
Revision Summary

- Article 1.1: New article has been reserved for Preservation and Rehabilitation (PR) Criteria still under development.
- Article 1.1: Figure 1.1.1 has been renumbered to Figure 1.2.1.
- Article 1.2: Has been renumbered from Article 1.1, LRFD and LFD Bridge and Structure Design.
- Article 1.2: Reference has been revised from Section 6.12 to Section 6.3.12 of this Manual regarding the Inventory and Operating Load ratings for the HL-93. The IDOT Internet web site address is revised.
- Article 1.3: Has been renumbered from Article 1.2, Seismic Design of Bridges.
- Article 1.4: Has been renumbered from Article 1.3, Design Section Engineers (DSE) Manual.
- Article 2.5: The real discount rate that should be used in the Life Cycle Cost Analysis has been updated.
- Article 3.1: TS&L Plans included with 30% design submittal.
- Article 5.1: The updated Tollway Manuals and AASHTO Specifications have been referenced and the concrete design compressive strength has been corrected from Class SP to Class SI. Table has been visually improved.
- Article 5.1: The design live loads for Box Culverts have been clarified.
- Article 5.1: The limit on maximum design dead load for the Noise Abatement Walls (NAWs) has been deleted.
- Article 5.1: A summary table for required design loads and specifications has been added for Overhead Sign Supports.
- Article 5.1: Figure 5.1.1 has been added to illustrate the lateral load design requirements for box culverts.
- Article 5.2: Requirements for Design Minimum Vertical Clearances have been clarified.
• Article 5.3: Reference has been made to Article 10.7 of this Manual for the required grading of the slope wall, for the case of an abutment constructed on an embankment.

• Article 5.3: Figure 5.3.1 has been deleted.

• Article 5.4: Inserted article for Deck Width. Revised subsequent article numbers.

• Article 5.5: Specified minimum number of beam lines.

• Article 6.2: Revised to require structural seal on all GPE sheets.

• Article 6.3.7: Revised requirements for superelevation transition locations.

• Article 6.3.12: A revision has been made to include future wearing surface in the Inventory and Operating Rating for new, reconstructed and widened structures.

• Article 6.3.12: Figure 6.3.12.1 has been updated and is required to be included with the prefinal and final submittal package.

• Article 6.4: Has been revised to clarify “Summary of Quantity” and “Total Bill of Material” and to include requirements for Element Level Inspection Quantities.

• Section 7.0: General Notes have received minor edits.

• Article 7.1.3: Note 6 has been added in reference to steel erection tolerances. Note 8 has been added in reference to NTR for load carrying components.

• Article 7.1.4: Note 1 has been added to clarify contractor responsibilities for measuring existing structures. Notes 18, 19 and 20 have been added/revised to clarify construction-related requirements for PCC beams of different span lengths.

• Article 7.3: Notes have been moved into this Article from the Culvert Section.

• Article 8.1: Has been revised to include construction staging requirements for removal of superstructures and substructures. Pay Items for Removal have been clarified.

• Article 8.2: Has been revised to restrict drilling into new deck slabs.
• Article 8.3: Requirements for Transverse Limits of Protective Shield System, presented in the summary table, have been clarified for the case of deck removal and replacement.

• Article 10.3: Sentence added for preference of open abutments on crossroad bridges. Clarification has been made regarding acceptable use of MSE retaining walls in combination with pile supported integral, semi-integral and stub abutments.

• Article 10.3: “Reserved” figures have been removed and previous Figures 10.3.1 through 10.3.15 have been renumbered.

• Article 10.3: Figures 10.3.1 and 10.3.2, pavement joint dimensions have been removed.

• Article 10.3: Figures 10.3.3 and 10.3.9, revised barrier reinforcement bars.

• Article 10.3: Figure 10.3.6, orientation of stub abutment piles has been corrected to show bending about strong axis.

• Article 10.3: Figure 10.3.10, orientation of integral abutment piles has been corrected to show bending about weak axis. Figures 10.3.7, 10.3.8 and 10.3.10 titles revised to specify application to crossroad bridges only.

• Article 10.8: Figures 10.8.1 and 10.8.2 have been deleted.

• Article 10.9: Figure 10.9.1 has been revised to clarify the design requirements for the anchor rod location.

• Article 10.10: New article has been added for shoulder barrier requirements. Article 11.6: A revision has been made to clarify the crash wall requirements.

• Article 11.6: Revisions have been made to clarify the crash wall requirements.

• Article 12.5.4: New article has been added for Diaphragms and Cross-Frames Design Details.

• Article 13.2.2: Revisions have been made for the required limits of concrete compressive strengths for precast prestressed beams. Added Table 13.2.2.1, design chart for Tollway Bulb-T Beams.

• Article 13.2.3: New IDOT IL-Beams added.
• Article 13.2.4: Added section for new Tollway U-Beams.

• Article 13.3: Has been revised to include new Tollway U-Beams, construction-related notes and reference to Figures 13.3.2 and 13.3.3.

• Article 13.3: Figures 13.3.2 and 13.3.3 have been updated to show revised location of the G6 bar in the I-Beams and Bulb-T Beams, respectively.

• Article 13.5.2: Has been revised to include reference to new Tollway base sheets for new Tollway Bulb-T beams.

• Article 13.6: Added requirement for resetting bearings for long span continuous PPC beams.

• Article 14.1: Clarification has been made regarding allowable use of fixed bearing to support PPC beams.

• Article 14.2.3: A new requirement has been added to specify the responsibilities of the fabricator in the contract documents.

• Article 15.1: A new requirement has been added so that the horizontal geometry of bridge deck matches the horizontal geometry of the roadway. Deck thickness requirements have been clarified.

• Article 15.2: Deck thickness requirements have been clarified. Direction to adjust scuppers when overlaying bridge decks.

• Article 15.3: Revised and clarified bridge deck cross slope requirements.

• Article 15.4: Figure 15.4.1 has been updated to show revised steel reinforcement in bridge barriers.

• Figures 15.5.1, 15.5.2 and 15.5.3 have been renumbered to 15.5.1.1, 15.5.1.2 and 15.5.1.3 respectively.

• Article 15.5.2: Has been revised for clarification and reference to the updated Tollway Standard Drawings C3 and C4.

• Article 15.6: Figure 15.6.1 joint seal width has been revised.

• Article 15.7: Figure 15.7.1 has been revised to show updated steel reinforcement details and to cross reference Figure 15.7.2.

• Article 15.7: Figure 15.7.3 has been revised to cross reference Figures 15.7.5 through 15.7.7.
• Article 15.7: Figure 15.7.4 has been revised to show updated steel reinforcement
details and to cross reference Figures 15.7.6 and 15.7.7.

• Article 15.7: Figure 15.7.6 has been revised to show updated steel reinforcement
details for median-mounted light pole, Type F barrier.

• Article 15.7: Figure 15.7.7 has been revised to show updated steel reinforcement
details for median-mounted light pole, Type F barrier.

• Article 16.2: Edits have been made for clarification.

• Article 16.3: Figures 16.3.3 and 16.3.4 have been renumbered to 16.4.1 and
16.4.2, respectively.

• Article 16.3: Figure 16.3.5 has been renumbered to 16.4.3 and effective
embedded length of expansion bolts called out.

• Article 16.3: Figure 16.3.6 has been renumbered to 16.4.4.

• Article 16.3: Figure 16.3.7 has been renumbered to 16.4.5 and cross reference to
Figure 16.3.5 revised to Figure 16.4.3.

• Article 16.3: Figure 16.3.8 has been renumbered to 16.4.6.

• Article 16.5: Has been revised for additional painting requirements.

• Article 17.2: Figure 17.2.1.1 has been revised to include an additional design
requirement.

• Article 17.2: Figure 17.4.1 has been revised to show the total number of
longitudinal steel bars required in concrete patches of reconstructed expansion
joints.

• Article 17.5: Reference to Tollway Base Sheets added. Figure 17.5.1 has been
revised for clarification.

• Section 19.0: Revised title.

• Article 19.1: Deleted reference to Standards G3 through G9 and replaced with
base sheets.

• Article 19.2.1: Added reference to IDOT ABD 12.3 and IDOT base sheets for the
use of partial depth precast concrete approach slabs. Figures 19.2.1.1 has been
deleted. References to Tollway and IDOT base sheets have been added.
• Article 19.2.2: Changed reference to IDOT and Tollway base sheets. Deleted Figure 19.2.2.1.

• Article 19.2.3: Changed reference to Tollway base sheets and Figure 10.3.10. Deleted Figure 19.2.3.1.

• Article 19.4: Changed reference to base sheets and deleted Figure 19.4.1.

• Article 21.1: The 5-ft requirement for minimum hydraulic culvert height has been deleted. Requirements for type study have been added.

• Article 21.2: Incorporated General Notes into Section 7 and deleted from this Section, removing Article 21.2.3 and renumbering 21.2.4 through 21.2.6.

• Article 21.2.1: Has been revised to clarify the information that should be shown on the General Plan and Elevation sheet.

• Article 21.2.5: Reference to Figure 5.3.8.1 has been revised to Figure 6.7.1.

• Article 22.3.1: Has been revised to reference Figures 22.3.1 through 22.3.7 only.

• Article 22.3.1: Figure 22.3.1.1 has been revised for clarification of details.

• Article 22.3.1: Rodent shield details have been deleted from Figure 22.3.1.3.

• Article 22.3.1: Figure 22.3.1.4 has been deleted.

• Article 22.3.1: Figure 22.3.1.5 has been renumbered to Figure 22.3.1.4 and revised to include washers and nuts with expansion anchors.

• Article 22.3.1: Figure 22.3.1.6 has been renumbered to Figure 22.3.1.5 and revised to include washers and nuts with expansion anchors.

• Article 22.3.1: Figure 22.3.1.7 has been renumbered to Figure 22.3.1.6 and added cross-reference to Figure 22.3.1.7.

• Article 22.3.1: Figure 22.3.1.8 has been renumbered to Figure 22.3.1.7.

• Article 22.3.2: Added abbreviation for West O'Hare Access Bypass.

• Article 22.4.2: Figure 22.4.2.1 has been revised for clarification.

• Article 22.5.1: Figure 22.5.1.1 has been revised to reference Tollway Standards and Figure 22.3.1.2.
• Article 22.5.1: Figure 22.5.1.2 has been revised for clarification of back face slope of wall stem.

• Article 22.5.1: Figure 22.5.1.3 has been revised to show revised geometry of the barrier and approach roadway gutter.

• Article 22.5.2: Has been revised to include crash load design requirements. Has been revised to include requirements for drainage behind the stem of a retaining wall.

• Article 22.5.3: Has been revised to include crash load design requirements. Has been revised to indicate the minimum thickness required for pile-supported footings.

• Article 22.5.4: Has been revised for clarification of the required size of footing key and slope of battered pile.

• Article 22.6: Has been revised to cross-reference renumbered figures. Also, new requirements have been added for design of structural steel in contact with the ground.

• Article 22.6.1: Figures 22.6.1 and 22.6.3 have been revised and renumbered. Figure 22.6.2 has been revised and renumbered to 22.12.1.

• Article 22.12: Figure 22.12.1 snow storage dimensions have been modified.

• Article 22.13: Has been revised to reference a renumbered figure for the F-Shape barrier.

• Article 22.14: Has been revised to reference Figure 22.14.1 for calculating the overturning moment of the barrier moment slab. Has been revised to clarify the Rigid Body Definition. Requirement for CA-6 beneath moment slab has been added.

• Article 23.2.2: Has been revised to clarify the vehicle impact load requirements for design of noise abatement walls.

• Article 23.3.2: Added abbreviation for West O'Hare Access Bypass.

• Article 23.5: Has been added for Railroad Bridge Fence.

• Article 24.1: Has been revised to reference updated Tollway Manuals and Base Sheets. Design Method of existing signs has been clarified.

• Article 24.3: Has been updated to clarify overhead sign structure vertical clearance requirements.
• Article 24.4: Figure 24.4.2 has renumbered to Figure 24.8.1.

• Article 24.9: Has been revised to include Standard F17. Has been revised to prohibit the use of DMS and static signs on the same structure. Figure 24.5.1 has been deleted.

• Article 24.10: Added ITS Gantry.

• Article 24.12: Added abbreviation for West O’Hare Access Bypass.

• Article 25.1: Has been revised to clarify the responsibilities of the designer.

• Article 25.2.1: Has been revised to clarify requirements of the shop drawing submittals for miscellaneous items.

• Article 25.4: Fabrication requirements for miscellaneous items have been added.

• Article 26.3: Figure 26.3.1 has been revised for clarification and renumbered to Figure 26.3.2.

• Article 26.3: Figure 26.3.2 has been revised for clarification and renumbered to Figure 26.3.1.

• Article 26.3: Figures 26.3.3 and 26.3.4 have been revised for clarification.

• Article 26.4: Has been revised to clarify the requirements of supplemental reinforcement for approach slab resurfacing and repairs.

• Article 26.4: Figures 26.4.2 and 26.4.3 have been revised for clarification.

• Article 26.6: Figures 26.6.1 through 26.6.4 have been revised for clarification of required temporary bracing details.

• Article 26.9: New article added to address design requirements for deck drains in major maintenance projects.
# TABLE OF CONTENTS

## SECTION 1.0  INTRODUCTION

1.1 Reserved

1.2 LRFD and LFD Bridge and Structure Design

1.3 Seismic Design of Bridges

1.4 Design Section Engineers (DSE) Manual

## SECTION 2.0  STRUCTURE INSPECTION AND CONDITION REPORTS

2.1 Inspection and Testing

2.2 Preparation of Structure Condition Reports

2.3 Hydraulic Analysis

2.4 Scour Analysis

2.5 Life Cycle Cost Analysis

## SECTION 3.0  TYPE, SIZE & LOCATION (TS & L) PLANS

3.1 General

3.2 Bridge Type Study

3.3 Structure Report

3.4 Hydraulic Information

3.5 Structural Geotechnical Report

## SECTION 4.0  CONTEXT SENSITIVITY AND AESTHETICS

4.1 Introduction

4.2 Bridges

4.3 Walls

## SECTION 5.0  DESIGN CRITERIA

5.1 Structural Design Criteria

5.2 Design Minimum Vertical Clearances

5.3 Design Horizontal Clearances

5.4 Deck Width

5.5 Minimum Number of Beam Lines

5.6 Field Survey

5.6.1 General

5.6.2 Modified Barrier Rails (Parapets)
# TABLE OF CONTENTS

5.6.3  Bearings .......................................................................................................................... 5-9
5.6.4  Bridge Deck Widening ................................................................................................... 5-9
5.7    Construction ....................................................................................................................... 5-10
5.8    Railroad Crossings ........................................................................................................... 5-11

SECTION 6.0  PLAN PREPARATION ...................................................................................... 6-1
6.1    CADD Standards .............................................................................................................. 6-1
6.2    Plan Sheet Organization .................................................................................................... 6-1
  6.2.1  Bridges ........................................................................................................................... 6-1
  6.2.2  Culverts ........................................................................................................................... 6-1
  6.2.3  Conventional Concrete Retaining Walls ......................................................................... 6-1
  6.2.4  Performance Based Retaining Walls .............................................................................. 6-2
6.3    General Plan and Elevation ............................................................................................... 6-2
  6.3.1  Plan and Elevation Views ............................................................................................... 6-2
  6.3.2  Benchmark ....................................................................................................................... 6-3
  6.3.3  Structure Description ...................................................................................................... 6-3
  6.3.4  Design Criteria ............................................................................................................... 6-3
  6.3.5  Horizontally Curved Alignments .................................................................................... 6-4
  6.3.6  Profile Sketches .............................................................................................................. 6-4
  6.3.7  Superelevation Transitions ............................................................................................ 6-4
  6.3.8  Location Map ................................................................................................................. 6-4
  6.3.9  Highway Classification ................................................................................................... 6-5
  6.3.10 Railroad Information ..................................................................................................... 6-5
  6.3.11 Waterway Information .................................................................................................. 6-5
  6.3.12 Structure Rating ............................................................................................................ 6-5
6.4    Total Bill of Material ......................................................................................................... 6-5
6.5    Abbreviations .................................................................................................................... 6-5
6.6    Index of Sheets ................................................................................................................... 6-6
6.7    Concrete Reinforcement Detailing ..................................................................................... 6-6
# TABLE OF CONTENTS

## SECTION 7.0 GENERAL NOTES
- 7.1 Structural General Notes
  - 7.1.1 Cast-In-Place Concrete
  - 7.1.2 Reinforcement Bars
  - 7.1.3 Structural Steel
  - 7.1.4 Construction
- 7.2 Supplemental General Notes
  - 7.2.1 Demolition Plan
  - 7.2.2 Erection Plan
  - 7.2.3 Structural Assessment Reports for Contractor’s Means and Methods
- 7.3 Additional Notes included in the Plans

## SECTION 8.0 CONSTRUCTION STAGING
- 8.1 General
- 8.2 Temporary Concrete Barriers
- 8.3 Protective Shield System
- 8.4 Temporary Shoring

## SECTION 9.0 SUBSTRUCTURE AND SHEET PILING LAYOUTS
- 9.1 Substructure Layout
- 9.2 Pile Numbering
- 9.3 Drilled Shaft Numbering
- 9.4 Temporary Soil Retention Systems
- 9.5 Temporary and Permanent Sheet Piling
- 9.6 Cofferdams
- 9.7 Temporary Sheeting and Bracing for Railroads
- 9.8 Structural Sub Drains

## SECTION 10.0 ABUTMENTS
- 10.1 General
- 10.2 Design
- 10.3 Abutment Types
- 10.4 Abutment Foundations
## TABLE OF CONTENTS

10.4.1 Piles ................................................................................................................. 10-2
10.4.2 Drilled Shafts .................................................................................................. 10-3
10.5 Widening Existing Abutments ........................................................................ 10-3
10.6 Bridge Seats ...................................................................................................... 10-4
10.7 Slope Paving ...................................................................................................... 10-4
10.7.1 New Bridges - Grade Separation Structures ........................................... 10-4
10.7.2 New Bridges - Stream Crossings ............................................................... 10-4
10.7.3 New Bridges - Railroad Crossings .............................................................. 10-4
10.7.4 Existing Bridges .......................................................................................... 10-4
10.7.5 New Bridges - Side Slopes .......................................................................... 10-5
10.8 Wing walls ........................................................................................................... 10-5
10.9 Abutment Cap Reinforcement ......................................................................... 10-5
10.10 Shoulder Barrier ............................................................................................ 10-5

### SECTION 11.0 PIERs

11.1 General .............................................................................................................. 11-1
11.2 Design ................................................................................................................ 11-1
11.3 Pier Types .......................................................................................................... 11-1
11.3.1 Grade Separation ......................................................................................... 11-1
11.3.2 Stream Crossing ........................................................................................... 11-2
11.3.3 Railroad Crossings ........................................................................................ 11-2
11.4 Widening Existing Piers .................................................................................. 11-2
11.5 Integral Concrete Pier Caps .............................................................................. 11-3
11.6 Pier Base Walls ................................................................................................... 11-3
11.6.1 New or Widened Piers ................................................................................ 11-3
11.6.2 Existing Piers to Remain ............................................................................. 11-4
11.7 Pier Columns ....................................................................................................... 11-4
11.8 Foundations ........................................................................................................ 11-5
11.8.1 Spread Footings ........................................................................................... 11-5
11.8.2 Piles .............................................................................................................. 11-5
11.8.3 Drilled Shafts ............................................................................................... 11-5
# TABLE OF CONTENTS

11.9 Pier Cap Reinforcement .......................................................... 11-5

SECTION 12.0 STRUCTURAL STEEL ............................................. 12-1

12.1 General .................................................................................. 12-1
12.2 Design ................................................................................... 12-1
12.3 Intermediate Vertical Stiffeners .............................................. 12-1
12.4 Bearing Stiffeners ................................................................. 12-2
12.5 Superstructure Diaphragms ..................................................... 12-2
  12.5.1 End Diaphragms and Cross Frames at Expansion Joints .... 12-2
  12.5.2 Diaphragms and Cross-Frames at Expansion Bearings .... 12-2
  12.5.3 Diaphragms and Cross-Frames at Intermediate Points .... 12-2
  12.5.4 Diaphragms and Cross-Frames Design Details ............. 12-3
12.6 Table of Moments and Shears ................................................. 12-3
12.7 Painting of Structural Steel .................................................... 12-3
12.8 Weathering Steel ................................................................. 12-3

SECTION 13.0 PRECAST PRESTRESSED CONCRETE (PPC) ......... 13-1

13.1 General .................................................................................. 13-1
13.2 Design ................................................................................... 13-1
  13.2.1 IDOT and 28” Tollway Beams ........................................... 13-1
  13.2.2 Tollway Bulb-T Beams ....................................................... 13-1
  13.2.3 IDOT IL-Beams ............................................................... 13-2
  13.2.4 PPC U-Beams ................................................................. 13-2
13.3 Details ................................................................................... 13-2
13.4 Table of Moments and Shears ................................................. 13-3
13.5 Superstructure Diaphragms .................................................... 13-3
  13.5.1 Abutment (End) Diaphragms .......................................... 13-3
  13.5.2 Pier Diaphragms ............................................................. 13-3
13.6 Handling, Storage and Transportation of Beams .................... 13-4
13.7 Extending Spans .................................................................... 13-5
  13.7.1 Introduction ................................................................. 13-5
  13.7.2 Design ........................................................................ 13-5
# TABLE OF CONTENTS

13.7.3 Durability ................................................................................................ 13-5
13.7.4 Splices and Splice Locations ................................................................. 13-5
13.7.5 Pretensioning and/or Post-tensioning .................................................. 13-6
13.7.6 Size of Post-Tensioning Tendons ....................................................... 13-6
13.7.7 Pretensioning Strand Size .................................................................... 13-6
13.7.8 Long Term Prestressing Losses ........................................................... 13-6
13.7.9 Tendon Layout .................................................................................... 13-6
13.7.10 Camber and Geometry Control ......................................................... 13-6
13.7.11 Creep Redistributions of Forces and Moments ................................... 13-7
13.7.12 Elastic Shortening Losses ................................................................... 13-7
13.7.13 Deck Design ........................................................................................ 13-7

SECTION 14.0 BEARINGS ................................................................................. 14-1
14.1 General ....................................................................................................... 14-1
14.2 Design ........................................................................................................ 14-1
   14.2.1 Elastomeric Bearings ........................................................................ 14-2
   14.2.2 Low Profile Steel Rocker Bearings (Fixed Only) .............................. 14-2
   14.2.3 Floating (Pot) Bearings .................................................................... 14-2

SECTION 15.0 CONCRETE BRIDGE DECKS AND BARRIERS ....................... 15-1
15.1 New and Replacement Decks .................................................................. 15-1
15.2 Existing Deck Widенийs and Repairs ...................................................... 15-1
15.3 Cross Slopes .............................................................................................. 15-2
   15.3.1 Tangent Sections ............................................................................. 15-2
   15.3.1.2 New, Replacement and Widened Decks ....................................... 15-2
   15.3.1.2 Overlays ...................................................................................... 15-2
   15.3.2 Superelevated Sections .................................................................... 15-2
   15.3.3 New and Replacement Decks ........................................................... 15-2
   15.3.4 Deck Widенийs and Overlays ......................................................... 15-3
15.4 Reinforcement Bars .................................................................................. 15-3
15.5 Barriers and Raised Medians .................................................................... 15-3
   15.5.1 Parapets and Barriers on Structures ............................................. 15-3
# TABLE OF CONTENTS

15.5.2 Roadside Barriers ................................................................................................................................. 15-4
15.6 Longitudinal Open Joints .......................................................................................................................... 15-5
15.7 Bridge Mounted Lighting .......................................................................................................................... 15-5
15.8 Slipform Barrier ........................................................................................................................................ 15-5
15.9 Pouring Sequence ....................................................................................................................................... 15-5
15.10 Closure Pour ............................................................................................................................................. 15-5

SECTION 16.0 DECK DRAINAGE .................................................................................................................. 16-1
16.1 Deck Drains .............................................................................................................................................. 16-1
16.2 Drainage Scuppers .................................................................................................................................. 16-1
16.3 Drain Pipe .................................................................................................................................................. 16-2
   16.3.1 Polyvinyl Chloride Pipe ............................................................................................................. 16-2
   16.3.2 Reinforced Fiberglass Pipe .................................................................................................. 16-3
   16.3.3 Galvanized Steel Pipe ........................................................................................................... 16-3
16.4 Pipe Supports .......................................................................................................................................... 16-3
16.5 Painting .................................................................................................................................................... 16-3
   16.5.1 Aluminum Tube ......................................................................................................................... 16-3
   16.5.2 Polyvinyl Chloride Pipe ....................................................................................................... 16-4
   16.5.3 Reinforced Fiberglass Pipe .................................................................................................. 16-4
   16.5.4 Galvanized Steel Pipe ........................................................................................................... 16-4

SECTION 17.0 BRIDGE DECK EXPANSION JOINTS .................................................................................. 17-1
17.1 General .................................................................................................................................................... 17-1
17.2 New or Replacement Bridge Decks ......................................................................................................... 17-1
   17.2.1 Strip Seals .................................................................................................................................. 17-1
   17.2.2 Modular Joints ......................................................................................................................... 17-1
17.3 Existing Bridge Deck Widening .............................................................................................................. 17-1
17.4 Existing Bridge Deck Repair and Rehabilitation .................................................................................... 17-2
17.5 Approach Slabs ...................................................................................................................................... 17-2
17.6 Fabrication ............................................................................................................................................ 17-2

SECTION 18.0 DECK ELEVATIONS .............................................................................................................. 18-1
18.1 New Bridges ............................................................................................................................................ 18-1
# TABLE OF CONTENTS

18.2 Existing Bridge Deck Overlays ................................................................. 18-2

SECTION 19.0 APPROACH AND TRANSITION SLABS ........................................ 19-1

19.1 General ..................................................................................................... 19-1
19.2 Approach Slabs for Tollway Bridges ......................................................... 19-1
  19.2.1 Integral and Semi-Integral Abutments .................................................. 19-1
  19.2.2 Vaulted Abutments ........................................................................... 19-1
  19.2.3 Pile Bent/Stub Abutments ................................................................. 19-2
19.3 Approach Pavement for IDOT, County, Township or Municipal Structures ... 19-2
  19.3.1 Integral and Semi-Integral Abutments ................................................. 19-2
  19.3.2 Vaulted Abutments ........................................................................... 19-2
  19.3.3 Pile Bent/Stub Abutments ................................................................. 19-2
19.4 Approach Bent .......................................................................................... 19-2
19.5 Approach Slab and Pile Bent Pay Items .................................................... 19-2

SECTION 20.0 SOIL BORING LOGS ................................................................. 20-1

SECTION 21.0 CULVERTS ............................................................................. 21-1

21.1 General ..................................................................................................... 21-1
  21.1.1 Cast-In-Place Concrete Culverts ......................................................... 21-1
  21.1.2 Precast Concrete Culverts ................................................................. 21-2
21.2 Plan Preparation ...................................................................................... 21-2
  21.2.1 General Plan and Elevation ................................................................. 21-2
  21.2.2 Design Criteria ................................................................................ 21-3
  21.2.3 Bill of Material ................................................................................. 21-3
  21.2.4 Construction Staging ....................................................................... 21-3
  21.2.5 Concrete Reinforcement Details ....................................................... 21-3

SECTION 22.0 RETAINING WALLS ............................................................... 22-1

22.1 Wall Types .............................................................................................. 22-1
22.2 Retaining Wall Selection Process .............................................................. 22-1
22.3 Plan Preparation ...................................................................................... 22-2
  22.3.1 Plan Sheet Organization ................................................................. 22-2
  22.3.2 Naming Convention ........................................................................ 22-3
# TABLE OF CONTENTS

