

# Chapter Thirty-nine

## STRUCTURE PLANNING/GEOMETRICS

BUREAU OF DESIGN AND ENVIRONMENT MANUAL



**Chapter Thirty-nine**  
**STRUCTURE PLANNING/GEOMETRICS**

**Table of Contents**

<b><u>Section</u></b>	<b><u>Page</u></b>
39-1 ADMINISTRATION.....	39-1.1
39-1.01 Introduction .....	39-1.1
39-1.02 BB&S Functions.....	39-1.1
39-1.03 BB&S Organization .....	39-1.2
39-2 BRIDGE POLICIES AND DESIGN .....	39-2.1
39-2.01 Specifications for Bridge Design.....	39-2.1
39-2.02 Specifications for Bridge Construction.....	39-2.1
39-2.03 Standard Practice Manuals .....	39-2.1
39-2.04 Policy Memoranda .....	39-2.2
39-2.05 Experimental Bridge Features .....	39-2.2
39-3 BRIDGE PLANNING PROCESS .....	39-3.1
39-3.01 Bridge Improvements .....	39-3.1
39-3.01(a) Scope of Work Definitions .....	39-3.1
39-3.01(b) Coordination.....	39-3.2
39-3.02 Bridge Condition Reports .....	39-3.3
39-3.02(a) Definition.....	39-3.3
39-3.02(b) Purpose .....	39-3.3
39-3.02(c) Applicability .....	39-3.3
39-3.02(d) Proposed Structure Sketches.....	39-3.4
39-3.03 Preliminary Bridge Investigations .....	39-3.7
39-3.03(a) Bridge Type Studies.....	39-3.7
39-3.03(b) Selection of a Superstructure System .....	39-3.7
39-3.03(c) Temporary In-Stream Work.....	39-3.10
39-3.04 Type, Size, and Location Plans .....	39-3.10
39-4 BRIDGE SIZING/GEOMETRICS .....	39-4.1
39-4.01 Type of Highway Facility .....	39-4.1
39-4.02 Bridge Widths.....	39-4.1
39-4.03 Underpass Width.....	39-4.2
39-4.04 Vertical Clearances .....	39-4.2
39-4.05 Sidewalks and Bikeways .....	39-4.2

**Table of Contents**

(Continued)

<b><u>Section</u></b>		<b><u>Page</u></b>
39-4.06	Highways Over Railroad.....	39-4.3
39-4.07	Design Flood Frequency .....	39-4.3
39-4.08	Bridges on Horizontal Curves.....	39-4.3
39-4.09	Skew Angle .....	39-4.4
39-4.10	Cross Slopes.....	39-4.4
39-4.11	Gradeline on Bridges .....	39-4.4
39-5	TYPICAL SECTIONS .....	39-5.1
39-6	TABLES OF DESIGN CRITERIA.....	39-6.1

# Chapter Thirty-nine

## STRUCTURE PLANNING/GEOMETRICS

### 39-1 ADMINISTRATION

#### 39-1.01 Introduction

The Bureau of Bridges and Structures (BB&S), the Bureau of Design and Environment (BDE), the Central Bureau of Land Acquisition (CBLA), the Central Bureau of Local Roads and Streets (CBLRS), and the Bureau of Safety Programs and Engineering (BSPE) comprise the Office of Program Development within IDOT. The BB&S provides expertise in bridge management, bridge design, and structural, hydraulic, and foundation engineering.

The Engineer of Bridges and Structures is responsible for formulating and administering policies and procedures that will ensure development of the bridge program and result in safe, economical, visually pleasing structures on the State highway system with the best use of resources for accomplishing the Department's objectives. The Bureau Chief of BB& S fulfills the role of "State Bridge Engineer" in relations with FHWA and AASHTO.

#### 39-1.02 BB&S Functions

The functions of the Bureau of Bridges and Structures include:

- the development of policies and procedures for the administration of highway bridges and structures;
- the preparation of preliminary and final bridge and structure designs, plans, and specifications;
- the review and approval of structural work performed by consulting engineers;
- the review and approval of fabrication shop plans;
- the inspection of structural steel fabrication;
- the preparation and review of plans for bridge repairs;
- the load capacity rating and inventory of bridges on the State highway system;
- the preparation or review of retaining walls over 10 ft (3.0 m) in height;
- the directing of bridge maintenance and inspection activities; and
- the administration and technical expertise for local agencies on bridge issues.

**39-1.03 BB&S Organization**

To administer its responsibilities, the BB&S is organized into four sections:

- Structural Services,
- Bridge Planning,
- Bridge Design, and
- Services Development.

Organizational charts and functions of the sections are presented in the *Bridge Manual*, Section 1, "Introduction."

## **39-2 BRIDGE POLICIES AND DESIGN**

The Bureau of Bridges and Structures (BB&S) administers policies for the design, structural details, and preparation of plans for bridges and structures on the State highway system by using a system of design specifications, standard practice manuals, standard plans, and policy memoranda. The following sections discuss these.

### **39-2.01 Specifications for Bridge Design**

IDOT uses the *AASHTO Standard Specifications for Highway Bridges and AASHTO LRFD Bridge Design Specifications* as its principal specifications for the design of bridges and other structures. This includes all interim specifications and guide specifications when published and as directed by policy memoranda. These specifications form the basis for all bridge design by the BB&S or by an outside entity retained by the State of Illinois.

### **39-2.02 Specifications for Bridge Construction**

The Department's *Standard Specifications for Road and Bridge Construction* govern all bridge construction contracts unless supplemented, revised, or superseded by the plans or in the special provisions for the contract documents. All bridge designs shall be prepared to be consistent with these specifications and provisions.

### **39-2.03 Standard Practice Manuals**

The BB&S publishes a series of standard practice manuals to guide bridge and structural designs and plans in Illinois. These manuals represent a second level of control under the *AASHTO Standard Specifications for Highway Bridges and AASHTO LRFD Bridge Design Specifications*, and they present the preferred design methods, treatments, and standardized designs of the BB&S. These manuals guide the bridge designer in preparing bridge designs and plans to meet the specifications and preferences of the BB&S, but they are not intended to restrict progressive technology, innovation, or architectural improvements. Any proposed improvements other than typical designs should be thoroughly discussed with BB&S management prior to initiating any action.

The BB&S has developed the following standard practice manuals:

1. *Bridge Manual*. This *Manual* provides policies and practices for the planning and design of the component parts of bridges in general, and it guides the development of Type, Size, and Location (TS&L) plans and final plans.
2. *Prestressed Concrete Manual*. This *Manual* provides policies and design procedures for prestressed concrete bridge members and presents standard designs for prestressed concrete bridge members for use on State and local bridges.

3. *Culvert Manual*. This *Manual* provides standard design parameters for single-cell, reinforced concrete box culverts. When used within the limitations set forth, the *Manual* allows engineers and technicians outside the BB&S to prepare plans for these structures without direct structural engineering supervision.
4. *Sign Structures Manual*. This *Manual* provides standard design procedures and standard base sheets for steel and aluminum sign structures.
5. *Drainage Manual*. This *Manual* provides the drainage policies and procedures for use in the planning and design of drainage structures on the State Highway System.
6. *Structural Services Manual*. This *Manual* assists Department personnel and consulting engineers in the preparation of bridge repair plans. Information and details are provided for the types of repairs most often required for typical bridge structures.

See Chapter 60 for more information on standard practice manuals published by the BB&S.

#### **39-2.04 Policy Memoranda**

Policies of the Bureau of Bridges and Structures may be issued, amended, or supplemented by a Bridge Memorandum. These memoranda are effective the date of issuance on designs and plans not yet approved by the Engineer of Bridges and Structures, unless otherwise stated in the memorandum. Before initiating a project, bridge designers should check with the BB&S for the latest Department version of Bridge Memoranda.

#### **39-2.05 Experimental Bridge Features**

In cooperation with authorized agencies, the BB&S advises other agencies and/or develops construction plans for structures that include new products or design concepts in part or for all of the structure. These experimental projects are cataloged and periodic field inspections are made to evaluate the benefits from the experimental components.

After adequate study under actual traffic and weather conditions, the experimental products or design concepts are either included as acceptable for policy use and placed in the appropriate manual (see Section 39-2.03) or they are rejected.

### 39-3 BRIDGE PLANNING PROCESS

#### 39-3.01 Bridge Improvements

##### 39-3.01(a) Scope of Work Definitions

The scope of work for a bridge project may be any of the following:

1. Bridge Replacement. Replacement of the entire existing bridge (i.e., superstructure, substructure, and foundation).
2. Bridge Reconstruction. At a minimum, complete replacement of the superstructure and could include work on the substructure and foundation.
3. Existing Bridge to Remain in Place. If an existing bridge is structurally sound, if it meets the Department's design loading capacity, if it meets the minimum width criteria, and if it is not a high-crash location, it is unlikely to be cost effective to improve the geometrics of the bridge. When these conditions are met, an existing bridge can remain in place. In some cases, only the bridge substructure (e.g., abutments, piers) and/or foundation (e.g., footings, piles) may require rehabilitative work. These may also be considered existing bridges to remain in place for the application of geometric design criteria.
4. Bridge Rehabilitation. Major work on one or more of the components of an existing bridge (i.e., superstructure, substructure, and/or foundation).
5. Bridge Deck Rehabilitation. If the existing bridge deck is structurally deficient, it may be rehabilitated as part of a project. In addition, where the bridge deck is structurally sound but its width is inadequate (i.e., the bridge is functionally deficient), the bridge deck may be rehabilitated solely to widen the bridge deck. Bridge deck widening may then require work to the superstructure and/or substructure.
6. Bridge Deck Repair. The existing bridge deck is structurally adequate, but partial and full-depth repairs are required and an overlay is necessary to improve rideability and to maintain the integrity of the deck.
7. Bridge Rails/Transitions. For reconstructed bridges or rehabilitated bridge decks, the existing bridge rails and approaching guardrail-to-bridge-rail transitions may need upgrading to meet current Department criteria. For existing bridges to remain in place within the project limits, the Bureau of Bridges and Structures will evaluate the adequacy of the existing bridge rail to determine if it should be upgraded. The roadway designer will evaluate the adequacy of the existing approaching bridge rail transition for needed upgrading. See Chapter 38 for more information on guardrail-to-bridge-rail transitions.

Also, for 3R bridge projects, see Sections 49-3 and 50-2.

**39-3.01(b) Coordination**

This Section clarifies how structure information should be coordinated with the Bureau of Bridges and Structures (BB&S) and with the Bureau of Design and Environment (BDE). This coordination is through the Bridge Condition Report (Section 39-3.02) and the Proposed Structure Sketch. To indicate the bridge information necessary for completion of location study work, this Sketch is included in all Phase I reports. Complete information regarding Bridge Condition Reports can be found in the Bureau of Bridges and Structures manual *BCR Procedures and Practices*.

Bridge Condition Reports (BCR) will ensure that the scope of work proposed in a Phase I report will agree with the design in the final bridge plans. These reports accommodate early structural input into the overall planning process and, as a result, they greatly reduce the need for revisions to approved Phase I reports.

BDE must approve the typical section that shows the proposed clear roadway bridge width as a part of the Proposed Structure Sketch. This concurrence must occur before submission of the BCR by the district to the Bureau of Bridges and Structures.

A BCR and a Proposed Structure Sketch are required for every structure that is within a roadway section covered by a Phase I report or which is the subject of Phase I report by itself. Structures may fall into one of the following categories that would require a BCR or an Abbreviated BCR:

- gap the structure temporarily,
- allow structure to remain in place,
- deck repair and resurface,
- rehabilitate the structure, or
- replace the structure.

Before design approval can be granted on a roadway project that includes structures or on a bridge by itself, the BCRs on all bridges must be approved by the BB&S and concurrence must be received on all Proposed Structure Sketches.

For structures allowed to remain in place within a 3R type highway project, the Illinois Structure Information System—Master Report (S107) may be submitted in lieu of a formal BCR. In addition to the Master Report, the PONTIS Bridge Report for maintenance needs should be submitted.

Structures located within SMART and 3P projects do not require the submittal of a BCR. However, where a structure lies within the limits of such projects, coordination must be initiated with the BB&S before determining resurfacing options across the bridge.

Unless involvement is specifically requested by a district, the Bureau of Bridges and Structures does not evaluate maintenance type work on structures. However, if a project is a deck repair and overlay which is not funded with maintenance funds, it will require the submittal of an

Abbreviated BCR. If the evaluation of the deck leads to a decision to replace the deck, then normal procedures for bridge improvements must be initiated and followed.

The BCR allows BB&S concurrence on the proposed design based on the existing condition of the structure. Upon BB&S review, the Bureau will document agreement with the following geometric and structural factors:

- proposed clear roadway bridge width combined with structural feasibility,
- replacement or reuse of components,
- proposed general configuration features, and
- stage construction possibilities.

The BB&S concurrence relates to the structural adequacy and economic feasibility of the bridge improvement proposal. If appropriate, the economics of any proposal will be investigated at this time. In some instances, environmental factors may preclude economic considerations. Therefore, the Phase I report must contain sufficient information to justify recommendations concerning environmental factors.

### **39-3.02 Bridge Condition Reports**

#### **39-3.02(a) Definition**

A Bridge Condition Report is defined as a report to establish the scope of work on the extent of repair, replacement (partial or total), and widening or other improvements. The BCR allows the Bureau of Bridges and Structures to determine the most cost-effective method of correcting the reported structural, geometric, or hydraulic deficiencies and for restoring a bridge to a structurally adequate and functionally serviceable condition.

#### **39-3.02(b) Purpose**

A BCR is required for every structure that is within a roadway section addressed in a Phase I report or which is the subject of a Phase I report by itself. The BCR, combined with the Proposed Structure Sketch (Section 39-3.02(d)), allows early structural input into the overall planning process.

Whenever the scope of anticipated rehabilitation work is limited to bridge deck and minor structural repairs without the need for widening or replacement options, only the preparation of an Abbreviated BCR is required. Because the geometrics of the structure will not be altered, this type of work normally will not require a Type, Size, and Location (TS&L) Plan (Section 39-3.04).

#### **39-3.02(c) Applicability**

The Bridge Condition Report will provide:

- a description of the physical conditions and deficiencies that mandate repair or replacement,

- a verification of the apparent soundness of any substructure elements recommended for reuse plus the economic advantage gained by their reuse,
- a statement of any geometric or hydraulic improvement requirements, and
- a recommendation for the scope of the proposed work.

The recommended scope of work should address the approximate dimensions of a replacement structure but not so precisely that configuration refinements resulting from subsequent hydraulic, soils, or structural-economic studies are restricted. The format of the BCR required by the BB&S is necessary to enable the Bureau to make accurate structural, economic, and policy decisions for the cost-effective expenditure of bridge rehabilitation funds.

With total structure replacements, a description of the conditions that led to the inclusion of the bridge in the program is usually sufficiently supportive of the replacement recommendation. However, where projects involve extensive repair of bridge components, BCRs must be supported by in-depth field inspection, physical testing, and economic analysis to determine the scope and cost-effectiveness of repairs. Before concurring with the reuse of any substructure elements, the Bureau of Bridges and Structures will verify their capacity to sustain the loads to which they will be subjected in the reconstructed bridge.

