width of the approach roadway.
   b) Four-Lane Rural Design
      i) Right Shoulder: 8’-0” to 12’-0”; Interstate 10’-0” to 12’-0”
      ii) Left Shoulder: 4’-0” to 6’-0”
   c) Six- or Eight-Lane Rural Divided Highway
      i) Right Shoulder: 10’-0” to 12’-0”; Interstate 10’-0” to 12’-0”
      ii) Left Shoulder: 10’-0” to 12’-0”; Interstate 10’-0” to 12’-0”
      The full inside shoulder allows disabled vehicles in the left lane to stop on the inside shoulder rather than try to cross two or three lanes of traffic to get to the outside shoulder. A 56’-0” bridge width using 10’-0” inside and 10’-0” outside shoulders allows space for a temporary median barrier and four 11’-0” lanes with 2’-6” shy distance to barriers.
   d) Mainline Rural Bridge with Auxiliary Lane
      i) Right Shoulder: 6’-0” to 8'-0"
   e) Mainline Rural Bridge with Entrance or Exit Ramps
      i) Right Shoulder: 6’-0” to 8'-0"
   f) Rural Bridges with Turn Lanes
      i) Right Turn Lane
         (1) Right shoulder: 4’-0” to 6'-0"
      ii) Left Turn Lanes
         (1) Adjacent to a barrier railing: 4’-0” to 6’-0”
   g) Rural Ramp Bridges (one 16'-0" lane, one-way)
      i) Right Shoulder: 6'-0"
      ii) Left Shoulder: 4'-0"
      On ramp bridges the dimension from edge of lane to gutter is reduced to prevent the appearance of a two-lane bridge on a one-lane ramp. The roadway width is 26'-0", which allows traffic to pass a stalled vehicle. With a 16'-0" lane the outside 2'-0" could, in effect, be considered as part of the shoulder for a 12'-0" lane.

For ramp bridges on sharp curves or with substantial truck traffic, refer to additional width requirements for ramp bridges specified in section 2-4.a below.

2) Urban Design (Approach Curbs)

For urban designs the bridge gutter lines shall be aligned with the curb line on the approaching roadway with the following exceptions:

a) On four-lane divided highways where there are no median curbs, the left shoulder shall be: 4'-0" to 6'-0".
b) On six- and eight-lane divided highways where there are no median curbs, the left shoulder shall be 10'-0" minimum.
c) On one-lane urban ramps (16'-0" approach roadway), both right and left shoulders shall be 4'-0" (provides a 24'-0" roadway).
d) Where an auxiliary lane, ramp, or taper extends onto a mainline bridge, the right shoulder shall be: 4'-0" to 6'-0".
e) The minimum distance to a barrier railing is 4'-0" to 6'-0".

Urban shoulder widths will vary according to functional class, traffic volumes, multi-modal needs, scope of work, and quality of pavement surface. Provide a 2'-0" reaction distance to a raised island type median or sidewalk curb where vehicle speeds are 40 mph and under. For design speeds 45 mph and higher, provide a 4'-0" reaction distance.

3) Bus Shoulders

Where the right shoulder has been designated as a bus shoulder a 12'-0" width shall be provided across bridges. See Road Design Manual 4-4.03 and Table 4-4.03A.

4) Additional Width Criteria

a) Where a ramp (loop) bridge is on a radius of 190'-0" or less, or when the volume of trucks is 10% or greater, the effective traffic lane is increased from 16'-0" to 18'-0" in width to accommodate truck turning movements. Increase the width of the ramp bridge accordingly.
b) For curved bridges longer than 100 feet, check the horizontal stopping sight distance and increase the inside shoulder width up to a maximum of 10'-0". See *Road Design Manual*, Chapter 3 for calculation of this distance. The 2001 edition of the AASHTO book, *A Policy on Geometric Design of Highways and Streets*, changed the height of object from 6" (muffler) to 2'-0" (tail light). In 2001, MnDOT adopted the design policy revisions as recommended in NCHRP Report 400 (1997) for stopping sight distance (SSD). Table 2.1.2.1 has been updated to reflect MnDOT's current practice and gives widths required for a

c) continuously curving bridge for various design speeds and curvature, and applies only where the line of sight is blocked by the railing.