22.4 Wall Design Criteria ................................................................. 22-3  
   22.4.1 Design Specifications ....................................................... 22-3  
   22.4.2 Design Loads ................................................................. 22-3  
   22.4.3 Design Stresses ............................................................... 22-4  
   22.4.4 Wall Layout ................................................................. 22-4  

22.5 Cast-in-Place T-Shaped or L-Shaped Walls ........................................ 22-4  
   22.5.1 Description .................................................................. 22-4  
   22.5.2 Stem ............................................................................ 22-5  
   22.5.3 Footing ......................................................................... 22-5  
   22.5.4 Stability ....................................................................... 22-5  

22.6 Flexible Retaining Walls ............................................................ 22-6  
   22.6.1.1 Location .................................................................... 22-7  
   22.6.1.2 Plans and Specifications ............................................. 22-7  

22.7 Precast Modular Walls .............................................................. 22-8  

22.8 Soldier Pile Retaining Walls ....................................................... 22-9  

22.9 Permanent Sheet Pile Retaining Walls ........................................ 22-9  

22.10 Soil Nailed and Other Specialized Wall Systems ............................ 22-9  

22.11 Temporary Soil Retention Systems ........................................... 22-9  

22.12 Snow Storage Area ............................................................... 22-9  

22.13 Parapet Shape ..................................................................... 22-9  

22.14 Moment Slab on Retaining Wall Design Guides ............................ 22-10  

---

SECTION 23.0 NOISE ABATEMENT WALLS AND RAILROAD BRIDGE  
   FENCING .................................................................................. 23-1  

23.1 General .................................................................................. 23-1  

23.2 Design Criteria ....................................................................... 23-2  
   23.2.1 Design Specifications ..................................................... 23-2  
   23.2.2 Design Loads ............................................................... 23-2  
   23.2.3 Design Height .............................................................. 23-4  
   23.2.4 Stresses ....................................................................... 23-4  

23.3 Plan Preparation ..................................................................... 23-4  

---

March 2015 ix Illinois Tollway
# STRUCTURE DESIGN MANUAL

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.3.1</td>
<td>General</td>
<td>23-4</td>
</tr>
<tr>
<td>23.3.2</td>
<td>Naming Convention</td>
<td>23-5</td>
</tr>
<tr>
<td>23.3.3</td>
<td>Ground Mounted Noise Abatement Wall</td>
<td>23-5</td>
</tr>
<tr>
<td>23.3.4</td>
<td>Structure Mounted Noise Abatement Wall</td>
<td>23-6</td>
</tr>
<tr>
<td>23.4</td>
<td>Specifications</td>
<td>23-6</td>
</tr>
<tr>
<td>23.5</td>
<td>Railroad Bridge Fencing for New Tollway Structures over Railroads</td>
<td>23-7</td>
</tr>
<tr>
<td>24.0</td>
<td>SECTION 24.0 OVERHEAD SIGN SUPPORTS</td>
<td>24-1</td>
</tr>
<tr>
<td>24.1</td>
<td>Design Specifications</td>
<td>24-1</td>
</tr>
<tr>
<td>24.2</td>
<td>Sign Structure Type Selection</td>
<td>24-1</td>
</tr>
<tr>
<td>24.3</td>
<td>Overhead Sign Structure Clearance</td>
<td>24-1</td>
</tr>
<tr>
<td>24.4</td>
<td>Span Type</td>
<td>24-2</td>
</tr>
<tr>
<td>24.5</td>
<td>Cantilever Type</td>
<td>24-3</td>
</tr>
<tr>
<td>24.6</td>
<td>Monotube Type</td>
<td>24-3</td>
</tr>
<tr>
<td>24.7</td>
<td>Butterfly Type</td>
<td>24-3</td>
</tr>
<tr>
<td>24.8</td>
<td>Bridge Mounted Sign Structures</td>
<td>24-3</td>
</tr>
<tr>
<td>24.9</td>
<td>Span Type (Steel)</td>
<td>24-4</td>
</tr>
<tr>
<td>24.10</td>
<td>ITS Gantry Frame (Steel)</td>
<td>24-4</td>
</tr>
<tr>
<td>24.11</td>
<td>Overhead Sign Structures with End Cantilever(s)</td>
<td>24-4</td>
</tr>
<tr>
<td>24.12</td>
<td>Non-Standard Sign Structures</td>
<td>24-4</td>
</tr>
<tr>
<td>24.13</td>
<td>Naming Convention</td>
<td>24-5</td>
</tr>
<tr>
<td>25.0</td>
<td>SECTION 25.0 SHOP DRAWINGS</td>
<td>25-1</td>
</tr>
<tr>
<td>25.1</td>
<td>General</td>
<td>25-1</td>
</tr>
<tr>
<td>25.2</td>
<td>Required Shop Drawings</td>
<td>25-1</td>
</tr>
<tr>
<td>25.2.1</td>
<td>Structural Steel and Expansion Joints</td>
<td>25-2</td>
</tr>
<tr>
<td>25.2.2</td>
<td>Prestressed Concrete</td>
<td>25-2</td>
</tr>
<tr>
<td>25.2.3</td>
<td>Bearings</td>
<td>25-3</td>
</tr>
<tr>
<td>25.3</td>
<td>Special Requirement Items</td>
<td>25-3</td>
</tr>
<tr>
<td>25.4</td>
<td>Miscellaneous Items</td>
<td>25-4</td>
</tr>
<tr>
<td>25.5</td>
<td>Erection Plan</td>
<td>25-5</td>
</tr>
<tr>
<td>25.5.1</td>
<td>General</td>
<td>25-5</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

25.5.2  Required Information .......................................................................................... 25-5  
SECTION 26.0  REHABILITATION AND REPAIR ................................................................. 26-1  
  26.1  General .................................................................................................................. 26-1  
  26.2  Precast Concrete Repairs ...................................................................................... 26-1  
  26.3  Aluminum Sign Truss Repairs ................................................................................ 26-2  
  26.4  Approach Slab Resurfacing and Repairs ............................................................... 26-3  
  26.5  Aggregate Slope Paving Repairs .......................................................................... 26-3  
  26.6  Metal Culvert Temporary Repairs ........................................................................ 26-3  
  26.7  Bearing Repairs .................................................................................................... 26-3  
  26.8  Fiber Reinforced Polymer Repairs ....................................................................... 26-3  
  26.9  Deck Drains .......................................................................................................... 26-4
SECTION 1.0 INTRODUCTION

1.1 Reserved

1.2 LRFD and LFD Bridge and Structure Design

The Illinois State Toll Highway Authority (Tollway) is transitioning from the American Association of State Highway and Transportation Officials (AASHTO) 2002 “Standard Specifications for Highway Bridges – Division I” Load Factor Design (LFD) and Allowable Stress Design (ASD) to the latest edition of the AASHTO LRFD Bridge Design Specifications for new bridge construction. It is anticipated that this process will be ongoing over the next few years. As such, this Design Manual refers to both the AASHTO Standard and LRFD Specifications.

The design of all new and replacement structures after November of 2007 shall be in accordance with the latest edition of the AASHTO “LRFD Bridge Design Specifications” except as modified by the following Illinois Department of Transportation (IDOT) Manuals: Bridge, Culvert, Drainage, Geotechnical and Sign Structures, or as amended herein by the Tollway Structure Design Manual. The most current IDOT manuals related to structural policy, documents and procedures are available on the Internet web pages at the following site:

http://www.idot.illinois.gov/

Navigation to technical manuals begins with “Doing Business” then “Procurements”.

The AASHTO LRFD Bridge Design Specifications was not completely adopted by IDOT. Several parts were modified or subjected to interpretation by IDOT. The following examples are representative of some of the changes made by IDOT:

- Portions of Live Load Distribution for bridges have been simplified and/or not adopted (Section 3.3.1).

- When to apply lateral stresses for steel beam design has been interpreted (Section 3.3.5).

- Moment Redistribution in LRFD and LFD is not allowed (Section 3.3.6).

- Seismic design is according to LRFD with some interpretations, but the Bridge Manual clarifies options in LRFD to use for Illinois (Sections 3.7, 3.10 and 3.15).

- Vehicle collision design forces and the approach to design have been interpreted by IDOT (Section 3.9.3.7 and ABD Memo 12.1). The 600 kip force shall be applied to the top of the crashwall.

- The phi factor to use for pile design has been interpreted (Section 3.10).
The loading to use for Constructability Checks in LRFD (and LFD) has been clearly specified and interpreted (Section 3.3.26).

Existing structures that are to be rehabilitated, reconstructed and/or widened shall be designed in accordance with the appropriate Division I or IA (LFD or ASD) of the latest AASHTO “Standard Specifications for Highway Bridges”. All other structures shall be designed by the specification indicated in the following “Structural Design Specifications Selection Table.”

<table>
<thead>
<tr>
<th>Structural Design Specification Selection Table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New or Replacement Projects:</strong></td>
</tr>
<tr>
<td>Bridges</td>
</tr>
<tr>
<td>Concrete Culverts and Retaining Walls</td>
</tr>
<tr>
<td>Overhead Sign Structures</td>
</tr>
<tr>
<td><strong>Rehabilitation, Reconstruction and Widening Projects:</strong></td>
</tr>
<tr>
<td>For existing ASD or LFD Designs</td>
</tr>
<tr>
<td>For existing LRFD Designs</td>
</tr>
<tr>
<td><strong>Ratings:</strong></td>
</tr>
<tr>
<td>For Existing ASD or LFD Designs</td>
</tr>
<tr>
<td>For New and Existing LRFD Designs</td>
</tr>
</tbody>
</table>

**Design Truck**

For New or Replacement Projects on mainline and ramp flyover bridges and bridge culverts only, the Design Truck in the AASHTO LRFD Bridge Design Specification Article 3.6.1.2.2 shall be replaced with the “IL-120” Design Truck as shown in Figure 1.2.1. This truck shall be applied in accordance with Article 3.6.1.3 and is referred to as the “IL-120 loading”. The bridge design shall also meet the design requirements for the HL-93 loading. The Design Tandem remains as given in Article 3.6.1.2.3. The structural design shall be based on the maximum force effects resulting from the IL-120 loading, the HL-93 loading and the Design Tandem.

The IL-120 Design Truck shall be used for fatigue design. All other requirements of Section 3.6.1.4 shall apply.

Load factors and combinations shall be according to Section 3.4.
The Inventory and Operating Load Ratings for the HL-93 shall be shown on the General Plan and Elevation sheet. Refer to Section 6.3.12.

Design loads for decks and deck systems shall be in accordance with AASHTO 3.6.1.3.3, using the design truck given in AASHTO 3.6.1.2.2 or the design tandem given in AASHTO 3.6.1.2.3.

For live load deflection evaluation, the deflection shall be taken as the larger of:

- The maximum deflection resulting from the IL120, HL93 truck, or HL93 Tandem alone, or
- The deflection resulting from the design lane load plus the maximum deflection resulting from 25 percent of the IL120, HL93 truck, or the HL93 Tandem.

Crossroad bridges, over the Tollway, shall be designed in accordance with the latest edition of the AASHTO LRFD Bridge Design Specifications, using the HL-93 loading.

**1.3 Seismic Design of Bridges**

Tollway structures shall be designed to meet the minimum requirements for AASHTO Seismic Performance Zone 1 (LRFD) or Category A (LFD) with a low probability of being exceeded during the normal life expectancy for a bridge. Bridges and their components that are designed to resist Zone 1 (Category A) forces and constructed in accordance with the design details contained in the latest IDOT bridge manual should not experience total collapse, but may sustain repairable damage due to seismically induced ground shaking.

**1.4 Design Section Engineers (DSE) Manual**

For a complete list of Tollway terms, definitions and acronyms including project requirements, see the latest DSE Manual.
IL-120 DESIGN TRUCK

MARCH, 2015

FIGURE 1.2.1

ILLINOIS TOLLWAY
SECTION 2.0 STRUCTURE INSPECTION AND CONDITION REPORTS

2.1 Inspection and Testing

Inspection of existing bridges, culverts, and retaining walls shall be conducted in accordance with the latest, Federal Highway Administration (FHWA) Bridge Inspector’s Reference Manual” and its supplement “Inspection of Fracture Critical Bridge Members,” and the AASHTO “Manual for the Condition Evaluation of Bridges.” Underwater inspections and evaluations when required shall be conducted according to the latest FHWA Manual for “Underwater Inspection of Bridges.”

The Designer shall compare their findings to those of the latest Tollway “Structure Inspection Field Report”. Any discrepancies in ratings shall be explained and justified in the Designer’s Structure Inspection Report. Defects in the structure or approach roadway which are or may become hazardous to the public or railroads shall be reported immediately to the Tollway.

2.2 Preparation of Structure Condition Reports

Structure condition reports shall be submitted during the master planning or pre-conceptual phase. Reports shall follow the guidelines of the latest IDOT “Bridge Condition Report Procedures and Practices”. Existing structures to be abandoned and/or removed or completely replaced will not be inspected or require a condition report. Only those structures which are to be rehabilitated, reconstructed or widened will require both in-depth inspections and condition reports.

In general, retaining walls shall not be inspected nor require a condition report, unless the existing wall(s), or portions thereof, are to be incorporated into the proposed project. In which case, an inspection shall be performed and a condition report prepared for each wall or section to be utilized in conjunction with the project.

Before any element of a structure and/or its foundations can be considered for reuse in replacing, reconstructing or rehabilitating an existing structure, it must be evaluated and analyzed in accordance with Section 2.2 of the Bridge Manual. The results of these evaluations and analysis shall be summarized and included in the Structure Condition Report for each structure where reuse is being considered. The backup data and calculations for each summary shall not be submitted for review unless requested by the Tollway.

2.3 Hydraulic Analysis

All new structures and existing structures to be replaced, reconstructed, widened or extended which are over or conveying waterways will require a hydraulic analysis to determine if the resulting waterway opening meets current Tollway standards and IDNR-OWR permit requirements.
The results of the analysis will be summarized in a Waterway Information Table which shall be included in the Hydraulic Report for each structure. The report will also include any recommendations for improving the waterway opening or channel alignment at each structure.

2.4 Scour Analysis

All new structures and existing structures to be replaced, reconstructed or widened which are over waterways, will require a scour analysis to determine if the resulting or proposed opening will increase the flow and potentially undermine the adjacent structure foundations. The scour analysis shall be performed in accordance with the latest editions of the following FHWA, Hydraulic Engineering Circulars (HEC): HEC-18, Evaluating Scour at Bridges; HEC-20, “Stream Stability at Highway Structures”, and HEC-23, “Bridge Scour and Stream Instability Countermeasures – Experience, Selection and Design Guidance. Results of the analysis shall be summarized in a “Design Scour Elevation Table” and the scour critical analysis codings as directed below, and shall be included in the Hydraulic Report, Structure Condition Report and the TS & L.

Provide the following information as defined in the Illinois Highway Information System, Structure Information and Procedure Manual:

- Scour Critical Evaluation (Item 113)
- Scour Critical Analysis Date (Item 113A)
- Scour Critical Evaluation Method (Item 113B)
- Scour Critical Analysis By Name (Item 113C)
- Scour Critical Remark (Item 113D)
- Channel & Channel Protection Condition (Item 61)
- Waterway Adequacy Appraisal (Item 71)
- Pier Navigation Protection (Item 111)

The report shall also include any recommendations to mitigate or prevent scour at each structure.

2.5 Life Cycle Cost Analysis

Life Cycle Cost Analysis (LCCA) is required for all replacement verses rehabilitation decisions. LCCA for bridge elements such as beams, piers, abutments, etc. (excluding decks) shall be performed in accordance with procedures outlined in Publication No. FHWA-SA-98-079, NCHRP Report 483 “Bridge Life-Cycle Cost Analysis” and the following guidelines:

1. No inflation, that is, constant dollars shall be used. Inflation is included in the real discount rate calculation, provided.
2. A real discount rate of 2.6% shall be used. (From Equation 14, NCHRP 483)
3. The analysis period shall be 100 years.

4. The life of a new bridge element shall be 100 years, unless fatigue dictates a shorter life.

5. Two scenarios shall be compared.
   a. Repair of the structural element.
   b. Replacement of structural element.

6. If the first cost of repair is 10% or less than the cost of a new structural element, then an LCCA is not necessary and replacement is not required.

7. If the first cost of repair is 80% or more than the cost of a new structural element, then an LCCA is not necessary and replacement shall be recommended.

8. Unit prices, quantities and intervals of repairs shall be established by the Designer and reviewed by the Tollway.

9. The effects of salt contamination on deterioration from open or expansion joints, adjacent roadways, etc. shall be considered.

10. Additional expenses due to related and necessary activities such as maintenance of traffic, removal, temporary support or movement, adjacent removal and replacement, new dimensions, etc. shall be included.

11. The functionality and strength of the existing structural member shall be considered.

12. The salvage value is the percentage of the design life of the most recent rehabilitation remaining at the end of the analysis period multiplied by the cost of this rehabilitation.
SECTION 3.0 TYPE, SIZE & LOCATION (TS & L) PLANS

3.1 General

The TS & L Plans form the basis for preparation of Construction Contract Plans. TS & L plans typically shall be submitted with the 30% design submittal. TS & L Plans are required for new or replacement structures, and all reconstructions, widenings and superstructure replacements. Structures identified for rehabilitation and/or redecking will not require TS & L Plans. TS & L Plans for Tollway structures will not require completion of a “Structure Report” (BBS Form 153) or Preliminary Bridge Design and Hydraulic Report (BLR Form 10210) nor “Project Development Outline”. TS & L Plans for those structures that are either fully or partially funded and/or maintained by IDOT shall follow all guidelines and requirements of Section 2.0 of the latest IDOT Bridge Manual. Prior to submittal of any TS & L Plans, the Plans shall be checked for compliance with the Sub-Section 2.3.13 of the latest IDOT Bridge Manual.

3.2 Bridge Type Study

A Bridge Type Study is the process by which the most appropriate structure type for a given location is determined. A Bridge Type Study considers the structure types feasible for the site parameters or environmental commitments, provides the reasoning for eliminating or developing particular alternatives, including cost estimates for all alternatives considered, and finally explains the rationale for the selection of the structure type chosen. The Bridge Type Study is a part of the planning process which justifies the TS & L Plan and is usually not submitted for review. However, for major bridges or when requested by the Tollway, the Bridge Type Study will be submitted to the Tollway for review and acceptance before preparation of the TS & L Plan can commence.

Such a study would provide additional written treatments concerning economic evaluations for the viable alternatives, span length versus pier height studies for the approaches, pier type structural and aesthetic studies, main spans and the approaches structure type aesthetic studies, and architectural presentations of the alternative systems presented in the study. The report should also document unusual design procedures, deviations from or variations of AASHTO Specifications to be used, special materials or details proposed or tests anticipated.

Beam selection criteria shall be in accordance with the Illinois Department of Transportation (IDOT) Bureau of Design and Environment (BDE) Manual and Sections 12 and 13. All Tollway bridges shall be designed in accordance with requirements of Article 1.2.

3.3 Structure Report

Structure Reports are not required to construct, reconstruct, widen or extend Tollway mainline or ramp structures. However, if the Tollway is planning on constructing,
reconstructing, widening or extending a structure that is jointly maintained by the Tollway, IDOT or a local agency, then the Designer will be required to complete the appropriate Structure Report as noted above and submit it with the TS & L Plan package for IDOT’s review and approval.

3.4 Hydraulic Information

TS & L Plans for all new structures and existing structures to be replaced, reconstructed, widened or extended which span over or conveying waterways will require a Waterway Information Table, a Design Scour Elevation Table, if required, and the scour critical analysis codings as described in Article 2.4 of this Manual.

3.5 Structural Geotechnical Report

TS & L Plans for all new structures and existing structures to be replaced, reconstructed, widened or extended will require a subsurface soil investigation and Structure Geotechnical Report (SGR) in accordance with IDOT’s Bridge Manual Articles 2.1.5.3, 2.3.4.3 and 2.3.6.3. The Designer along with the Geotechnical Engineer will develop a subsurface exploration program for each structure. The subsurface exploration and analyses shall be in accordance with the latest IDOT and Tollway Geotechnical Manuals. The data from the exploration program shall be analyzed and the resulting foundation recommendations shall be documented in the SGR in accordance with the “All Geotechnical Manual Users” (AGMU) Memo 05.2 issued September 26, 2005.
SECTION 4.0 CONTEXT SENSITIVITY AND AESTHETICS

4.1 Introduction
Context Sensitive Solutions (CSS) is an interdisciplinary process, embraced by the Tollway that seeks effective, multimodal transportation results by working with stakeholders to develop, build and maintain cost-effective transportation facilities which is appropriate to and reflects the project’s surroundings. When implementation of the CSS process has been initiated for a particular project, the DSE is expected to coordinate potential enhancements during the appropriate phase of planning and design. When a formal CSS process is not implemented, the DSE should consider context of the site as an integral part of the functional and aesthetic design development.

4.2 Bridges
All bridges make an aesthetic impression on the surroundings and the DSE must consider and control the impact early in the design phase. The main aesthetic of a bridge is primarily a product of the structural members themselves. The structure form and shape, through the use of proper materials, dimensional relationships and proportions should be used to emphasize the lightness, slenderness and horizontal continuity, allowing the bridge structure to produce the primary aesthetic on its own. Supplemental details such as texture and color can be important but are ordinarily considered secondary or complementary enhancements to the structural shape. Ornamentation should not be added or should be kept to a minimum and used only with special requirements for structures of significance.

Detailing and placement for appurtenances such as drain pipes, conduits, utilities, fencing, rails, signage and lighting should be coordinated for visual compatibility and design consistency. Drain pipes and other conduit systems should employ simple details and be located as visually unobtrusive as possible.

The standard treatment for a bridge and its overpass and underpass area is the use of a basic utilitarian highway bridge, essential erosion control and seeding in landscape areas, and routine Tollway signage identifying the crossroad. Upgrade treatments for a bridge and the overpass or underpass area where a response to the significance of the crossroad, physical context, or community has been determined, may include the addition and aesthetic enhancements of architectural elements, landscape treatments and signage components. Throughout design, the DSE should orchestrate all primary aesthetic structural elements and details for efficiency and economy to minimize cost and to achieve an attractive bridge.
4.3 Walls

Due to the potential size, quantity and location, walls including noise walls and retaining walls are often highly visible components within the Tollway corridors. The vertical and horizontal alignment, material type, textures and color become important elements of consideration. The primary wall aesthetic theme is to create a natural appearance that blends with the surrounding environment. Walls should be designed as visual assets from the prospective views of motorists and adjoining communities. The DSE shall develop all wall types together with surrounding structural and non-structural elements to create a visual relationship to one another and provide a harmonious aesthetic throughout the corridor.
### SECTION 5.0 DESIGN CRITERIA

#### 5.1 Structural Design Criteria

The following criteria shall be used for the design of structures on the Illinois Tollway. The applicable information shall be shown on the contract plans as discussed in Article 6.3.4.

#### BRIDGES – NEW OR REPLACEMENT

<table>
<thead>
<tr>
<th>Design Specifications</th>
<th>Design Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 AASHTO LRFD Bridge Design Specifications (except as modified by IDOT and Tollway Structure Design Manual)</td>
<td>Live Load: (Tollway Mainline Structures &amp; Ramps)</td>
</tr>
<tr>
<td>Tollway Structure Design Manual</td>
<td>HL-93 and IL-120</td>
</tr>
<tr>
<td>Illinois Department of Transportation Bridge Manual</td>
<td>Live Load: Other Structures</td>
</tr>
<tr>
<td>Tollway Geotechnical Engineer’s Manual</td>
<td>HL-93</td>
</tr>
<tr>
<td>IDOT All Bridge Designers Memorandum 11.3 (Rev.) (when applicable)</td>
<td>Future Wearing Surface</td>
</tr>
<tr>
<td>March 2015</td>
<td></td>
</tr>
<tr>
<td>January 2012</td>
<td></td>
</tr>
<tr>
<td>March 2015</td>
<td></td>
</tr>
</tbody>
</table>

#### BRIDGES – REHABILITATION AND WIDENING

<table>
<thead>
<tr>
<th>Design Specification</th>
<th>Design Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Existing ASD or LFD Designs: AASHTO Standards Specifications for Highway Bridges</td>
<td>For Existing ASD or LFD Designs: Live Load: All Structures</td>
</tr>
<tr>
<td>17th Edition with all interims</td>
<td>HS-20</td>
</tr>
<tr>
<td>For Existing LRFD Designs: 2014 AASHTO LRFD Bridge Design Specifications (except as modified by IDOT and Tollway Structure Design Manual)</td>
<td>For Existing LRFD Designs: Live Load: All Structures</td>
</tr>
<tr>
<td>7th Edition</td>
<td>HL-93</td>
</tr>
<tr>
<td>Tollway Structure Design Manual</td>
<td>Tollway Geotechnical Engineer’s Manual</td>
</tr>
<tr>
<td>March 2015</td>
<td>March 2015</td>
</tr>
<tr>
<td>Illinois Department of Transportation Bridge Manual</td>
<td>Seismic Retrofitting Guidelines for Highway Bridges Report No. FHWA/RD-83/007</td>
</tr>
<tr>
<td>January 2012</td>
<td>For rehabilitation only</td>
</tr>
<tr>
<td>IDOT All Bridge Designers Memorandum 11.3 (Rev.)</td>
<td>Tollway Geotechnical Engineer’s Manual</td>
</tr>
<tr>
<td></td>
<td>March 2015</td>
</tr>
<tr>
<td>Future Wearing Surface</td>
<td>Match existing design</td>
</tr>
<tr>
<td>BRIDGES – Design Stresses</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Reinforced Concrete</strong></td>
<td></td>
</tr>
<tr>
<td>$f'_c =$ Compressive Strength (Class SI) Substructure Centerline Crash Walls</td>
<td>3,500 psi</td>
</tr>
<tr>
<td>$f'_c =$ Compressive Strength (Class BS) Parapets, Approach Slabs Centerline Barrier Walls</td>
<td>4,000 psi (Design)</td>
</tr>
<tr>
<td>$f'_c =$ Performance Mix Bridge Decks Centerline Diaphragms</td>
<td>4,000 psi (Design)</td>
</tr>
<tr>
<td><strong>Reinforcement</strong></td>
<td></td>
</tr>
<tr>
<td>$f_y =$ Yield Strength (LFD and LRFD)</td>
<td>60,000 psi</td>
</tr>
<tr>
<td>$f_s =$ Tension (Grade 60) (ASD Design)</td>
<td>24,000 psi</td>
</tr>
<tr>
<td>$f_s =$ Stainless Steel Mainline Bridges and Flyover Ramps</td>
<td>60,000 psi</td>
</tr>
<tr>
<td><strong>Prestressed Concrete (LRFD)</strong></td>
<td></td>
</tr>
<tr>
<td>$f'_c =$ Compressive Strength (IDOT Bms.)</td>
<td>6,000 psi (typ.) and up to 7,000 psi</td>
</tr>
<tr>
<td>$f'_c =$ Compressive Strength (Tollway Bms.)</td>
<td>6,000 psi (typ.) and up to 8,000 psi</td>
</tr>
<tr>
<td>$f'_{ci} =$ Release Compressive Strength (as required, but less than $f'_c$) (IDOT Bms.)</td>
<td>4,000 psi (min.) 5,200 psi (max.)</td>
</tr>
<tr>
<td>$f'_{ci} =$ Release Compressive Strength (as required, but less than $f'_c$) (Tollway Bms.)</td>
<td>4,000 psi (min.) 6,800 psi (max.)</td>
</tr>
<tr>
<td>Compression before losses</td>
<td>0.6 $f'_{ci}$</td>
</tr>
<tr>
<td>Compression after losses (Service I)</td>
<td>Case (a): $0.60\varphi_w f'_c$; $\varphi_w = 1$ for IDOT members Case (b): 0.45 $f'_c$</td>
</tr>
<tr>
<td>Tension after losses (Service III)</td>
<td>0.19 $\sqrt{f'_c}$ (max)</td>
</tr>
<tr>
<td>Tension before losses</td>
<td>0.24 $\sqrt{f'_c}$</td>
</tr>
<tr>
<td>Fatigue: Compression after losses</td>
<td>0.40$f'_c$</td>
</tr>
<tr>
<td>Fatigue: Tension after losses limit for determination of cracked vs. uncracked</td>
<td>Uncracked $\leq 0.095\sqrt{f'_c}$</td>
</tr>
<tr>
<td><strong>Prestressing Strands</strong></td>
<td></td>
</tr>
<tr>
<td>0.5 inch diameter low relaxation</td>
<td>0.153 in²</td>
</tr>
<tr>
<td>0.6 inch diameter low relaxation</td>
<td>0.217 in²</td>
</tr>
<tr>
<td>$f_{pu} =$ ultimate strength</td>
<td>270,000 psi</td>
</tr>
<tr>
<td>$f_{pbt} =$ initial tension</td>
<td>202,500 psi $= 0.75 f_{pu}$</td>
</tr>
<tr>
<td>$f_s =$ allowable final tension</td>
<td>183,600 psi (0.5 or 0.6 inch nominal diameter strands)</td>
</tr>
<tr>
<td><strong>Structural Steel</strong></td>
<td></td>
</tr>
<tr>
<td>$f_y =$ yield strength</td>
<td>50 ksi (Typ.)</td>
</tr>
</tbody>
</table>
### BRIDGES – Deflection