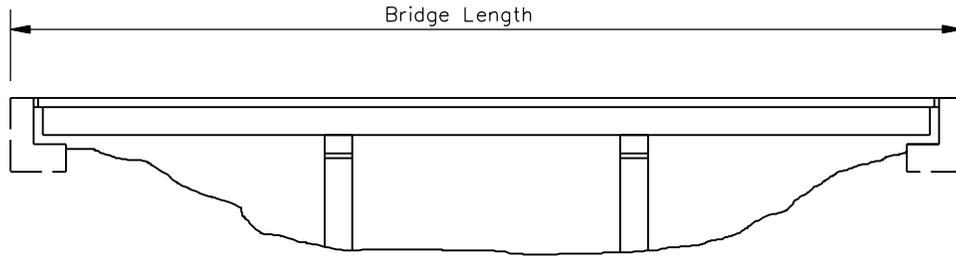
The BCR, with its comprehensive recommendation for the proposed scope of work and the support information, is submitted by the district for review and concurrence by the Bureau of Bridges and Structures. After this concurrence is obtained, the memo approving the BCR will be incorporated into or referenced in the Phase I report (see Chapter 12). After all necessary coordination with other agencies has been accomplished, the completed Phase I report and the Proposed Structure Sketch should be submitted to BDE for informational purposes.

### **39-3.02(d) Proposed Structure Sketches**

The bridge information necessary to complete the location/design study phase varies with the complexity and type of project under consideration; however, all bridge projects require the submittal of a Proposed Structure Sketch to the Bridge Planning Section for review and approval. This Sketch should be included or referenced in the Phase I report. For a typical Proposed Structure Sketch, see Figure 39-3.A.

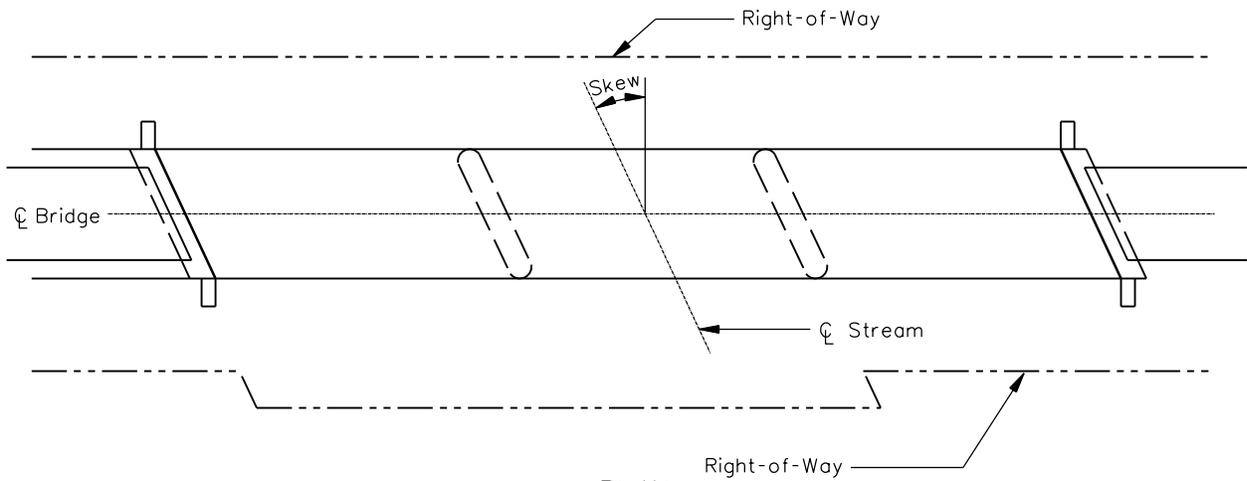
A Proposed Structure Sketch will generally present the following information:

- type of bridge proposed (closed abutments vs. spill-through, existing elements to be reused, etc., but not details such as girder or deck type) and approximate structure length. A preliminary hydraulic analysis may be required to establish the appropriate structure length and vertical profile;

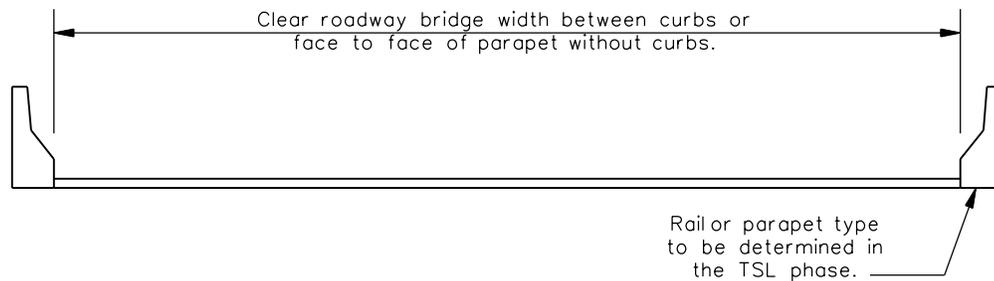


Note: The number and location of piers outside the stream channel, the profile gradeline, and bridge length are subject to refinement in the TSL phase.

ELEVATION  
PROPOSED STRUCTURE



PLAN  
PROPOSED STRUCTURE



PROPOSED STRUCTURE WIDTH

**PROPOSED STRUCTURE SKETCH**

**Figure 39-3.A**

- approximate profile and horizontal alignment and approximate right-of-way or easement widths. The accuracy of the profile will depend upon the nature of right-of-way adjacent to the bridge project. Usually, it will be necessary to establish exact right-of-way requirements only if Section 4(f) property or other very sensitive right-of-way is affected;
- proposed skew angle of feature crossed. See Section 39-4 for further guidance on crossing angles;
- approximate pier locations proposed by the district. Comments on pier location received from the Illinois Department of Natural Resources, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and other affected agencies should be incorporated as appropriate;
- typical section showing the proposed clear roadway bridge width. It is not necessary to show beam locations or type; and
- the need for bikeways across the structure, bicycle railings, and pedestrian railings.

The Proposed Structure Sketch should contain the following note or variation thereof: *“The number and location of piers outside the stream channel, the profile gradeline, and the bridge length are subject to refinement in the TSL phase.”* Care should be taken to make the Proposed Structure Sketch as diagrammatic as possible and no more restrictive to the final design than is necessary to gain design approval.

For rehabilitation, reconstruction, and replacement projects, the information necessary for the location/design study phase is provided in the Bridge Condition Report (BCR). The Proposed Structure Sketch is typically included with the BCR. However, only the Proposed Structure Sketch and memo from the BB&S approving each Bridge Condition Report (if required) need be included in a Phase I report. In addition for each structure location, a few color photographs or prints should be included in the Phase I report as exhibits.

For major stream crossing projects, the determinations made in the location/design study phase on the vertical and horizontal alignment are typically refined such that minor adjustments in the TS&L or design phases will not significantly affect the project impacts. Because of the potentially large variations in structure depths between major river crossing structure types, high and low vertical profile options may need to be addressed. Significant impacts caused by either the high or low profile options might lead to the elimination of certain structure types from further consideration.

Structure type evaluation at this stage should normally be limited to the determination of those structure types that are feasible for the given crossing conditions and within the same general economic range. A detailed evaluation of structure types for major stream crossings is performed during the bridge type study phase.

**39-3.03 Preliminary Bridge Investigations**

Before initiating Type, Size, and Location (TS&L) Plans for a structure, an investigative procedure that establishes the proper alignment and/or the scope of work to be performed is completed in the Phase I study. This procedure establishes the alignment, develops a profile gradeline, provides an environmental assessment, and addresses those factors affecting the socio-economic conditions and the overall impact of the project. It may also include a proposal for stage construction so that traffic may continue using the route during construction. The results of these procedures and studies are summarized in the Phase I report.

**39-3.03(a) Bridge Type Studies**

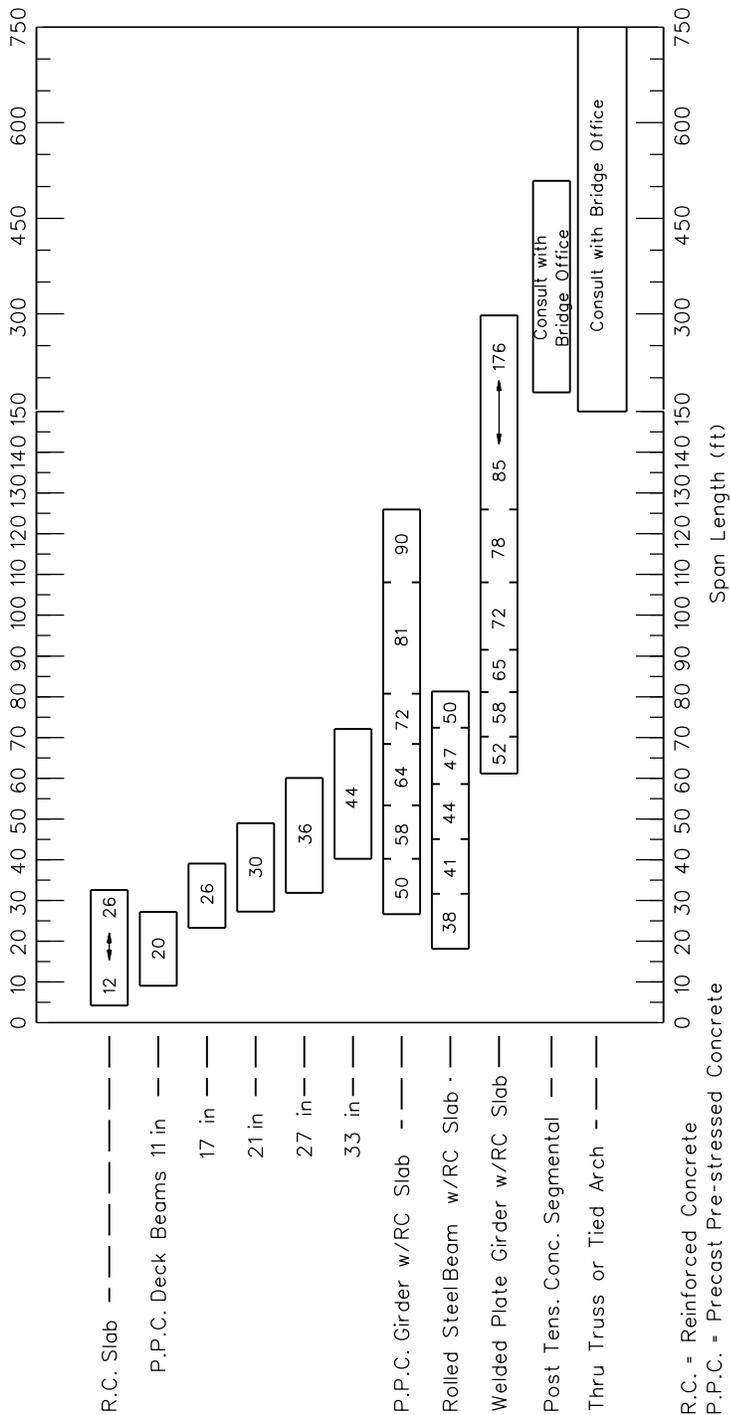
A Bridge Type Study is necessary for the preparation of a TS&L Plan. The study is the process by which the most appropriate structure type for a given location is determined, and it is a compilation of the necessary economic, aesthetic, and site evaluations that lead to that selection. A well-conceived Bridge Type Study will:

- provide hydraulic and geotechnical considerations,
- consider the structure types feasible for the site parameters or environmental commitments,
- provide the reasoning for eliminating or developing particular alternatives, and
- provide cost estimates for all alternatives considered and the rationale for the selection of the structure type chosen.

The Bridge Type Study is typically a part of the planning process that justifies the proposed bridge type and as such is not submitted for review. However, for major river crossings or when requested by BB&S, a bridge type study becomes a formal report requiring approval of the Bridge Planning Engineer before TS&L plan preparation.

**39-3.03(b) Selection of a Superstructure System**

For Phase I work, the designer should refer to Figure 39-3.B, which provides a list of commonly employed superstructure types; the span ranges for which they are generally applicable; and the approximate construction depth (profile grade to low beam) required for their use. The values provided are general guidelines only and should not be used for detailed TS&L determination.

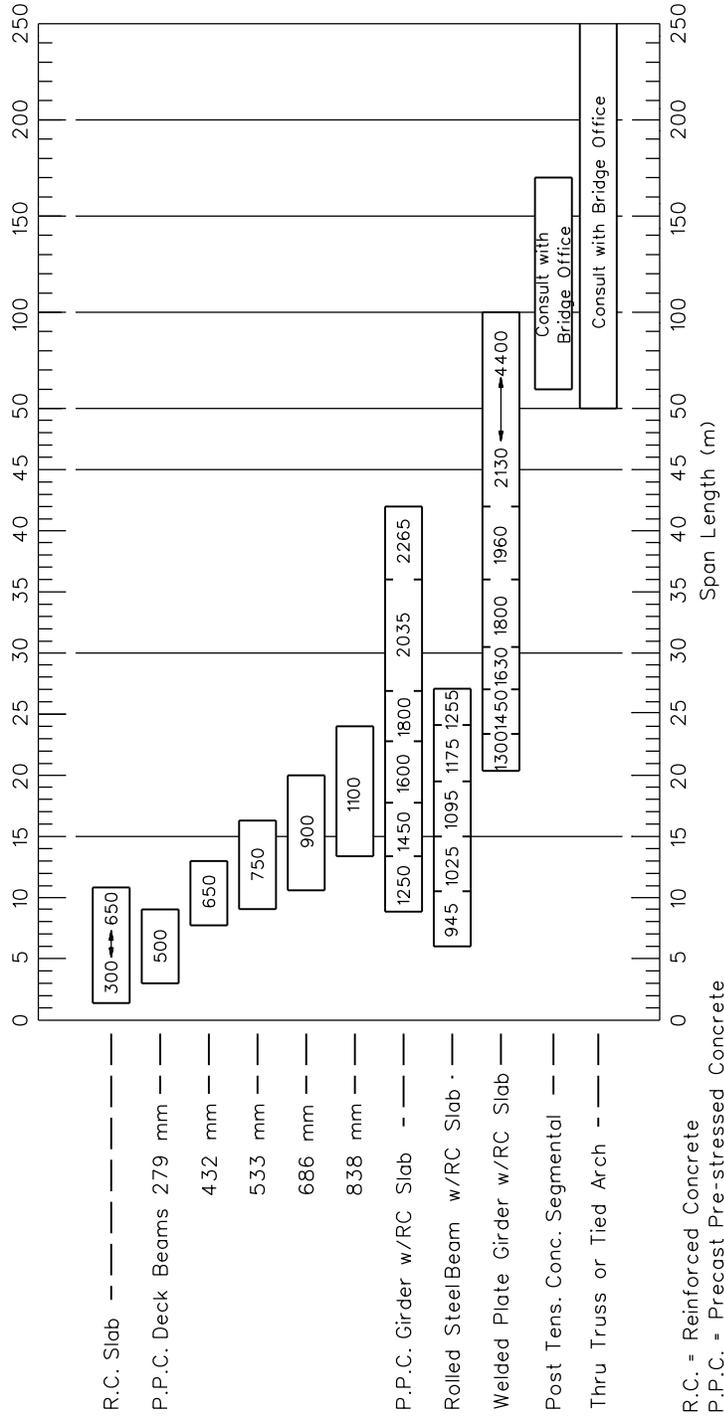


Notes:

1. Numbers within bars denote the construction depth in inches (profile grade to low clearance point) required for a simple span structure of charted length with a 40-ft wide, normal crowned bridge roadway, and a future wearing surface allowance of 25 lbs/ft<sup>2</sup>. The values given are general guideline values and should not be used for detailed type, size, and location plans.
2. Span lengths for the indicated construction depths may be increased 20% to 25% for continuous beam designs.