Table 2.1.2.1
Shoulder Width Requirements for Curved Bridges

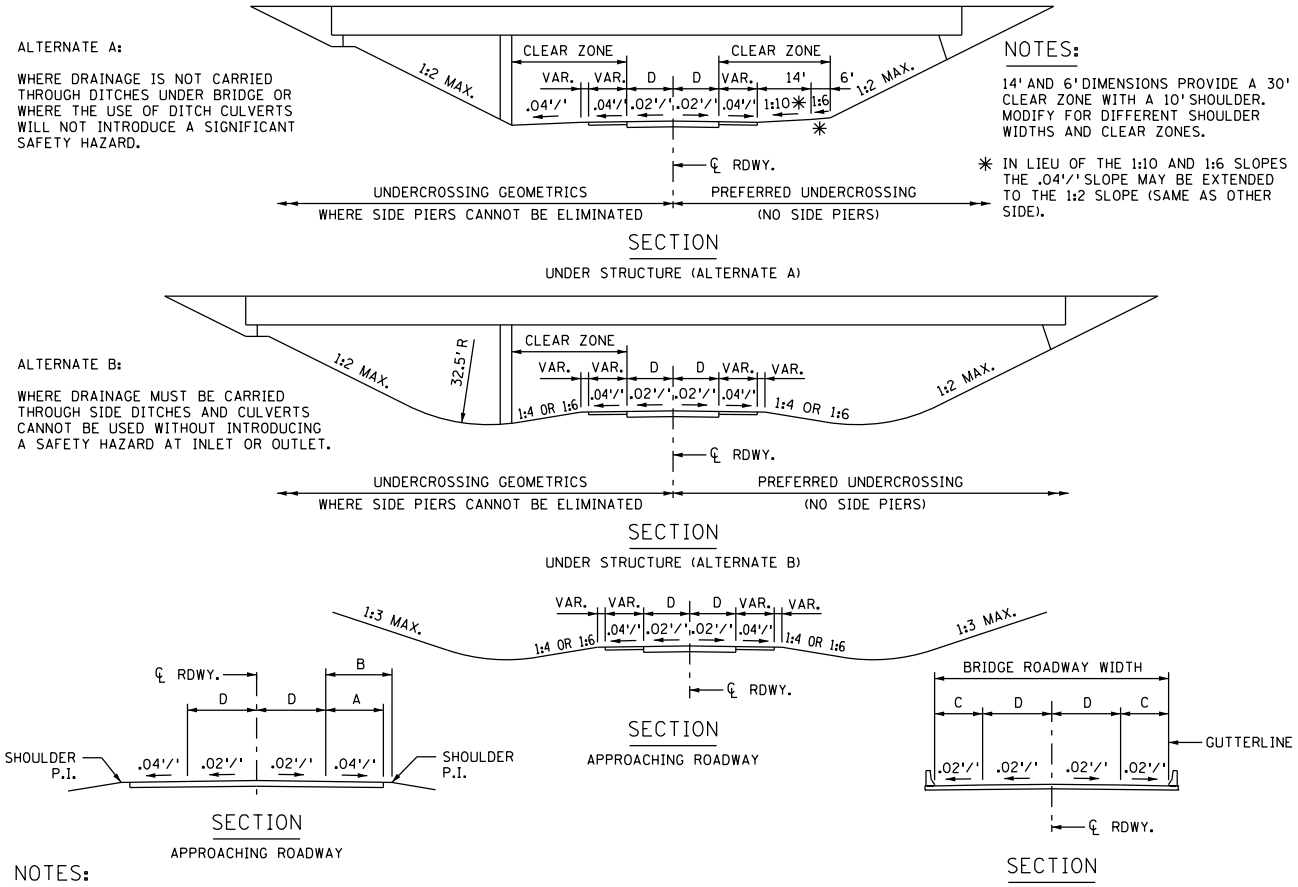
DESIGN SPEED	SHOULDER WIDTH FOR DEGREE OF CURVATURE LISTED		
	6 FT.	8 FT.	10 FT.
70 mph	to 1^o	1^o	> 1^o
60 mph	to 1^o 30'	> 1^o 30' to 1^o45'	> 1^o45'
50 mph	to 3^o	> 3^o to 3^o 30'	> 3^o 30'
40 mph	to 5^o 45'	> 5^o 45' to 6^o 45'	> 6^o 45'

d) For bridges on tapers, the taper should begin or end at a pier or an abutment, or continue across the entire length of the bridge. Extra width to eliminate or simplify a taper or curvature is permissible where justified by simplified design and construction.