<table>
<thead>
<tr>
<th>Bridges Carrying Mainline Tollway Routes or Ramps</th>
<th>For LRFD designs:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Live Load deflections shall be the larger of:</td>
</tr>
<tr>
<td></td>
<td>1. Max deflection resulting from IL-120, HL93 truck or HL-93 Tandem alone.</td>
</tr>
<tr>
<td></td>
<td>2. Max deflection resulting from design lane load plus the max deflection resulting from 25% of the IL-120, HL93 truck or HL-93 Tandem trucks.</td>
</tr>
<tr>
<td></td>
<td>Span Length/800 (if sidewalk present, Span Length/1000)</td>
</tr>
</tbody>
</table>

For LFD or ASD designs: HS-20 Live Load

| Other Bridges | Same as above, except requirements for IL-120 Live load do not need to be met. |

### BRIDGES

#### Seismic Design

<table>
<thead>
<tr>
<th>Seismic Performance Category (SPZ), (SPC)</th>
<th>Zone 1 (LRFD), Category A (LFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrock Acceleration Coefficient (A) (LFD)</td>
<td>Site-specific based on existing soil type. Review SGR for additional information.</td>
</tr>
<tr>
<td>Design Spectral Acceleration at 1.0 sec (Sdl)</td>
<td></td>
</tr>
<tr>
<td>Design Spectral Acceleration at 0.2 sec (Sds)</td>
<td></td>
</tr>
<tr>
<td>Site Coefficient (S) (LFD)</td>
<td></td>
</tr>
<tr>
<td>Soil Site Class (LRFD)</td>
<td></td>
</tr>
</tbody>
</table>

### BOX CULVERTS

<table>
<thead>
<tr>
<th>Design Specifications</th>
<th>2014 AASHTO LRFD Bridge Design Specifications</th>
<th>7th Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tollway Structure Design Manual</td>
<td>March 2015</td>
</tr>
<tr>
<td></td>
<td>Tollway Geotechnical Engineer’s Manual</td>
<td>March 2015</td>
</tr>
<tr>
<td></td>
<td>Illinois Department of Transportation Bridge Manual</td>
<td>January 2012</td>
</tr>
<tr>
<td></td>
<td>IDOT All Bridge Designers Memorandum 11.3 (Rev.)</td>
<td>November 2, 2011</td>
</tr>
<tr>
<td></td>
<td>AASHTO Material Specifications M259 and M273</td>
<td>For Precast Culverts</td>
</tr>
<tr>
<td></td>
<td>Strength Methods (Load Factor Design)</td>
<td>Service Load Design Method for modifications or extensions of existing foundations</td>
</tr>
</tbody>
</table>
### BOX CULVERTS – Design Loads

<table>
<thead>
<tr>
<th>Dead Loads</th>
<th>Concrete (vertical)</th>
<th>150 pcf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Earth</td>
<td>120 pcf</td>
</tr>
<tr>
<td>Live Load</td>
<td>HL-93 Loading (and IL-120 Tollway Mainline Structures and Ramps)</td>
<td></td>
</tr>
<tr>
<td>Earth Pressure (equivalent fluid pressures)</td>
<td>Height of Fill (above roof)</td>
<td>40 pcf</td>
</tr>
<tr>
<td></td>
<td>Height of Barrel</td>
<td>50 pcf</td>
</tr>
</tbody>
</table>

Surcharge load of 2 feet of equivalent soil is added for culverts when live load is considered in the design of the barrel. Refer to Figure 21.1.1.1.

### BOX CULVERTS – Design Stresses

<table>
<thead>
<tr>
<th>Reinforced Concrete</th>
<th>$f'_c = $Compressive Strength (Class SI)</th>
<th>3,500 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precast Concrete</td>
<td>$f'_c = $Compressive Strength</td>
<td>5,000 psi</td>
</tr>
<tr>
<td>Reinforcement</td>
<td>$f_y = $Yield Strength</td>
<td>60,000 psi</td>
</tr>
<tr>
<td></td>
<td>$f'_s = $Tension (Grade 60) (ASD)</td>
<td>24,000 psi</td>
</tr>
<tr>
<td>Welded Wire Fabric</td>
<td>$f_y = $Yield Strength</td>
<td>65,000 psi</td>
</tr>
</tbody>
</table>

### RETAINING WALLS

**Design Specifications**

- 2012 AASHTO LRFD Bridge Design Specifications, as modified by IDOT Bridge Manual
  6th Edition
- Tollway Structure Design Manual
  March 2015
- Tollway Geotechnical Engineer’s Manual
  March 2015
- IDOT Bridge Manual
  January 2012

### RETAINING WALLS – Design Loads

<table>
<thead>
<tr>
<th>Dead Loads</th>
<th>Concrete</th>
<th>150 pcf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Earth</td>
<td>120 pcf</td>
</tr>
<tr>
<td>Live Loads</td>
<td>Walls adjacent to roadways</td>
<td>Live load surcharge equivalent to 2 feet of earth.</td>
</tr>
<tr>
<td></td>
<td>When a barrier wall or railing is constructed integrally with the top of the wall.</td>
<td>Top of wall designed for transfer of impact loads.</td>
</tr>
<tr>
<td>Impact Loads</td>
<td>Overturning &amp; Sliding (Static) Strength (Dynamic)</td>
<td>23 kips over 8 feet 124 kips over 8 feet</td>
</tr>
<tr>
<td>Earth Pressure</td>
<td>The formula to compute lateral earth pressure is by Coulomb’s equation for the resultant parallel to the backfill slope. Based on soil data from borings accounting for water level and long-term drained conditions for passive resistance.</td>
<td></td>
</tr>
</tbody>
</table>

### RETAINING WALLS – Design Stresses

<table>
<thead>
<tr>
<th>Reinforced Concrete</th>
<th>$f'_c = $Compressive Strength (Class SI)</th>
<th>3,500 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforcement</td>
<td>$f_y = $Yield Strength</td>
<td>60,000 psi</td>
</tr>
<tr>
<td>Soldier Piles</td>
<td>$f_y = $Yield Strength</td>
<td>36,000 psi</td>
</tr>
<tr>
<td>Timber Lagging</td>
<td>$F_b = $Extreme Fiber Bending</td>
<td>1,000 psi</td>
</tr>
</tbody>
</table>
### NOISE ABATEMENT WALLS

<table>
<thead>
<tr>
<th>Design Specifications</th>
<th>2014 AASHTO LRFD Bridge Design Specifications</th>
<th>7th Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AASHTO Guide Specifications for Structural Design of Sound Barriers</td>
<td>Current Edition</td>
</tr>
<tr>
<td></td>
<td>Tollway Structure Design Manual</td>
<td>March 2015</td>
</tr>
<tr>
<td></td>
<td>Tollway Geotechnical Engineer’s Manual</td>
<td>March 2015</td>
</tr>
</tbody>
</table>

### NOISE ABATEMENT WALLS – Design Loads

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Description</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead Load</td>
<td>Noise walls mounted on bridges and retaining walls</td>
<td>Self-weight of structure mounted Noise abatement walls</td>
</tr>
<tr>
<td>Wind Loads</td>
<td>Applied over the exposed area</td>
<td>35 psf</td>
</tr>
<tr>
<td>Seismic Loads</td>
<td>2014 AASHTO LRFD Bridge Design Specifications</td>
<td>See Seismic Design above</td>
</tr>
<tr>
<td>Vehicle Impact Loads</td>
<td>2014 AASHTO LRFD Bridge Design Specifications Section 15</td>
<td>See Structure Design Manual Article 23.2.2</td>
</tr>
</tbody>
</table>
| Deflection              | Maximum Allowable Panel Deflection                                           | Structure Mounted: L/180  
                                        Ground Mounted: L/240 |

### NOISE ABATEMENT WALLS – Other Requirements

- The design height is determined by the DSE in conjunction with the noise mitigation study for each area.
- If NAW is to resist lateral earth pressure due to unequal ground lines, the requirement shall be shown on the Plans.
- Crashworthy NAW shall be identified as such on the plans for NAW located within the clear zone. NAWs outside the clear zone need not be designed for vehicle impact load.

### OVERHEAD SIGN SUPPORTS

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Illinois Department of Transportation Sign Structures Manual</td>
<td>Latest</td>
</tr>
<tr>
<td></td>
<td>Tollway Standard Drawings</td>
<td>March 2015</td>
</tr>
<tr>
<td></td>
<td>Tollway Base Sheets</td>
<td>March 2015</td>
</tr>
<tr>
<td>Design Loads</td>
<td>Dead Load: (LRFD Method)</td>
<td>Self-weight</td>
</tr>
<tr>
<td></td>
<td>Wind Load: (LRFD Method)</td>
<td>Per “Loading” requirements on Tollway Standard F Drawings</td>
</tr>
</tbody>
</table>
5.2 Design Minimum Vertical Clearances

The following table lists the minimum vertical clearance requirements for vehicular and railroad bridges. Early coordination with railroads is required to ensure that these minimum vertical clearances are acceptable for railroad bridges over the Tollway.

<table>
<thead>
<tr>
<th>Bridge Over Tollway</th>
<th>Type of Work</th>
<th>Vertical Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tollway Single Interstate Routes (1)</td>
<td>New Bridge or Reconstructing Bridge</td>
<td>16'-5&quot;*</td>
</tr>
<tr>
<td></td>
<td>Widening or Rehabilitating Existing Bridge</td>
<td>16'-0&quot;</td>
</tr>
<tr>
<td>Other Tollway Routes (2)</td>
<td>New Bridge or Reconstructing Bridge</td>
<td>16'-5&quot;** desirable 15'-5&quot;*** minimum</td>
</tr>
<tr>
<td></td>
<td>Widening or Rehabilitating Existing Bridge</td>
<td>15'-5&quot;*** desirable Existing Vertical Clearance Minimum</td>
</tr>
<tr>
<td>Tollway Bridge Over</td>
<td>Type of Work</td>
<td>Vertical Clearance</td>
</tr>
<tr>
<td>All Routes</td>
<td>New Bridge or Reconstructing Bridge</td>
<td>16'-0&quot; desirable 15'-3&quot; minimum</td>
</tr>
<tr>
<td></td>
<td>Widening or Rehabilitating Existing Bridge</td>
<td>16'-0&quot; desirable Existing Vertical Clearance Minimum</td>
</tr>
</tbody>
</table>

* 16'-5" allows for an ultimate 16'-0" clearance after a 5" overlay is constructed.

** 15'-5" allows for an ultimate 15'-0" clearance after a 5" overlay is constructed.

(1) The following segments of the Tollway are considered Single Interstate Routes (Military Defense Route):

- Tri-State: All sections shared with I-80
- Tri-State: North of Jane Addams Memorial
- Jane Addams Memorial: West of Tri-State
- Reagan Memorial: West of Veterans Memorial
- Veterans Memorial: All sections
(2) The following segments of the Tollway are considered Other Tollway Routes:

<table>
<thead>
<tr>
<th>Route Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tri-State</td>
<td>South of Jane Addams Memorial</td>
</tr>
<tr>
<td>Edens Spur</td>
<td>All Sections</td>
</tr>
<tr>
<td>Jane Addams Memorial</td>
<td>East of Tri-State</td>
</tr>
<tr>
<td>Reagan Memorial</td>
<td>East of Veterans Memorial</td>
</tr>
<tr>
<td>Elgin O’Hare Expressway</td>
<td>All sections</td>
</tr>
<tr>
<td>West O’Hare Access</td>
<td>All sections</td>
</tr>
</tbody>
</table>

In addition to the above, vertical clearances shall comply with requirements of the latest IDOT Traffic Manual. If the clearance is less than 14’-6”, the clearance shall be posted on a rectangular “Low Clearance” sign mounted to the structure over the highway. If the clearance is less than 14’-0”, the clearance shall also be posted on a “Low Clearance” sign in advance of the structure over the highway, as a supplement to the sign mounted to the structure.

The following minimum vertical clearances shall be used for all other structures:

- Pedestrian overpass structures – 17’-5”.
- Overhead sign structures
  - Static signs – 26’-5” shall be provided from the high point of the roadway beneath the sign structure to the centerline of the truss, which includes an allowance for 9’ from the centerline of the truss to the bottom of an 18’ tall sign panel.
  - Dynamic Message Signs (DMS) – 22’-5” shall be provided from the high point of the roadway beneath the sign structure to the centerline of a gantry, cantilever, butterfly or span-type sign structure that is intended only for installation of DMS. This includes an allowance for 5’ from the centerline of the truss to the bottom of a 10’ tall DMS.
- Mainline and Ramp Plaza Canopies – 17’-5”.
- I-PASS overhead equipment truss structures – 18’-0”.
- Structures over railroads – 23’-0” between top of rail and low structure measured at or within 9’-0” each side of center of outside tracks or as mandated by the operating railroad. On widening structures, not less than the existing, unless written approval is obtained from the railroad. Any clearance less than 21’-6” will require Interstate Commerce Commission approval.
- Stream crossings – 2’-0” measured between design high water and low structure, or 1’-0” between any measured high water and low structure. Use whichever criterion produces the highest low structure.
5.3 Design Horizontal Clearances

Edge of pavement to the nearest face of existing piers on the Tollway System shall be 10'-0" minimum.

The horizontal clearance (clear zone) from the edge of traveled way to the closest face of shoulder piers or abutments shall be established by a Barrier Warrant Analysis prepared by the Design Section Engineer and reviewed by the Tollway. The preferred design for a bridge crossing over the Tollway is a two-span continuous structure without shoulder piers and with slope walls to provide an “open feel”.

In the case of an abutment constructed on an embankment, the toe portion of the slope wall shall be graded to a maximum slope of 1:4 (V:H) unless shielded by barrier or guardrail. The limit (Grade Break Point) of 1:4 slope shall be determined by a Barrier Warrant Analysis as previously described. The remainder of the slope wall shall be graded to a maximum of 1:2 (V:H). The entire slope wall shall be paved. See Article 10.7.

5.4 Deck Width

On the Tollway System, minimum bridge widths shall match the approach or departure roadway, including pavement lane widths, shoulder widths and gutters, and shall be in accordance with the latest Roadway Design Criteria. The bridge shoulder width shall equal the roadway shoulder width plus 1'-0" for guardrail or 2'-0" for F-shape or single-slope barrier. In cases where the approach and departure gutters are different, the larger bridge shoulder dimension shall be used.

Increase shoulder widths on long curved bridges, if necessary, to provide required sight distances.

5.5 Minimum Number of Beam Lines

The Tollway preference is to support all of the mainline and directional ramp bridges on a minimum of six lines of beams or girders unless the ramp traffic can be detoured for the duration of construction and/ or reconstruction.
5.6 Field Survey

5.6.1 General

Prior to the beginning of the conceptual or TS&L designs, a field survey shall be completed and shall include, but shall not be limited to, the items as outlined herein. A stationing system shall be established and all topography within the site which is relevant to the proposed work shall be collected utilizing one of the networks of Continuously Operating Reference Stations (CORS) coordinated by the National Geodetic Survey (NGS). Tollway CORS stations are located at the following Maintenance and or Plaza facilities:

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Station I.D Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALSIP</td>
<td>TM01</td>
</tr>
<tr>
<td>GURNEE</td>
<td>TMO4</td>
</tr>
<tr>
<td>SCHAUMBURG</td>
<td>TMO5</td>
</tr>
<tr>
<td>BELVIDERE</td>
<td>TMO6</td>
</tr>
<tr>
<td>ROCKFORD</td>
<td>TMO7</td>
</tr>
<tr>
<td>NAPERVILLE</td>
<td>TM08</td>
</tr>
<tr>
<td>DEKALB</td>
<td>TM11</td>
</tr>
<tr>
<td>DIXON</td>
<td>TM12</td>
</tr>
<tr>
<td>BOLINGBROOK</td>
<td>TP89</td>
</tr>
</tbody>
</table>

A permanent Benchmark for each structure shall be established and all elevations taken for the structure shall be tied to this Benchmark.

5.6.2 Modified Barrier Rails (Parapets)

On existing barriers that are proposed for modification, the joint locations shall be field verified before designing the new longitudinal reinforcement bars.

5.6.3 Bearings

A condition survey shall be made of the existing bearings to verify the recommendations made in the Bridge Condition Report. On bearings proposed for replacement, measurements between the bottom of the beam and the top of the bearing seat shall be taken at all four corners of existing bearings to determine if shims are required.

5.6.4 Bridge Deck Widening

On bridges that are to be widened, the following data shall be obtained or verified:

- Elevations along the bottom of the beam adjacent to the widening and elevations at the top of the deck at the same points.
- Verification of the locations of existing stiffeners and/or diaphragm connections on steel beams adjacent to the widening.
5.7 Construction

General:

If the designer’s construction scenario requires a special method of work or restriction to the way the contractor builds the structure, it should be defined in the contract documents.

An example would be:

- **Precast Beams:***

  The pre-cast beams have been designed to accommodate loads arising from normal hoisting, storage and transportation. Specifically:

  - The lifting apparatus used to pick the beams will distribute loads evenly between all the lifting points shown. Furthermore, load distributing slings and pins with the same radius as that shown for lifting loops on the drawings will be used every time the beams are hoisted including movement in the precast yard.

  - Beams will be supported within a distance equal to 1 1/2 times the depth of the beam from each end of the beam during storage and transportation.

  - Beams will be stored with webs vertical.

  - Beams will be transported on roads and bridges conforming to AASHTO standards with regard to smoothness and maximum superelevation.

If the Contractor wishes to use methods of hoisting, storage and transportation that are different from the parameters listed above, a detailed proposal must be presented with detailed shop drawings and structural calculations sealed by the Contractor’s Illinois licensed Structural Engineer. No extra payment will be considered for changes required to conform to the Contractor’s proposed method of work. No work is to proceed without the explicit approval of the CM.

The Contractor remains responsible to provide the expert knowledge and necessary care to ensure the delivery and final disposition of the beams in a condition required by the specifications.
5.8 Railroad Crossings

Right of entry, insurance and railroad safety training are required when inspecting and working on railroad’s right of way.

The following information shall be provided on the drawings and within the contract documents:

<table>
<thead>
<tr>
<th>Information</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Specifications:</td>
<td>Used for design of all railroad bridges.</td>
</tr>
<tr>
<td>Grade Separation Manual (Railroad Specific)</td>
<td></td>
</tr>
<tr>
<td>AREMA (Latest Release)</td>
<td>Used for design of railroad bridges and bridge structures over Railroads. AREMA and Railroad Specific Grade Separation Manuals shall be used.</td>
</tr>
<tr>
<td>Tollway Structure Design Manual</td>
<td></td>
</tr>
<tr>
<td>Loading:</td>
<td></td>
</tr>
<tr>
<td>Cooper E-80 or Railroad Specific</td>
<td>For new structures: minimum = 23’-0” For existing structures: not less than existing nor less than 21’-6”</td>
</tr>
<tr>
<td>Horizontal and vertical clearance diagram</td>
<td>Based on the latest AREMA or Railroad guidelines.</td>
</tr>
<tr>
<td>Existing and proposed vertical clearance measured from top of rail to the</td>
<td>For new structures: minimum = 23’-0” For existing structures: not less than existing nor less than 21’-6”</td>
</tr>
<tr>
<td>bottom of lowest beam</td>
<td></td>
</tr>
<tr>
<td>Horizontal dimensions between the center line existing tracks and face of</td>
<td>This information is critical for the Contractor to establish work limits, including stock piling of material and storage of construction equipment.</td>
</tr>
<tr>
<td>substructure elements</td>
<td></td>
</tr>
<tr>
<td>Temporary soil retention systems that support railroad surcharge</td>
<td>These systems must be designed by the Designer’s Illinois licensed Structural Engineer and submitted to the Tollway and the Railroad during preliminary plan submittal stage.</td>
</tr>
<tr>
<td>Railroad flagging requirements</td>
<td>Coordinate with Railroads to determine railroad flagging requirements for the contract. A contract allowance is to be included in the contract for railroad flagging that will be performed by the Railroad during construction and invoiced through the construction contract. Allowance special provisions for railroad flagging are available from the Tollway.</td>
</tr>
<tr>
<td>Specific railroad requirements</td>
<td>The Tollway requires the Designer to include the specific railroad requirements in the special provisions. Such requirements are specific to each railroad but may include contact persons, insurance requirements, flagging requirements, right-of-entry agreement requirements, railroad safety training, etc.</td>
</tr>
<tr>
<td>Number, type and time of trains passing over/under the proposed structure</td>
<td>This information is critical for the Contractor to develop an appropriate work plan.</td>
</tr>
<tr>
<td>Each day</td>
<td></td>
</tr>
<tr>
<td>Railroad Milepost Number</td>
<td>Obtained from the railroad.</td>
</tr>
</tbody>
</table>
SECTION 6.0 PLAN PREPARATION

6.1 CADD Standards

Plan presentation shall be in accordance with the Tollway CADD Standards Manual.

6.2 Plan Sheet Organization

Each bridge, culvert and retaining wall shall consist of a set of sequentially numbered plan sheets. Plan sheets shall be organized in such a manner as to facilitate construction. The General Plan and Elevation sheet for each structure shall include a structural seal with signature and expiration date. Shown below are plan sheet lists for several types of structures.

6.2.1 Bridges

1. General Plan and Elevation
2. General Notes, Index of Sheets and Total Bill of Material
3. Construction Staging
4. Substructure Layout, Temporary Retention and Slope Paving Details
5. Limits and details of Temporary Soil Retention System
6. Pile Driving and/or Drilled Shaft Installation Records
7. Abutment Details
8. Pier Details
9. Framing Details
10. Bearing and Anchor Rod Details
11. Superstructure Elevations
12. Superstructure Details
13. Expansion Joint Details
14. Drainage Details
15. Approach Slab Details
16. Boring Logs

6.2.2 Culverts

1. General Plan and Elevation
2. General Notes, Index of Sheets and Total Bill of Material
3. Construction Staging (if required)
4. Foundation Layout and Details (if required)
5. Limits of Temporary Soil Retention Systems (if required)
6. Barrel Details
7. Head and Wing Wall Details
8. Approach Slab Details (if required)
9. Boring Logs

6.2.3 Conventional Concrete Retaining Walls

1. General Plan and Elevation
2. General Notes, Index of Sheets and Total Bill of Material
3. Construction Staging (if required)
4. Substructure Layout and Limits of Temporary Soil Retention System (if required)
5. Existing Pile Driving and/or Drilled Shaft Installation Records (if available)
6. Plans and Elevations Details
7. Sections and Details
8. Rebar Lists and Bending Diagrams
9. Drainage Details
10. Boring Logs and Plan Locations

6.2.4 Performance Based Retaining Walls

Plans included in Contract Documents shall include the following for each wall:
1. General Plan and Elevation
2. Index of Sheets and Bill of Material
3. Construction Staging (if required)
4. Proposed Elevations of Top and Bottom of the Wall, Finished Ground Lines at the Back and Front Face of the Wall and Existing Surface Profile
5. Existing Pile Driving and/or Drilled Shaft Installation Records (if available)
6. Cross Sections of all Significantly Different Sections
7. Drainage Details
8. Location of all ancillary structures such as, light standards, overhead sign structures, drainage openings and noise abatements walls
9. Boring Logs and Boring Locations in Plan

Working Drawings shall include the information required in Article 6.2.3

6.3 General Plan and Elevation

6.3.1 Plan and Elevation Views

The plan and elevation views for each bridge shall include at a minimum the following information:

- Horizontal and vertical alignments for roadways, waterways and facilities
- Skew angles
- Bridge and approach roadway widths
- Minimum vertical and horizontal clearances
- Stations and elevations at the centerline of each pier and back of and centerline of bearing for each abutment
- Span lengths and numbers
- Type and depth of spans, i.e., 72-inch P.P.C. I-beam or 48-inch Steel Plate Girder, etc.
• Location, size, and type of expansion joints
• Location of fixed and expansion bearings, deck drainage, signing and lighting
• Guardrail anchorage and terminal type
• Approach pavement length and width
• Limits and type of slope paving
• Bottom of footing elevations and foundation type including pile or drilled shaft size, length and capacity
• Location of soil borings
• Location of all existing and proposed utilities (overhead and buried) and storm sewers in the vicinity of the bridge
• Waterway Information Table and Scour Elevation Table (if required).

Station equations shall not be located between the backs of abutments.

6.3.2 Benchmark

Include location and description of the benchmark in the upper left-hand corner of the General Plan and Elevation Sheet.

6.3.3 Structure Description

Structure Rehabilitation - Include a description of the existing structure and list of Major Items of Work as well as the required maintenance of traffic (MOT).

Structure Widening - Include a description of the existing structure and required MOT.

Structure Replacement - Include a description of the existing and proposed structure as well as the required MOT.

New Structure - Include a description of the proposed structure and MOT if required.

Salvage – For the removal of existing structures, reconstruction and rehabilitation, indicate if any items of the existing bridge will be salvaged for future Tollway use.

6.3.4 Design Criteria

Design criteria are listed in Section 5.1. The design criteria shown on the plans shall include the following:

• Design specifications
• Construction Specifications
• Design loads
• Design stresses
• Live load deflection criteria
• Seismic criteria

6.3.5 Horizontally Curved Alignments

For bridges on horizontally curved alignments, provide a "Horizontal Offset Sketch" as shown in Figure 6.3.5.1. The sketch shall establish a local tangent at a stationing point along the horizontal curve.

Distances along the local tangent and offsets from the local tangent shall be shown for the centerline of each pier and abutment.

6.3.6 Profile Sketches

Provide "Profile Grade" sketches for the structure, roadways, waterways and facilities crossed by the bridge. Indicate location and limits of the bridge on the appropriate Profile Grade Sketch. For examples of "Profile Grade" sketches, see Figures 6.3.6.1 and 6.3.6.2.