**CONSTRUCTION DEPTH SELECTION GUIDE  
(US Customary)**

**Figure 39-3.B**



Notes:

1. Numbers within bars denote the construction depth in millimeters (profile grade to low clearance point) required for a simple span structure of charted length with a 12-m wide, normal crowned bridge roadway, and a future wearing surface allowance of 1.2 kN/m<sup>2</sup>. The values given are general guideline values and should not be used for detailed type, size, and location plans.
2. Span lengths for the indicated construction depths may be increased 20% to 25% for continuous beam designs.

**CONSTRUCTION DEPTH SELECTION GUIDE  
(Metric)**

Figure 39-3.B

**39-3.03(c) Temporary In-Stream Work**

As a part of determining the scope of work to be performed, give consideration to anticipated need for temporary in-stream work features for construction of the project (e.g., temporary stream crossings, work pads, temporary bypass channels, cofferdams). This information will need to be described in a work permit submittal to the US Army Corps of Engineers for work involving discharge of dredged or fill material into waters of the United States. To the extent that any needed temporary work features can be anticipated and addresses in the permit submittal for the bridge/culvert, it will avoid the need for having the contractor seek separate permit coverage for the temporary work in the construction phase with the associated potential for delaying construction operations while awaiting receipt of the permit authorization for the temporary work features.

**39-3.04 Type, Size, and Location Plans**

The bridge planning process encompasses the collection of the applicable site information, its analysis, the application of established policies and practices, and the consideration of reasonable alternatives and their economic evaluations to establish the bridge configuration that is the most cost effective and functionally, structurally, and aesthetically appropriate.

Type, Size, and Location (TS&L) Plans are detailed bridge configuration plans which are used as the basis for the development of construction plans. TS&L Plans are approved by the Bureau of Bridges and Structures only after the processing for approval of a Structure Report including an approved Hydraulics Report, an existing bridge survey, and detailed roadway data. Approved TS&L Plans may be used in lieu of a Proposed Structure Sketch in a Phase I report should their timely development so permit; however, the less detailed Proposed Structure Sketch, developed specifically for the Phase I report, will not be construed to be TS&L Plans.

The Planning Section of the *Bridge Manual* has been developed as a guide and a control for the preparation of TS&L Plans and for the promulgation of policy interpretations of the control documents. In addition, consider the following when preparing TS&L Plans:

- No new structure number should be assigned when a project involves the re-use of any existing bridge element in the rehabilitation.
- For details on Hydraulic Reports, use the *Drainage Manual*.
- A completed Structure Report and Structure Geotechnical Report must accompany any TS&L Plan submittal by a consultant.
- Boring logs are required to be submitted to the Bureau of Bridges and Structures for the development of in-house TS&L Plans.

### **39-4 BRIDGE SIZING/GEOMETRICS**

A variety of factors determine the appropriate size of a bridge under design. Section 39-4 discusses these factors and other geometric design elements pertaining to bridge design (e.g., bridges on horizontal curves, cross slopes). Section 39-5 presents typical sections for bridge overpasses and underpasses. Section 39-6 presents tables of geometric design criteria for bridges on the rural and urban State highway system and for frontage roads.

The design criteria provided in Section 39-4 are applicable to all new or reconstructed bridges on the State highway system, except where specific policy items are governed by other Department directives. See Parts IV, Road Design Elements, and V, Design of Highway Types. Bridge widths for 3R-type improvements are included in Chapters 49 (non-freeways) and 50 (freeways).

#### **39-4.01 Type of Highway Facility**

The type of highway facility has a significant impact on bridge size. The highway facility will be defined by its:

- functional classification;
- rural or urban location;
- number of lanes (i.e., two lane or multilane);
- presence of a median (i.e., divided or undivided); and
- operational function (i.e., mainline, ramp, or frontage road).

Part V presents a comprehensive discussion on highway geometric design based on functional classification and rural/urban location. Specifically for bridges, the typical sections in Section 39-5 and the tables of design criteria in Section 39-6 are based on the type of highway facility with appropriate references to Part V, Highway Systems.

#### **39-4.02 Bridge Widths**

The bridge width will be determined by:

- the highway type;
- the approaching roadway width;
- the presence of sidewalks and/or bikeways (see Section 39-4.05);
- the presence of auxiliary lanes (e.g., acceleration lanes at interchanges); and
- for divided facilities, whether a single or dual structure is used.

See Sections 39-5 and 39-6 for bridge width criteria and application.

### **39-4.03 Underpass Width**

The roadway section passing beneath a bridge will determine the bridge length in combination with structural design elements (e.g., abutment type). The underpass width will be based on the following roadway design elements:

- the approaching roadway width;
- the presence of sidewalks and/or bikeways (see Section 39-4.05);
- the presence of auxiliary lanes (e.g., acceleration lanes at interchanges); and
- the horizontal clearance to obstructions (i.e., the roadside clear zone).

For high unit cost bridges, the designer should consider locating abutments or piers on the right side of the roadway adjacent to the shoulder where the savings in structure cost could make the required barrier protection cost effective. All reduced clearances below the minimum horizontal clearance requirements must be economically justified and barrier protection must be provided.

The maximum practical horizontal clearance between the left edge of the roadway and pier in the median of divided highways will be realized by placing a single pier at the center of the median. Median piers should have protective barrier where warranted as discussed in Chapter 38.

### **39-4.04 Vertical Clearances**

The vertical clearance for underpassing roadways will significantly impact the size of the overpassing structure. In some cases, the required vertical clearance may also impact the selection of the superstructure type. Sections 33-5, 39-5 and 39-6 and Part V, Highway Systems, presents the Department's vertical clearance criteria for underpassing roadways based on functional classification, project scope, and rural/urban location.

### **39-4.05 Sidewalks and Bikeways**

If pedestrian activity is anticipated, provide sidewalks on both sides of urban structures. The standard sidewalk width on structures is 5 ft (1.5 m). See the *Bridge Manual* for sidewalk details. Also, see Section 48-2.04 for a detailed discussion on sidewalks. In addition, examine the gradeline of the sidewalks for ADA requirements (see Section 58-1). Where wider sidewalks exist on approaching roadways, sidewalk widths greater than 5 ft (1.5 m) can be considered. See the typical urban sections in Section 39-5.

Special sidewalks or bikeways, separated from the roadway by a traffic barrier, may be provided as discussed in Chapter 17. Bikeway widths will be determined from the bikeway design criteria but in no case will the width be less than 5 ft (1.5 m) for a one-way bikeway or 10 ft (3.0 m) for a two-way bikeway across a structure. For geometric combinations, see the typical sections in Chapter 17 and Section 39-5.

### **39-4.06 Highways Over Railroad**

Where a highway bridge overpasses a railroad, the specific horizontal and vertical clearances and the bridge size will be cooperatively determined by the Department and the railroad. The Department's planner/designer shall become acquainted with 92 Ill. Admin. Code 1500.160(c), 23 C.F.R. 646.212(a-2) and (a-3) and the "Appendix to Subpart B of Part 646 – Horizontal & Vertical Clearance Provisions for Overpass and Underpass Structures" prior to any discussions with the railroad. The typical sections in Section 39-5 illustrate the typical minimum geometric design requirements for railroads.

### **39-4.07 Design Flood Frequency**

Design flood frequency is directly related to the ratio of structure capacity to public benefit. A structure which carries large volumes of traffic on a multilane facility is expected to remain in use during extreme flood conditions. To maintain the high level of traffic service afforded by these facilities, a considerable expenditure of funds is justified to provide that service. Conversely, a structure carrying lesser traffic volumes on a lower functional classification facility does not warrant a design based on extreme flood conditions. The *Drainage Manual* and its Appendix contain detailed information on design flood frequencies. Chapter 40 also addresses general drainage issues and procedures.

Because urban highway facilities are intended to accommodate higher traffic volumes at reduced speeds, when compared to rural designs, it is apparent that optimum public benefit requires the assignment of higher flood frequency values for design to provide uninterrupted service for urban bridges. Consideration must also be given to the seriousness of flooding abutting properties that may result in property damage, possible loss of life, and adverse public reaction. Therefore, a flood frequency of 50 years is used for all designs except TWS–2 classifications.

### **39-4.08 Bridges on Horizontal Curves**

Superelevation transitions should be avoided on bridges and their approaches. To achieve this in rural areas, the beginning of a horizontal curve should be a minimum of 400 ft (120 m) from the back of the bridge abutment. In some cases, however, superelevation transitions are unavoidable on urban bridges (e.g., because of right-of-way restraints). Where a curve is necessary on a bridge, the desirable treatment is to place the entire bridge and its approaches on a flat horizontal curve with minimum or no superelevation. In this case, a uniform superelevation rate is provided throughout (i.e., the superelevation transition is neither on the bridge nor its approaches) or the normal crown section is maintained throughout the curve.

Where a bridge is located within a superelevated horizontal curve, the entire bridge roadway is sloped in the same direction and at the same rate across the deck (i.e., the shoulders or gutters and traveled way will be in a planar section). See the typical superelevated sections in Section 39-5. This also applies to the approach traveled way and the approach shoulder pavements. The approach traveled way and approach shoulders are illustrated in the *Highway Standards*.

However, the high-side shoulder on a roadway section off the bridge should slope away from the traveled way at a rate such that the maximum shoulder rollover does not exceed 8.0%. To accomplish the longitudinal shoulder slope transition away from the bridge, the designer should refer to the applicable figure in Section 39-5. See Chapter 32 for more information on horizontal alignment.

#### **39-4.09 Skew Angle**

Crossing angles between the mainline and other roadways, railways, or waterways desirably should not be less than 60 degrees (not greater than 30 degree skew). In extreme conditions, crossing angles between waterways and roadways may be 45 degrees and, between intersecting roadways or between roadways and railways, may be 30 degrees (not greater than 60 degree skew). Where these maximums are difficult to meet, consider relocating and/or realigning the intersecting roadways/waterways.

#### **39-4.10 Cross Slopes**

The typical sections in Section 39-5 provide the cross slope criteria for bridges. Note that, on tangent sections, the shoulder cross slope on a bridge is flatter (i.e., 1/4"/ft (2%)) than the typical shoulder cross slope on the approaching roadway section (i.e., 1/2"/ft (4%)).

#### **39-4.11 Gradeline on Bridges**

Where a bridge is planned for a new construction or reconstruction project and where the bridge is not within the limits of a vertical curve, the designer should strive to provide a minimum longitudinal gradient of 0.50% across the bridge. In addition, where a vertical curve cannot be avoided on the structure, a K value of 167 (51) for drainage should not be exceeded.

### 39-5 TYPICAL SECTIONS

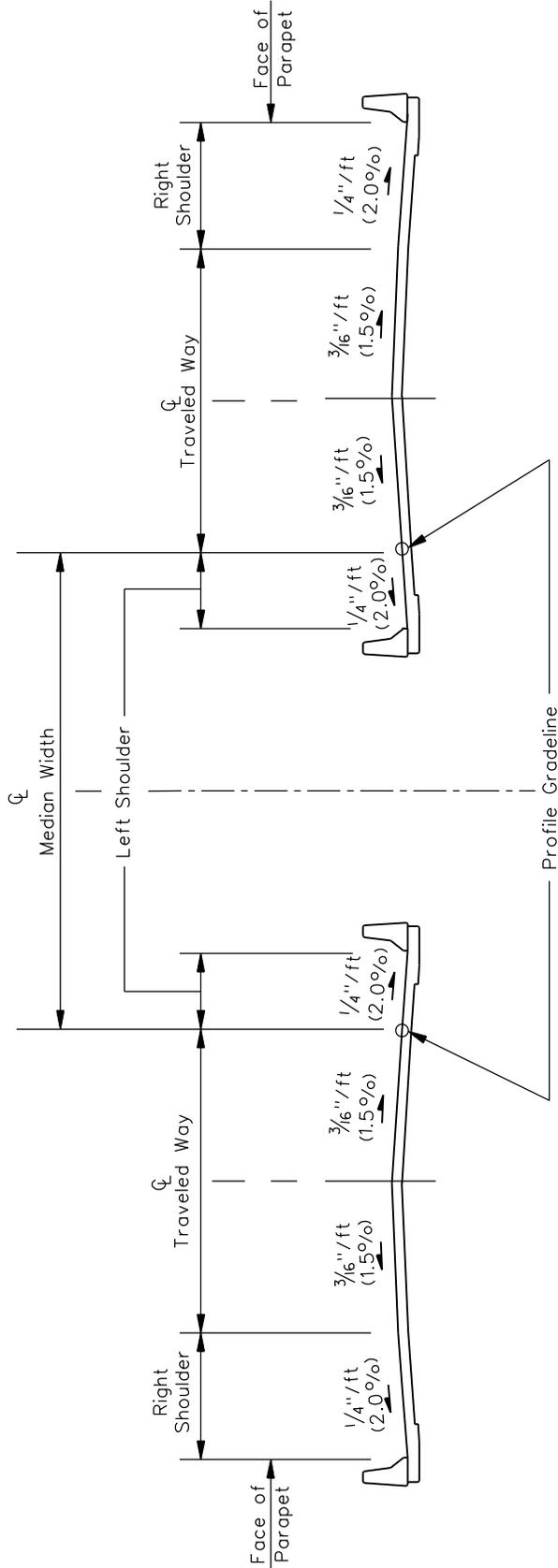
Section 39-5 presents typical sections for bridges on tangent or with superelevation, for roadways beneath bridges, and for highways passing over railroads. With the exception of cross slopes on bridges, the typical sections do not provide the numerical dimensions for the various cross section elements; i.e., these are nomenclature presentations. See Section 39-6 and the referenced chapters in the *BDE Manual* for the applicable numerical criteria.

Section 39-5 presents the following typical section figures:

- Clear Roadway Width of Bridges for New and Reconstructed Four-Lane Divided Highways (Figure 39-5.A).
- Clear Roadway Width of Bridges for New and Reconstructed Six-Lane Divided Highways (Figure 39-5.B).
- Clear Roadway Width of Bridges for New and Reconstructed Four-Lane Highways with Concrete Barrier (Figure 39-5.C).
- Clear Roadway Width of Bridges for New and Reconstructed Six-Lane Highways with Concrete Barrier (Figure 39-5.D).
- Clear Roadway Width of Bridges for New and Reconstructed Four-Lane Divided Highways with Additional Lane for Acceleration or Deceleration (Figure 39-5.E).
- Clear Roadway Width of Single-Lane Ramp Structures (Figure 39-5.F).
- Clear Roadway Width of Bridges for New and Reconstructed Rural Two-Lane Highways (Figure 39-5.G).
- Clear Roadway Width of Superelevated Bridges on Multilane Divided Highways (Figure 39-5.H).
- Clear Roadway Width of Superelevated Bridges on Multilane Highways with Concrete Barrier (Figure 39-5.I).
- Clear Roadway Width of Superelevated Bridges on Rural Two-Lane Highways (Figure 39-5.J).
- Clear Roadway Width of Bridges for New and Reconstructed Urban Highways with Raised-Curb Median (Figure 39-5.K).
- Clear Roadway Width of Bridges for New and Reconstructed Urban Highways with Bikeways (Figure 39-5.L).
- Clear Roadway Width of Bridges for New and Reconstructed Two-Lane Urban Highways (Flush/Traversable Median) (Figure 39-5.M).

- Clear Roadway Width of Superelevated Bridges on Urban Highways with Raised-Curb Median (Figure 39-5.N).
- Clear Roadway Width of Superelevated Bridges on Urban Highways with Flush/Traversable Median (Figure 39-5.O).
- Clear Roadway Width of Superelevated Bridges on Two-Lane Urban Highways (Figure 39-5.P).
- Clearances for Bridges over Divided Highways (Figure 39-5.Q).
- Clearances for Bridges over Two-Lane Highways (Figure 39-5.R).
- Highway Grade Separation over Railroad (Figure 39-5.S).