Cross Slopes on Bridges

1) The cross slope on bridge traffic lanes is the same as the approaching roadway lanes, normally 0.02 ft./ft. The shoulder cross slope on the bridge may continue at 0.02 ft./ft. or, if better drainage is desired, may be 0.005 ft./ft. greater than the adjacent lane, with a maximum cross slope of 0.04 ft./ft. If a shoulder functions as a pedestrian access route, cross slopes must not exceed 2% to be ADA-compliant. When the bridge deck is superelevated, the shoulders shall have the same slopes as the adjacent bridge traffic lanes. The 0.005 ft./ft. maximum cross slope change between adjacent lanes and shoulders is determined for constructability by limiting the need for atypical detailing such as special bar bends in the deck. Additionally, effects of straight beams that are non-concentric with the deck cross slope can typically be neglected with the limited cross slope change. Effects of cross slope change increase on curved alignments, which require additional consideration and adjustment of stools, seat elevations, and resulting encroachment on vertical clearances.

Keep superelevation transitions off bridges. In instances where they are unavoidable, it is preferable for ease of deck pouring to maintain a straight line across the deck at all locations (allows a straight screed between paving rails placed at both sides of the deck.)



NOTES:

BRIDGE SHOULDER WIDTH SHOULD NORMALLY HAVE THE SAME SHOULDER WIDTH AS THE USABLE SHOULDER ON APPROACH ROADWAY. BRIDGE SHOULDER WIDTH RANGE ALLOWS FOR FLEXIBILITY TO ADDRESS FUNCTIONS OF THE SHOULDER (SEE SECTION 2.1.2).

MINIMUM BRIDGE SHOULDER WIDTH IS 4'.

BRIDGE ROADWAY WIDTH IS MEASURED GUTTER TO GUTTER.

(1) ROADWAY LANE WIDTH MAY BE 9' MINIMUM FOR ROADS WITH A DESIGN SPEED OF 40 MPH OR LOWER AND WITH A DESIGN ADT LESS THAN 250.

(2) ON RECONSTRUCTION PROJECTS, EXISTING 11-FOOT LANES MAY BE RETAINED WHERE THE HORIZONTAL ALIGNMENT IS SATISFACTORY AND THERE IS NO CRASH PATTERN SUGGESTING THE NEED FOR WIDENING.

(3) REFER TO TECH MEMO 12-07-TS-02 AND TECH MEMO 12-12-TS-06 FOR FULL DESIGN REQUIREMENTS FOR TRAVELED LANE WIDTH STANDARDS AND SHOULDER WIDTH STANDARDS FOR STATE HIGHWAYS.

A- PAVED SHOULDER.

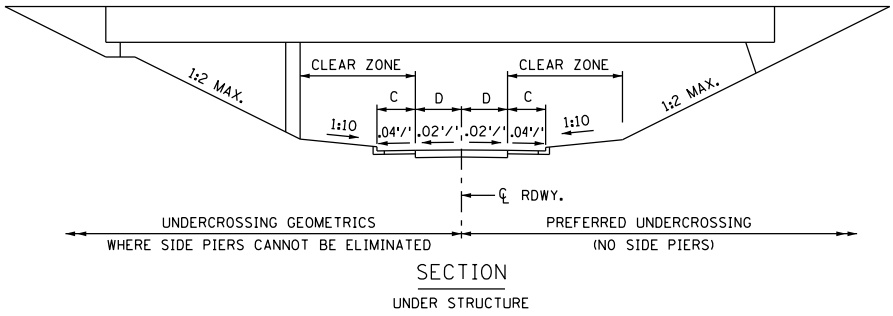
B- USABLE SHOULDER. EDGE OF LANE TO SHOULDER P.I.

C- SEE TABLE FOR C.