6.3.7 Superelevation Transitions

Superelevation Transitions (SET) shall not be located on bridges or approach slabs. A Design Deviation is required if a SET occurs within the limits of the bridge or approach slab. If a SET must be located on a bridge or approach slab, its limits shall be indicated on the General Plan and the appropriate vertical Profile Sketch. The SET diagrams and details shown in the structural and roadway portions of the plans shall also be referenced on the General Plan and Elevation sheet. See Article 15.3 for specific requirements of bridge and approach cross slopes.

6.3.8 Location Map

Provide a "Location Map" containing the following information in the lower right hand corner of the sheet. For an example of a "Location Map" see Figure 6.3.8.1.

• Range, Township, Principle Meridian and Section Numbers
• North Arrow
• Location of Structure(s)
• Four Township Numbers
• Significant Landmarks

6.3.9 Highway Classification

For grade separations, provide the following information for the Route over and under the proposed structure(s): Route Identification, Class, DHV (existing and future), ADT (existing and future), ADTT (existing and future truck traffic) and Design Speed.

6.3.10 Railroad Information

For railroad crossings, provide the number, type and time of trains passing over/under the proposed structure each day. In addition, all structures on or over railways shall be located by the Railroad Mile Post (MP) number.

6.3.11 Waterway Information

For waterway crossings, provide a waterway information table in accordance with Section I-302.02 of the latest IDOT Drainage Manual and the scour critical analysis codings as described in Article 2.4 of this Manual.

6.3.12 Structure Rating

The Inventory and Operating Rating for each new, reconstructed or widened structure shall be calculated by the Designer for the HL-93 loading and shown on the General Plan and Elevation Sheet. The load rating shall include future wearing surface. The Designer shall also complete and submit the “Illinois Tollway Bridge Superstructure Rating Form” shown in Figure 6.3.12.1 to the Tollway for their review and comment. The “Bridge Superstructure Rating Form” is required to be submitted for all Tollway mainline bridges and cross road bridges with the pre-final and final submittals. The “Bridge Superstructure Rating Form” may be downloaded from the Tollway’s internet site at www.illinoistollway.com, under Construction & Engineering, Consultant Resources, Manuals, Bridges & Structures.

6.4 Total Bill of Material

A coded "Summary of Quantities" for individual Pay Items and a "Total Bill of Material" shall be shown in the plans for each structure. The "Total Bill of Material" shall be divided into Superstructure, Substructure, Total and Record Quantities and shall be placed on the first or second sheet of the structure plans. Summary of Quantities shall be provided for all Pay Items included in the structure contract on appropriate plan sheets. The total of all of the individual Summary of Quantities shall equal the Total shown in the Total Bill of Material.

In addition, designers shall provide element level inspection quantities when the forms are made available.

6.5 Abbreviations

Provide a list of all abbreviations and their meanings which will be used on the
drawings. A list of some typical abbreviations is shown below.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.G.L.</td>
<td>PROFILE GRADE LINE</td>
</tr>
<tr>
<td>N.B.L.</td>
<td>NORTH BOUND LANES</td>
</tr>
<tr>
<td>S.B.L.</td>
<td>SOUTH BOUND LANES</td>
</tr>
<tr>
<td>S.</td>
<td>SOUTH ABUTMENT</td>
</tr>
<tr>
<td>ABUT</td>
<td></td>
</tr>
<tr>
<td>N.</td>
<td>NORTH ABUTMENT</td>
</tr>
<tr>
<td>E.F.</td>
<td>EACH FACE</td>
</tr>
<tr>
<td>F.F.</td>
<td>FRONT FACE</td>
</tr>
<tr>
<td>B.F.</td>
<td>BACK FACE</td>
</tr>
<tr>
<td>P.J.F.</td>
<td>PREFORMED JOINT FILLER</td>
</tr>
<tr>
<td>P.J.S.</td>
<td>PREFORMED JOINT SEALER</td>
</tr>
<tr>
<td>BK/</td>
<td>BACK OF</td>
</tr>
<tr>
<td>T/</td>
<td>TOP OF</td>
</tr>
<tr>
<td>PROP.</td>
<td>PROPOSED</td>
</tr>
<tr>
<td>EXIST.</td>
<td>EXISTING</td>
</tr>
</tbody>
</table>

6.6 Index of Sheets

Provide an Index of Sheets for each bridge. The index shall list all of the sheet numbers and titles that are part of the bridge plans. The titles in the index must exactly match the individual sheet titles.

6.7 Concrete Reinforcement Detailing

Separate Reinforcement Bar Schedules shall be prepared for each element of the structure and shown along with bending diagrams of each bent bar on the appropriate plan sheet. See Figure 6.7.1 for the Reinforcement Bar List format.

When detailing lengths of reinforcement bars, consideration shall be given to transportation and handling and, where extremely long lengths are contemplated, to availability and special orders. When the location of bar splices is arbitrary, as in the case of the longitudinal reinforcement of deck slabs on beams and girders, the preferred maximum lengths are as follows:

- #6 bars and up ...... 36'-0"
- #4 & #5 bars .......... 30'-0"

Bars shall be detailed to the closest inch of length and the weight of reinforcement bars shown in the Bill of Material shall be to the nearest ten (10) pounds.

To provide uniformity on all structure plans, bar designations used shall be as follows:

- a – Deck Slab (Transverse)
- b – Deck Slab, Sidewalk and Median (Longitudinal)
- c – Sidewalk and Median (Transverse)
- d – Barrier Rail (Curb and Parapets) (Vertical) or Dowels (at any location except Footing to Wall)
- e – Barrier Rail (Curb and Parapets) (Longitudinal)
- g – PPC or CIPC Beams
- h – Substructure and Walls (Horizontal)
- m – Diaphragm for PPC I-Beams (Horizontal)
n – Footing to Wall (Dowels)
p – Pile Caps and Pier Caps (Longitudinal)
s – Stirrup and Tie Bars
t – Footing (Transverse)
u – Ends of Pier Caps, Pile Caps and Crash Walls
v – Substructure and Walls (Vertical)
w – Footing (Longitudinal)
x – Deck Slab – Longitudinal Deck Cantilevers at Expansion Joints

In no case shall the same designation be used for reinforcement bars of a different size, length and shape when they are employed in other elements of the structure.
LOCATION MAP

MARCH, 2015

FIGURE 6.3.8.1

ILLINOIS TOLLWAY
The HL-93 Inventory and Operating ratings for each new, reconstructed or widened structure shall be calculated by the DSE and shown on the General Plan and Elevation sheet. The DSE shall fill out the following information, to be submitted with the Prefinal Submittal package and updated and resubmitted with the Final Submittal package.

### Inventory Data

<table>
<thead>
<tr>
<th>Tollway Bridge No.:</th>
<th>IDOT Bridge No.:</th>
<th>Tollway Milepost:</th>
<th>Feature Over:</th>
<th>Feature Under:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Rating Methodology:</th>
<th>LFR</th>
<th>LRFR</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Superstructure Rating</th>
<th>Inventory</th>
<th>Operating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength (LFR or LRFR)</td>
<td>Flexure:</td>
<td>Shear:</td>
</tr>
<tr>
<td>Service (LRFR Only)</td>
<td>Flexure:</td>
<td>Shear:</td>
</tr>
</tbody>
</table>

### Design Stresses

<table>
<thead>
<tr>
<th>PPC Beams:</th>
<th>Concrete:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel:</td>
<td>Reinforcing Steel:</td>
</tr>
</tbody>
</table>

### Bridge Deck

- New Construction/Replacement
- Structural Deck Widening

<table>
<thead>
<tr>
<th>Deck Thickness:</th>
<th>in</th>
<th>Overlay Thickness:</th>
<th>in</th>
<th>Future Wearing Surface:</th>
<th>psf</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Deck expansion joint locations:</th>
<th>Abutments:</th>
<th>Piers:</th>
</tr>
</thead>
</table>

### Superstructure

- New Construction/Beam Replacement
- Superstructure Widening

<table>
<thead>
<tr>
<th>Beam Girder Description:</th>
<th>Bearings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Type</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Span:</th>
<th>Location of Critical Bridge Rating:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Span Lengths (separated by commas):</th>
<th>(list from south to north or west to east)</th>
</tr>
</thead>
</table>

Identify main load carrying superstructure members:

<table>
<thead>
<tr>
<th>Span Nos.</th>
<th>Beam Nos.*</th>
<th>Impact Factor</th>
<th>Moment</th>
<th>Shear</th>
<th>Superimposed Dead Load</th>
</tr>
</thead>
</table>

*Beams numbered increasing from left to right while looking upstation.

### Signatures:

Engineer of Record:

Received By:

<table>
<thead>
<tr>
<th>Print Name:</th>
<th>Date</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Tollway GEC</th>
<th>Date</th>
<th>Print Name:</th>
</tr>
</thead>
</table>

Form Date: March 2016
# REINFORCEMENT BAR LIST

<table>
<thead>
<tr>
<th>BAR</th>
<th>No.</th>
<th>SIZE</th>
<th>LENGTH</th>
<th>SHAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>d51(E)</td>
<td>28</td>
<td>#5</td>
<td>4'-3&quot;</td>
<td></td>
</tr>
<tr>
<td>e50(E)</td>
<td>18</td>
<td>#5</td>
<td>13'-3&quot;</td>
<td></td>
</tr>
<tr>
<td>h51(E)</td>
<td>6</td>
<td>#5</td>
<td>5'-5&quot;</td>
<td></td>
</tr>
<tr>
<td>h52(E)</td>
<td>24</td>
<td>#5</td>
<td>3'-9&quot;</td>
<td></td>
</tr>
<tr>
<td>h53(E)</td>
<td>24</td>
<td>#5</td>
<td>8'-6&quot;</td>
<td></td>
</tr>
<tr>
<td>h61(E)</td>
<td>24</td>
<td>#5</td>
<td>2'-0&quot;</td>
<td></td>
</tr>
<tr>
<td>h62(E)</td>
<td>34</td>
<td>#5</td>
<td>3'-8&quot;</td>
<td></td>
</tr>
<tr>
<td>h51(E)</td>
<td>20</td>
<td>#6</td>
<td>7'-3&quot;</td>
<td></td>
</tr>
<tr>
<td>h52(E)</td>
<td>54</td>
<td>#6</td>
<td>5'-4&quot;</td>
<td></td>
</tr>
<tr>
<td>v51(E)</td>
<td>18</td>
<td>#5</td>
<td>4'-8&quot;</td>
<td></td>
</tr>
<tr>
<td>v52(E)</td>
<td>18</td>
<td>#5</td>
<td>4'-6&quot;</td>
<td></td>
</tr>
<tr>
<td>v53(E)</td>
<td>18</td>
<td>#5</td>
<td>2'-6&quot;</td>
<td></td>
</tr>
<tr>
<td>s51(E)</td>
<td>18</td>
<td>#5</td>
<td>4'-0&quot;</td>
<td></td>
</tr>
<tr>
<td>s52(E)</td>
<td>18</td>
<td>#5</td>
<td>1'-3&quot;</td>
<td></td>
</tr>
<tr>
<td>s53(E)</td>
<td>18</td>
<td>#5</td>
<td>6'-11&quot;</td>
<td></td>
</tr>
<tr>
<td>t51(E)</td>
<td>50</td>
<td>#6</td>
<td>5'-8&quot;</td>
<td></td>
</tr>
<tr>
<td>t52(E)</td>
<td>24</td>
<td>#6</td>
<td>10'-5&quot;</td>
<td></td>
</tr>
<tr>
<td>t53(E)</td>
<td>24</td>
<td>#6</td>
<td>2'-8&quot;</td>
<td></td>
</tr>
</tbody>
</table>

## BILL OF MATERIAL

<table>
<thead>
<tr>
<th>PAY ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>RECORD QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MARCH, 2015

FIGURE 6.7.1

ILLINOIS TOLLWAY
SECTION 7.0 GENERAL NOTES

7.1 Structural General Notes

The following general plan notes, in addition to those from Subsection 3.1.3 of the latest IDOT Bridge Manual, shall be included in the Contract Plans as applicable.

7.1.1 Cast-In-Place Concrete

1. All exposed concrete edges shall have a ¾" x 45° chamfer, except where shown otherwise. Chamfer on vertical edges shall be continued a minimum of one foot below finished ground level.

2. Cast counter weights at least 48 hours in advance of placing deck slab.

7.1.2 Reinforcement Bars

1. Reinforcement bars, including epoxy-coated reinforcement bars, shall conform to the requirements of AASHTO M-31 (ASTM A706), Grade 60, deformed bars.

2. Reinforcement bars designated "(E)" shall be epoxy coated.

3. Reinforcement bar bending details shall be in accordance with the latest "Manual of Standard Practice for Detailing Reinforced Concrete Structures", ACI 315.

4. Reinforcement bar bending dimensions are out to out.

5. Bars noted thus, 3x2-#5 indicates 3 lines of bars with 2 lengths of bars per line.

6. Cover from the face of concrete to face of reinforcement bars shall be 3" for surfaces formed against earth and 2 inches for all other surfaces unless otherwise shown.

7. Bridge seat reinforcement shall be carefully placed as detailed in the plans to avoid interference with drilling holes for anchor rods. The beams shall be erected in final position prior to drilling holes for anchor rods.

8. The number of ties as specified shall be doubled for lap splices at the stage construction line of concrete bridge decks when traffic is allowed on the first completed stage during the pouring of the second stage.

9. Slope walls shall be reinforced with welded wire fabric, 6" x 6" - W4.0 x W4.0, weighing 58 pounds per 100 square feet.

7.1.3 Structural Steel

1. All bearing and side retainer anchor rods shall be set before permanently bolting diaphragms or cross frames over supports.
2. All side retainers shall be installed and bolted down prior to forming and pouring the deck slab.

3. Web plates shall be furnished in available mill lengths and widths with a minimum number of web splices. Location of splices shall be subject to the approval of the Designer and shall be a minimum of 1'-0" from stiffeners or flange splices.

4. Bearing stiffeners and ends of beams shall be perpendicular to flange (for rolled beams or grades ≤ 3%).

5. Bearing stiffeners at abutments shall be vertical and ends of beams shall be vertical. Bearing stiffeners at piers shall be perpendicular to flange (for grades greater than 3% on plate girder bridges or skews greater than 20%).

6. The calculated deflections of the primary beams under steel self-weight shall be used to detail diaphragms, cross-frames and lateral bracing connections, and to erect structural steel such that the beams will be plumb within a tolerance of +/- 1/8 inch per vertical foot throughout.

7. Painting of new structural steel shall be accomplished in accordance with Section 506 of the Standard Specifications except field-applying intermediate or final coats of paint on new steel shall not be allowed.

8. Load carrying components – including tension flanges, webs and splice plates – designated “NTR” shall conform to the AASHTO Impact Testing Requirement, Zone 2. [This note shall be included on sheets detailing structural steel main members]

7.1.4 Construction

1. Plan dimensions and details relative to existing structure have been taken from existing plans and are subject to nominal construction variations. It shall be the Contractor's responsibility to verify such dimensions and details in the field and make necessary approved adjustments prior to construction or ordering of materials. Such variations shall not be cause for additional compensation for a change in the scope of work; however, the Contractor will be paid for the quantity actually furnished at the unit price for the work.

2. Contractor shall not scale dimensions from the Contract Plans for construction purposes. Scales shown are for information only.

3. No construction joints except those shown on the plans will be allowed unless approved by the Engineer.

4. The Contractor may request copies of existing construction plans that are currently on file with the Tollway. The request shall be in writing with the understanding that any reproduction cost will be at the Contractor's expense.
5. No concrete cutting will be permitted until the cutting limits have been outlined by the Contractor and approved by the Engineer.

6. It shall be the Contractor's responsibility to verify the location of all utilities prior to starting construction. Contact J.U.L.I.E., 800-892-0123.

7. It shall be the Contractor's responsibility to verify the location of all fiber optic utilities prior to starting construction. The Contractor shall initiate the location process for the fiber optic cable by completing a "Request Tollway Utilities Locate" form filled in online at the Tollway website under “Doing Business” at least four (4) business days prior to starting any underground operations, excavations or digging of any type in the general area of the fiber optic cable.

8. The Contractor shall use care when excavating around existing foundations. Any damage to the existing structure and/or supporting foundation shall be repaired or replaced at the Contractor's expense.

9. Existing reinforcement which is to be incorporated into the new construction shall be blast cleaned to grey metal, straightened (without heating), and cut to fit. Cost of which shall be included with that for “Concrete Removal.”

10. Temporary soil retention systems, sheeting, bracing or cofferdams shall be constructed at the locations shown on the plans and/or as required for the excavation to protect the adjacent areas from settling or falling into the excavated areas.

11. Concrete sealer shall be applied to the surfaces of all pier and abutment seats, including backwalls located below roadway expansion joints. Sealer shall also be applied to all exposed surfaces of piers in the median or piers, abutments and wingwalls that are adjacent to the roadway. Existing surfaces shall be power washed in accordance with the applicable portions of Section 592 of the latest IDOT Standard Specifications for Road and Bridge Construction.

12. After the beams (girders) are set, all elevations for determining fillet heights shall be taken at one time.

13. Prior to placing the new concrete for the deck, all loose rust, loose mill scale, loose paint and all other foreign material shall be removed from the embedded portions of steel flanges. The removal shall be accomplished in accordance with the requirements of the SSPC Surface Preparation Specifications SP7 for Brush-Off Blast Cleaning. Cost shall be included with that for “Concrete Removal.” (Use for bridge rehabilitation projects where the full-depth removal of existing concrete deck is specified, and where cleaning and painting of existing structural steel is not specified as an item of work).

14. The existing aluminum handrail shall be removed and delivered to the Tollway Maintenance Yard M-______.
15. Upon completion of each structure, the Contractor shall measure the resulting horizontal and vertical clearances and submit them to the CM for review and inclusion in the As Built plans (Record Drawings).

16. The embankment configuration shown shall be the minimum that must be placed and compacted prior to construction of the abutments and bridge approach slabs.

17. The soil boring logs represent point information. Presentation of this information in no way implies that subsurface conditions are the same at locations other than the exact location of the boring.

18. Whenever any material is deposited into a drainage system or drainage structures, the deposited material shall be removed at the close of each working day. At the conclusion of construction operations, all drainage systems and structures shall be free from dirt and debris deposited during the various construction operations.

19. Precast Prestressed Concrete I-Beams and Bulb-T Beams may be shipped to the site and erected as soon as the beam reaches sufficient strength for transportation or a minimum of 5 days after casting, whichever is longer.

20. For structures made continuous for the design live loads, a minimum period of 60 days between casting of the beam and placing of the concrete deck shall be provided. [Only used for structures made continuous for live load.]

21. At structures with precast prestressed beams exceeding 99 feet in length and supported on bearing assemblies, the beams may be placed on bearings upon delivery, but the bearings shall be reset after the 60th calendar day after beam casting. The cost of repositioning of the beams on the bearings or resetting of bearings shall be included in the contract unit price for [insert beam pay item designation].

22. The fabricator, the contractor and the beam transportation company shall provide adequate bracing and support for the PPC beams during handling, transporting, storing and erecting.

23. For PPC Bulb-T beams longer than 120 feet, the contractor shall submit calculations for lateral stability during shipping, handling, and erection to the Engineer for approval prior to shipping. The calculations shall be sealed and signed by an Illinois licensed Structural Engineer. [See Section 13.3 of this Manual.]

7.2 Supplemental General Notes

The following general plan notes may be included in the Contract Plans as applicable, with appropriate modifications.
7.2.1 Demolition Plan

1. The Contractor shall submit a demolition plan to the CM for review and acceptance, detailing the proposed methods of demolition and the amount, location(s) and type(s) of equipment to be used. With the exception of removal of single box culverts, for work adjacent to or over an active roadway, railroad or navigable waterway, the demolition plan shall include an assessment of the structure’s condition and an evaluation of the structure’s strength and stability during demolition and shall be signed and sealed by an Illinois licensed Structural Engineer.

7.2.2 Erection Plan

1. The Contractor shall retain the services of an Illinois licensed Structural Engineer, experienced in the analysis and preparation of complex steel beam erection plans, for the completion of a project-specific erection plan. The structural engineer, herein referred to as the Erection Engineer, shall sign and seal the erection plan, drawings, and calculations for the proposed erection of the structural steel.

2. The erection plan shall be complete in detail for all phases, stages, and conditions anticipated during erection. The erection plan shall include structural calculations and supporting documentation necessary to completely describe and document the means, methods, temporary support positions, and loads necessary to safely erect the structural steel in conformance with the contract documents and as outlined herein. The erection plans shall address and account for all items pertinent to the steel erection including items such as sequencing, falsework, temporary shoring and/or bracing, beam stability, crane positioning and movement, means of access, pick points, beam shape, permissible deformations and roll, interim/final plumbness, cross frame/diaphragm placement and connections, bolting and anchor bolt installation, sequences and procedures, and blocking and anchoring of bearings. The Contractor shall be responsible for the stability of the partially erected steel structure during all phases of the steel erection.

3. The erection plans and procedures shall be submitted to the CM for review and acceptance prior to starting the work. Review, acceptance and/or comments by the CM shall not be construed to guarantee the safety or final acceptability of the work or compliance with all applicable specifications, codes, or contract requirements, and shall neither relieve the Contractor of the responsibility and liability to comply with these requirements, nor create liability for the Tollway. Significant changes to the erection plan in the field must be approved by the Erection Engineer and accepted by the CM.
7.2.3 Structural Assessment Reports for Contractor’s Means and Methods
(Used when an existing bridge is to be removed or rehabilitated in the contract)

1. A Structural Engineer, licensed in the State of Illinois, shall prepare and submit Structure Assessment Reports (SARs) for the proposed work associated with removing, modifying or reconstructing existing structures or portions thereof. Unless noted otherwise, a SAR shall be required when the Contractor’s means and methods apply loads to the structure or change its structural behavior. A SAR shall be submitted to the CM for review and acceptance prior to starting the work, in accordance with the latest IDOT Guide Bridge Special Provision, “Structural Assessment Reports For Contractor’s Means and Methods” prior to beginning the work covered by that SAR. Separate portions of the work may be covered by separate SARs which may be submitted at different times or as dictated by the Contractor’s schedule.

2. An Existing Structure Information Package (ESIP) will be provided by the Tollway to the Contractor upon request. This package will typically include existing or “As Built” plans, and the latest National Bridge Inspection Standards (NBIS) inspection report. The availability of structural information from the Tollway is solely for the convenience and information of the Contractor and shall not relieve the Contractor of the duty to make, and the risk of making, examinations and investigations as required to assess conditions affecting the work. Any data furnished in the ESIP is for information only and does not constitute a part of the Contract. The Tollway makes no representation or warranty, express or implied, as to the information conveyed or as to any interpretations made from the data.

7.3 Additional Notes included in the Plans. See Articles in () for application.

1. The information shown for TSRS is estimated. It is the Contractor’s responsibility to provide a design and details for each TSRS, complete with calculations and drawings, signed and sealed by an Illinois licensed Structural Engineer, for the CM’s review and acceptance before starting work. (9.4)

2. Hard driving may be encountered during the sheet piling installation. The Contractor shall provide the appropriate driving equipment for the soil conditions indicated on the boring logs. (9.5)

3. The information shown for cofferdams is estimated. It is the Contractor's responsibility to provide a design and details for each cofferdam, complete with calculations and drawings, signed and sealed by an Illinois licensed Structural Engineer, for the CM's review and acceptance before starting work. (9.6)

4. The fabricator, the Contractor and the beam transportation company shall provide adequate bracing and support for the PPC beams during handling, transporting, storing and erecting to ensure the safety of the personnel associated with the construction of the project. (13.3)
5. All stainless steel hardware for drainage systems shall be coated with antiseize compound. (16.2)

6. Drain pipe for Bridge Drainage System, including all piping, fittings, support brackets, inserts, bolts, and splash shown blocks, shall be as specified in GBSP 12, Drainage System, effective June 10, 1994 and revised January 7, 1997, except as modified herein. Drain pipe may be Polyvinyl Chloride (PVC) Pipe, Reinforced Fiberglass pipe or Galvanized Steel Pipe. (16.3)

7. Polyvinyl Chloride (PVC) Pipe and fittings shall be 8” diameter schedule 80 meeting the requirements of ASTM D1785 (F441), D2464 and D2467 colored to match the adjacent beam and/or column as approved by the Engineer. (16.3.1 & 16.5)

8. Reinforced Fiberglass pipe and fittings shall be 8” diameter, meeting the requirements of ASTM D2996 RTRP with a 30,000 psi minimum short-time rupture strength hoop tensile stress. The exterior surfaces of fiberglass pipe and fittings shall be pigmented in accordance with the pipe manufacturer’s recommendations or cleaned, given a prewash in accordance with MIL - P – 15328 and top coated with an epoxy-based coating recommended for outdoor applications by the prewash manufacturer. Final color shall be submitted to the Engineer for approval. (16.3.2 & 16.5)

9. The exterior surfaces of aluminum tubes shall be cleaned and given a wash coat pretreatment in accordance with SSPC - SP1 and SSPC - Paint 27. The pretreated surfaces shall be painted with an adhesion bonding primer and top coat per the system recommended by the pretreatment manufacturer for painting aluminum surfaces in an exterior environment. (16.5)

10. All stainless steel hardware for drainage systems shall be coated with antiseize compound. (16.2)

11. All Culvert concrete shall be Class SI. (21.2)

12. Reinforcement bar splices shall be in accordance with the following tables unless shown otherwise on the drawing. (21.2)

<table>
<thead>
<tr>
<th>Bar Splice - Barrel (Grade 60 Bars)</th>
<th>Bar Splice - Wingwalls (Grade 60 Bars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Size</td>
</tr>
<tr>
<td>#4 1’ -4”</td>
<td>#4 1’ -8”</td>
</tr>
<tr>
<td>#5 1’ -8”</td>
<td>#5 2’ -2”</td>
</tr>
<tr>
<td>#6 2’ -0”</td>
<td>#6 2’ -7”</td>
</tr>
<tr>
<td>#7 2’ -9”</td>
<td>#7 3’ -5”</td>
</tr>
<tr>
<td>#8 3’ -8”</td>
<td>#8 4’ -6”</td>
</tr>
<tr>
<td>#9 4’ -7”</td>
<td>#9 5’ -9”</td>
</tr>
</tbody>
</table>
13. Non-Metallic water seal used in wingwall shall extend from the top of footing to within 6 inches of top of the headwall. (21.2)

14. A minimum of 6 feet of the barrel shall be poured monolithically with horizontal cantilever wingwalls. (21.2)
SECTION 8.0  CONSTRUCTION STAGING

8.1  General

The plans shall clearly identify and show all stages of construction, both superstructure and substructure details, required to replace, widen or reconstruct each structure, while simultaneously maintaining traffic in one or both directions. For an example of a Construction Staging Plan, see Figure 8.1.1. Construction stage lines shall be shown and located in all plan views and cross sections. The Designer shall verify that the structure and adjacent roadway staging match. Stage lines shall be located within the center half of the slab span between beams/girders. Stage Lines shall be located along the edge of a traveled lane wherever possible. Otherwise, they shall be located within the center third of the lane.

Pay items for structural removal shall be per bridge. For example, Structure 1 Removal, Structure 2 Removal, etc.

8.2  Temporary Concrete Barriers

The Construction Staging Plans shall also show the location of all temporary concrete barriers for each stage of construction where barriers are required. The temporary concrete barrier shall be anchored to the existing deck slab when the distance from the back of the barrier to the edge of the slab is less than 3'-9". Drilling of anchors into new deck slabs will not be permitted and the 3'-9" distance to the edge of the new slab shall be provided.