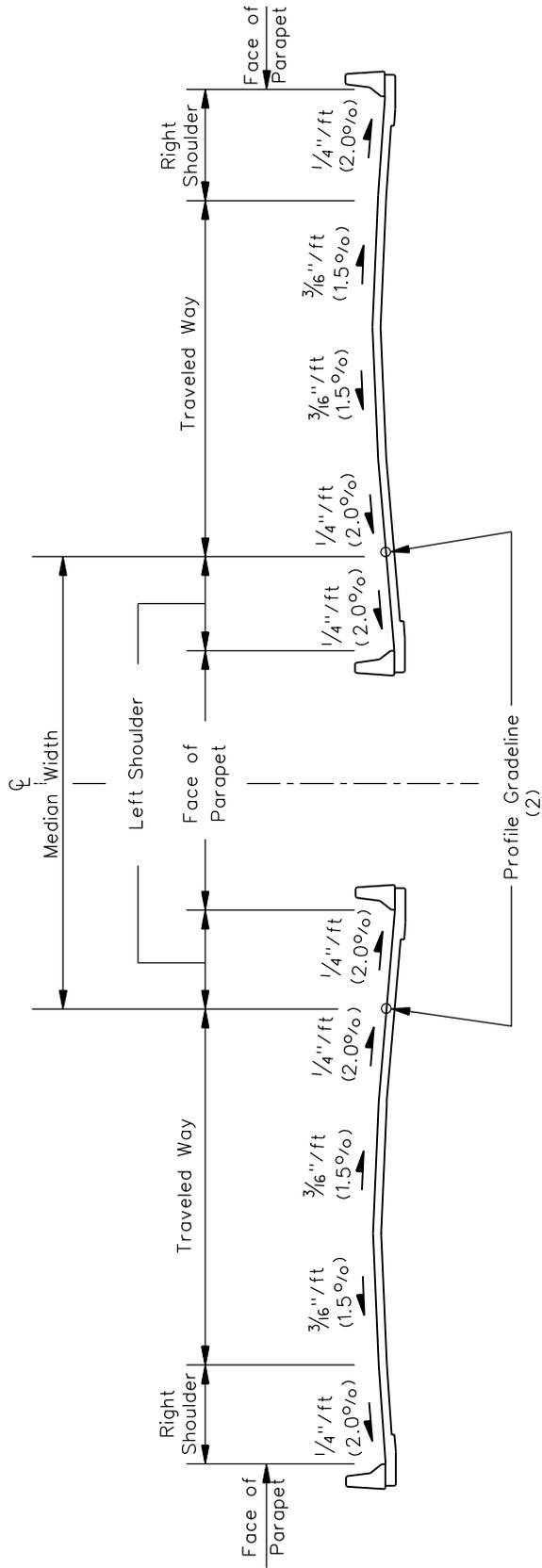
See the *Bridge Manual* for more details on bridge design.



Note: See Figure 39-6A and 39-6.C.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED FOUR-LANE DIVIDED HIGHWAYS**

Figure 39-5.A

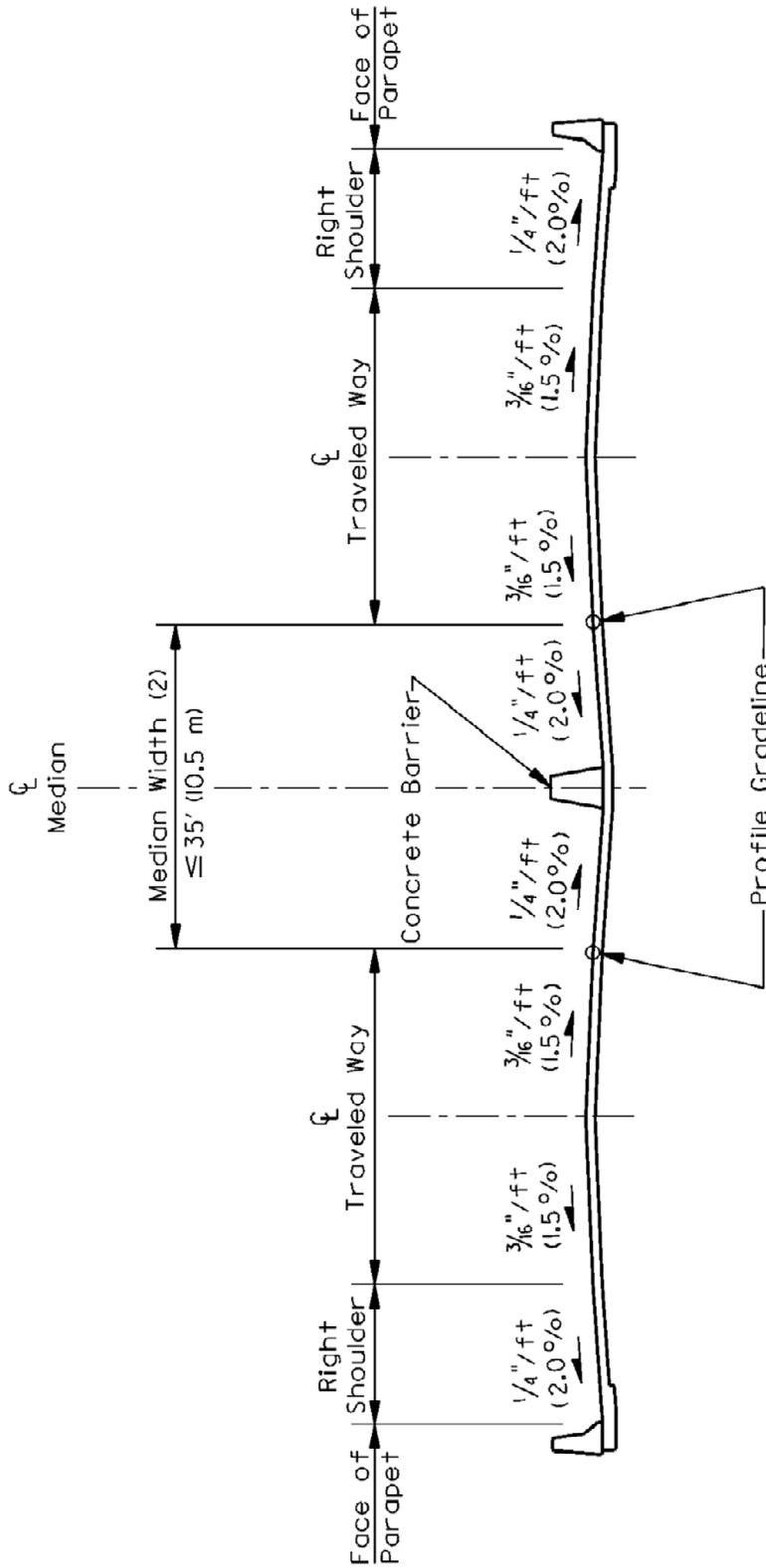


Notes:

1. See Figures 39-6.A and 39-6.C.
2. Profile gradeline is set at the location shown above where the approach traveled way is initially designed for three lanes in each direction.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED SIX-LANE DIVIDED HIGHWAYS**

**Figure 39-5.B**

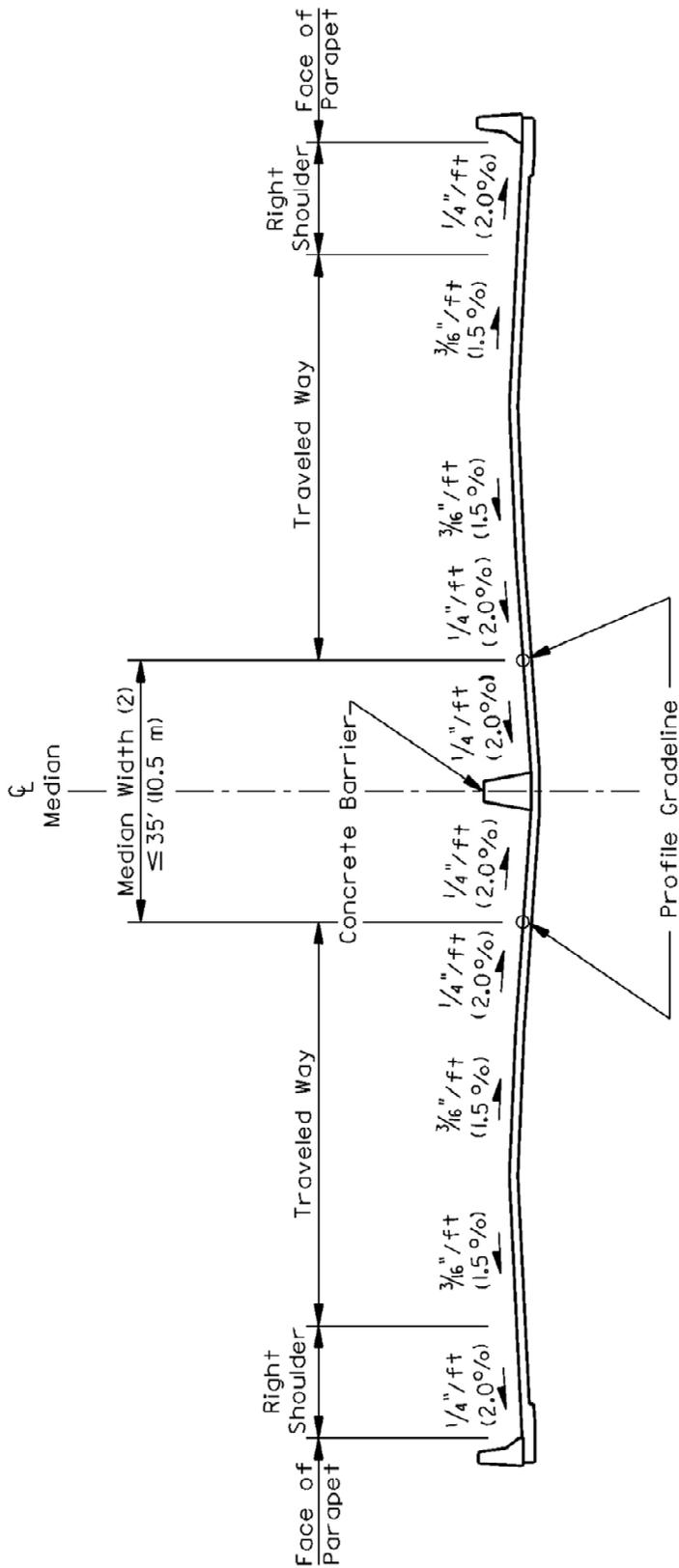


Notes:

1. See Figures 39-6.A and 39-6.C.
2. In all cases, the median width on the approach roadway and the median on the bridge structure must be similar.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED FOUR-LANE DIVIDED HIGHWAYS WITH CONCRETE BARRIER**

Figure 39-5.C

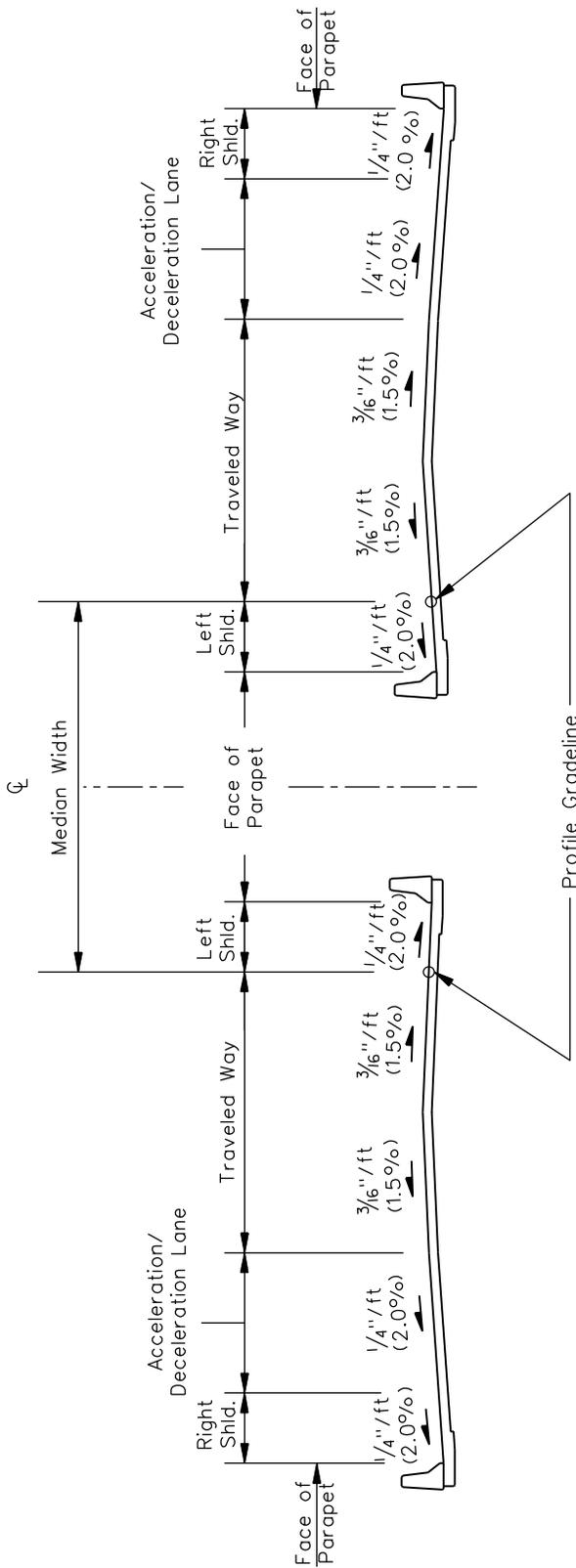


Notes:

1. See Figures 39-6.A and 39-6.C.
2. In all cases, the median width on the approach roadway and the median on the bridge structure must be similar.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED SIX-LANE DIVIDED HIGHWAYS WITH CONCRETE BARRIER**

Figure 39-5.D

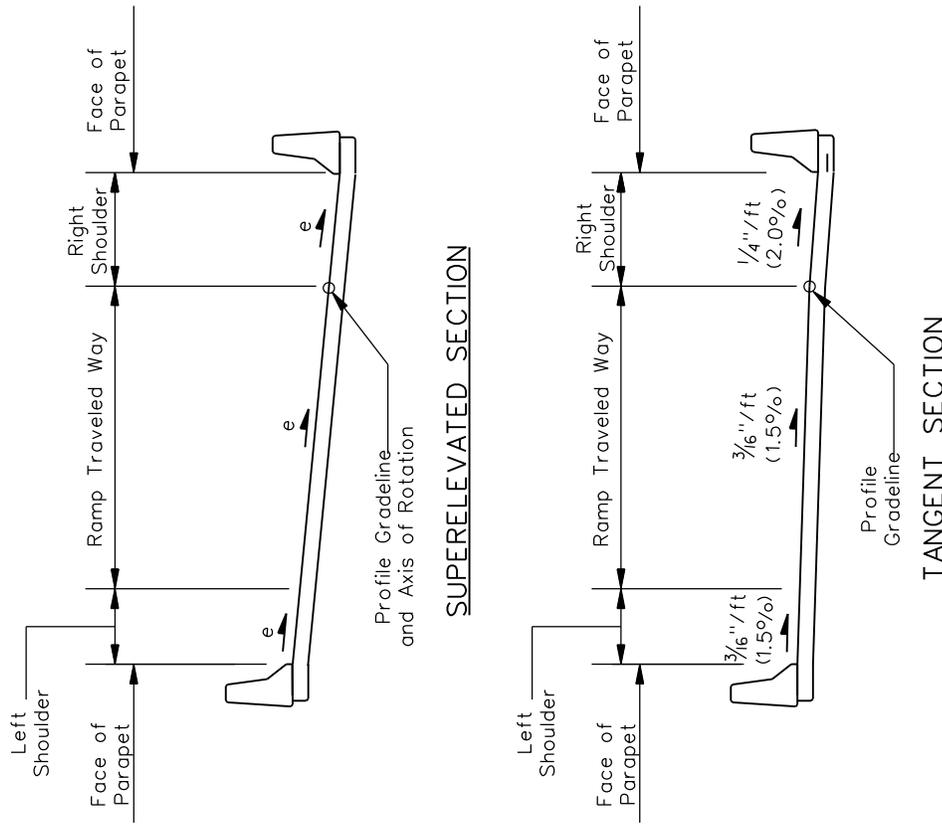


Notes:

1. See Figures 39-6.A and 39-6.C.
2. Where an exit terminal lies within the limits of a bridge, the cross slope of the standard exit terminal must be modified to fit the cross slope of the bridge deck. In this case, the designer should use a minimum uniform cross slope of 1/4 inch per foot (2%) on the terminal or, if the mainline is on a curve to the right, the designer should use the superelevation rate of the mainline for the terminal cross slope, but not greater than 5/8 inch per foot (5%). In both cases, the cross slope is measured perpendicular to the edge of the mainline pavement. See Section 37-6.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED FOUR-LANE DIVIDED HIGHWAYS**

**Figure 39-5.E**

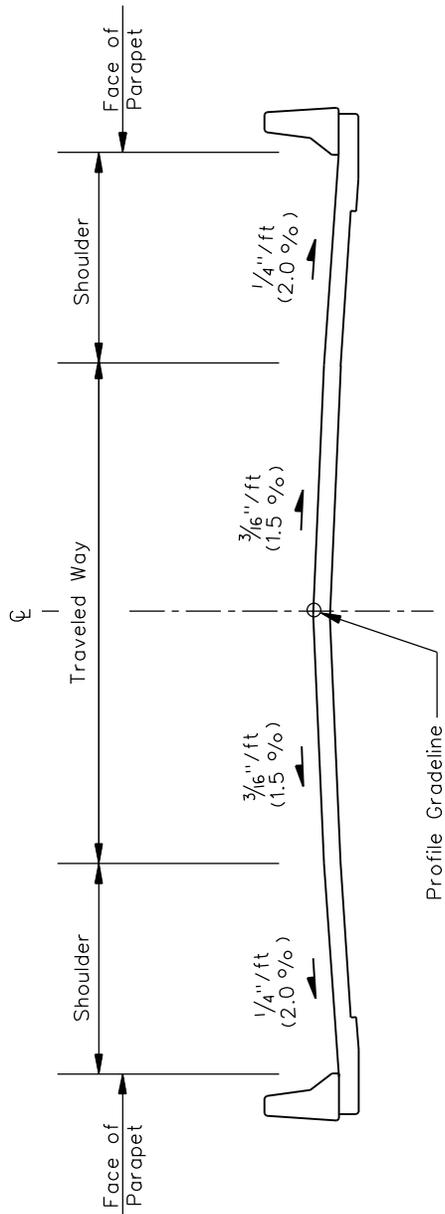


Notes:

1. See Section 37-4 for width criteria.
2. See Note 2. on Figure 39-5.H for roadway shoulder transition to superelevated bridge.

**CLEAR ROADWAY WIDTH OF SINGLE-LANE RAMP STRUCTURES**

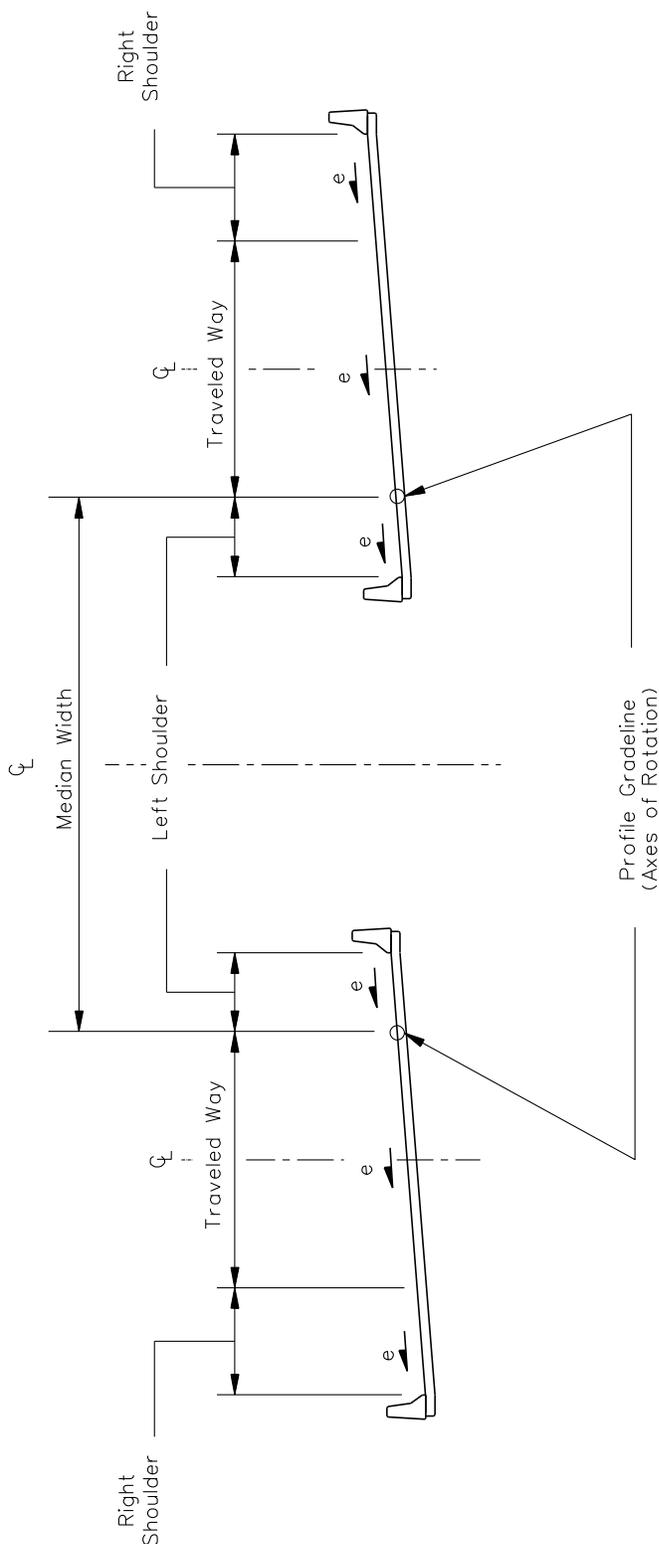
**Figure 39-5.F**



Note: See Figures 39-6.A and 39-6.B.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED RURAL TWO-LANE HIGHWAYS**

Figure 39-5.G

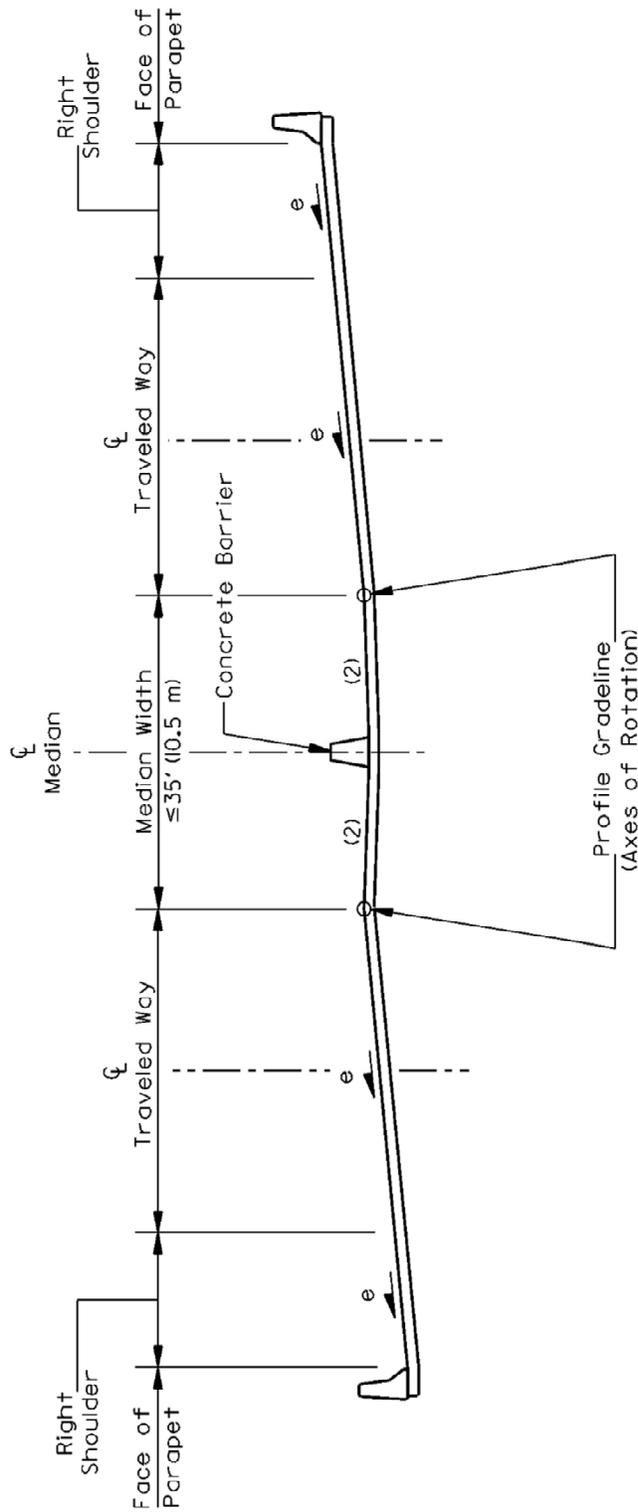


Notes:

1. See Figures 39-6.A and 39-6.C.
2. Where a bridge lies within a horizontal curve with superelevation, the shoulder on the high side of the bridge (starting just off the end of the bridge approach shoulder pavement) will be gradually transitioned into the design slope of the shoulder on the approaching roadway. Also see the Highway Standards. This transition should be accomplished by providing a maximum relative longitudinal difference in gradient of 0.40% between the edge of the traveled way and the outside edge of the shoulder. Also see Chapter 32.

**CLEAR ROADWAY WIDTH OF SUPERELEVATED BRIDGES ON MULTILANE DIVIDED HIGHWAYS**

Figure 39-5.H

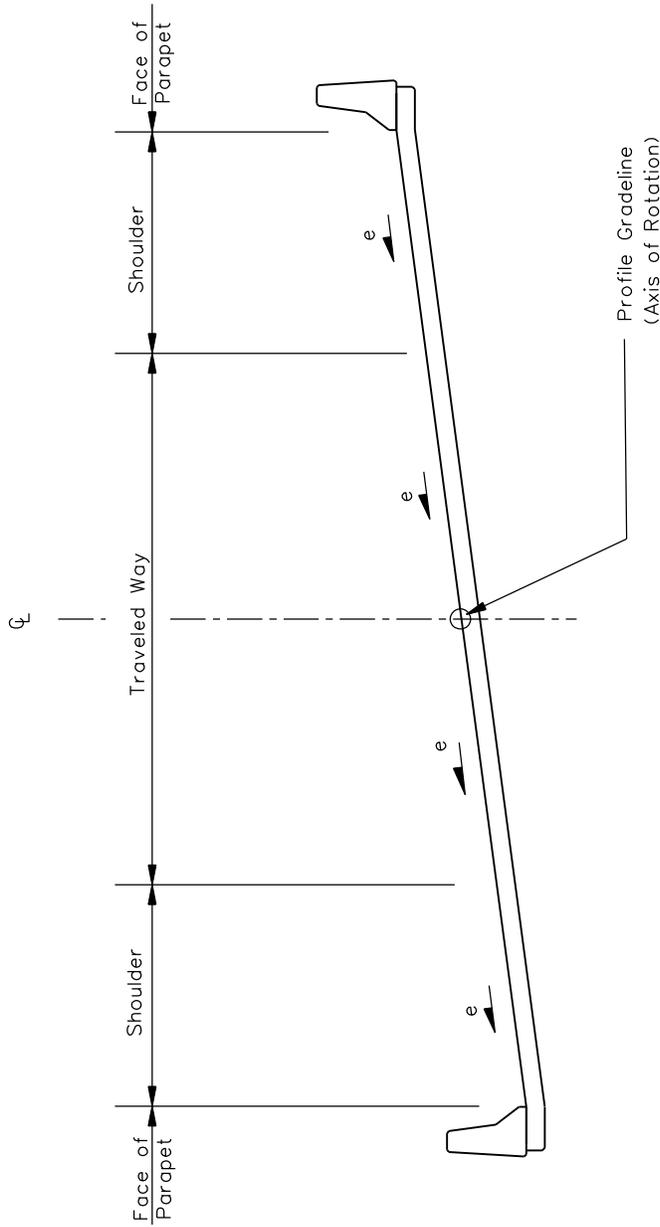


Notes:

1. See Figures 39-6.A and 39-6.C.
2. The usual shoulder cross slope on structure with this type median is 1/4"ft (2%). However, the crossover crown between the traveled way and median shoulder should not exceed 6%.
3. Where a bridge lies within a horizontal curve with superelevation, the shoulder on the high side of the bridge (starting just off the end of the bridge approach shoulder pavement) will be gradually transitioned into the design slope of the shoulder on the approaching roadway. Also see the Highway Standards. This transition should be accomplished by providing a maximum relative longitudinal difference in gradient of 0.40% between the edge of the traveled way and the outside edge of the shoulder. Also see Chapter 32.