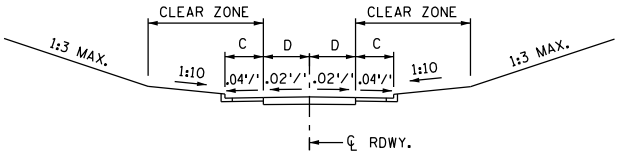
TABLE 2.1.4.1

HIGHWAY CATEGORY (FUNCTIONAL CLASS) AND PROJECTED ADT	TRAVEL LANE WIDTH OF APPROACH ROADWAY (3)			B	A	C	BRIDGE LANE AND SHOULDER WIDTH		
							BRIDGE WIDTH RANGE		
	DESIGN SPEED			ROADWAY USABLE SHOULDER	ROADWAY PAVED SHOULDER	BRIDGE SHOULDER WIDTH	12' LANES - D BRIDGE ROADWAY WIDTH	11' LANES - D BRIDGE ROADWAY WIDTH	10' LANES - D BRIDGE ROADWAY WIDTH
PRINCIPAL ARTERIAL (Rural)	40-45 mph	50-55 mph	60+ mph						
ADT < 400	11' TO 12'	11' TO 12'	12'	4'	2'	4'	32'	30'	NA
ADT 400 - 1500	11' TO 12'	11' TO 12'	12'	6'	2' TO 6'	6' TO 8'	36' TO 40'	34' TO 38'	NA
ADT 1500 - 2000	11' TO 12'	12'	12'	6'	4' TO 6'	6' TO 8'	36' TO 40'	34' TO 38'	NA
ADT > 2000	12'	12'	12'	8'	8'	8' TO 12'	40' TO 48'	NA	NA
	DESIGN SPEED								
MINOR ARTERIAL (Rural)	40-45 mph	50-55 mph	60+ mph						
ADT < 400	11' TO 12'	11' TO 12'	12' (2)	4'	2'	4'	32'	30'	NA
ADT 400 - 1500	11' TO 12'	11' TO 12'	12' (2)	6'	2' TO 6'	6' TO 8'	36' TO 40'	34' TO 38'	NA
ADT 1500 - 2000	11' TO 12'	12' (2)	12' (2)	6'	4' TO 6'	6' TO 8'	36' TO 40'	34' TO 38'	NA
ADT > 2000	12' (2)	12' (2)	12' (2)	8'	8'	8' TO 10'	40' TO 44'	38' TO 42'	NA
	DESIGN SPEED								
COLLECTOR (Rural)	20-30 mph	35-50 mph	55+ mph						
ADT < 400	10' TO 12' (1)	10' TO 12' (1)	11' TO 12'	2'	1.5' TO 2'	4'	32'	30'	28'
ADT 400 - 1500	10' TO 12' (1)	11' TO 12'	11' TO 12'	5'	1.5' TO 5'	5' TO 6'	34' TO 36'	32' TO 34'	30' TO 32'
ADT 1500 - 2000	11' TO 12'	11' TO 12'	12' (2)	6'	1.5' TO 6'	6' TO 8'	36' TO 40'	34' TO 38'	NA
ADT > 2000	12' (2)	12' (2)	12' (2)	8'	1.5' TO 8'	8' TO 10'	40' TO 44'	NA	NA

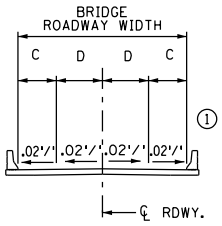
Figure 2.1.4.1
Geometrics
2-Lane Highway (Rural)



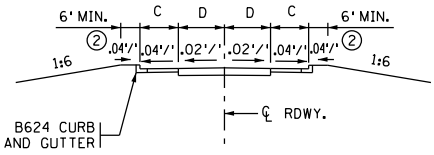
SECTION
UNDER STRUCTURE



SECTION
APPROACHING ROADWAY



SECTION
BRIDGE DECK



SECTION
APPROACHING ROADWAY

NOTES:

MINIMUM BRIDGE ROADWAY WIDTH SHOULD MATCH APPROACH ROADWAY WIDTH MEASURED FROM GUTTER TO GUTTER.

MINIMUM SHOULDER WIDTH ON BRIDGES IS 4'-0"

① SEE FIG. 2.1.4.7 WHERE SIDEWALKS ARE WARRANTED.

② INCREASE AS NECESSARY TO MATCH SIDEWALK NEEDS.