8.3  Protective Shield System

A drawing or drawings shall be included in the bridge plans to define the limits of a protective shield system when it is required. The quantity of protective shield system to be installed shall be stated within the Plans. Removal of PROTECTIVE SHIELD SYSTEM shall not be measured for payment. A special provision is required to cover the cost of designing, furnishing, erecting, maintaining and removing temporary protective shields at the locations and limits shown in plans. The Contractor is responsible for the convenience and safety of the public during erection and construction of each element of the structure in accordance with Section 107.09 of the latest Tollway Supplemental Specifications.

A protective shield system will be required under the superstructure or at the lower level of the superstructure whenever equipment, falling objects or material may cause damage to existing aerial wire lines, railroads, streets, highways, regulatory waterways, vehicular or waterway traffic or injury to pedestrians, bicyclist or individuals traveling in trains, vehicles or water craft. The lateral limits of the protective shield system are shown in the following table:
<table>
<thead>
<tr>
<th>Case</th>
<th>Construction or Reconstruction</th>
<th>Transverse Limits of Protective Shield System</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>New construction</td>
<td>Outside of new parapet + 2’ to outside of new parapet + 2’</td>
</tr>
<tr>
<td>2</td>
<td>Deck and superstructure widening</td>
<td>Existing fascia beam to outside of new parapet + 2’</td>
</tr>
<tr>
<td>3</td>
<td>Deck removal and replacement</td>
<td>Outside of existing parapet + 5’ to outside of existing parapet + 5’</td>
</tr>
<tr>
<td>4</td>
<td>Deck replacement and widening</td>
<td>Outside of new parapet + 2’ to outside of new parapet + 2’</td>
</tr>
</tbody>
</table>

The limits of the protective shield system for bridge projects limited to full and partial depth deck patching will be set considering the area of the deck to be improved. At a minimum, protective shield system shall extend 10’ beyond the expected limits and at least 5’ beyond actual limits of partial or full depth repair above traffic.

### 8.4 Temporary Shoring

The staging plans shall also indicate the location of all temporary shoring including the applied loads required to support portions of the new or existing structure during each stage of construction. The Contractor is responsible for designing, detailing, erecting, maintaining and removing the temporary shoring utilizing the information shown in the proposed and/or existing plans for his or her particular method of construction.
SECTION 9.0 SUBSTRUCTURE AND SHEET PILING LAYOUTS

9.1 Substructure Layout

The basic geometry for the location of the substructure must be clearly shown on the plans. All elements of the substructure must be referenced to the same single longitudinal reference line. For an example of a substructure location plan on tangent alignment, see Figure 9.1.1. For an example of a substructure layout on curved alignment, see Figures 3.1.8-2 and 3.1.8-3 of the latest IDOT Bridge Manual.

9.2 Pile Numbering

On any structure, proposed to be supported on piling, a "Pile Driving Record" table shall be included with the substructure layout or on a separate plan sheet. The "Pile Location" and "Pile Number" column will be completed during design leaving some additional rows for field changes during construction. The pile numbering system will be used to identify the individual pile and its location in the substructure and "Pile Driving Record". For an example of the pile numbering system and driving record, see Figure 9.1.1 and Figure 9.2.1, respectively. This data is for record purposes and shall be filled in by the CM during pile driving.

9.3 Drilled Shaft Numbering

On any structure proposed to be supported by drilled shafts, a "Drilled Shaft Installation Record" table shall be included with the substructure layout or on a separate plan sheet. The "Shaft Mark" column will be completed during design leaving some additional rows for field changes during construction. The drilled shaft numbering system will be used to identify the individual drilled shaft and its location in the substructure and "Drilled Shaft Installation Record". For an example of the drilled shaft installation record, see Figure 9.3.1. This data is for record purposes and shall be filled in by the CM during drilled shaft construction.

9.4 Temporary Soil Retention Systems

The location and limits of the Temporary Soil Retention System(s) (TSRS) shall be shown and identified on the substructure location plan and/or separate plan sheets in accordance with Section 3.13 of the latest IDOT Bridge Manual. The Designer shall specify the use of TSRS wherever possible. Temporary sheet piling shall only be used when site conditions and/or constraints preclude the use of TSRS or where cofferdams are required to construct elements of the substructure underwater.
The following note shall appear on the substructure location plan when TSRS are required:

“The information shown for TSRS is estimated. It is the Contractor’s responsibility to provide a design and details for each TSRS, complete with calculations and drawings, signed and sealed by an Illinois licensed Structural Engineer, for the CM’s review and acceptance before starting work.”

9.5 Temporary and Permanent Sheet Piling

The location and limits of all temporary and permanent sheet piling shall be clearly shown and identified on the substructure location plan and/or separate plan sheets in accordance with Section 3.13.1 of the latest IDOT Bridge Manual. The cut off elevation for any part that is to remain in place shall also be shown.

The inside face of the temporary sheeting shall be offset 2'-0" from the proposed footing; while the inside face of any permanent sheeting will be located along the edge of the footing.

The following note shall be added to the plans if a stiff or dense soil layer is present which may require jetting and/or a larger hammer to penetrate:

“Hard driving may be encountered during the sheet piling installation. The Contractor shall provide the appropriate driving equipment for the soil conditions indicated on the boring logs.”

9.6 Cofferdams

Cofferdams shall be used to construct all elements of the substructure which are located in water. When shallow water is present; i.e., less than 2 feet, other methods of dewatering that allow the Contractor maximum flexibility during construction may be considered.

The location and limits of all cofferdams shall be clearly shown and identified on the substructure location plan. The top and bottom elevations of the cofferdam shall also be shown, as well as the cutoff elevation for any part that is to remain-in-place. The inside face of the cofferdam shall be offset 1'-0" from the proposed footing. The cofferdam and seal coat shall be designed in accordance with Section 3.13.3 of the latest IDOT Bridge Manual.

The following note shall appear on the substructure location plan when cofferdams are required:

“The information shown for cofferdams is estimated. It is the Contractor’s responsibility to provide a design and details for each cofferdam, complete with calculations and drawings, signed and sealed by an Illinois licensed Structural Engineer, for the CM’s review and acceptance before starting work.”
9.7 Temporary Sheeting and Bracing for Railroads

Excavations adjacent to active railroad tracks or substructure elements supporting railway operations shall be protected by temporary sheeting and bracing system designed and detailed in the Contract Plans. The system shall be designed in accordance with the latest Grade Separation Manual (Railroad Specific), AREMA, AASHTO and IDOT Specifications.

9.8 Structural Sub Drains

The location and limits of structural sub drains behind abutments and wingwalls including invert elevations, slopes, and outfalls shall be shown on the substructure location plan.
SUBSTRUCTURE LOCATION PLAN

* DIMENSIONS REQUIRED FOR ALL SUBSTRUCTURE UNITS

LEGEND:

H - H-PILES

TEMPORARY SOIL RETENTION SYSTEM OR SHEET PILING
**PILE DRIVING RECORD**

Date Piles Driven: __________________________
(Month Year)

Type & Size of Pile Used: __________________________

Pile Driving Equipment Used: __________________________
Energy Rating: __________________________

Hammer Used: Type __________________________ Stroke __________________________ Weight __________________________

Formula Used To Calculate Capacity: __________________________

Pile Driving Contractor: __________________________
CM: __________________________

<table>
<thead>
<tr>
<th>Pile Location</th>
<th>Pile Number</th>
<th>Ground Surface Elevation</th>
<th>Cut-off Elevation</th>
<th>Penetrated Length, Ft</th>
<th>5' to 4'</th>
<th>4' to 3'</th>
<th>3' to 2'</th>
<th>2' to 1'</th>
<th>1' to 0'</th>
<th>12' to 6'</th>
<th>6' to 0'</th>
<th>Capacity Tons</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** * For piles driven to refusal, blow count for the last foot shall be recorded in 6 inches increments.
Pile damage, obstruction, pile rejection, test piles etc. shall be recorded in Remarks column.
**DRILLED SHAFT INSTALLATION RECORD**

<table>
<thead>
<tr>
<th>Shaft Mark</th>
<th>Shaft Dia., Ft.</th>
<th>Bell Dia., Ft.</th>
<th>Bottom Elevation</th>
<th>Soil Description</th>
<th>Qu=Unconfined Compressive Strength, tsf</th>
<th>Moisture Content %</th>
<th>Ratio of Depth to Diameter</th>
<th>Field Bearing Pressure ksf*</th>
<th>Temporary Casing Used Length, Ft.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Field bearing pressure shall be calculated based on unconfined compressive strength and ratio of depth to diameter of bell. The field bearing pressure shall be 1.5 times Qu if the ratio of the depth of the drilled shaft measured from the top of the shaft to the bottom of the bell (or bottom of shaft if no bell is present) to the diameter of the bell (or shaft if no bell is present) is equal to or greater than 4.0. If the depth to diameter ratio is less than 4.0, the Engineer should contact the Tollway.
SECTION 10.0 ABUTMENTS

10.1 General

Abutments shall be designed in accordance with the latest AASHTO Specifications as noted in Section 1.1 of this manual, and Section 3.8 of the latest IDOT Bridge Manual, except as herein modified.

10.2 Design

The friction force caused by an expansion bearing sliding on its bearing plate or deforming on the supporting substructure element shall be included in the design of the substructure. These forces are determined by multiplying the coefficient of friction by the total dead load reactions on the bearing. For steel on steel, use a coefficient of 0.30, for self-lubricating bronze on steel a coefficient of 0.15 and teflon on teflon, use a coefficient of 0.10.

For elastomeric bearings, the force required to deform the elastomeric pad shall not be less than 25 pounds per square inch of bearing area for Type I bearings or 0.04 times the dead load reaction for Types II and III bearings.

10.3 Abutment Types

Integral or semi-integral abutments shall be utilized whenever possible for new grade separation structures and stream and railroad crossings. High wall abutments may be considered where integral and semi-integral abutments are not feasible.

For bridges over the Tollway mainline, the preferred abutment type is open abutment with slopewalls and no shielding.

- Integral abutments shall be used with steel beams and girders, cast-in-place concrete slabs, or precast, pre-tensioned concrete beams. Beams shall be composite with the cast-in-place concrete deck. The superstructure shall be designed and constructed as a continuous unit between abutments. New integral abutments shall be designed and detailed in accordance with the IDOT ABD Memorandum 12.3, "2012 Integral Abutment Bridge Policies and Details", dated July 25, 2012. See Figures 10.3.1 through 10.3.3 and 10.3.10 for additional details.

- Semi-integral abutments shall be utilized where soil conditions require the use of two or more rows of piles to support the proposed loadings. Regardless, the superstructure shall be designed and constructed as a continuous unit between the abutments. The semi-integral concept may also be utilized to eliminate expansion joints at existing stub abutments. However, the existing backwall and part of the approach slab will need to be reconstructed. The existing superstructure may also need to be made composite and continuous between
the modified abutments, if it is not already. New semi-integral abutments shall be
designed and detailed in accordance with the IDOT ABD Memorandum 12.3,
"2012 Integral Abutment Bridge Policies and Details", dated July 25, 2012. See
Figures 10.3.3 through 10.3.5 for details.

- Stub abutments with expansion joints shall be utilized where the existing soil
condition and proposed loading (reactions) would require two or more rows of
piles for support. They shall also be used when the proposed span length and/or
skew angles exceed the maximums specified for integral and semi integral
abutments. See Figure 10.3.6 for details.

- For crossroad bridges not carrying Tollway traffic, combinations of MSE retaining
walls and pile supported integral, semi integral and stub abutments should be
utilized in lieu of highwall or vaulted abutments to reduce span lengths and
increase vertical clearance or eliminate the need for shoulder piers and short end
spans. See Figures 10.3.7 and 10.3.9 for details of a pile supported stub
abutment with MSE walls. See Figure 10.3.8 for details of a pile supported semi-
integral abutment with MSE walls. See Figure 10.3.10 for details of a pile
supported integral abutment with MSE walls. MSE walls shall not wrap around
under the approach slab barrier when integral or semi-integral abutments are
used. Approach Slabs shall be supported by the abutment and a pile bent at the
approach to transition slab joint when MSE Walls are used at abutments.

- Conventional cast-in-place concrete highwall abutments founded on spread
footings or piles shall not be utilized to support new or replacement structures
unless specifically authorized by the Tollway. Only existing structures which are
to be widened and are currently supported by conventional highwall abutments
shall utilize the same design to extend the existing abutments and construct new
wingwalls.

- Vaulted abutments, either sand filled or void, founded on spread footings or piles
shall not be utilized to support new or replacement structures unless specifically
authorized by the Tollway. Only existing structures which are to be widened and
are currently supported by vaulted abutments shall utilize the same design to
extend the existing abutments and construct new curtain walls.

10.4 Abutment Foundations

10.4.1 Piles

Piles for foundations shall be designed in accordance with the Section 3.10 of the latest
IDOT IDOT Bridge Manual.

Abutment piles should avoid relying on the lateral load carrying capacity of the piles and
should be designed to carry all horizontal loads with the batter component of the pile.
The lateral load capacity of soil may be considered when the required batter exceeds 4"
in 12". However the resulting long time deflection of the pile shall be calculated and
accounted for in sizing the joint.

Piles used in integral abutments shall be placed in a single row. Steel "H" piles are preferred for structure lengths up to 200 feet and required for structure lengths between 200 feet and 550 feet.

Consideration shall be given to conflicts with existing buried and overhead utilities or other obstructions when designing pile layouts.

The following information shall be included on Abutment sheets when piles are used:

**PILE DATA**

PILE TYPE AND SIZE:

NOMINAL REQUIRED BEARING:

FACTORED RESISTANCE AVAILABLE OR

ALLOWABLE RESISTANCE AVAILABLE:

ESTIMATED PILE LENGTH:

NUMBER OF PILES REQUIRED: _______ plus _____ test pile(s)

LEGEND - DENOTING THE FOLLOWING:

EXISTING PILES

EXISTING BATTERED PILES

PROPOSED PILES

PROPOSED BATTERED PILES

TEST PILES

10.4.2 Drilled Shafts

Drilled shafts shall be designed in accordance with Section 3.10 of the latest IDOT Bridge Manual.

10.5 Widening Existing Abutments

In general, abutments shall be widened in kind, especially those which can be viewed by the traveling public. At locations not exposed to the traveling public, such as structures over railroads or streams, other types of designs may be considered. The final selection shall be based on serviceability and economics.

Foundations for widened abutments widened to the outside shall be the same type as the existing. However, construction procedures and type of construction shall be considered when placing new foundations adjacent to existing so as not to reduce the load carrying capacity or cause settlement of existing foundations. Existing soil borings and new soil borings (if required) shall also be considered in the final selection. Abutment widenings shall be designed to carry any longitudinal or transverse forces passed through the bearings from the superstructure. Abutments widened to the outside shall be tied to the existing with dowel bars drilled into the existing concrete.
Abutments for structures widened to the inside forming a median closure, will be separated along the centerline of the Tollway with a preformed joint filler and a 6 inch non-metallic water seal. Abutments widened to the inside shall be tied to the existing with dowel bars drilled into the existing concrete.

10.6 Bridge Seats

The bridge seats shall be constructed in steps poured monolithically with the abutment. The minimum step shall be ¾ inches. Metal shims shall be provided for each bearing if step is less than ¾ inches. The elevation and height of each step shall be shown on the plans. Steps shall be reinforced when one or more of the preceding steps equal to or exceed 4 inches; see Figure 10.6.1. In all cases, the bridge seats between the bearings shall be sloped ¼ inch to drain. The bearing seat shall meet the minimum support length requirements specified in the AASHTO Seismic Design Section for Seismic Performance Zone 1 (LRFD) or Category A (LFD).

Concrete sealer shall be applied to the exposed surfaces of all backwalls, bridge seats and bearing pedestals that are located under expansion or rotation joints between the deck and backwall.

Placement of reinforcement in abutment caps shall be detailed so as not to interfere with anchor rod locations. Multiple reinforcement layers should be considered to alleviate congestion. A detailed cross section showing anchor rod and reinforcement locations shall be provided on the plans.

10.7 Slope Paving

10.7.1 New Bridges - Grade Separation Structures

Grade separation structures shall have 4-inch thick reinforced concrete slopewalls, as shown in the Standard Drawings.

10.7.2 New Bridges - Stream Crossings

Stream crossings shall have 6-inch thick reinforced concrete or stone riprap slopewalls, as shown in the Standard Drawings.

10.7.3 New Bridges - Railroad Crossings

Railroad crossings shall have 6-inch thick bituminous coated aggregate slope paving, as shown in Figures 10.7.3.1 and 10.7.3.2.

10.7.4 Existing Bridges

Bridge abutment slopes on existing bridges to be rehabilitated shall be repaired and restored to the original design configuration. Slopes on bridges to be widened shall be protected with the same design as the existing bridge. Slopes which do not have any
slope protection shall be covered with 6 inches of aggregate slope paving unless there are floor drains in the deck above; in which case, they shall be paved with a 4-inch thick reinforced concrete slopewall.

**10.7.5 New Bridges - Side Slopes**

Embankment cones shall consist of maximum side slopes 1:2.5 (V:H) with a transition slope wrapping around the abutment to the slopewall. See Figure 10.7.5. A shoulder barrier transition shall be used upstream of the crash wall, even if the shoulder width is not transitioning.

**10.8 Wing walls**

The traffic face of the shoulder barrier shall be carried the full length of each wing wall, vaulted span or approach slab. The sloping curb portion of the barrier shall not be battered to a vertical face or clipped at the leaving or entering end of the barrier. See Standard Drawings C9, C10 and C11 for the required end treatment of a barrier mounted on a wing wall, vaulted span or approach slab.

**10.9 Abutment Cap Reinforcement**

A detail scaled drawing of the reinforcement and the holes drilled for the bearing anchor rods shall be provided in the plans, see Figure 10.9.1. The detail drawing shall include all reinforcement that may interfere with the drilling operation, the reinforcement spacing and the clearances of the reinforcement to the edge of the cap and the future holes.

**10.10 Shoulder Barrier**

A Concrete Shoulder Barrier Transition, height and shape, shall be used upstream of a high wall abutment, even if the shoulder width is not transitioning.
**ELEVATION A-A**

**INTEGRAL ABUTMENT & WINGWALL DETAILS**

(STEEL BEAM SHOWN- PPC BEAM SIMILAR)

- 2” MIN. PREFORMED JOINT FILLER WITH CONCRETE FLAT HD. C.S. 2½” LONG NAILS @ 12” STAGGEREDCTS. VERTICALLY

- 2” MIN. PREFORMED JOINT FILLER WITH SUITABLE ADHESIVE**

* INCREASE WHEN EXPANSION MOVEMENT GREATER THAN 1”.

** A SUITABLE ADHESIVE MUST BE COMPATIBLE WITH PREFORMED JOINT FILLER MATERIAL AND CONCRETE. SURFACE PREPARATION SHALL BE CONDUCTED IN ACCORDANCE WITH MANUFACTURER’S GUIDELINES.
INTEGRAL ABUTMENT DETAILS

(STEEL BEAM SHOWN, PPC BEAM SIMILAR)

SECTION B–B
- Geocomposite wall drain
- 3/8" x 1'-4" Neoprene sheet (55 durometer) attached full height at edges to the end diaphragm/backwall and wingwall with a 3/8" x 5" steel plate and 1/2" Ø anchor bolts, nuts and washers at 12" cts. vertically. Included with the cost of concrete superstructure.

SECTION D–D
- 2" min. preformed joint filler with sealant and backer rod
- * The actual PJF size to be designed considering effective expansion length.
2" MIN. PREFORMED JOINT FILLER*
WITH SUITABLE ADHESIVE. **

BOTTOM TRANSVERSE
STEEL MUST BE
DESIGNED

* INCREASE WHEN EXPANSION MOVEMENT IS
GREATER THAN 1 INCH.

** ADHESIVE MUST BE COMPATIBLE WITH
PREFORMED JOINT MATERIAL AND
CONCRETE. SURFACE PREPARATION
SHALL BE CONDUCTED IN ACCORDANCE
WITH MANUFACTURER’S GUIDELINES.

TYPICAL SECTION THRU WINGWALL

NOTE:
PILE SPACING SHALL BE 4'-0" MIN. TO 8'-0" MAXIMUM

INTEGRAL OR SEMI-INTEGRAL ABUTMENT
WINGWALL DETAILS

MARCH, 2015

FIGURE 10.3.3

ILLINOIS TOLLWAY
ELEVATION A-A

SEMI-INTEGRAL ABUTMENT & WINGWALL DETAILS

(STEEL BEAM SHOWN-PPC BEAM SIMILAR)
NOTE 2 - EXPANSION OR ROTATION JOINT

SECTION THRU ABUTMENT
(STEEL BEAM SHOWN, PPC BEAM SIMILAR)

NOTES:
1. DIMENSIONS AT RT. L’S EXCEPT AS NOTED.
2. HATCHED AREA TO BE POURRED AFTER SUPERSTRUCTURE FALSE WORK HAS BEEN REMOVED. QUANTITY OF CONCRETE INCLUDED WITH CONCRETE SUPERSTRUCTURE.
3. FOR SLOPEWALL DETAILS, SEE TOLLWAY STANDARD G2.
4. FOR APPROACH SLAB DETAILS SEE TOLLWAY BASE SHEETS M-RDY-408 AND M-RDY-409
5. COST OF NON METALLIC WATERSEAL INCLUDED IN CONCRETE STRUCTURES PAY ITEM.

STUB ABUTMENT DETAILS

MARCH, 2015
FIGURE 10.3.6
ILLINOIS TOLLWAY
**SEAL COPING W/CONCRETE AND PJF (FRONT FACE ONLY) SLOPE TO DRAIN**

**C.I.P. COPING**

**SUPERSTRUCTURE**

**STUB ABUTMENT**

**APPROACH SLAB**

**BACK OF ABUTMENT**

**LIMITS OF REINFORCED SOIL MASS**

**TOP OF EXPOSED PANEL LINE**

**PRECAST FACE PANELS**

**DRAINAGE AGGREGATE**

**GEOTECHNICAL FABRIC**

**TOP OF FINISHED GRADE**

**3'-0" MIN.**

**SOIL REINFORCEMENT**

**SELECT BACKFILL**

**EMBANKMENT**

**EXISTING GROUND LINE**

**4" PERFORATED PIPE UNDERDRAIN**

**1'-6"**

**TOP OF LEVELING PAD**

**LIMITS OF REMOVAL OF UNSUITABLE MATERIAL. BACKFILL WITH POROUS GRANULAR EMBANKMENT OR ENGINEERED FILL**

**X'-X" 0.7 x "H" MIN.**

**LIMITS OF STRUCTURE EXCAVATION**

**SLEEVE EACH PILE FROM TOP OF GROUND TO BOTTOM OF PROPOSED ABUTMENT BEFORE PLACING AND COMPACTING THE SELECT FILL. FILL THE ANNULAR SPACE BETWEEN THE PILE AND SLEEVE WITH DRY SAND.**

**COMBINATION HIGHWALL ABUTMENT DETAILS**

**FOR CROSSROAD BRIDGES ONLY**

**(M.S.E. WALL & STUB ABUTMENT)**

**MARCH, 2015**

**FIGURE 10.3.7**

**ILLINOIS TOLLWAY**
SEAL COPING W/CONCRETE
AND PJF (FRONT FACE
ONLY) SLOPE TO DRAIN

TOP OF EXPOSED
PANEL LINE
PRECAST
FACE PANELS
DRAINAGE
AGGREGATE
GEOTECHNICAL
FABRIC
TOP OF FINISHED
GRADE
4' PERFORATED
PIPE UNDERDRAIN

TOP OF LEVELING PAD

LIMITS OF REMOVAL OF UNSUITABLE
MATERIAL. BACKFILL WITH POROUS GRANULAR
EMBANKMENT OR ENGINEERED FILL
X' X'" 0.7 X "H" MIN.

LIMITS OF STRUCTURE EXCAVATION

SUPERSTRUCTURE
BACKWALL/END DIAPHRAGM
APPROACH SLAB

SEMI INTEGRAL
ABUTMENT

TOP OF 3'-0"
MIN.
BACK OF
ABUTMENT

SOIL REINFORCEMENT

SELECT BACKFILL

LIMITS OF REINFORCED
SOIL MASS

EMBANKMENT

EXISTING
GROUND LINE

PILES *

* SLEEVE EACH PILE FROM TOP OF GROUND TO BOTTOM OF PROPOSED
ABUTMENT BEFORE PLACING AND COMPACTING THE SELECT FILL. FILL
THE ANNULAR SPACE BETWEEN THE PILE AND SLEEVE WITH DRY SAND.

COMBINATION HIGHWALL ABUTMENT DETAILS
FOR CROSSROAD BRIDGES ONLY
(M.S.E. WALL & SEMI INTEGRAL ABUTMENT)

MARCH, 2015

FIGURE 10.3.8

ILLINOIS TOLLWAY
THE M.S.E. WALL SUPPLIER’S INTERNAL STABILITY DESIGN SHALL ACCOUNT FOR THE APPROACH SLAB’S BEARING PRESSURE SURCHARGE OF 1.0 KSF. AND HORIZONTAL SLIDING FORCE OF 1.15 KIPS/FT. OF WALL.

NOTE:
FOR APPROACH SLABS WITH NO BARRIER RAIL BEYOND THE TRANSITION SLAB JOINT, THE BARRIER SHAPE SHALL MATCH THE SHAPE OF THE BRIDGE RAIL.

SECTION THROUGH BRIDGE APPROACH SLAB FOR STUB ABUTMENT WITH WRAP-AROUND MSE WINGWALLS

MARCH, 2015

FIGURE 10.3.9

ILLINOIS TOLLWAY
SLEEVE NOTE:
CORRUGATED GALVANIZED STEEL PIPE, GAGE 10 MIN. THE BOTTOM OF THE SLEEVE SHOULD EXTEND AT LEAST 1' INTO GRANULAR SUBBASE MATERIAL AS SHOWN ON THE PLANS. THE PIPE SHOULD EXTEND THRU THE ENTIRE HEIGHT OF THE SELECT BACKFILL, UP TO THE BOTTOM OF THE CONCRETE PILE CAP. THE SLEEVE SIZE MUST ACCOMMODATE THE PILE SIZE AND ANTICIPATED PILE DEFLECTION.

INTEGRAL ABUTMENT DETAILS
FOR CROSSROAD BRIDGES ONLY

MARCH, 2015

FIGURE 10.3.10

ILLINOIS TOLLWAY
ELEVATION

$d = $ DEVELOPMENT LENGTH

NOTE 1:
EXTEND EXTERIOR h(E) BARS
FULL LENGTH OF ABUTMENT IF REQUIRED FOR TEMPERATURE AND SHRINKAGE

TYPICAL SECTION

BRIDGE SEAT DETAILS

MARCH, 2015

FIGURE 10.6.1

ILLINOIS TOLLWAY
EXPANSION JT.

APPROACH SLAB

BACKWALL

PILE SUPPORTED STUB ABUTMENT

8" SLAB

FILLET

P.P.C.

BEAM

6" AGGREGATE SLOPE PAVING WITH BITUMINOUS COATING

1'-0" BELOW ELEVATION

3'-0" BERM

SLOPED TO DRAIN

VEGETATION CONTROL BARRIER (GEOTEXTILE)

SECTION A-A

AGGREGATE SLOPE PAVING WITH BITUMINOUS COATING DETAILS

MARCH, 2015

FIGURE 10.7.3.1

ILLINOIS TOLLWAY
TYPICAL SECTION
(At Pier with Crashwall)

Aggregate Slope Paving with Bituminous Coating Details

March, 2015

Figure 10.7.3.2

Illinois Tollway
EMBANKMENT CONES

MARCH, 2015

*TRAFFIC BARRIER GUIDELINES
ARTICLE 3.5

EMBANKMENT CONES

MARCH, 2015

FIGURE 10.7.5

ILLINOIS TOLLWAY
SECTION 11.0 PIERS

11.1 General

Piers shall be designed in accordance with the latest AASHTO specifications and Section 3.9 of the latest IDOT Bridge Manual, except as herein modified.