**CLEAR ROADWAY WIDTH OF SUPERELEVATED BRIDGES ON MULTILANE HIGHWAY WITH CONCRETE BARRIER**

Figure 39-5.1

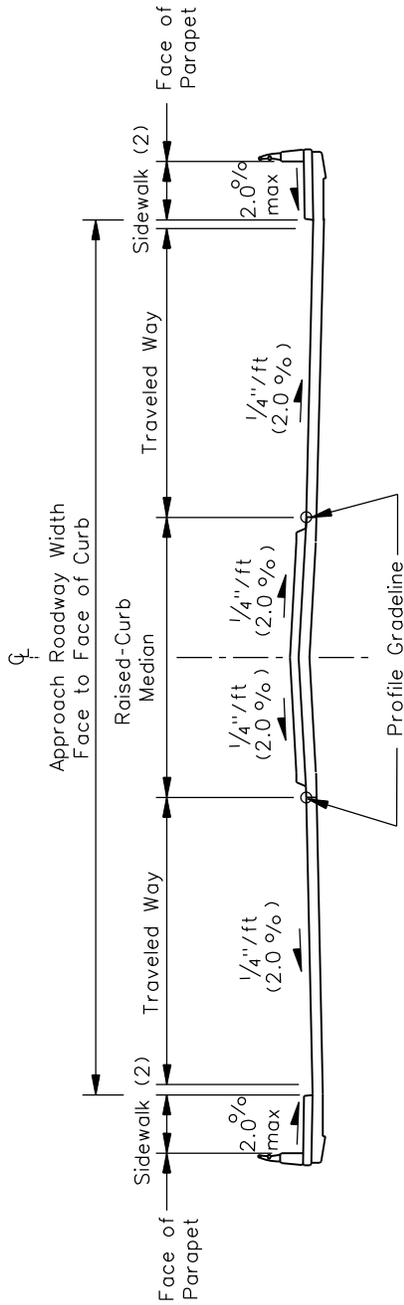


Notes:

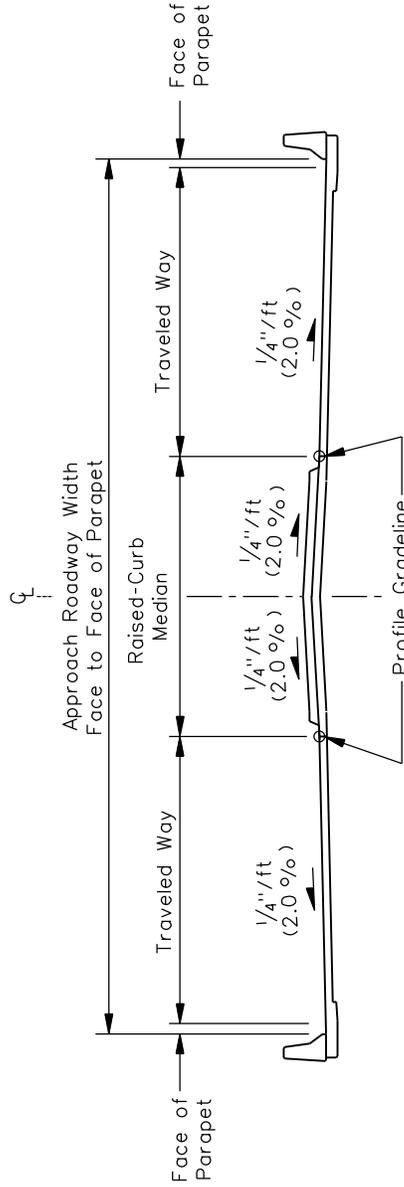
1. See Figures 39-6.A and 39-6.B.
2. Where a bridge lies within a horizontal curve with superelevation, the shoulder on the high side of the bridge (starting just off the end of the bridge approach shoulder pavement) will be gradually transitioned into the design slope of the shoulder on the approaching roadway. Also see the Highway Standards. This transition should be accomplished by providing a maximum relative longitudinal difference in gradient of 0.40% between the edge of the traveled way and the outside edge of the shoulder. Also see Chapter 32.

**CLEAR ROADWAY WIDTH OF SUPERELEVATED BRIDGES ON RURAL TWO-LANE HIGHWAYS**

Figure 39-5.J



Sidewalk — Both Sides

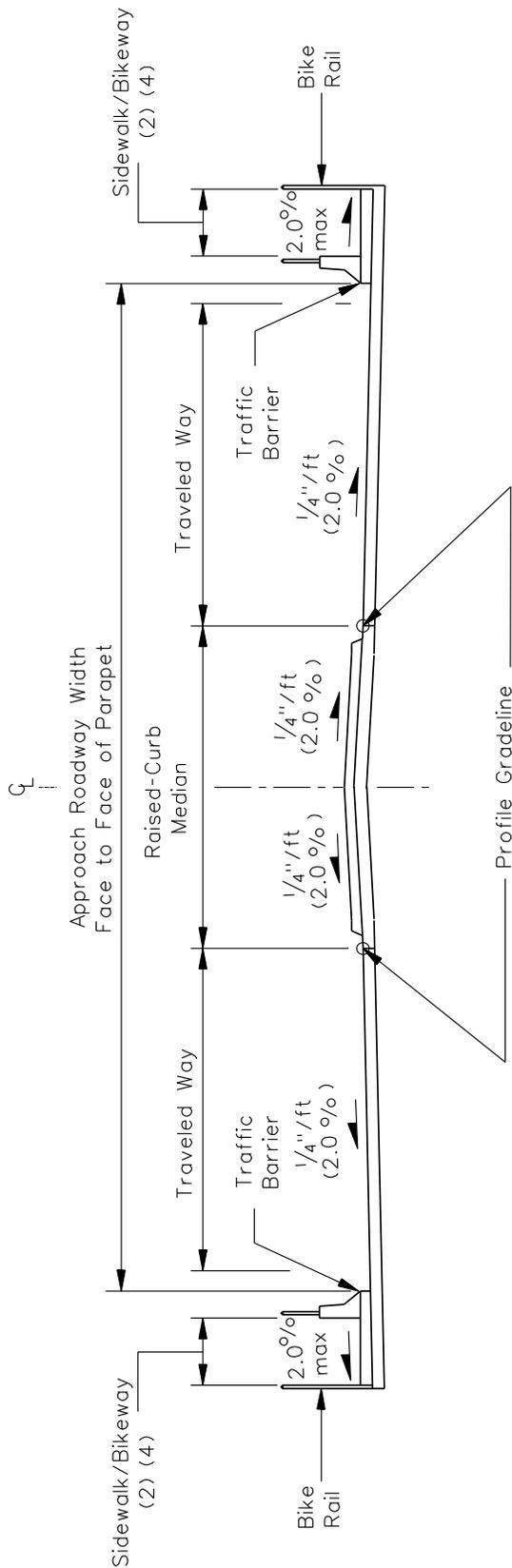


Sidewalk Not Provided

Note: See Figure 39-6.C. Raised sidewalks without physical separation may only be used with posted limits of 40 mph or lower.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED URBAN HIGHWAYS WITH RAISED-CURB MEDIAN**

**Figure 39-5.K**

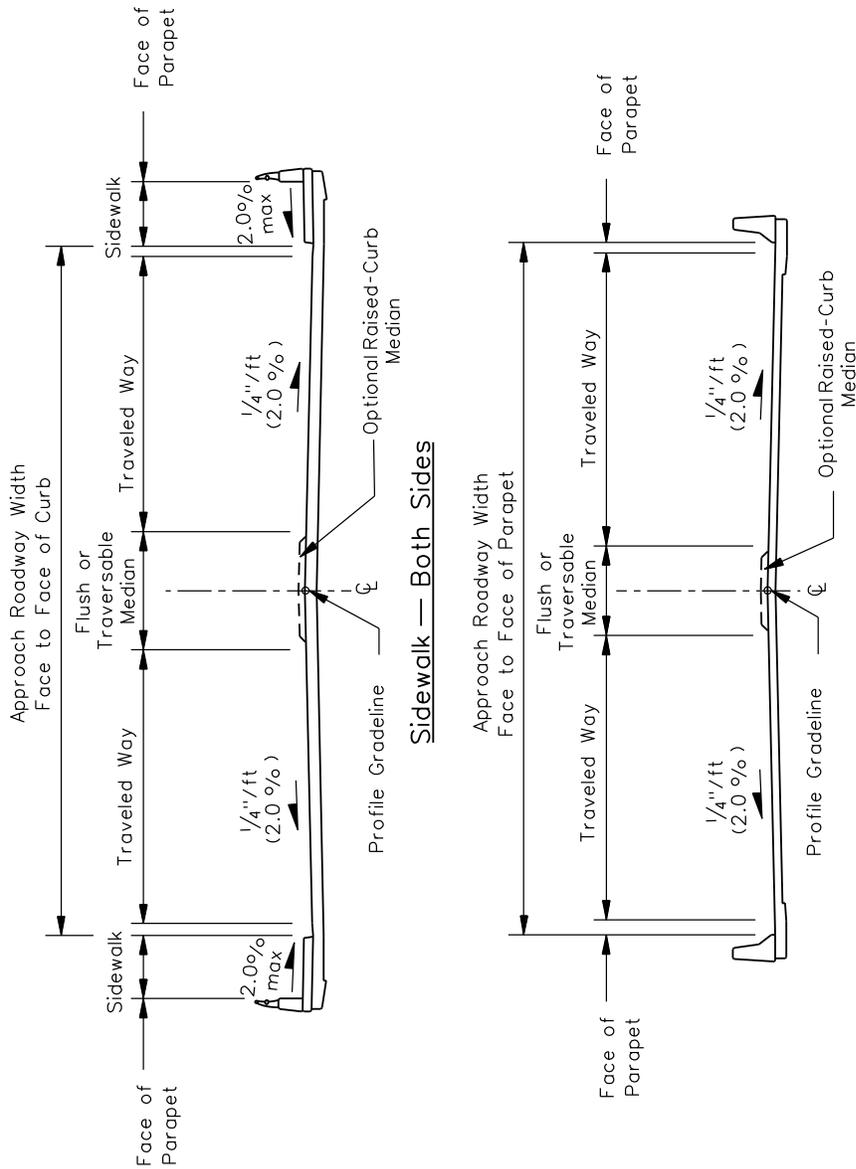


**Notes:**

1. See Figure 39-6.C and Chapter 17. The configuration shown is most typically applied for pedestrian accommodation at higher speeds. If a side path is provided on one or both sides, design the clear width and parapets for the path in accordance with Chapter 17 guidance. In those cases the side path will be directly on the deck rather than raised as illustrated.
2. Where a flush/traversable median is used on the approach, a raised-curb median may be used across the structure where bridge decks are subject to frequent icing conditions.
3. This template for separation of sidewalks may be considered where there are vehicular posted speed limits of 45 mph or greater, or high pedestrian volumes or a concentration of elementary school children present at lower posted speeds. Always provide separation in conjunction with a two-way side path.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED URBAN HIGHWAYS WITH BIKEWAYS**

**Figure 39-5.L**



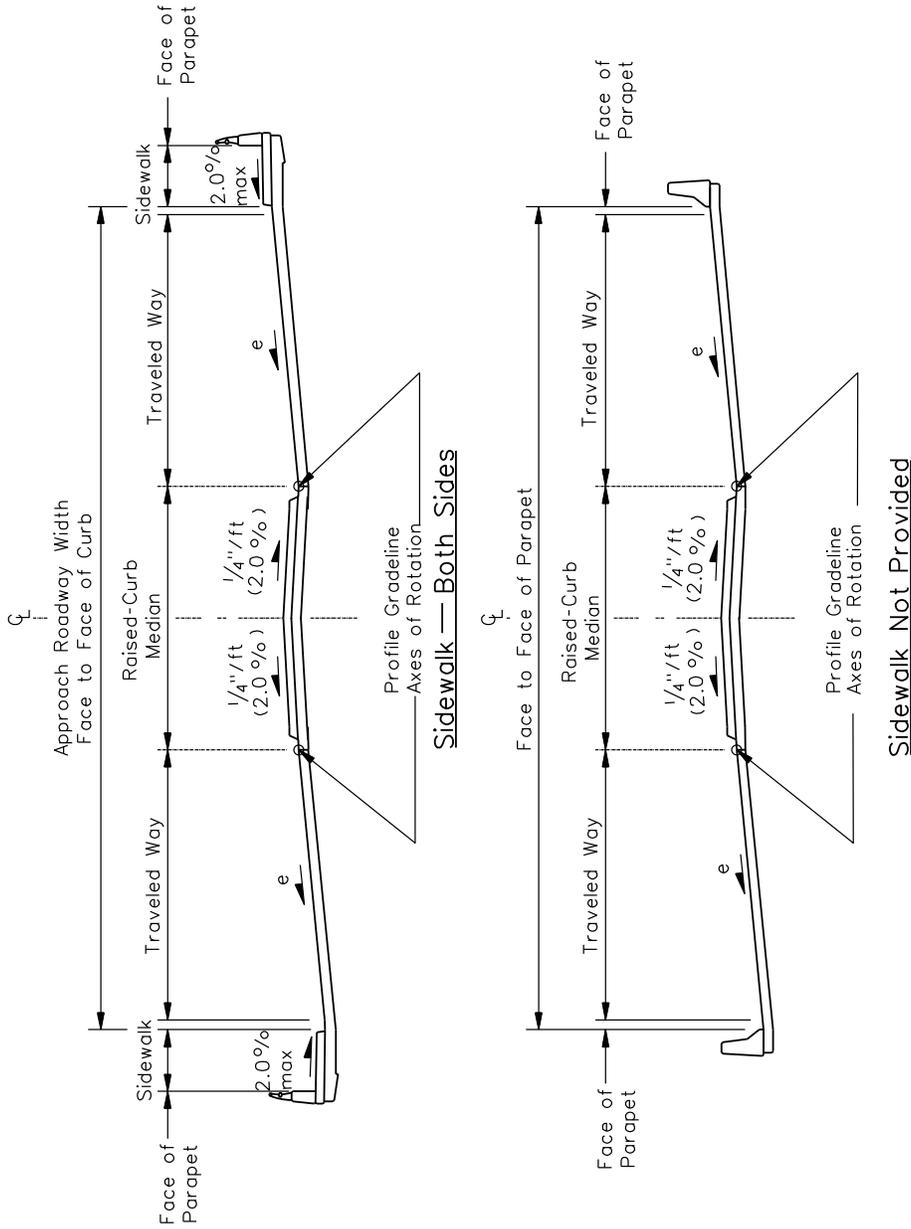
**Sidewalks Not Provided**

**Notes:**

1. See Figure 39-6.C and Section 48-2. Raised sidewalks without physical separation may only be used with posted limits of 40 mph or lower.
2. Where a flush/traversable median is used on the approach, a raised-curb median may be used across the structure where bridge decks are subject to frequent icing conditions.

**CLEAR ROADWAY WIDTH OF BRIDGES FOR NEW AND RECONSTRUCTED TWO-LANE URBAN HIGHWAYS  
(Flush/Traversable Median)**

**Figure 39-5.M**

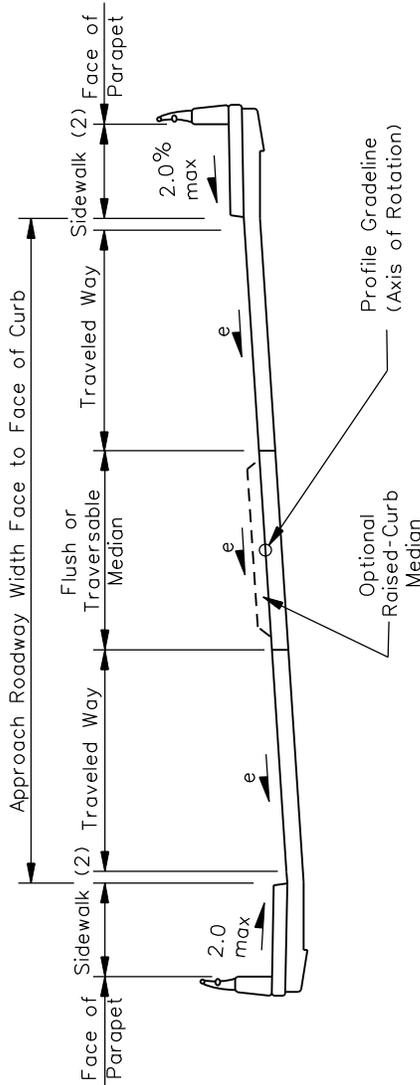


Notes:

1. See Figure 39-6.C and Section 48-2. Raised sidewalks without physical separation may only be used with posted limits of 40 mph or lower.
2. Where an urban bridge lies within a horizontal curve with superlevation, the gutter on the high side of the bridge (starting just off the end of the bridge approach pavement) is gradually transitioned into the design slope of the gutter on the approaching roadway. See the Highway Standards. This transition should be accomplished by providing a maximum relative longitudinal difference in gradient of 0.50% between the edge of the traveled way and the flow line of the gutter. Also see Chapter 32 and Section 48-5.