C- REFER TO TECHNICAL MEMO 12-12-TS-06 SHOULDER WIDTH STANDARDS FOR STATE HIGHWAYS

D- REFER TO TECHNICAL MEMO 12-07-TS-02 TRAVELED LANE WIDTH STANDARDS FOR STATE HIGHWAYS

Figure 2.1.4.2
Desirable Geometrics
2-Lane Highway (Urban)

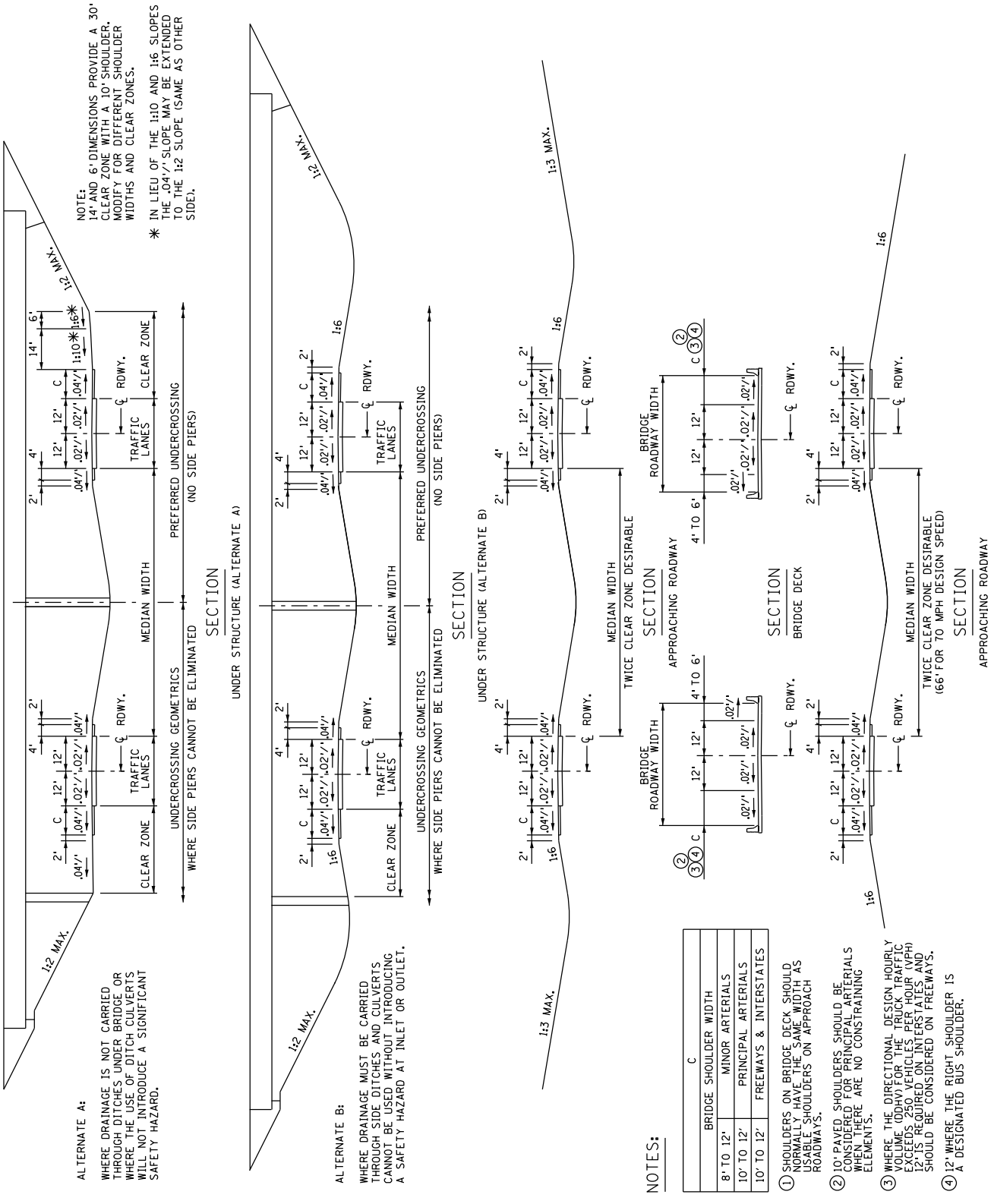
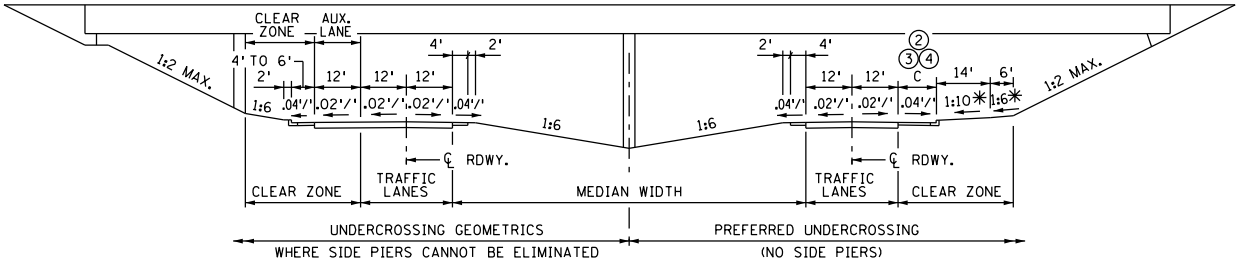