Multi-column pier shapes, as shown in Figure 11.3.1.1 (Except Single Column Hammer-head) and Figure 11.3.1.2, are the most commonly used pier types for grade separation structures. The use of square or round columns is appropriate; however the standard application of square columns is preferred whenever practical to provide system consistency. A typical 3” offset between the face of column and the face of the pier cap, and a 6” offset between the face of column and the face of the crash wall is desirable.

Piers under deck joints, in medians or within 12 feet of the outer edge of shoulder shall have all exposed surface areas treated with a concrete sealer. For cases involving structure widening, the existing concrete substructure shall be power washed and both the new and existing surfaces treated with a concrete sealer.

11.2 Design

The friction force caused by an expansion bearing sliding on its bearing plates or deforming on the supporting substructure element must be included in the design of the structure. These forces are determined by multiplying the coefficient of friction by the total dead load reactions on the bearing. For steel on steel, use a coefficient of 0.30, for self-lubricating bronze on steel use a coefficient of 0.15 and Teflon on Teflon, use a coefficient of 0.10.

For elastomeric bearings, the force required to deform the elastomeric pad shall not be less than 25 pounds per square inch of bearing area for Type I bearings or 0.04 times the dead load reaction for Types II and III bearings.

The fixed pier(s) design shall include the “net” frictional force from expansion bearings on adjacent piers.

The bearing seat shall meet the minimum support length requirements specified in the AASHTO Division I-A Seismic Design Section for Seismic Performance Zone 1.

11.3 Pier Types

11.3.1 Grade Separation

Grade separation piers shall be proportioned in accordance with the dimensions as shown on Figures 11.3.1.1 through 11.3.1.8. Care shall be used in applying these criteria on piers with heights greater than 20'-0" measured from the top of crash wall.
The minimum cap and crash wall width for grade separation piers shall be 6” (3” offset each side) greater than the minimum column width of 2’-6”, unless the bearings require a larger seat area. In which case, the width of the cap may be increased by up to 12” (6” offset each side) before the minimum column and crash wall widths would also need to be increased to maintain a minimum offset of 3” on each side.

Grade separation piers used with integral abutments may be supported by a single row of piles, provided the capacity of the piles is not exceeded and the number of spans on either side of the Pier are equal and their total lengths are approximately the same (± 5%). Otherwise, a larger footing with multiple rows of piles shall be used. See Figure 11.3.1.8 for details of an integral pier.

11.3.2 Stream Crossing

Stream crossing piers shall be a solid wall with vertical faces and rounded ends. The minimum width shall be a constant 2’-6” from top to bottom. If a greater width is required for the bearing seats, a wider cap shall be utilized to maintain a constant 2’-6” pier width. Details of a fixed or expansion pier, supported by a pile footing are shown on Figure 11.3.2.1. Expansion piers may also be supported by a single line of encased piles or drilled shafts as shown on Figure 11.3.2.2.

11.3.3 Railroad Crossings

Railroad crossings shall utilize grade separation type piers unless the horizontal clearance to the centerline of the nearest track is less than 25’-0”, in which case they shall be modified with crash walls meeting the requirements of the latest edition of A.R.E.M.A. and the railroad. See Figure 11.3.3.1 for details.

11.4 Widening Existing Piers

In general, existing piers shall be widened in-kind, especially those which can be viewed by the traveling public, except Article 11.6 shall be followed. At locations not exposed to the traveling public, such as structures over railroads or streams, other designs may be considered. The final selection will be based on serviceability and economy.

Pier widenings shall be designed to carry all forces which pass through the bearings. All pier widenings shall be tied to the existing cap, column and footing areas with dowel bars drilled into the existing concrete. Minimum depth embedment of dowels in existing concrete shall be 12 inches for vertical bars and the development length for horizontal bars. Maximum spacing shall be 18 inches.

Foundations for widened piers shall be the same type as the existing structure. Existing soil borings and new soil borings (if required) shall also be considered. Construction and installation procedures shall be considered when placing new foundations adjacent to existing so as not to reduce the load carrying capacity or cause settlement of existing foundations.
Special attention shall be given to the widening of existing piers that consist of 3-foot diameter hollow precast columns without footings. The extensions shall be designed using 3 foot diameter columns supported on pile foundations.

Generally, piers at dual crossings which are to be widened each side of the centerline of median, will be separated along the centerline with an open joint or preformed joint filler, except for their footings, which shall be constructed without an expansion joint. If a construction joint in the footing is needed, the longitudinal reinforcement shall cross the joint to maintain continuity.

Pier caps with rounded ends shall be attached to the new work as shown in Figure 11.4.1. Pier walls with rounded ends shall be attached to the new work as shown in Figure 11.4.2.

11.5 Integral Concrete Pier Caps

An integral pier cap is a pier cap that is incorporated either entirely or largely within the depth of the superstructure. The cap can be constructed of either concrete or steel. For steel superstructures, the longitudinal beams are typically run continuous through the cap. When the superstructure is constructed of prestressed concrete, a pier segment may run continuous through the cap or the ends of beams may be cast into the integral cap. When the beams are not continuous through the cap, a positive connection is made between the cap and the beams with post-tensioning.

Integral pier caps may be utilized to: improve vertical clearances, simplify framing, eliminate bearings, improve aesthetics and reduce the mass of the structure which reduces the seismic design forces.

The beams will be supported on falsework while the caps are constructed. The top surface of the cap is intentionally roughened. Stirrups are extended from the top surface of the cap to provide a positive connection to the deck. After tensioning of cap tendons, the falsework supporting the beams and cap are removed. The deck concrete is then placed according to the pouring sequence shown in the plans.

A post-tensioning tendon shall be placed in each corner of the cap along with one or more draped tendons. Strand tendons shall be used rather than bars for simplicity of construction and to allow more flexibility in the tendon profile.

After placement and hardening of the cap concrete but before the deck is cast, tendons shall be tensioned from one end according to a specified sequence. Tendons are then grouted to provide corrosion protection and to provide bond between the strands and the structure.

11.6 Pier Base Walls

11.6.1 New or Widened Piers

- Within the clear zone or requiring shielding based on a Level 3 Barrier Warrant Analysis:
Provide a crash wall that extends a minimum of 5’-0” above the ground that is built to withstand a 600 kip impact load at the top of the crash wall. The design of the crash wall shall be performed in accordance with All Bridge Designers (ABD) Memorandum 12.1, except all structures shall be considered “critical or essential”.

For crash walls poured integrally with piers, the top of wall shall typically follow the profile grade of the edge of shoulder. A level or tangent top of wall may be used for those cases where the maximum height does not exceed the minimum by more than 3 inches. However, level top of wall is preferred in this case.

- Well outside the clear zone as determined by a Barrier Warrant Analysis:
  No crash wall or shielding is required.

**11.6.2 Existing Piers to Remain**

- Within the clear zone or requiring shielding based on a Level 3 Barrier Warrant Analysis:

  Existing piers that do not require new walls or columns shall be modified in accordance with Base Sheet M-BRG-507 and M-BRG-508. Existing crash walls shall be modified to meet the dimension and reinforcement details shown in these Base Sheets. Modifications shall be designed for Test Level 4 (TL-4) Crash Load as specified in Article A13.2 of the AASHTO Bridge Design Manual. Additional dead load to the pier foundation shall be analyzed. A concrete shoulder barrier transition shall be used upstream of the crash wall, even if the shoulder width is not transitioning. The barrier height and shape shall transition as shown on Tollway Standard Drawing C4.

  A single-face reinforced concrete barrier designed to meet TL-4 impact loading shall be used to shield bridge piers when it is not cost effective to comply with the above requirements. This is considered a Design Deviation and shall be documented as such. See Tollway Standard C3 for details.

- Well outside the clear zone as determined by a Barrier Warrant Analysis:
  No crash wall or shielding is required.

**11.7 Pier Columns**

If pier columns are over 20 feet high, a bonded construction joint or joints shall be detailed at approximately mid-height or third points.
11.8 Foundations

11.8.1 Spread Footings

The minimum width of any spread footing under an expansion pier shall be one-fourth the distance from the top of the pier to the bottom of the footing. If the spread footing is founded on rock, this ratio may be reduced to one-fifth of the pier height, and keyed a minimum of 6 inches into sound rock. The maximum applied and allowable bearing pressure for each pier foundation shall be shown on the appropriate plan sheet.

Any construction joints allowed in pier footings shall be bonded construction joints with continuous reinforcement.

11.8.2 Piles

Piles foundations shall be designed in accordance with Section 3.10 of the latest IDOT Bridge Manual.

The minimum width between the outside rows of piles in a pile supported footing shall be one-fifth of the pier height, but no greater than 8'-0".

The following information shall be included in the plans for each pier foundation supported by Piles:

- **PILE DATA**
  - PILE TYPE AND SIZE
  - NOMINAL REQUIRED BEARING:
  - ALLOWABLE RESISTANCE AVAILABLE:
  - ESTIMATED PILE LENGTH:
  - NUMBER OF PILES REQUIRED: _______ plus ______test pile(s)

- **LEGEND - DENOTING THE FOLLOWING:**
  - EXISTING PILES
  - PROPOSED PILES
  - PROPOSED BATTERED PILES
  - TEST PILES

11.8.3 Drilled Shafts

Drilled shafts shall be designed and detailed in accordance with Section 3.10 of the latest IDOT Bridge Manual.

11.9 Pier Cap Reinforcement

A detail scaled drawing of the reinforcement and the holes drilled for the bearing anchor rods shall be provided in the plans, as shown in Figure 11.9.1. The detail drawing shall include all reinforcement that may interfere with the drilling operation, the reinforcement spacing and the clearances of the reinforcement to the edge of the cap and the future holes.
TWO COLUMN ELEVATION

SINGLE COLUMN ELEVATION

THREE COLUMN ELEVATION

FOUR COLUMN ELEVATION

GRADE SEPARATION PIERS

MARCH, 2015  FIGURE 11.3.1.1  ILLINOIS TOLLWAY
END ELEVATION

MEDIAN PIER FOR STRUCTURE OVER TOLLWAY

MARCH, 2015

FIGURE 11.3.1.3

ILLINOIS TOLLWAY
NEW PIER

BOTTOM OF BEAM OR GIRDER

6" FACE OF PIER CRASH WALL

HORIZONTAL CLEARANCE* EDGE OF TRAVELED WAY

END ELEVATION

* AS DETERMINED BY BARRIER WARRANT ANALYSIS

SHOULDER PIER FOR STRUCTURE OVER TOLLWAY
END ELEVATION

MEDIAN PIER FOR TOLLWAY STRUCTURE OVER LOCAL ROAD

MARCH, 2015

FIGURE 11.3.1.6

ILLINOIS TOLLWAY
END ELEVATION

SHOULDER PIER FOR TOLLWAY STRUCTURE OVER LOCAL ROAD

MARCH, 2015  FIGURE 11.3.1.7  ILLINOIS TOLLWAY
BOTTOM OF BEAM OR GIRDER

3'-0"
MIN.

2-6"
MIN.

1'-3"
6"

X

3'
MIN.

3'-6"

1:2

4'
MIN.

CLEARANCE TABLE

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>X &gt; 25'-0&quot;</td>
<td>0&quot;</td>
</tr>
<tr>
<td>12'&lt;X&lt;25'-0&quot;</td>
<td>6'-0&quot;</td>
</tr>
<tr>
<td>X&lt;12'-0&quot;</td>
<td>12'-0&quot;</td>
</tr>
</tbody>
</table>

* OBTAIN APPROPRIATE SLOPE FROM THE RAILROAD

END ELEVATION

RAILROAD CROSSING PIER

MARCH, 2015

FIGURE 11.3.3.1

ILLINOIS TOLLWAY
EXISTING HORIZONTAL BARS SHALL BE BLAST CLEANED TO GREY METAL, STRAIGHTENED AND STRUCTURALLY INCORPORATED INTO THE NEW WORK (COST IS INCLUDED WITH THE COST OF “CONCRETE REMOVAL”)

NOTE: CROSS HATCHED AREAS INDICATE CONCRETE REMOVAL.
EXISTING HORIZONTAL BARS SHALL BE BLAST CLEANED TO GREY METAL, STRAIGHTENED AND STRUCTURALLY INCORPORATED INTO THE NEW WORK (COST IS INCLUDED WITH THE COST OF “CONCRETE REMOVAL”).

NEW SOLID WALL PIER OR CRASH WALL EXTENSION

NOTE:
CROSS HATCHED AREAS INDICATE CONCRETE REMOVAL.

WIDENING EXISTING PIER WALL

MARCH, 2015

FIGURE 11.4.2

ILLINOIS TOLLWAY
** IF GREATER THAN 1.5X REQUIRED STIRRUP SPACING PROVIDE ADDITIONAL S(E) BARS

CAP PLAN

PIER CAP SECTION A-A

ANCHOR ROD LOCATION

MARCH, 2015

FIGURE 11.9.1

ILLINOIS TOLLWAY
SECTION 12.0 STRUCTURAL STEEL

12.1 General

The design and detailing of steel superstructures shall be in accordance with the appropriate AASHTO Specifications and the provisions of Section 3.3 of the IDOT Bridge Manual except as herein modified.

12.2 Design

Structural steel shall be AASHTO M270 Grade 50 (ASTM A709) unless otherwise noted. Grade 70 steel may be used in areas of high stress, if this will result in a more economical solution.

All horizontally curved structures not considered essentially straight and/or structures with skews greater than 45 deg. shall be designed and/or checked using three-dimensional analysis. If either type of structure is to be constructed in stages, the beams in each stage shall be checked using three-dimensional analysis for stability, and bending, shear and torsion stresses. For these conditions, the Designer should consider using a closer spacing (15'- 20') for crossframes or diaphragms.

Generally, all shop connections shall be welded. All field connections shall be made with 7/8-inch diameter zinc-coated, high-strength bolts per AASHTO M164 (ASTM A325), and shall be designed as friction type connections.

In order to minimize fillet heights on steel structures, the beam or plate girder slopes shall be changed at the splices to conform to the general configuration of the bottom of the formed deck slab.

Plate girders shall be cambered for dead load deflection and vertical curve geometry except where the resulting camber would be less than one inch.

Welded plate girder flange transitions shall be limited to twice the thickness of the thinner plate.

Provide top of beam or girder web elevations at the center line of each splice and/or bearing shown on the framing plan.

Fracture critical details shall be identified in the plans.

Load carrying components – including tension flanges, webs and splice plates – shall be designated “NTR” on the plans and shall conform to the AASHTO Impact Testing Requirement, Zone 2.

12.3 Intermediate Vertical Stiffeners

Intermediate vertical stiffeners shall be a minimum of 7/16 inch thick and shall be welded to the web with a 1/4-inch minimum continuous fillet weld. The distance between

March 2015 12-1 Illinois Tollway
the end of the stiffeners and the near edge of the web-to-tension-flange fillet weld shall be no more than six times or less than four times the web thickness.

For plate girders with web depths equal to or smaller than 54 inches, it is preferable not to utilize intermediate stiffeners. For plate girders with web depths larger than 54 inches, the web thickness may be increased to a maximum ⅝ inch to eliminate or limit the vertical stiffeners to only one or two locations per span beyond those provided for cross frame attachments. The minimum web thickness of a plate girder shall be 7/16 inch.

12.4 Bearing Stiffeners

Bearing stiffeners need not be welded to either flange of rolled beams or plate girders, except as hereafter indicated. They shall be milled on the bearing end and have a tight fit at the other end.

On all skewed plate girders, or rolled beams with skews 45 deg. and larger and on all horizontally curved beams and plate girders, the bearing stiffeners shall be welded to both flanges where these stiffeners are used as connecting plates for cross frames or diaphragms. Welding to the flanges shall be done with fillet welds on both sides of stiffeners. The length of the fillet weld at the mill to bear end shall be the width of the stiffener minus 1 inch (½ inch at each end). The length of the fillet weld at the other end shall be the full width of stiffener. The bearing stiffener plates at the junction of the flanges and the web shall be clipped 1 inch horizontally and a minimum of 1½ inch vertically for rolled beams, or four times the web thickness plus the size of web-to-flange fillet weld for plate girders.

12.5 Superstructure Diaphragms

12.5.1 End Diaphragms and Cross Frames at Expansion Joints

End diaphragms at expansion joints located over piers and/or abutments shall consist of a thickened slab supported on an end diaphragm or cross-frame as shown in the latest IDOT Bridge Manual.

12.5.2 Diaphragms and Cross-Frames at Expansion Bearings

Steel diaphragms and cross-frames at expansion piers or abutments shall be designed to allow for jacking on the diaphragm or cross-frame for resetting, repair or replacement of expansion bearings. If jacking cannot be performed on the end diaphragms, then provisions shall be made in the design of the beam seats to allow jacking from directly under the beam. The jacking loads and their locations shall be shown on the drawings. The jacking loads shall be broken down into dead and live load components so the contractor has the option of jacking with or without the live load on the structure.

12.5.3 Diaphragms and Cross-Frames at Intermediate Points

The connecting plates for the cross frames and diaphragms located near the support
within a distance equal to twice the girder depth shall be welded to both flanges. This requirement shall also apply to the cross frames and diaphragms in all other areas for skewed and horizontally curved plate girders only. In these cases, flange stress shall be investigated for fatigue under Category C.

Cross frames for horizontally curved plate girders and girders with skews greater than 45 deg. shall be designed and detailed with top and bottom chord members. The cross frames shall be orientated in a straight line, and perpendicular to the fascia girders. Cross frames shall not be staggered or placed parallel to the skew for horizontally curved or heavily skewed structures.

For non-skewed girders, the connecting plates for the cross frames and diaphragms, in all areas other than the areas near the supports, should be welded to the compression flange and undercut at the tension flange. The distance between the near edge of the web-to-tension-flange weld and the end of the connecting plate shall be six times the web thickness. Special consideration shall be given to the connections between floor beams and the main girder for two-girder system bridges to prevent fatigue cracking in the webs.

12.5.4 Diaphragms and Cross-Frames Design Details

The calculated deflections of the primary beams under steel self-weight shall be used to detail diaphragms, cross-frames and lateral bracing connections, and to erect structural steel such that the beams will be plumb within a tolerance of +/- 1/8 inch per vertical foot throughout. This requirement shall be added as a note to the General Notes.

12.6 Table of Moments and Shears

To provide ready information for any future analysis of a structure and to provide the reviewing agencies with a basis for checking of the design, all detailed bridge plans shall include, as a part of said plans, a Table of Moments and Shears. Refer to the latest IDOT Bridge Manual Section 3.1.12 for suggested table layouts.

12.7 Painting of Structural Steel

Painting of steel beams shall be performed in accordance with the applicable IDOT GBSPs and All Bridge Designers (ABD) Memorandum 10.1. Desirable finish color is Gray, Munsell No. 5B 7/1. If existing bridge structure contains finish colors that are different than gray, then the Designer shall match this color as closely as possible. A typical color on the Tollway system other than gray is interstate green with the Munsell No. 7.5G 4/8. Shop Painting is used exclusively for new structural steel, field painting of intermediate and finish coats is not allowed.

12.8 Weathering Steel

Weathering steel may be considered for Tollway structures over railroads and waterways. Tollway approval is required during Preliminary stages of design.
SECTION 13.0 PRECAST PRESTRESSED CONCRETE (PPC)

13.1 General

The design and detailing of PPC I-Beams and Bulb-T beams shall be in accordance with the latest AASHTO LRFD Bridge Design Specification and Section 3.4 of the latest IDOT Bridge Design Manual except as herein modified.

13.2 Design

The prestressing strands used in PPC beam designs shall be either 0.5” or 0.6” diameter, low relaxation strands with areas of 0.153 or 0.217 square inches, respectively.

In the design of continuous composite PPC structures, the superimposed dead load, live load and impact stresses shall be computed on the basis of full continuity at the interior supports.

While it is the Tollway’s intent to continue to follow IDOT’s policy to design prestressed beams with draped strand, there may be situations where a well-documented request to use debonding can be considered, especially for the Longer Span Beams.

The final compressive stress in the bottom flange of the PPC beams at piers for continuous designs shall be calculated at the strand load transfer point (assumed to be at the strand transfer length from the end of the beam) and the edge of bearing pad or diaphragm.

Vertical stirrups are required at the ends of all prestressed beams to resist 6% of the total initial prestressing force at 18 ksi located within a distance of ¼ of the beam depth from the end of the beam. For 63-inch and 72-inch beams, the minimum stirrup reinforcement shall be 5 pairs of #6 bars.

13.2.1 IDOT and 28” Tollway Beams

The 28-day concrete strength for these prestressed beams shall be 6,000 psi and may be increased to a maximum of 7,000 psi. The higher strength, above 6,000 psi, shall be used only when economical. Concrete strengths at strand release shall be a minimum of 4,000 psi and a maximum of 5,200 psi.

13.2.2 Tollway Bulb-T Beams

The 28-day concrete strength for these prestressed beams shall be 6,000 psi and may be increased to a maximum of 8,000 psi. The higher strength, above 8,000 psi, shall be used only when economical and requires Tollway approval. Concrete strengths at strand release shall be a minimum of 4,000 psi and a maximum of 6,800 psi. The maximum number of 0.6” diameter draped strands shall be 8.

See Table 13.2.2.1 for maximum length of Tollway Bulb-T PPC Beams. The maximum
number of 0.6” diameter draped strands shall be 8.

13.2.3 IDOT IL-Beams

On March 3, 2015, IDOT issued All Bridge Designer Memorandum 15.2, which details eleven new PPC beam sections with six beam depths of 27, 36, 45, 54, 63 and 72 inches. These beams may be selected for use on Tollway bridges.

Twenty two PPC I-Beam and Bulb-T sections may be used on the Tollway system. The shallowest is a standard 28-inch Tollway section. The next four are standard 36-inch, 42-inch, 48-inch and 54-inch IDOT I-Beams. The next two sections are 63-inch and 72-inch IDOT Bulb-T beams. The next four sections are the 36-inch, 45-inch, 54-inch and 72 inch Tollway Bulb-T beams. Refer to Tollway Base Sheets M-BRG-509-520 for details. Also, refer to Table 13.2.2.1 for guidelines on maximum span lengths for the Tollway Bulb-T beams. Finally, the eleven (11) new IDOT Bulb T shapes may also be used on Tollway projects.

The 28-inch I-Beam shall only be used where a proposed widening would require a shallower section to preserve the existing vertical clearance. See Figure 13.3.1 for beam details.

13.2.4 PPC U-Beams

U-Beams may be considered for bridge sites that require longer spans, curved alignments, reduced number of girders and piers, aesthetic appearance, fast fabrication and easy maintenance. Shipping and picking weights, transportation route, temporary supports, and other site-specific constraints are some important considerations when using U-Beams. Post-tensioned Spliced U-Beams can be a viable option compared to segmental construction with; no specialty contractor, fabricator or equipment required, fewer splices, better redundancy with multiple webs, use of standard girder shape, and non-integral deck.

The design and detailing of PPC U-Beams shall be in accordance with the AASHTO LRFD Bridge Design Specification. Both Pre-tensioned and Post-tensioned PPC U-Beams are allowed on the Tollway System. Three Pre-tensioned (48-inch, 60-inch or 72-inch depths) and Two Post-tensioned Spliced (72-inch or 84-inch) sections can be used.


13.3 Details

The 28-inch I-Beam shall only be used where a proposed widening would require a shallower section to preserve the existing vertical clearance. See Figure 13.3.1 for
beam details. At all piers supporting continuous spans, a minimum of two #8 bars for I-Beams and three #8 bars for Bulb-T beams shall be added to the bottom flange, projecting beyond the beam end in accordance with the details shown in Section 3.4 of the latest IDOT Bridge Manual. See Figures 13.3.2 and 13.3.3.

When beams exceed 100 feet in length, the Designer shall verify that a precaster, certified by the Precast Prestressed Concrete Institute (PCI) will be capable of fabricating and transporting the beams to the bridge site within the project schedule.

When PCC Bulb-T beams are used for spans in excess of 120 feet, calculations shall be provided for the lateral stability of the beams during shipping, handling, and erection and shall be submitted to the Engineer for approval. The calculations shall be sealed and signed by an Illinois licensed Structural Engineer.

In order to limit the damage to the top flanges of the PPC Bulb-T beams during deck replacement projects, IDOT issued All Bridge Designers (ABD) Memorandum No. 12.2. The content of this memorandum shall be incorporated into design of PPC Bulb Tee-beam structures, and as modified for the Tollway Bulb-T beams.

13.4 Table of Moments and Shears

To provide ready information for any future analysis of a structure and to provide the reviewing agencies with a basis for checking of the design, all detailed bridge plans shall include a Table of Moments and Shears. See Subsection 3.1.12 of latest IDOT Bridge Manual for an example of a moment and shear table for PPC I-Beams.

13.5 Superstructure Diaphragms

13.5.1 Abutment (End) Diaphragms

End Diaphragms at expansion abutments shall consist of a thickened deck slab as shown in Figure 13.5.1.1 for I-Beams and the latest IDOT Bridge Manual Base Sheet PBT-2J for Bulb-T Beams.

End Diaphragms at integral abutments shall be as shown on the latest IDOT Bridge Manual Base Sheets PI-2DDI for I Beams and PBT-2DDI for Bulb-T Beams.

13.5.2 Pier Diaphragms

Fixed piers shall be attached to the superstructure by full-depth diaphragms using the details shown in the latest IDOT Bridge Manual Base sheets PI-2F for I-Beams and PBT-2J for BULB-T Beams. Expansion piers shall be separated from the superstructure by partial depth diaphragms and expansion bearings as shown in the latest IDOT Bridge Manual Base sheets PI-2F for I-Beams and PBT-2J for Bulb-T Beams, and Base Sheets M-BRG-510 through M-BRG-520 for Tollway Bulb-T beams.

Double expansion piers shall be separated from the superstructure by thickening the deck slab on each side of the joint similar to the details shown in Figure 13.5.1.1 and the latest IDOT Bridge Manual Base Sheet PBT-2J for Bulb-T beams, and Base Sheets
M-BRG-510 through M-BRG-520 for Tollway Bulb-T beams.

The design of diaphragms at expansion joints shall include provisions to allow jacking on the diaphragms to lift the beam ends for resetting, repair or replacement of bearings. If jacking cannot be done on the end diaphragms, provisions shall be made in the design of the beam seat to allow jacking from directly under the beam. The jacking loads and their locations shall be shown on the drawings. The jacking loads shall be broken down into dead and live load components so the contractor has the option of jacking with or without the live load on the structure.

The Illinois Department of Transportation (IDOT) issued All Bridge Designers (ABD) Memorandum 10.3 entitled “Revised and Construction Policies for PPC I-Beams and Bulb T-Beams” on June 15, 2010, which has now been incorporated into the 2012 IDOT Bridge Manual. This Memorandum implemented three changes to address positive restraint moments at the bottom of beams due to the time dependent effects of creep and shrinkage.

### 13.6 Handling, Storage and Transportation of Beams

All handling, storage and transportation of PPC Beams shall be in accordance with the latest version of Manual for Fabrication of Precast Prestressed Concrete Products, Section 3.6 except as herein modified. All designers shall include these provisions in the contract documents.