**CLEAR ROADWAY WIDTH OF SUPERELEVATED BRIDGES ON URBAN HIGHWAYS WITH RAISED-CURB MEDIAN**

Figure 39-5.N

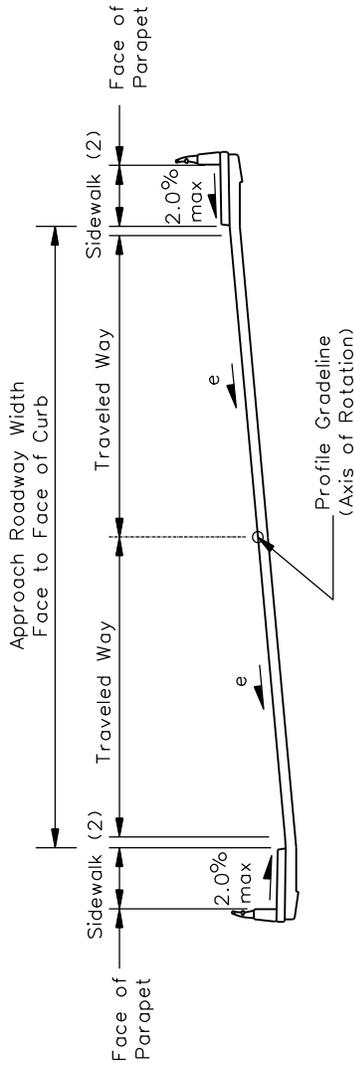


Notes:

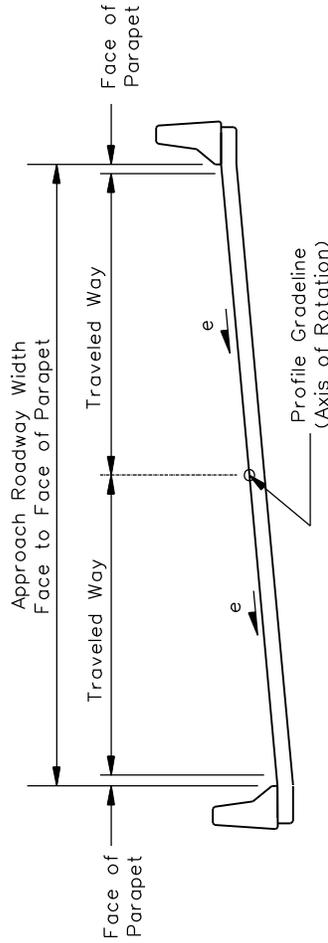
1. See Figure 39-6.C and Section 48-2. Raised sidewalks without physical separation may only be used with posted limits of 40 mph or lower.
2. Where an urban bridge lies within a horizontal curve with superelevation, the gutter on the high side of the bridge (starting just off the end of the bridge approach pavement) is gradually transitioned into the design slope of the gutter on the approaching roadway. See the Highway Standards. This transition should be accomplished by providing a maximum relative longitudinal difference in gradient of 0.50% between the edge of the traveled way and the flow line of the gutter. Also see Chapter 32 and Section 48-5.

**CLEAR ROADWAY WIDTH OF SUPERELEVATED BRIDGES ON URBAN HIGHWAYS WITH FLUSH/TRAVERSABLE MEDIAN**

Figure 39-5.0



**Sidewalk — Both Sides**



**Sidewalk Not Provided**

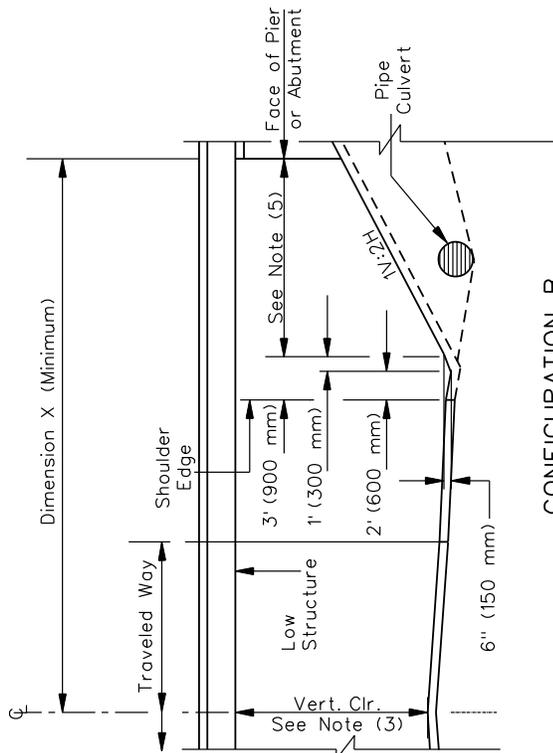
**Notes:**

1. See Figure 39-6.C and Section 48-2. Raised sidewalks without physical separation may only be used with posted limits of 40 mph or lower.
2. Where an urban bridge lies within a horizontal curve with superelevation, the gutter on the high side of the bridge (starting just off the end of the bridge approach pavement) is gradually transitioned into the design slope of the gutter on the approaching roadway. See the Highway Standards. This transition should be accomplished by providing a maximum relative longitudinal difference in gradient of 0.50% between the edge of the traveled way and the flow line of the gutter. Also see Chapter 32 and Section 48-5.

**CLEAR ROADWAY WIDTH OF SUPERELEVATED BRIDGES ON TWO-LANE URBAN HIGHWAYS**

**Figure 39-5.P**



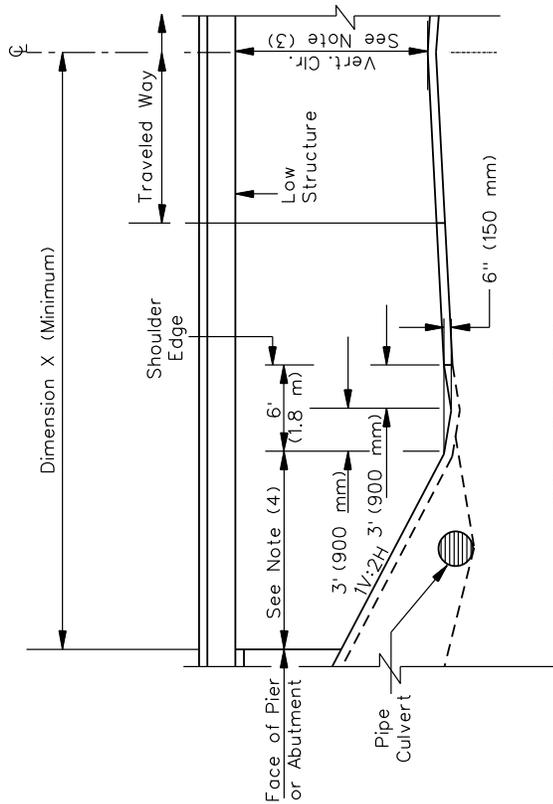


CONFIGURATION B

Notes:

1. Locate the upstream traffic end of a through pipe culvert outside the clear zone of the near edge of traveled way.
2. All horizontal dimensions are right-angle dimensions.
3. Locate the minimum clearance point at the least clearance point above the usable roadway under, including stabilized shoulders.
4. Where  $DS \geq 60$  mph (100 km/h), distance is equal to 14 ft (4.2 m). For  $DS < 60$  mph (100 km/h), distance is equal to 10 ft (3.0 m).
5. Where  $DS \geq 50$  mph (80 km/h), distance is equal to 10 ft (3.0 m). For  $DS < 50$  mph (80 km/h) distance is equal to 6 ft (1.8 m).

DS: Design Speed



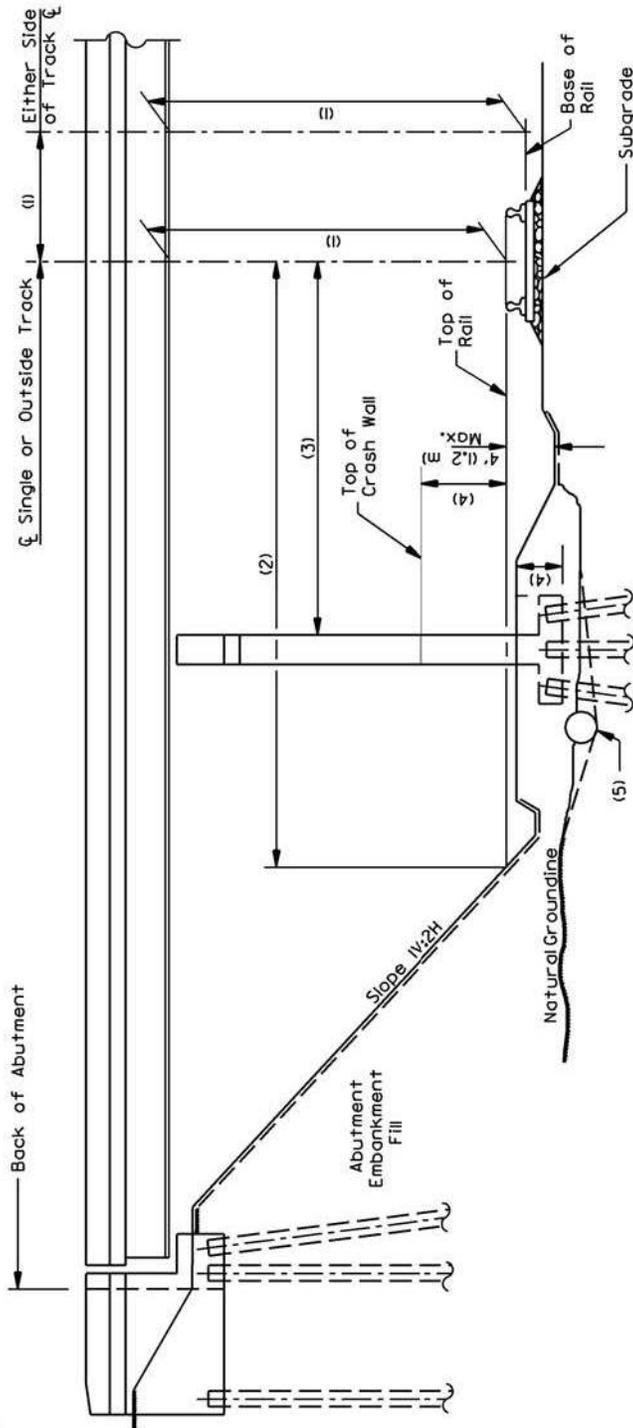
CONFIGURATION A

Functional Classification of Underpassing Highway	Current ADT or 20-Year DHV	Config.	X (Min.)	Minimum Vertical Clearance
Rural Principal Arterial or Minor Arterial*	All ADT's	A	42' (12.8 m)	16'-6" (5.0 m) (new) 16'-0" (4.9 m) (reconst)
Local Road or Collector	DHV over 400	A	36' (11.0 m)	14'-9" (4.5 m)
Local Road or Collector	DHV 200-400	A	36' (11.0 m)	14'-9" (4.5 m)
Local Road or Collector	DHV 100-200	B	30' (9.0 m)	14'-9" (4.5 m)
Local Road or Collector	ADT 250-400	B	28' (8.5 m)	14'-9" (4.5 m)
Local Road or Collector	ADT < 250	B	23' (7.0 m)	14'-9" (4.5 m)
Frontage Road A	ADT over 2000	A	40' (12.0 m)	16'-0" (4.9 m)
Frontage Road B	ADT ≥ 750	A	32' (10.0 m)	14'-9" (4.5 m)
Frontage Road B	ADT < 750	B	30' (9.0 m)	14'-9" (4.5 m)
Frontage Road C	ADT < 400	B	23' (7.0 m)	14'-9" (4.5 m)

For marked highways functional classified as collectors, use the arterial criteria.

CLEARANCES FOR BRIDGES OVER TWO-LANE HIGHWAYS

Figure 39-5.R



Typical section at right angle to track.

**HIGHWAY GRADE SEPARATION OVER RAILROAD**

**FIGURE 39-5.S**

**Footnotes for Figure 39-5.S**

For multiple track facilities, all dimensions apply to the centerline of the outer tracks. All horizontal dimensions are measured perpendicular to the railroad tracks.

- (1) *A vertical clearance of not less than 23 ft-0 in. (7.0 m) above the top of rail shall be provided for all new or reconstructed highway bridges constructed over a railroad track. Beginning at a point in the centerline of track, 23 ft-0 in. (7.0 m) above the top of the rail, the vertical clearance line shall extend thence horizontally each way to a point 9 ft, 0 in. (2.7 m) from the centerline of the track, from which points the horizontal clearance lines shall extend vertically downward to points level with the base of the rail. Illinois Commerce Commission may permit a lesser clearance if it determines that the 23 ft-0 in. (7.0 m) clearance standard cannot be justified based on engineering, operational, and economic conditions. The existing vertical clearance or 21 ft-6 in. (6.6 m), whichever is greater, is permitted for bridge rehabilitation projects that do not require pier and/or cap replacement, girder removal and/or replacement, and/or widening of the existing piers or pier caps. (92 Ill. Admin. Code 1500.160).*
- (2) *A cross section with a horizontal distance of 20 ft-0 in. (6.1 m) measured at right angles from the centerline of track at the top of rails, to the face of the embankment slope, is permitted. The 20 ft-0 in. (6.1 m) may be increased at individual structure locations as appropriate to provide for drainage if justified by a hydraulic analysis or to allow adequate room to accommodate special conditions, such as where heavy and drifting snow is a problem. The railroad must demonstrate that this is normal practice to address these conditions in the manner proposed. This dimension may be increased by up to 8 ft (2.5 m) on one side only, as may be necessary for off-track maintenance equipment, provided adequate horizontal clearance is not available in adjacent spans and where justified by the presence of an existing maintenance road or by evidence of future need for such equipment. (92 Ill. Admin. Code 1500.160).*
- (3) *Piers should be placed at least 9 ft-0 in. (2.8 m), measured from the nearest point along the edge of the pier, horizontally from the centerline of the track and preferably beyond the drainage ditch. (Appendix to Subpart B of Part 23 C.F.R. 646).*
- (4) *Crash walls for piers from 12 ft to 25 ft (3.6 m to 7.6 m) clear from the centerline of track shall have a minimum height of 6 ft (1.8 m) above the top of the rail. Piers less than 12 ft (3.6 m) clear from the centerline of track shall have a minimum crash wall height of 12 ft (3.6 m) above the top of the rail. The crash wall shall be at least 2 ft, 6 in. (760 mm) thick and at least 12 ft-0 in. (3.6 m) long. When two or more columns compose a pier, the crash wall shall connect the columns and extend at least 1 ft (300 mm) beyond the outermost column parallel to the track. The crash wall shall extend at least 4 ft-0 in. (1.2 m) below the lowest surrounding grade. (Volume 2 Chapter 8 Section 2.1.5 of AREMA Manual for Railway Engineering).*
- (5) *Intercepted drainage along railroad embankment shall be accommodated with a minimum 3 ft (900-mm) diameter culvert or carried along highway embankment.*

**39-6 TABLES OF DESIGN CRITERIA**

Figure 39-6.A presents the Department's design criteria for new or reconstructed bridges on the rural State highway system. Figure 39-6.B presents the Department's criteria for new or reconstructed bridges on rural frontage roads. Figure 39-6.C presents the Department's criteria for new or reconstructed bridges on the urban State highway system.