Figure 2.1.4.3
Desirable Geometrics
4-Lane Divided Highway (Rural)



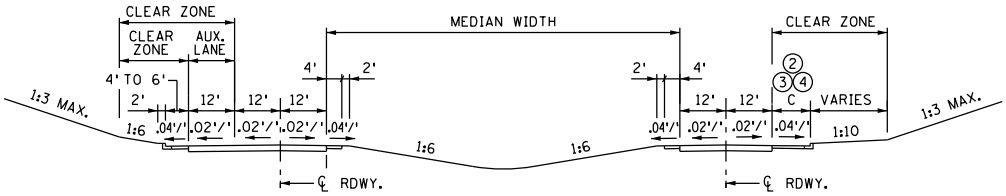
SECTION

UNDER STRUCTURE

NOTES:

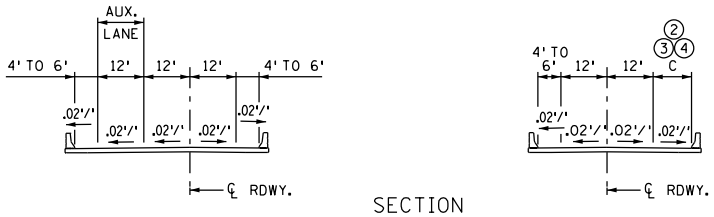
14' AND 6' DIMENSIONS PROVIDE A 30' CLEAR ZONE WITH A 10' SHOULDER. MODIFY FOR DIFFERENT SHOULDER WIDTHS AND CLEAR ZONES.

✳ IN LIEU OF THE 1:10 AND 1:6 SLOPES THE .04'/' SLOPE MAY BE EXTENDED TO THE 1:2 SLOPE.



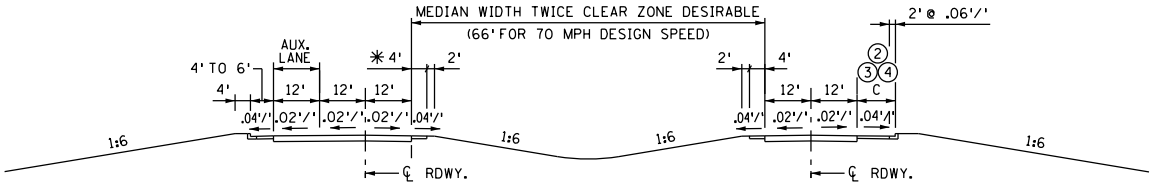
SECTION

APPROACHING ROADWAY



SECTION

BRIDGE DECK



SECTION

APPROACHING ROADWAY

✳ FOR DESIGN SPEEDS 40 MPH OR GREATER. FOR LESSER SPEED A 4' SHOULDER TO A CURB AND GUTTER IS USED.

NOTES:

C	
BRIDGE SHOULDER WIDTH	
8' TO 12'	MINOR ARTERIALS
10' TO 12'	PRINCIPAL ARTERIALS
10' TO 12'	FREEWAYS & INTERSTATES

(1) SHOULDERS ON BRIDGE DECK SHOULD NORMALLY HAVE THE SAME WIDTH AS USABLE SHOULDERS ON APPROACH ROADWAYS.

(2) 10' PAVED SHOULDERS SHOULD BE CONSIDERED FOR PRINCIPAL ARTERIALS WHEN THERE ARE NO CONSTRAINING ELEMENTS.