IDOT requires that all PPC I-Beams and Bulb T-Beams on continuous structures shall be a minimum of 45 days old before they are permitted to be shipped to the job site. This waiting period combined with a typical minimum timeframe of 15 days from delivery to casting of the deck results in a period of 60 days minimum between casting of the beam and placing of the concrete deck. In addition, “G6” hook bars are provided at the beam ends made continuous over piers using a cast-in-place concrete diaphragm. These requirements are intended to mitigate the loss of contact between the bottom flange of the beams and the diaphragm over the pier as well as other design and construction problems caused by beam creep, shrinkage, shortening and camber.

The Tollway allows the Contractor to ship beams to the site on or after the 5th calendar day after the beam is cast if the beam has attained the specified strength.

For I-beams and T-beams on multi-span, continuous structures (beams with G6 bars), the casting of the deck and continuity diaphragm shall not occur prior to 60 calendar days after casting of the youngest beam. At structures with beams exceeding 99 feet in length and supported on bearing assemblies, the beams may be placed on bearings upon delivery, but the bearings shall be reset after the 60th calendar day after beam casting. Repositioning of the beams on the bearings or resetting of bearings after the 60th calendar day shall be at the contractor’s expense.
13.7 Extending Spans

13.7.1 Introduction

Precast Bulb Tee-Beams have been used with great success all over the country for the construction of much longer spans (200 to 300-foot range) than can normally be achieved with precast concrete I-Beams. The spliced beam concept has been used mostly to extend spans, but can also be used to reduce construction depth. This type of construction, generally, competes well with steel plate girders in the 200 to 300 foot span range.

Before considering this method in the TS&L stage, designers should survey precasters in the general project area and determine if there is interest and capability on the part of precasters to manufacture the beams cost effectively and that they are able to ship them to the project site.

13.7.2 Design

- The design requires specialized software capable of evaluating the time dependent effects of creep, shrinkage and relaxation on moments and deflections and the effects of sequential construction steps.
- The design shall meet the requirements of the latest AASHTO Bridge Design and AASHTO Guide Specifications for Segmental Bridges.
- The latest edition of the Prestressed Concrete Institute (PCI) Bridge Manual.
- The latest editions of the Post–Tensioning Institute (PTI) for Post-Tensioning and Grouting of Tendons.
- The latest Florida Department of Transportation (FDOT) Specifications for the Design and Construction of Spliced I-Girder Bridges.

13.7.3 Durability

NCHRP Report 517 discusses the durability of spliced I-Beams extensively. The main issue is the lack of quality control during the grouting of post-tension ducts. The Contractor shall submit to the CM for review and acceptance a GROUTING PLAN and MANUAL setting out the procedures he or she intends to follow. Bleed tubes shall be installed in accordance with FHWA recommendations. In addition, the CM and the Contractor’s key staff involved with the project should attend grouting classes and obtain appropriate certification.

13.7.4 Splices and Splice Locations

Spliced I-Beam bridges shall be constructed with cast-in-place splices. Match cast splices are not permitted.
The location of splices will determine the length and weight of the sections and thus, will affect transportation and erection. Splices have to meet both serviceability and strength requirements. Protruding reinforcement must be provided to control both conditions. The CM shall require the shop drawings to show how ducts are to be spliced.

Report 517 discusses extensively how the AASHTO LRFD code applies to spliced I-Beam bridges and suggests revisions to the LRFD code, which would eliminate situations where application of the code to spliced I-Beams is vague. The report also recommends the use of the AASHTO GUIDE LINES for DESIGN and CONSTRUCTION of SEGMENTAL BRIDGES.

13.7.5 Pretensioning and/or Post-tensioning

Pretensioning is generally more cost effective than post-tensioning. Therefore, the design approach should be to maximize pretensioning and minimize post-tensioning. The required forces should be provided by the post-tensioning tendons that can be conveniently placed in the section and the balance by pretensioning strand.

13.7.6 Size of Post-Tensioning Tendons

Post-tensioning duct sizes should be limited to 40% of the web thickness. The corresponding tendon size for an 8 inch web is 12-0.6 inch strands. The 3.2 inch duct is standard for this tendon size. A bigger tendon requires a thicker web.

13.7.7 Pretensioning Strand Size

Strands shall not have an area greater than 0.217 square inches, which corresponds to a 0.6-inch diameter.

13.7.8 Long Term Prestressing Losses

The formulas for determination of long term losses provided in the LRFD code do not work well for spliced I-Beams. The calculations are too cumbersome and the results too conservative to be practical and are therefore not recommended. Spliced I-Beam bridges must be designed using suitable software. The cost savings realized by having a reliable and accurate calculation of long term prestressing losses already warrants the cost of purchase or rental of a program. Losses should be around 10-12%.

13.7.9 Tendon Layout

The vertical alignment of post-tensioning tendons should be kept as simple as possible. It may be chored with PI’s and PT’s with minimum radius of curvature at these points, or it may be parabolic. The minimum radius depends on the duct material, metal or polyethylene. Longitudinally, the ducts should always be centered in the web.

13.7.10 Camber and Geometry Control

Vertical alignment control is achieved by chording the individual segments as required to compensate for short and long term deflections and to achieve the required
geometry. In addition, fillets are varied. The fillets can be substantial and the additional weight must be accounted for.

13.7.11 Creep Redistributions of Forces and Moments

Creep is defined in this context as the continued shortening of concrete members subjected to permanent compressive forces starting at the time of the application of the load and ending some 30 years later. The rate of shortening is mathematically defined in several codes. Creep is one of the components of the long term prestressing losses.

First, there is the gradual compression of the deck poured on top of the beam. The top fiber of the beam is highly compressed under the weight of the deck and superimposed dead load. This top fiber tends to shorten over time but is restrained by the deck. As a consequence, the bottom fiber of the deck is compressed and the top fiber of the beam losses compression. At the end of the process, a substantial compressive force has been transferred from the beam to the deck. Because of creep, top fiber compression in the beam after losses never controls design.

Secondly, there is the development of fixed end moments at the ends of the individual beam elements. The beam cambers under the effect of the pretensioning. If left unrestrained this camber and thus the end rotations tend to grow due to creep. After splices are poured and cured, the increase of the end rotation is prevented and fixed end creep moments are developed. These effects must be accounted for in the design.

13.7.12 Elastic Shortening Losses

These losses occur when pretensioning and post-tensioning forces compress and thus shorten the concrete member and consequently decrease the forces in them. These losses shall be accounted for in the calculation of prestressing forces. However, the reverse occurs as well and the increase in prestressing forces because of these gains is generally not accounted for. Gains in prestressing forces occur, for example, when the bottom fiber of a simply supported beam goes from its maximum precompression stress to the max allowable tensile stress under the effect of deck dead load, superimposed dead loads and live load. The length of the bottom fiber increases and thus the length of the strand and the prestressing force increases. The increase in prestressing force often exceeds the calculated elastic shortening loss. For this reason code prescribed elastic shortening losses do not represent the actual losses very well.

13.7.13 Deck Design

The design examples provided in Report 517 consider the deck to be post-tensioned concrete because any stressing of tendons performed after the deck is cured produces stresses in it. This makes the deck subject to the stress limitations of post tensioned concrete and thus limits the tensile stresses accordingly.

This is an unnecessary limitation which places the spliced I-Beam bridge at a cost disadvantage when compared with traditional continuous prestressed beam bridges and steel bridges, which do not limit tensile stresses in the deck. In fact, a second stage post-tensioning and creep redistribution does compress most of the deck. In the
negative moment areas the deck will be in tension at maximum design loads just like any other deck. However, in the case of post-tensioned spliced I-Beam bridges the tension is less.

Longitudinal deck reinforcement of spliced I-Beam bridges must be designed using strength design methods. Service load stresses in the reinforcement must be determined and stress limitations must meet code requirements for reinforced concrete.

The shear reinforcement protruding from the top of the beam must be adequate to develop the tensile forces in the deck steel. Often the amount of the protrusion of this reinforcement varies. Because of the longer spans and depending on the vertical geometry, fillets are sometimes several inches thick which adds to the required length of the shear stirrups.

**Live Load Deflections:**

Live load deflections must be checked and shall be within the allowable L/800 limit, as set forth in design Example Number 3 of Report 517. Should this limit be exceeded, the only solution is to increase the stiffness of the structure (Higher E and/or I), assuming spans lengths have been set.

**Diaphragms:**

Permanent concrete diaphragms must be provided at abutments, piers and splices. Temporary steel diaphragms must be provided for stability of the beams during construction.

**Temporary Shoring:**

Temporary shoring shall be used to support the individual segments of spliced I-beams or for erection and construction of the deck. The shoring shall not be removed until the deck has been placed and the superstructure post tensioned and grouted. In special cases removal of shoring towers may be possible and desirable based on the construction method.
<table>
<thead>
<tr>
<th>Beam Spacing (ft)</th>
<th>36” Deep Beam</th>
<th>45” Deep Beam</th>
<th>54” Deep Beam</th>
<th>72” Deep Beam</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>104</td>
<td>123</td>
<td>139</td>
<td>169</td>
</tr>
<tr>
<td>5.0</td>
<td>101</td>
<td>119</td>
<td>135</td>
<td>165</td>
</tr>
<tr>
<td>5.5</td>
<td>98</td>
<td>117</td>
<td>132</td>
<td>162</td>
</tr>
<tr>
<td>6.0</td>
<td>96</td>
<td>114</td>
<td>129</td>
<td>158</td>
</tr>
<tr>
<td>6.5</td>
<td>94</td>
<td>111</td>
<td>126</td>
<td>155</td>
</tr>
<tr>
<td>7.0</td>
<td>93</td>
<td>110</td>
<td>124</td>
<td>152</td>
</tr>
<tr>
<td>7.5</td>
<td>91</td>
<td>107</td>
<td>121</td>
<td>148</td>
</tr>
<tr>
<td>8.0</td>
<td>87</td>
<td>103</td>
<td>119</td>
<td>146</td>
</tr>
<tr>
<td>8.5</td>
<td>85</td>
<td>101</td>
<td>116</td>
<td>143</td>
</tr>
<tr>
<td>9.0</td>
<td>84</td>
<td>99</td>
<td>114</td>
<td>141</td>
</tr>
</tbody>
</table>

The maximum spans provided in the table above were calculated based on the following design parameters:

1. Live Loads consist of Design Truck IL-120, Design Truck HL-93, Design Lane and Design Tandem loading, following requirements of Article 1.2 of this Manual.

2. Dead loads consist of self-weight of the Bulb-T beams, 2” thick fillet, 8” thick concrete deck, 50-psf future wearing surface and 200 plf of superimposed dead load to account for the Type F concrete barrier shared by 3 beams.

3. Compressive strengths of 4,000 psi and 8,000 psi for the bridge deck and BT-beam, respectively. The BT-Beam concrete strength was assumed to be 6,800 psi at the release.

4. The strands have a 0.60-inch diameter and ultimate strength of 270 ksi. The maximum numbers of straight and draped strands are 36, 40, 42 and 48 for the 36”, 45”, 54” and 72” deep BT-Beams, respectively.

5. For two-equal span bridges, the maximum span lengths presented in the table above may increase by approximately 5% to 10% due to continuity at the center support.
DIMENSIONS

1'-6"
2'-4"
4"
6"
6"
3/4" CHAMFER

REINFORCEMENT

A STIRRUPS
2-#5 BARS
FULL LENGTH OF BM.
MIN. LAP 2'-2"

1½" MIN.
CL. (TYP.)

B #3 BARS

ROW

NUMBER

A SIZE & SPACING OF STIRRUPS TO BE DETERMINED BY DESIGN.

B SPACE AT ± 10" CTS. AT ENDS OF BEAM FOR A DISTANCE OF 2 TIMES THE DEPTH OF THE BEAM.

BEAM PROPERTIES

A = 312.0 in²  Sₚ = 1,929.4 in²
I = 28,137.8 in⁴  C₀ = 13.42 in
S₀ = 2,079.2 in³  Cₚ = 14.58 in
WT. = 328 LBS./LIN. FT.

STD. GRID SYSTEM

(1/2" Ø STRANDS)

28" PPC I-BEAM DETAILS

MARCH, 2015  FIGURE 13.3.1  ILLINOIS TOLLWAY
I-BEAM DETAILS AT PIERS

MARCH, 2015

FIGURE 13.3.2

ILLINOIS TOLLWAY
ELEVATION

BEAM WEB

$\Phi$ BEAM

$\Phi$ PIER

BOTTOM OF BEAM

#8 BARS

TO INSIDE FACE OF BAR (TYP.)

$11''$

5''

5''

BEAM WEB

#8 BARS

6''

6''

#8 BARS

1'-0''

$1''$

$5''$

$3''$

$5''$

$1''$

$3''$

#8 BAR

* TIE #8 BARS WITH NO. 9 WIRE TIGHTLY TO PREVENT ANY MOVEMENT BETWEEN BARS.

#8 BAR * LENGTH = WIDTH OF BOTTOM GIRDER FLANGE +4'-0'' (DETAIL WITH DIAPHRAGM BARS)

PLAN

4'' INSIDE RADIUS

5'-3''

BT BEAM DETAILS AT PIERS

MARCH, 2015

FIGURE 13.3.3

ILLINOIS TOLLWAY
NOTES:
1. REINFORCEMENT BARS DESIGNATED (E) SHALL BE EPOXY COATED.

2. INSERTS AND THREADED DOWEL RODS SHALL ALSO BE EPOXY COATED. INSERTS FOR 3/4" Ø × 2'-0" THREADED (E) DOWEL RODS FASCIA BEAM ONLY

ELEVATION

HATCHED AREA TO BE POURED AFTER SUPERSTRUCTURE FORMS HAVE BEEN REMOVED. QUANTITY OF CONCRETE INCLUDED WITH STRUCTURE CONCRETE

SECTION A-A

END DIAPHRAGM AT ABUTMENT EXPANSION JOINTS

MARCH, 2015 FIGURE 13.5.1.1 ILLINOIS TOLLWAY
SECTION 14.0 BEARINGS

14.1 General

Bearings shall be designed and detailed in accordance with Section 3.7 of the latest IDOT Bridge Manual except as amended herein. Only floating (pot), elastomeric and low profile steel rocker bearings (fixed) are acceptable types. Sliding plate bearings will not be allowed.

Elastomeric bearings are generally used with precast prestressed concrete (PPC) beam and steel beam or girder spans having moderate load and movement requirements. Elastomeric bearing assemblies are divided into three types according to the expansion lengths which they will accommodate.

Low profile rocker bearings shall be used as fixed bearings to support PPC beams at fixed piers or fixed abutments with joints. See IDOT Base Sheets PI-2F and PI-2FB for details.

Only fabric or unreinforced elastomeric pads shall be used to support PPC beams at integral abutments.

Low profile rocker bearings shall be used as fixed bearings in combination with elastomeric types I, II and III expansion bearings to support steel spans. See Figure 3.7.1.2-1 in the latest IDOT Bridge Manual for details.

Rocker plates shall be used to support steel beams or girders at integral abutments. See Figure 3.7.1.2-2 in the latest IDOT Bridge Manual for details.

Only floating (pot) bearings will be used to support concrete (segmental or CIP box girders) or steel structures on curved alignment. They may also be used for concrete or steel structures on tangent alignments with high dead load reactions and skew angles and expansion lengths greater than 40° and 450 ft., respectively.

On steel bridge widening projects where the new deck is structurally tied to the existing and the extended substructure is discontinuous, the bearings for the new beams or girders resting on the discontinuous portion of the substructure shall be of the floating bearing type.

14.2 Design

Elastomeric and low profile steel rocker bearings including anchor bolts and pintels shall be designed and detailed in accordance with Section 3.7 of the latest IDOT Bridge Manual. Floating (pot) bearings shall be designed and detailed by the designer in accordance with Subsection 3.7.5 of the latest IDOT Bridge Manual. Inverted Pot Bearings will not be allowed.
14.2.1 Elastomeric Bearings

When designing elastomeric bearings, the procedures described and detailed in the Illinois Bridge Manual shall be used. The AASHTO Method B procedure is cost prohibitive for typical Illinois bridges given the lengthier design procedure and the extensive testing required to verify this bearing design. The current testing requirements in IDOT Standard Specifications are not sufficient to ensure an acceptable bearing designed by AASHTO Method B.

Pintels and sole plates bonded to elastomeric bearings shall be Type 304 stainless steel conforming to the requirements of ASTM A666 when under an expansion joint. Pintels and sole plates bonded to elastomeric bearings not under an expansion joint shall be galvanized in accordance with AASHTO M232 (ASTM A153). Bearing plates and shear studs embedded in PPC beams shall conform to the requirements of AASHTO M270 (Grade 36) and Section 1006.32 of the latest IDOT Standard Specifications. The bearing plates and shear studs shall be hot dipped galvanized after fabrication, in accordance with AASHTO M232 (ASTM A153).

Masonry and side retainer plates or equivalent rolled shapes shall conform to the requirements of AASHTO M270 (Grade 36). Side retainers and anchors shall be hot dipped galvanized after fabrication in accordance with AASHTO M232 (ASTM A153).

14.2.2 Low Profile Steel Rocker Bearings (Fixed Only)

Pintels, plates and rolled shapes shall conform to the requirements of AASHTO M270 (Grade 50). Rocker bearings including sole plates, pintels, masonry plates and anchors shall be hot dipped galvanized after fabrication in accordance with AASHTO M232 (ASTM A153).

14.2.3 Floating (Pot) Bearings

All bearing plates and rolled shapes shall conform to the requirements of AASHTO M270 (Grade 50). Prior to shipment, the exposed edges and other exposed portions of the structural steel bearing plates shall be cleaned and painted in accordance with Section 506 of the IDOT Standard Specifications. Painting shall be with the paint specified for shop painting of structural steel. During cleaning and painting, the stainless steel, TFE sheet and neoprene shall be protected from abrasion and paint.

It is the designer’s responsibility to also verify the floating bearing dimensions and geometry with producers who are approved by IDOT to provide bearings. The overall bearing height and plate thicknesses stated on the Contract Plans shall be chosen such that more than one producer is capable of bidding on the project.

If the service lateral design load is greater than 10%, but less than or equal to 20% of the design vertical load, a larger floating bearing may be selected based upon the lateral load. When service lateral design load exceeds a threshold value of 20% of the vertical design load, the designer should not select a larger floating bearing to satisfy the lateral load. Rather, designers should select a floating bearing size based on the vertical design load and the fabricator shall be responsible for modifying any necessary
components of the bearing to meet the lateral load requirement. The contract documents shall specify the responsibilities of the fabricator.
SECTION 15.0 CONCRETE BRIDGE DECKS AND BARRIERS

15.1 New and Replacement Decks

Cast-in-place, reinforced concrete decks supported on beams or girders shall be designed in accordance with the latest AASHTO LRFD Bridge Design Specifications and Section 3.2 of the latest IDOT Bridge Manual except as herein modified. The slab thickness shall be 8 inches for new and replacement bridges. On the Tollway System, minimum bridge widths shall match the approach roadway, including pavement lane widths, shoulder widths and gutters, and shall be in accordance with the latest Roadway Design Criteria. The bridge shoulder width shall equal the approach roadway shoulder width plus approach roadway gutter width. Increase shoulder widths on long curved bridges, if necessary, to provide required sight distances.

On bridge replacement or full deck replacement projects for the mainline bridges and flyover ramps under the Tollway jurisdiction that provide direct access to the Tollway, concrete type will be placed in accordance with the following policy:

- Performance Mix Concrete, f’c=4,000 psi min. shall be used for bridge decks and diaphragms.
- BS Concrete, f’c=4,000 psi shall be applied on bridge parapets, approach slabs and approach slab barrier walls.
- SI Concrete, f’c=3,500 psi shall be applied in all substructure elements of the approach and transition slabs.

Cross Road Bridge deck thickness, deck geometry and material property will depend on the Inter-Governmental Agreement (IGA). The above specified conditions shall be used if construction or ownership of the bridge deck is under Tollway’s jurisdiction.

15.2 Existing Deck Widensings and Repairs

For widenings, partial replacements or repairs of existing decks, the deck thickness shall match the existing deck thickness. The top reinforcement bars in the new deck portion shall be placed at the same level as the existing deck bars. The proposed deck widenings shall be designed using the design specifications used for the existing deck in accordance with Section 3.2 of the latest IDOT Bridge Manual. Full bar lap splice shall be provided between the old and new reinforcement bars at the longitudinal construction joint. When the length of the existing reinforcement projecting beyond the construction joint is insufficient to develop a full lap splice, the mechanical splice detail shown in Figure 15.2.1 shall be included in the plans.

When overlaying an existing bridge deck, scuppers shall be adjusted to match the new top of overlay elevations.
15.3 Cross Slopes

15.3.1 Tangent Sections

15.3.1.2 New, Replacement and Widened Decks

The cross slopes of new, replacement and widened decks shall match that of the approach roadway and/or shoulders. A Design Deviation is required for cross slopes not matching the approach roadway and shoulders.

15.3.1.2 Overlays

For bridges on tangent sections, the cross-slopes of the proposed bridge deck overlay, should match the existing cross slopes; however, the capacity of the existing beams or girders shall be checked. For bridges carrying Tollway traffic that do not have adequate capacity to carry the IL-120 Design Truck at Inventory Level and for other bridges that do not have adequate capacity to carry the AASHTO Design Loading at Operating Level, the following criteria should be followed:

- For longitudinal grades of 0.3% or less, the minimum cross-slope required shall be 1.5% for all lanes.
- For longitudinal grades between 0.3% and 1%; a minimum cross-slope of 1% for each lane immediately adjacent to the crown line is acceptable, although not desirable. A minimum cross-slope of 1.5% is still required for all other lanes.
- For longitudinal grades greater than 1%; a minimum cross-slope of 1% is acceptable for all lanes, although 1.5% is desirable.
- Maximum cross-slope for traveled lanes should be 2.5% and for shoulders should be 4%.

These criteria apply only to bridge deck overlays and their purpose is to minimize the overlay thickness, while providing a reasonably smooth surface with adequate ability to drain for the safety as well as the comfort of the traveling public. The transition to these cross slopes shall be completed on the roadway, transition slab and roadway shoulder, not on the bridge deck or approach slab.

15.3.2 Superelevated Sections

Superelevation Transitions shall not be located on bridges and approach slabs. See Article 6.3.7.

15.3.3 New and Replacement Decks

When a superelevated horizontal curve is located within the limits of a bridge and its approach slabs, the bridge deck and approaches shall be sloped at a constant rate. The approach slab and bridge deck shall be planar. The transition in the approach shoulder break shall occur in the transition slab and roadway shoulders at no greater than a 0.5%
relative gradient.

15.3.4 Deck Widenings and Overlays

For bridges on superelevated sections, the minimum cross-slope required for deck sections should equal the original design superelevation rate unless the deck is to be replaced.

The procedure for Preparing Profile Worksheets for Bridge Deck Overlays and approach pavement profile transitions is detailed in Section 18.2 of this Manual. See Article 15.3.1.2 for additional requirements for overlays.

15.4 Reinforcement Bars

The top and bottom longitudinal and transverse bars shall not be lapped at the same locations in the deck, except at staged construction joints. Transverse bars shall be lapped at the locations shown in Figure 15.4.1.

On PPC structures made continuous for live load and superimposed dead loads, the additional longitudinal reinforcement bars over the piers shall be designed and checked for fatigue in accordance with the latest AASHTO and IDOT Bridge Manual. These are the only deck reinforcement bars that need to be checked for fatigue. The additional longitudinal reinforcement shall be placed in the top and bottom of the deck between the #5 bars over the piers for the full width of the superstructure including portions of the deck under barrier rails, sidewalks, raised medians and median barriers.

Two minimum bar lengths are required for these additional bars; the shorter bars shall be 80% or less of the longer bar. This staggering of bars will help minimize transverse cracking at bar terminations.

On bridge replacement projects for mainline bridges and flyover ramps under Tollway jurisdiction that provide direct access to the Tollway, the use of stainless steel reinforcement bars shall be considered. Specifications for stainless steel reinforcement are available from the Tollway upon request. Stainless steel reinforcement bars are limited in use to bridge deck, parapet walls and beam end diaphragms. The rest of the structure shall use epoxy coated rebar. Stainless steel reinforcement bars shall not be considered for the cross road bridge structures.

15.5 Barriers and Raised Medians

15.5.1 Parapets and Barriers on Structures

The Type F-shape shoulder and median barrier sections shall be used on all structures carrying Tollway mainline and ramp traffic. Cross roads and all other structures should be per jurisdictional agency’s requirements.

The tops of back-to-back median barriers shall be constructed to the same elevation. To provide for differences in vertical elevations of the individual decks at the centerline of the Tollway, it will be necessary to increase the height of one barrier. This shall be
done as shown in Figure 15.5.1.2 for the Type F Median Barrier. Also, see Figure 15.5.1.1 for Type F Median Barrier Details when there is no elevation difference.

When a raised median curb is required on structure, the shape of the curb face, the height and the overall width are to match those of the approach roadway.

Reinforcement for parapets and barriers on structures carrying Tollway traffic or over Tollway traffic shall meet the requirements of AASHTO LRFD Bridge Design Specifications for TL-5 vehicle impact loading. These details shall be used for all 42” barrier walls and parapets mounted on moment slabs, approach slabs and bridge decks carrying Tollway traffic. Impact loading requirements for bridges not carrying or over Tollway traffic shall be coordinated with the agency responsible for the roadway.

The following revisions from the IDOT Bridge Manual Figure 3.2.4-4 shall be implemented.

- The #4 horizontal bars in the parapet shall be increased to #5 bars.
- The 11” spacing of the #5 front face vertical reinforcement bars shall be reduced to 7”.

The designer shall also verify the bridge slab and approach slab capacity at the junction with the parapet and barrier wall.

Although these design details are governed by end impact, at parapet ends and joints, these revisions apply to the full length of the 42” parapet and barrier wall. See Figure 15.5.1.3.

15.5.2 Roadside Barriers

All rigid roadside barriers adjacent to a Tollway roadway when the barrier is not located on a structure (bridge or retaining wall) shall be designed to meet AASHTO LRFD Bridge Design Specifications for TL-4 impact loading. See Tollway Standard Drawings C3 and C4.

Note that the minimum installation length for Single Face Reinforced Concrete Barrier is 25’. If a shorter installation or different configuration is needed, the Designer shall design the barrier for TL-4 impact loading by varying the footing size and/or the reinforcement. The same design methodology shall be used as outlined in Article 22.14. The magnitude of Equivalent Static Force used to check for sliding and overturning shall be 10 kips.

These details can be used with or without fill material behind the barrier. The use of single face barrier wall along a shoulder taper is unchanged and shall follow the policy shown in Tollway Traffic Barrier Guidelines, Article 13.2.1.

Refer to Article 22.14 for TL-5 parapet details in conjunction with retaining wall moment slabs and Article 15.5.1 for TL-5 parapet wall reinforcement details on Tollway bridges and bridge approach slabs.
15.6 Longitudinal Open Joints

Generally when the distance between the fascia girders exceeds 90 feet, the deck will be split with an open joint. The joint may be located in barrier sections or in a raised median. Joints in a raised median curb will be sealed using a 1-3/4 inch preformed pressurized joint seal. Distances greater than 90 feet between fascia girders will be considered on case by case basis. The Tollway prefers not to utilize open or sealed longitudinal joints unless they are located along the center line of the main line between the median barriers on each side of the joint. Details of a sealed joint are shown on Figure 15.6.1.

Longitudinal construction joints between the edges of shoulders will not be allowed unless they fall on a lane line and do not cross any beam or girder flanges.

15.7 Bridge Mounted Lighting

The Designer shall identify the location and size of all embedded conduits, expansion fittings and junction boxes on the structural drawings and reference the roadway electrical drawings for details.