Classification	Principal Arterial Highway System or NHS			Minor Arterial System		
	Freeway <sup>(3)</sup>	Expressway <sup>(3)</sup>	Two-Lane Highway	Four-Lane Highway <sup>(3)</sup>	Two-Lane Highway	
Highway Type	Freeway <sup>(3)</sup>	Expressway <sup>(3)</sup>	Two-Lane Highway	Four-Lane Highway <sup>(3)</sup>	Two-Lane Highway	
Manual Reference	Figure 44-5.A	Figure 45-4.A	Figure 47-2.J	Figure 47-3.C	Figure 47-2.K	
Design Hourly Volume	One-Way DHV		One-Way DHV Under 2050	Two-Way DHV Under 850 <sup>(4)</sup>	One-Way DHV Under 2525	Two-Way DHV Under 1050 <sup>(4)</sup>
	1950 to 2900	Under 1950				
Clear Roadway Bridge Widths (Face-to-Face of Parapets) <sup>(5)(6)(7)(8)</sup>	Dual 56'	Dual 40'	Dual 38' or 40'	44'	Dual 36' or 38'	32'
Minimum Width of Bridges (Face-to-Face of Parapets) Allowed to Remain in Place <sup>(6)(9)</sup>	Dual 56'	Dual 38'	Dual 36' w/24' traveled way 34' w/22' traveled way	40' w/24' traveled way 38' w/22' traveled way	Dual 36' w/24' traveled way 34' w/22' traveled way	32' w/24' traveled way 30' w/22' traveled way
Minimum Design Flood Frequency	50-year					
Minimum Clearance Above Design High-Water Elevation	2' <sup>(10)(11)</sup>			2' <sup>(11)</sup>		
Design Live Load	HS-20 <sup>(12)</sup>					
Vertical Clearance for Structures Over Highways <sup>(14) (15)</sup>	16'-0" min. Reconstruction/ 16'-9" New <sup>(15)</sup> Construction		16'-0" Reconstruction/16'-6" New Construction <sup>(13) (15)</sup>			
	See Figures 33-5.A, 39-5.Q and 39-5.R					
Horizontal Clearance for Structures Over Highways	See Figures 33-5.A, 39-5.Q and 39-5.R					
Vertical and Horizontal Clearance over Railroads	See Figure 33-5.A and 39-5.S					

**DESIGN CRITERIA FOR NEW OR RECONSTRUCTED<sup>(1)</sup> BRIDGES  
(Rural State Highway System<sup>(2)</sup>)  
(US Customary)**

**Figure 39-6.A**

Classification	Principal Arterial Highway System or NHS			Minor Arterial System		
	Freeway <sup>(3)</sup>	Expressway <sup>(3)</sup>	Two-Lane Highway	Four-Lane Highway <sup>(3)</sup>	Two-Lane Highway	
Highway Type	Freeway <sup>(3)</sup>	Expressway <sup>(3)</sup>	Two-Lane Highway	Four-Lane Highway <sup>(3)</sup>	Two-Lane Highway	
Manual Reference	Figure 44-5.A	Figure 45-4.A	Figure 47-2.J	Figure 47-3.C	Figure 47-2.K	
Design Hourly Volume	One-Way DHV		One-Way DHV Under 2050	Two-Way DHV Under 850 <sup>(4)</sup>	One-Way DHV Under 2525	Two-Way DHV Under 1050 <sup>(4)</sup>
	1950 to 2900	Under 1950				
Clear Roadway Bridge Widths (Face-to-Face of Parapets) <sup>(5)(6)(7)(8)</sup>	Dual 16.8 m	Dual 12.0 m	Dual 11.4 m or 12.0 m	13.2 m	Dual 10.8 m or 11.4 m	9.6 m
Minimum Width of Bridges (Face-to-Face of Parapets) Allowed to Remain in Place <sup>(6)(9)</sup>	Dual 16.8 m	Dual 11.4 m	Dual 10.8 m w/7.2 m traveled way 10.2 m w/6.6 m traveled way	12.0 m w/7.2 m traveled way 11.4 m w/6.6 m traveled way	Dual 10.8 m w/7.2 m traveled way 10.2 m w/6.6 m traveled way	9.6 m w/7.2 m traveled way 9.0 m w/6.6 m traveled way
Minimum Design Flood Frequency	50-year					
Minimum Clearance Above Design High-Water Elevation	600 mm <sup>(10)(11)</sup>			600 mm <sup>(11)</sup>		
Design Live Load	MS-18 <sup>(12)</sup>					
Vertical Clearance for Structures Over Highways <sup>(14)(15)</sup>	4.9 m min. Reconstruction/ 5.1 m New <sup>(15)</sup> Construction		4.9 m Reconstruction/5.0 m New Construction <sup>(13)(15)</sup>			
	See Figures 33-5.A, 39-5.Q and 39-5.R					
Horizontal Clearance for Structures Over Highways	See Figures 33-5.A 39-5.Q and 39-5.R					
Vertical and Horizontal Clearance over Railroads	See Figures 33-5.A and 39-5.S					

**DESIGN CRITERIA FOR NEW OR RECONSTRUCTED<sup>(1)</sup> BRIDGES  
(Rural State Highway System<sup>(2)</sup>)  
(Metric)**

**Figure 39-6.A**

**Footnotes for Figure 39-6.A**

- (1) *Implies reconstruction of a significant length of existing highway either on new location or on existing ROW. For reconstruction of relatively short intermittent highway segments within a project, the design criteria used, where cost-safety effective, should be consistent with the adjacent highway design, but not less than that allowed to remain in place.*
- (2) *For marked highways functionally classified as Collectors, use the Arterial criteria.*
- (3) *Volumes calculated with PHF = 1.0; adjust for local peak hour factors (PHF).*
- (4) *Based on 100% MUTCD passing sight distance; adjust for actual percentage. See Chapter 31 for the assumed truck percentage.*
- (5) *On freeways where truck traffic exceeds 250 DDHV, see Figure 44-5.A for the use of 12 ft (3.6 m) shoulders.*
- (6) *Bridge widths for bridge rehabilitation projects are discussed in Chapters 49 and 50.*
- (7) *Bridge widths are normally defined as the sum of the approach traveled way width and approach paved shoulder width.*
- (8) *For reconstruction projects, where the minimum required right or left shoulder widths on a structure can only be obtained with the addition of new beams and substructure, a cost-safety evaluation should be made to determine the appropriateness of providing the required width. Significant decreases of the required widths should not be considered.*
- (9) *Implies elements allowed to remain in place without a design exception approval when cost-effective and when safety record is satisfactory.*
- (10) *For new freeway or expressway construction, the bottom of the superstructure shall not be below the all time high-water elevation.*
- (11) *For reconstruction projects, the proposed low superstructure should not be below the existing superstructure unless 2 ft (600 mm) of clearance is achieved. Any proposed clearance less than 2 ft (600 mm) above design high-water elevation must be accompanied by a request for a design exception.*
- (12) *For the Interstate System, provisions shall be made for the Alternate Military Loading.*
- (13) *Use 14 ft-9 in. (4.5 m) for local roads and unmarked collector roads.*
- (14) *The minimum required vertical clearance must be available over the traveled way and any paved shoulders.*
- (15) *A vertical clearance of 17 ft-3 in. (5.25 m) shall be provided for through trusses, overhead signs, and pedestrian overpasses.*

CLASSIFICATION	FRONTAGE ROADS		
MANUAL REFERENCE	Figure 44-2.H		
TYPE	A	B	C
Horizontal Clearance	See Figure 39-5.R		
Clear Roadway Bridge Widths (Face-to-Face Parapets)	40' (30')	34' (28')	28' (26')
Minimum Design Flood Frequency	30-year	25-year	20-year
Minimum Clearance Above Design High-Water Elevation	2' <sup>(2)</sup>		
Design Live Load	HS-20		
Vertical Clearance for Structures Over Frontage Roads	See Figure 33-5.A, 39-5.R		
Vertical Clearance Over Railroad	See Figures 33-5.A and 39-5.S		

<sup>(1)</sup> *Minimum design criteria for existing geometric design elements allowed to remain in place are shown in parentheses.*

<sup>(2)</sup> *For structures allowed to remain in place, the low superstructure should not be lower than the design high-water elevation without a design exception.*

**BRIDGE DESIGN CRITERIA FOR NEW CONSTRUCTION AND RECONSTRUCTION<sup>(1)</sup>  
(Rural Frontage Roads)  
(US Customary)**

**Figure 39-6.B**

CLASSIFICATION	FRONTAGE ROADS		
MANUAL REFERENCE	Figure 44-2.H		
TYPE	A	B	C
Horizontal Clearance	See Figure 39-5.R		
Clear Roadway Bridge Widths (Face-to-Face Parapets)	12.0 m (9.0 m)	10.2 m (8.4 m)	8.4 m (7.8 m)
Minimum Design Flood Frequency	30-year	25-year	20-year
Minimum Clearance Above Design High-Water Elevation	600 mm <sup>(2)</sup>		
Design Live Load	MS-18		
Vertical Clearance for Structures Over Frontage Roads	See Figure 33-5.A, 39-5.R		
Vertical Clearance Over Railroad	See Figures 33-5.A and 39-5.S		

- (1) *Minimum design criteria for existing geometric design elements allowed to remain in place are shown in parentheses.*
- (2) *For structures allowed to remain in place, the low superstructure should not be lower than the design high-water elevation without a design exception.*

**BRIDGE DESIGN CRITERIA FOR NEW CONSTRUCTION AND RECONSTRUCTION<sup>(1)</sup>  
(Rural Frontage Roads)  
(Metric)**

**Figure 39-6.B**

Arterial Highways and Streets											
Classification	FW-6	FW-4	EX-6 Construction	EX-6 Reconstruction	EX-4 Reconstruction	OWS-4	OWS-3	OWS-2	TWS-6	TWS-4	TWS-2
Highway Type											
Manual Reference	Figure 44-5.A		Figure 45-4.B		Figure 48-6.B		Figure 48-6.A				
Design Hourly Volume	One-Way DHV <sup>(3)</sup>		One-Way DHV <sup>(3)</sup>		One-Way DHV		Two-Way DHV				
Clear Roadway Bridge Widths (Face-to-Face of Parapets or Curbs) <sup>(4)(5)(6)</sup>	Under 3700	Under 2500	3850	2850	1900	Over 1850	1300-1850	Under 1300	2050-2900	1250-2050	Under 1250
	56'	40'	56'	56'	38' - 40'	52'	40'	30'	76' plus median width	52' plus median width	30'
Minimum Design Flood Frequency	50 Years										
Minimum Clearance Above Design High-Water Elevation	2' <sup>(7)(8)</sup>										
Design Live Load	HS-20 <sup>(9)</sup>										
Vertical Clearance for Structures Over Highways <sup>(10)(11)(12)</sup>	16'-0" minimum Reconstruction/ 16'-9" New Construction		16'-0" Reconstruction/ 16'-6" New Construction		14'-9"		See Figures 33-5.A, 39-5.Q, and 39-5.R				
	See Figures 33-5.A and 39-5.Q		See Figure 39-5.R		Provide a 3' minimum clearance from edge of traveled way to face of pier or abutment; 5' desirable. Provide a 9" high curb adjacent to pier or abutment.						
Horizontal Clearance for Structures Over Highways	See Figures 33-5.A and 39-5.S										
Vertical and Horizontal Clearance Over Railroads	See Figures 33-5.A and 39-5.S										

FW = Freeway EX = Expressway OWS = One-Way Street TWS = Two-Way Street

**DESIGN CRITERIA FOR NEW OR RECONSTRUCTED<sup>(1)</sup> BRIDGES  
(Urban State Highway System<sup>(2)</sup>)  
(US Customary)**

**Figure 39-6.C**

Classification	Arterial Highways and Streets										
	FW-6	FW-4	EX-6 Construction	EX-6 Reconstruction	EX-4 Reconstruction	OWS-4	OWS-3	OWS-2	TWS-6	TWS-4	TWS-2
Highway Type	Figure 44-5.A	Figure 45-4.B	Figure 45-4.B	Figure 45-4.B	Figure 45-4.B	Figure 48-6.A	Figure 48-6.A	Figure 48-6.A	Figure 48-6.A	Figure 48-6.A	Figure 48-6.A
Manual Reference	One-Way DHV <sup>(8)</sup>	One-Way DHV <sup>(8)</sup>	One-Way DHV <sup>(8)</sup>	One-Way DHV <sup>(8)</sup>	One-Way DHV <sup>(8)</sup>	One-Way DHV	One-Way DHV	One-Way DHV	Two-Way DHV	Two-Way DHV	Two-Way DHV
Design Hourly Volume	Under 3700	Under 2500	3850	2850	1900	Over 1850	1300-1850	Under 1300	2050-2900	1250-2050	Under 1250
Clear Roadway Bridge Widths (Face-to-Face of Parapets or Curbs) <sup>(4)(5)(6)</sup>	16.8 m	12.0 m	16.8 m	16.8 m	11.4 m-12.0 m	15.6 m	12.0 m	9.2 m	22.8 m plus median width	15.6 m plus median width	9.2 m
Minimum Design Flood Frequency	50 Years										
Minimum Clearance Above Design High-Water Elevation	600 mm <sup>(7)(8)</sup>										
Design Live Load	MS-18 <sup>(9)</sup>										
Vertical Clearance for Structures Over Highways <sup>(10)(11)(12)</sup>	4.9 m minimum Reconstruction/ 5.1 m New Construction	4.9 m Reconstruction/ 5.0 m New Construction	See Figures 39-5.Q and 39-5.R								
Horizontal Clearance for Structures Over Highways	See Figure 33-5.A and 39-5.Q										
Vertical and Horizontal Clearance Over Railroads	See Figure 39-5.R										
	Provide a 1.0-m minimum clearance from edge of traveled way to face of pier or abutment; 1.5 m desirable. Provide a 225-mm high curb adjacent to pier or abutment.										
	See Figures 33-5.A and 39-5.S										

FW = Freeway EX = Expressway OWS = One-Way Street TWS = Two-Way Street

**DESIGN CRITERIA FOR NEW OR RECONSTRUCTED<sup>(1)</sup> BRIDGES  
(Urban State Highway System<sup>(2)</sup>)  
(Metric)**

**Figure 39-6.C**

**Footnotes for Figure 39-6.C**

- (1) *Implies reconstruction of a significant length of existing highway either on new location or on existing ROW. For reconstruction of relatively short intermittent highway segments within a project, the design criteria used, where cost-safety effective, should be consistent with the adjacent highway design, but not less than that allowed to remain in place.*
- (2) *For marked highways functionally classified as Collectors, use the Arterial criteria. For other streets on the unmarked State-maintained system, see the Bureau of Local Road and Streets Manual.*
- (3) *Volumes calculated with PHF = 1.0; adjust for local peak hour factor (PHF).*
- (4) *On freeways where truck traffic exceeds 250 DDHV, see Figure 44-5.A for the use of 12 ft (3.6 m) right shoulders.*
- (5) *Bridge widths for bridge rehabilitation projects are discussed in Chapters 49 and 50.*
- (6) *For urban bridges requiring sidewalks, the width of the sidewalks is 5 ft (1.5 m) unless a wider width is specified by the district.*
- (7) *For new freeway or expressway construction, the bottom of the superstructure will not be below the all time high-water elevation.*
- (8) *For reconstruction projects, the proposed low superstructure will not be below the existing superstructure unless a 2 ft (600 mm) clearance is achieved. Any proposed clearance less than 2 ft (600 mm) above design high-water elevation must be accompanied by a request for a design exception.*
- (9) *For the Interstate System, provisions will be made for the Alternate Military Loading.*
- (10) *The minimum required vertical clearance must be available over the traveled way and any paved shoulders.*
- (11) *For reconstructed urban arterials, existing structures with a vertical clearance of 14 ft 0 in (4.3 m) may be allowed to remain in place. For a freeway or expressway passing through a highly developed urban area, a 15 ft 0 in (4.5 m) vertical clearance may be provided if a circumferential route is designated around the urbanized area and if the circumferential route has a minimum vertical clearance of 16 ft 0 in (4.9 m).*
- (12) *A vertical clearance of 17 ft 3 in (5.25 m) shall be provided for through trusses, overhead signs, and pedestrian overpasses.*