(3) WHERE THE DIRECTIONAL DESIGN HOURLY VOLUME (DDHV) FOR THE TRUCK TRAFFIC EXCEEDS 250 VEHICLES PER HOUR (VPH) 12' IS REQUIRED ON INTERSTATES AND SHOULD BE CONSIDERED ON FREEWAYS.

(4) 12' WHERE THE RIGHT SHOULDER IS A DESIGNATED BUS SHOULDER.

Figure 2.1.4.4
Desirable Geometrics
4-Lane Divided Highway (Urban)

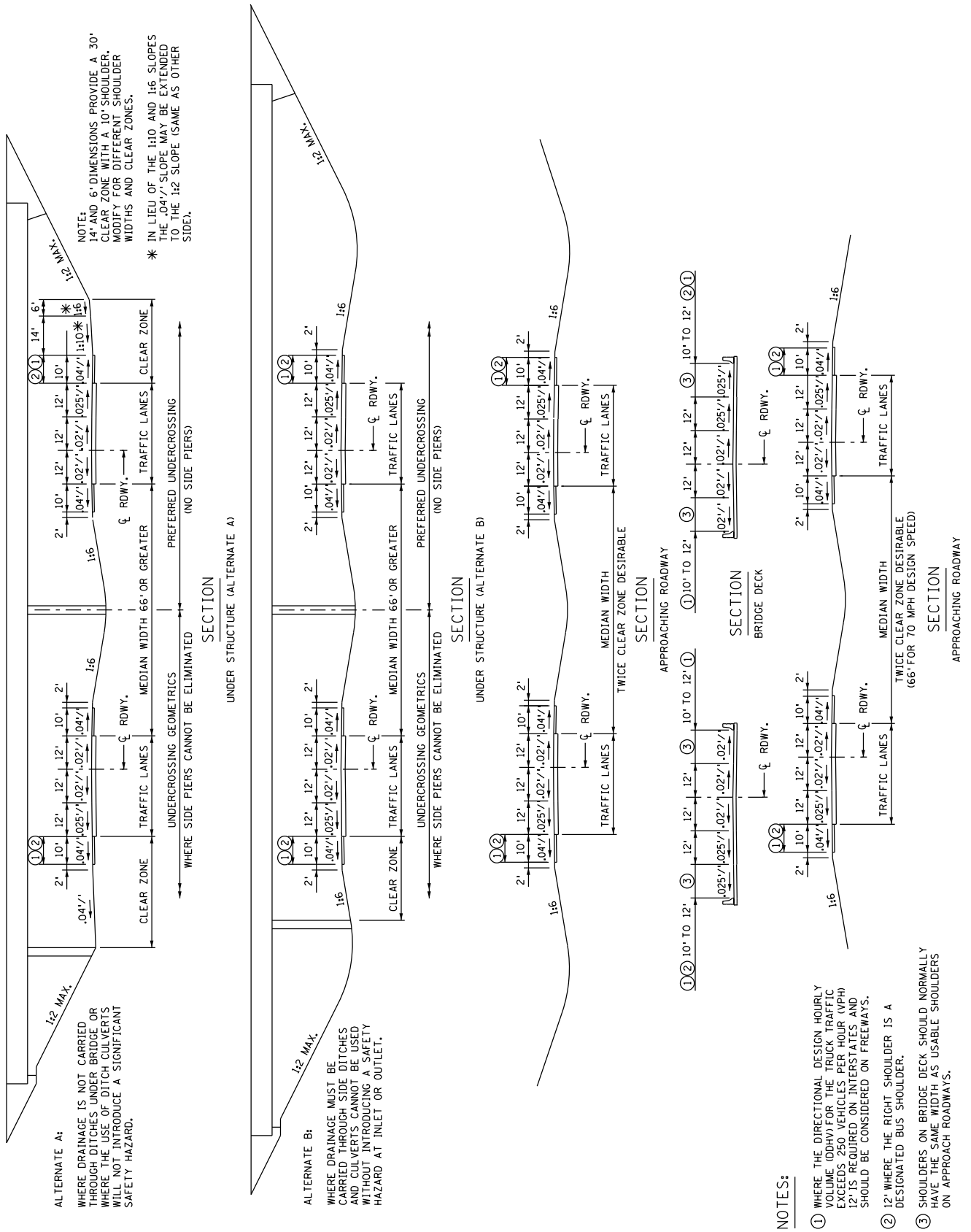


Figure 2.1.4.5
Desirable Geometrics
6-Lane Divided Highway (Rural)

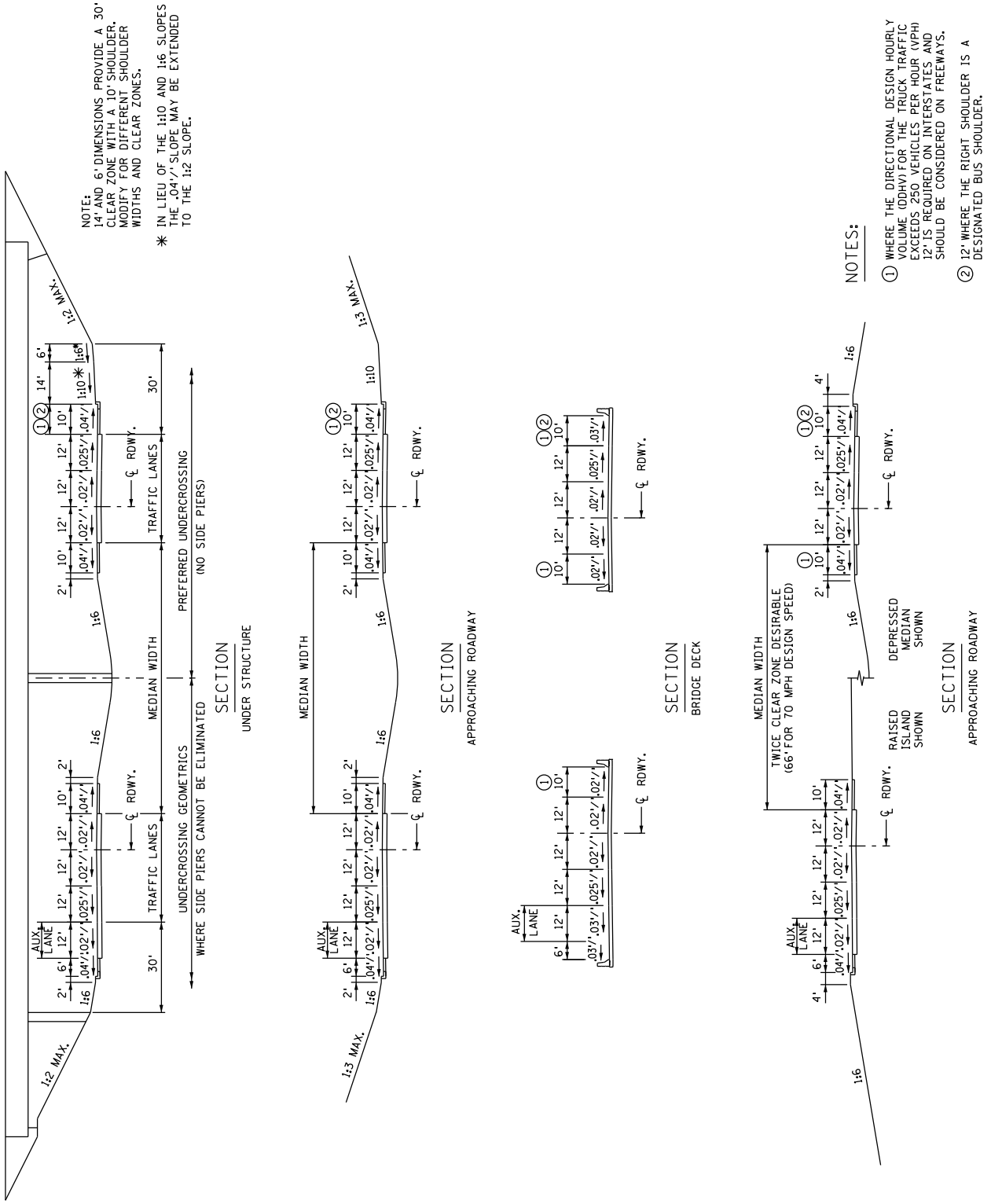


Figure 2.1.4.6
Desirable Geometrics
6-Lane Divided Highway (Urban/Suburban)
(Details for 8-Lane Divided Highway are similar)