Shoulder and median mounted light pole details for the 42-inch, Type F barrier are shown in Figures 15.7.1 through 15.7.7.

15.8 Slipform Barrier

Slipforming may be used to construct the barrier rail shown in plans. Slipforming shall be done in accordance with the latest IDOT “Guide Bridge Special Provision #61, “Standard Base Sheet SFP 34”, “42” and “All Bridge Designers (ABD) Memoranda 12.4 for slipforming of Parapet Option”.

15.9 Pouring Sequence

A pouring sequence shall be provided in the Contract plans for all new and existing steel superstructures on curved alignment and those with continuous or simple span lengths of 150 feet or greater. The same shall be done for tangent steel superstructures with a skew angle greater than 40 deg., regardless of the type of span or length. In addition, the concrete for the bridge deck shall be placed parallel to the skew when it is greater than 40 deg.

Special care shall be taken when construction staging reduces the width of the pour in relation to span length and/or the number of beams or girders to three or less, in the initial stage, the superstructure framing shall be checked for stability and out of plane displacements and rotation.

15.10 Closure Pour

On stage constructed bridges where the differential deflection between adjacent stages is 2” or greater, and it is not feasible or economical to use a deeper or stiffer beam or girder section, a closure pour should be considered. Closure pours will be considered
by the Tollway on a case-by-case basis.
MECHANICAL SPLICE DETAIL

NOTE: PPC BEAM SHOWN, STEEL BEAM SIMILAR

MARCH, 2015    FIGURE 15.2.1    ILLINOIS TOLLWAY
Figure 15.4.1

Reinforcement Splice Detail

- Splice bottom transverse reinforcement adjacent to edge of flange.
- Splice top transverse reinforcement at midspan of interior bay.

1. Detail shown for #5 bars. Details for different size bars shall be adjusted accordingly.

Note: Steel beams shown, concrete beams similar.
NOTES:
1. PPC BEAM SHOWN, STEEL BEAM SIMILAR
2. ALL FORM MATERIAL SHALL BE REMOVED FROM OPEN JOINT

BONDED CONSTR. JOINT (OPTIONAL)

BONDED CONSTRUCTION JOINT (MANDATORY)

1/2" MIN.

3/4" DRIP NOTCH (FULL LENGTH)

FIGURE 15.5.1.1

TYPE F MEDIAN BARRIER DETAILS
(NO ELEVATION DIFFERENCE)

MARCH, 2015
NOTES:
1. PPC BEAM SHOWN, STEEL BEAM SIMILAR
2. ALL FORM MATERIAL SHALL BE REMOVED FROM OPEN JOINT

ELEVATION DIFFERENCE —

TYPE F MEDIAN BARRIER DETAILS
(ELEVATION DIFFERENCE OF 2" OR LESS)

① THIS DIMENSION SHALL INCREASE BY THE THICKNESS OF THE PROPOSED OVERLAY
② FACE SLOPE SHALL BE AT CONSTANT 3¾"
   HORIZONTAL TO 2'-8" VERTICAL RATIO.

ELEVATION DIFFERENCE —

TYPE F MEDIAN BARRIER DETAILS
(ELEVATION DIFFERENCE GREATER THAN 2")

MARCH, 2015
FIGURE 15.5.1.2
ILLINOIS TOLLWAY
BONDED PREFORMED JOINT SEAL

TOP OF CONCRETE DECK OR RAISED MEDIAN

1/4" BONDED PREFORMED PRESSURIZED JOINT SEAL, INSTALLED WITH AN ADHESIVE IN ACCORDANCE WITH MANUFACTURER’S INSTRUCTIONS.

TYPICAL SECTION

BONDED PREFORMED JOINT SEAL
FOR LONGITUDINAL OPEN JOINT
SHOULDER MOUNTED LIGHT POLE DETAILS FOR TYPE F BARRIER

MARCH, 2015

FIGURE 15.7.1

ILLINOIS TOLLWAY
SECTION A-A

1. SEE FIGURE 15.7.1 FOR DETAILS OF d(E) AND e(E) BARS

2. STAINLESS STEEL STANDARD GRADE WIRE CLOTH - TYPE 304, 4 x 4 MESH, 0.047" WIRE DIAMETER.

SHOULDER MOUNTED LIGHT POLE DETAILS FOR TYPE F BARRIER

MARCH, 2015  FIGURE 15.7.2  ILLINOIS TOLLWAY
MEDIAN MOUNTED LIGHT POLE DETAILS
FOR TYPE F BARRIER

MARCH, 2015

FIGURE 15.7.3

ILLINOIS TOLLWAY

NOTES:
1. COST OF ANCHOR BOLTS IS INCLUDED IN THE COST OF CONCRETE SUPERSTRUCTURE PAY ITEM. 2" Ø PVC SHALL BE PAID FOR SEPARATELY.

2. SEE FIGURES 15.7.5 AND 15.7.6 FOR SECTION A. SEE FIGURE 15.7.7 FOR VIEW B.
BOTTOM PLAN
(SHOWING ADDITIONAL REINF. IN DECK AT LIGHT POLE LOCATIONS)

MEDIAN MOUNTED LIGHT POLE DETAILS
FOR TYPE F BARRIER

NOTE:
SEE FIGURES 15.7.5 AND 15.7.6 FOR SECTION A-A AND FIGURE 15.7.7 FOR VIEW B-B.
10" Ø ALUMINUM POLE (BY OTHERS)
CAP END OF CONDUIT. WHEN READY FOR WIRING, REPLACE CAP WITH BUSHING
STAINLESS STEEL MESH (BY OTHERS)
2" Ø PVC CONDUIT
1" Ø x 5'-7" ANCHOR BOLTS PROVIDE 2 FLAT WASHERS, 1 LEVELING NUT & 1 LOCKNUT FOR EACH BOLT. ALL NUTS & WASHERS MUST BE GALVANIZED. SEE FIGURE 15.7.1 FOR ANCHOR BOLT DETAIL.

SECTION A-A
(SHOWING ANCHOR BOLTS AND CONDUIT)
1 STAINLESS STEEL STANDARD GRADE WIRE CLOTH
TYPE 304, 4 x 4 MESH, 0.047" WIRE DIAMETER

MEDIAN MOUNTED LIGHT POLE DETAILS FOR TYPE F BARRIER
SECTION A-A
(SHOWING DIMENSIONS AND REINFORCEMENT)

MEDIAN MOUNTED LIGHT POLE DETAILS
FOR TYPE F BARRIER

NOTE:
(E) BARS SHALL BE (S) BARS FOR BRIDGE DECKS USING STAINLESS STEEL BARS.

SEE FIGURE 15.7.1 FOR DETAILS OF d2(E) & e2(E) BARS
*SEE BARRIER PLANS FOR BAR DESIGNATIONS

ILLINOIS TOLLWAY
MARCH, 2015

FIGURE 15.7.6
MARCH, 2015

FIGURE 15.7.7

SOUTHBOUND GUTTER ELEVATION, TOE OF BARRIER

10'

2'-8''

2'-9' 1/2''

1 3/4''

1 3/4''

2'-9' 1/2''

2'-9' 1/2''

1 3/4''

1 3/4''

1 3/4''

1 3/4''

1 3/4''

1 3/4''

1 3/4''

5/8''

3/8''

5/8''

5/8''

#5d4* (E) BARS

VIEW B-B

(SHOWING DIMENSIONS AND REINFORCING)

1) CUT IN FIELD TO CLEAR OPENING

* SEE BARRIER PLANS FOR BAR DESIGNATIONS

MEDIAN MOUNTED LIGHT POLE DETAILS

FOR TYPE F BARRIER
SECTION 16.0 DECK DRAINAGE

Bridge deck drainage shall be designed and detailed in accordance with the applicable portions of Chapters 7 and 8 of the latest IDOT Drainage Manual, Subsection 3.2.9 of the latest IDOT Bridge Manual, Section 10.4 and Table 10.1 of the Tollway Drainage Manual, except as amended here in.

16.1 Deck Drains

When floor drains are required, they shall be uniformly spaced along the gutter line on one or both sides of the bridge deck as indicated in the drainage study. In no case will the discharge from floor drains be collected in a closed drainage system and piped down and/or off the bridge. The free fall method of discharge will be permitted except over areas noted herein.

Floor drains may be angled if required to clear the beam or girder flange. Preference shall be given first to the use of 6 inch diameter reinforced fiberglass pipe or aluminum tube. If insufficient space exists between face-of-curb and the girder for a 6 inch diameter drain, consideration shall be given to the use of the 4" x 12" tube. Reinforced fiberglass pipe shall meet the requirements of Subsection 16.3.2. Aluminum shall be either an extrusion or welded plates meeting the requirements of ASTM B221, Alloy 6061-T6 or ASTM B209, Alloy 6061-T6.

Floor drains shall be omitted from sections of the decks where the discharge would fall on underlying roadways, bikeways, walkways, railroads, aggregate slope paving or unprotected earthen embankments, and other developed or highly erodible areas. Where free fall is not permitted scuppers and a closed drainage system as described below is used. Floor drains shall be located a minimum of 1/2 of the drop height from the face of any abutment or pier. The drop height is defined as the vertical distance between the bottom of the drain pipe and the top of the surface below. Drains shall be located a minimum of 4’ clear of all diaphragms and on the upstream side of bridge deck expansion joints. Drain pipes shall extend a minimum of 6” below the bottom of adjacent superstructure members.

16.2 Drainage Scuppers

The IDOT DS11 or DS12 Drainage Scuppers may be used. Drainage from scuppers may be collected in a closed drainage system and piped off the bridge or allowed to free fall to the ground except in the areas noted herein.

Scupper frames and grates shall be gray cast iron meeting the requirements of AASHTO M105, Class 35B. Stainless steel hold down bolts as specified in the Standard Specifications Article 1006.29(d) shall be used to secure the grates to the frames.

Structural steel weldments of equal sections and of the same configuration may be used in lieu of the grey cast iron frame. Fillet or full penetration welds shall be used for the weldments. Structural steel weldments shall not be used in lieu of the cast iron grates. Structural steel shall meet the requirements of AASHTO M270, Grade 50. Structural
steel frames shall be galvanized according to AASHTO M111. Contractor shall submit shop drawings of all structural steel weldments to the CM for review and acceptance prior to ordering any material or starting the work.

The height at the spigot end of the scupper shall be increased from 7-1/4 inches to 12 inches to allow the flange connection to be made below the deck slab. The connection will be made with stainless steel bolts, nuts and washers as specified in the Standard Specifications Article 1006.29(d). The following note shall be added to the list of General Notes.

“All stainless steel hardware for drainage systems shall be coated with antiseize compound.”

Freefall type scuppers shall be omitted from sections where the discharge would fall on underlying roadways, bikeways, walkways, railroads, aggregate slope paving, unprotected embankments and other developed or highly erodible areas. Scuppers with free fall discharge shall be located a minimum of 1/2 of the drop height from the face of any element of the substructure. The drop height is defined as the vertical distance between the bottom of the spigot and the top of the surface below. Scuppers shall be located clear of all diaphragms and on the upstream side of bridge deck expansion joints, whenever possible.

16.3 Drain Pipe

Wherever freefall discharge is not feasible, the drainage shall be collected and piped to the ground or lower roadway. Drain pipes shall not be placed on the traffic face of crash walls. Scuppers should be located directly above downspouts attached to the substructure. Midspan locations that would result in complex, lengthy drain piping should be avoided wherever possible. Where horizontal (collection) piping is required, horizontal runs shall be 8 inch in diameter. Vertical (downspouts) piping shall also be 8 inches in diameter. Figures 16.3.1 and 16.3.2 illustrate typical drainage system details. Drainage piping and fittings shall be polyvinyl chloride (PVC), reinforced fiberglass or galvanized steel. Cast iron pipe and fittings will not be allowed. The following note shall be added to the list of General Notes.

“Drain pipe for Bridge Drainage System, including all piping, fittings, support brackets, inserts, bolts, and splash shown blocks, shall be as specified in GBSP 12, Drainage System, effective June 10, 1994 and revised January 7, 1997, except as modified herein. Drain pipe may be Polyvinyl Chloride (PVC) Pipe, Reinforced Fiberglass pipe or Galvanized Steel Pipe.”

16.3.1 Polyvinyl Chloride Pipe

Polyvinyl Chloride (PVC) pipe and fittings shall be 8” diameter schedule 80 meeting the requirements of ASTM D1785 (F441), D2464 and D2467, colored in accordance with Article 16.5. These requirements shall be added as a note to the list of General Notes.
16.3.2 **Reinforced Fiberglass Pipe**

Reinforced Fiberglass pipe and fittings shall be 8" diameter, meeting the requirements of ASTM D2996 RTRP with a 30,000 psi minimum short-time rupture strength hoop tensile stress, pigmented or painted in accordance with Article 16.5. These requirements shall be added as a note to the list of General Notes.

16.3.3 **Galvanized Steel Pipe**

Seamless and welded pipe and fittings shall be 8" diameter, extra strong, galvanized steel pipe, meeting the requirements of ASTM A53.

16.4 **Pipe Supports**

Pipe hangers shall be provided for all horizontal (collection) drain pipes at each fitting, cleanout, or change in direction and at intermediate points not more than 5'-0" on centers. Collection pipe hangers shall have an allowable load capacity of not less than 500 lbs. and shall be designed so as not to apply excessive compressive stress to the pipe. See Figures 16.4.1 and 16.4.2 for pipe hanger details. Steel straps, bars and plates shall meet the requirements of AASHTO M270, Grade 36 or 50.

Pipe supports shall be provided for all vertical (downspout) drain pipes at points not more than 12'-0" on centers. See Figures 16.4.3 through 16.4.6 for drain pipe support details. Structural steel shapes shall meet the requirement of AASHTO M270, Grade 36.

All pipe hangers, supports and hardware shall be hot-dipped galvanized after fabrication in accordance with AASHTO M232 (ASTM A153) unless otherwise noted. All bolts, nuts and washers shall be stainless steel. Stainless steel bolts, and washers shall to the Standard Specifications Article 1006.29(d).

16.5 **Painting**

All exposed surfaces of floor drains, hangers, brackets and piping located on the exterior side of painted fascia beams and/or visible to the motoring public shall be painted or supplied in the appropriate color except stainless steel and galvanized shall not be painted. The color of the final coat shall match that of the adjacent beam and/or column, Munsell numbers 7.5G4/8 Interstate Green or 5B7/1 Gray. Final color shall be submitted to the Engineer for approval.

16.5.1 **Aluminum Tube**

The exterior surfaces shall be cleaned and given a wash coat pretreatment in accordance with SSPC - SP1 and SSPC - Paint 27. The pretreated surfaces shall be painted with an adhesion bonding primer and top coat per the system recommended by the pretreatment manufacturer for painting aluminum surfaces in an exterior environment. These requirements shall be added as a note to the list of General Notes.
16.5.2 Polyvinyl Chloride Pipe

The PVC pipe and fittings shall be colored to match the adjacent beam and/or column.

16.5.3 Reinforced Fiberglass Pipe

The exterior surfaces of fiberglass pipe and fittings shall be pigmented in accordance with the pipe manufacturer’s recommendations or cleaned, given a prewash in accordance with MIL - P – 15328 and top coated with an epoxy-based coating recommended for outdoor applications by the prewash manufacturer.

16.5.4 Galvanized Steel Pipe

Galvanized Steel Pipe shall not be painted.

16.5.5 Pipe Supports

The exposed surfaces of galvanized pipe supports shall not be painted.
EXPANSION REDUCER AND COLLAR (TYP.)
(SEE FIGURE 16.4.4)

PIPE SUPPORT (SEE FIGURE 16.4.3)

PIER

CLEAN OUT PLUG (TYP.)

Y-BRANCH CLEAN OUT (TYP.)

45° ELBOW (TYP.)

8”Ø DRAIN PIPE

NOTES:

1. DRAIN PIPES AND FITTINGS SHALL BE 8”Ø.

2. REDUCERS SHALL BE SIZED TO ACCOMMODATE LONGITUDINAL THERMAL MOVEMENT OF THE SUPERSTRUCTURE BETWEEN THE PIER AND THE SCUPPER.

3. BOLT PATTERN AND SIZE IN DRAIN PIPE FLANGE TO MATCH SCUPPER FLANGE.

TYPICAL DRAINAGE SYSTEM DETAILS FOR MEDIAN / FIXED PIERS
TYPICAL DRAINAGE SYSTEM DETAILS
FOR SHOULDER / EXPANSION PIERS

1. DRAIN PIPES AND FITTINGS SHALL BE 8”ø.

2. REDUCERS SHALL BE SIZED TO ACCOMODATE LONGITUDINAL THERMAL MOVEMENT OF THE SUPERSTRUCTURE BETWEEN THE PIER AND THE SCUPPER.

3. BOLT PATTERN AND SIZE IN DRAIN PIPE FLANGE TO MATCH SCUPPER FLANGE.
500 LBS. (250 LBS. EACH) MINIMUM CAPACITY STAINLESS STEEL CONCRETE INSERTS OR EXPANSION ANCHORS FOR 3/4"Ø THREADED RODS

3/4"Ø STAINLESS STEEL THREADED RODS WITH 2 STAINLESS STEEL WASHERS AND NUTS FOR EACH ROD.

8" DRAIN PIPE

1/8" FABRIC PAD

STAINLESS STEEL PIPE CLAMP

* DIMENSION AS REQUIRED BY PIPE CLAMP

COLLECTOR PIPE HANGER DETAILS
ALTERNATE COLLECTOR PIPE HANGER DETAILS
2-5/8" \( \phi \times 4" \) EFFECTIVE EMBED STAINLESS STEEL EXPANSION BOLTS

STAINLESS STEEL C4x7.25

8" \( \phi \) DRAIN PIPE

5/8" STAINLESS STEEL U-BOLT ASTM A 276, TYPE 304, CONDITION A, COLD FINISHED WITH 2 STAINLESS STEEL NUTS AND LOCKWASHERS

STAINLESS STEEL BEVELED WASHERS

2-11/16" \( \phi \) HOLES

2-11/16" \( \phi \) HOLES

ELEVATION

VERTICAL DRAIN PIPE SUPPORT DETAILS

MARCH, 2015

FIGURE 16.4.3

ILLINOIS TOLLWAY
SECTION A-A

1/4"Ø x 3/4" long stainless steel bolt and nut

2 1/2"

O.D. drain pipe + 1/4"

BEND & DRILL TEAT as required

10 gauge stainless steel collar

PLAN (LOOKING DOWN)

Stainless steel 5/32" Ø rivet (round head) (loose fit)

Teat (bend as required)

SECTION B-B

EXPANSION COLLAR DETAILS

March, 2015

Figure 16.4.4

Illinois Tollway
8" Ø DRAIN PIPE

5/8" Ø STAINLESS STEEL BOLT, NUT AND LOCK WASHER, HAND TIGHTEN

2½" × ¼" STAINLESS STEEL STRAP

1/8" NEOPRENE PAD

5/8" Ø STAINLESS STEEL BOLT, NUT AND LOCK WASHER

2½" × ¼" STAINLESS STEEL STRAP

1/8" NEOPRENE PAD

VARIES

1/4"

VARIES

1/4"

1/4"

1/4"

8" Ø DRAIN PIPE

2 1/2" × 1/4"

STAINLESS STEEL STRAP

VARIES

1/8" NEOPRENE PAD

3 1/2"

1 1/2"

1"

5/8" Ø STAINLESS STEEL BOLT, NUT AND LOCK WASHER

DRAIN PIPE SUPPORT DETAILS

MARCH, 2015

FIGURE 16.4.6

ILLINOIS TOLLWAY
SECTION 17.0 BRIDGE DECK EXPANSION JOINTS

17.1 General

All bridge deck expansion and fixed (rotational) joints shall be sealed to prevent water from penetrating to the bridge elements below the deck surface. Both expansion and fixed (rotational) joints will be designed and detailed in accordance with Section 3.6 of the latest IDOT Bridge Manual except as herein amended. Integral and semi integral abutments should be utilized wherever possible to eliminate the need for expansion joints at these locations. See Section 10 of this Manual for parameters pertaining to the use of these types of abutments.

Expansion and fixed joints installed on bridges with 10 deg. skews or greater shall be modified to intersect the barrier or curb line at 90 deg. This change in direction should occur 6 inches from the back face of curb or barrier.

17.2 New or Replacement Bridge Decks

Only Strip Seals and Modular Joints shall be utilized to seal expansion or fixed (rotation) joints in new or replacement decks. Unbonded Preformed Joint Seals, Neoprene, Bituminous, Poured Silicone and steel Finger Plates will not be allowed. Only Strip Seals and Modular Expansion Joints currently on the latest IDOT Pre-Qualified products list will be considered for use by the Tollway.

17.2.1 Strip Seals

Strip Seals shall be used to seal the deck joints of all new or replacement structures located on tangent alignments where the skew angle(s) are 60 deg. or less and the expansion length is not greater than 250’. They may also be used for structures on curved alignment provided the skew angles(s) are 40 deg. or less and the expansion length is equal to or less than 250’, measured along the center or baseline. The Tollway will consider the use of greater expansion lengths on a case-by-case basis. See Base Sheets M-BRG-500, M-BRG-501 and M-BRG-502 for details.

17.2.2 Modular Joints

Modular Joints shall be used to seal expansion joints of structures on tangent or curved alignment exceeding the strip seal limits specified above, provided skew angles are 60 deg. or less and the expansion length does not exceed 800 feet.

17.3 Existing Bridge Deck Widенийings

Structures that are to be widened on one or both sides shall utilize the same type of joint that is currently installed in the existing deck, provided it is in good condition. If the existing joint is not in good condition, or it is no longer manufactured, it shall be replaced and the deck reconstructed to utilize a Strip Seals or Modular Expansion Joints. Existing Preformed Joint Seals or Poured Silicone Joints shall be completely removed and replaced.
17.4 Existing Bridge Deck Repair and Rehabilitation

When a deck is only being repaired and/or resurfaced and isolated sections of the existing joint are in poor condition, they shall be reconstructed or repaired in-kind, provided the total length of repairs does not exceed 40% of the original length. Regardless of the repair length, the existing seal or gland shall be completely replaced.

Whenever the total length of repairs will exceed 40% of the original, or the entire joint is in poor condition, the existing joint shall be completely reconstructed and sealed with a Strip Seal or a Bonded Preformed Joint Seal. See Figure 17.4.1 for details.

When reconstructing expansion joints on existing bridges with skews greater than 10 deg., the joints shall be modified so they intersect the face of the barrier rail or curb at 90 deg. This modification typically consists of removing a short section of the existing barrier and relocating the barrier joint so that the modified expansion joint intersects it at 90 deg.

17.5 Approach Slabs

Only Bonded Preformed Joint Seals which are fully adhered to both faces of the open joint shall be utilized to construct the expansion joints between the approach and transition slabs and the transition slab and roadway pavement. Joint armor is not required or allowed. See Base Sheets M-RDY-408 and M-RDY-409 and Figure 17.5.1 for details.

17.6 Fabrication

All structural steel for expansion joints shall be hot dipped galvanized after fabrication in accordance with AASHTO M232 (ASTM A153).
BONDED PREFORMED JOINT SEAL

SECTION THRU JOINT SEAL

TYPICAL DETAIL AT BARRIER

BONDED PREFORMED JOINT SEAL DETAILS

MARCH, 2015

FIGURE 17.5.1

ILLINOIS TOLLWAY
SECTION 18.0 DECK ELEVATIONS

18.1 New Bridges

A table showing top of deck slab elevations along the centerline of each longitudinal beam or girder, stage construction joint, break in cross slope, and profile grade line shall be included in the bridge plans for all structures with steel or concrete stringers. This table is usually in the form of a computer output reduced in tabular form on individual plan sheets. Examples of these sheets are shown in Figures 3.1.9-1 through 3.1.9-4 of the latest IDOT Bridge Manual.

In addition, top of approach slabs elevations along each longitudinal profile grade line, break in cross slope, stage construction joint, edge of pavement or shoulder shall also be provided on separate individual plan sheet(s) after the deck elevation sheet(s). Examples of which are shown in Figures 3.1.9-5 and 3.1.9-6 of the latest IDOT Bridge Manual.

Where the stringer lies below a curb, sidewalk or median section, the elevations shall be given for a theoretical top of slab, which would be the projection of the cross slope from the roadway template to the centerline of stringer.

The increments for elevations along centerline of each web shall be 10 feet with any odd increment not greater than 15 feet or less than 5 feet placed at the end of a span. A new series of 10-foot increments shall begin in each respective span along the structure. In all cases, the increments shall progress in the direction of the stationing on the bridge for the full length of the structure. The theoretical top of slab elevations at these increment points shall be adjusted for dead load deflection and tabulated in a separate column, which will become the finished elevations for construction of the deck slab.

Actual dead load deflection diagrams (due to weight of concrete deck and all superimposed dead loads except future wearing surface) shall be shown on the top of the slab elevations indicating deflection ordinates at the quarter points and midpoint of all stringers of each span. However, if the variance in deflection between the exterior and interior stringers is one-eighth inch or less, one dead load deflection diagram shall be sufficient for all stringers. Dead load deflection diagrams shall be qualified with the following note:

"The above deflections are not for use in the field if the Engineer is working from the Theoretical Grade Elevations Adjusted for Dead Load Deflection."

If the superstructure will be constructed in stages, any concentrated superimposed dead loads (sound walls, barriers, sidewalks and medians) applied during the initial stage shall only be distributed to a maximum of three adjacent stringers erected in that stage. These initial concentrated superimposed dead loads will not be considered in the deflection calculations for stringers erected in subsequent stages.
18.2 Existing Bridge Deck Overlays

The procedure described below shall be used in the preparation of profile worksheets for bridge deck overlays and approach pavement profile transitions.

Profiles should be prepared for each edge of pavement and crown line. Where there is an auxiliary lane on the deck, a profile for the edge of the auxiliary lane should also be prepared. The profiles should have a longitudinal scale of at least 1 inch equals 50 feet, and a vertical scale of at least 1 inch equals 1 foot, although a vertical scale of 1 inch equals ½ foot will facilitate reading elevations from the profiles.

- Plot existing overlay surface elevations and existing concrete deck elevations at 20-foot centers on roadway and 10-foot centers on deck.

- Using 1-1/4-inch minimum concrete cover over the existing concrete high points and applying the cross-slope criteria as defined in Section 15.3, fit smooth curvilinear profiles following as close as possible the general direction and configuration of the original profile grade. Where scuppers are involved, cross sections should be drawn to verify that the scuppers will not present a problem.

- After the tentative profiles are sketched out, the cross-slope should be checked again for compliance with the criteria. More than one trial and error run may be required to achieve the best fit set of profiles for each individual deck. Profile lines should not follow theoretical grades and parabolic curves unless such grades and curbs happen to give the best fit for a particular location.

- The deck profiles should be transitioned back to the existing or proposed approach roadway elevation within 100 feet to 200 feet from each end of the bridge deck. The transition should be long enough and end at the most convenient point as to provide a continuous smooth profile, without breaks, dips or bumps.

- Upon review and acceptance by the Tollway, the profile worksheets should be finalized with all lines neatly drawn and identified. It is intended that these worksheets will be used by the CM during construction.

- The elevations for the overlay surface contour plans or screed elevations may be scaled directly from the profiles developed from the field survey.
SECTION 19.0 APPROACH AND TRANSITION SLABS

19.1 General

Approach and transition slabs shall be included with the plans for each new and widened bridge. Mainline or ramp bridges carrying Tollway traffic shall be provided with approach and transition slabs including shoulders at each abutment. The approach and transition slabs shall be 100 feet long as detailed in the latest Tollway Base Sheets M-RDY-59 and M-RDY-60.

Bridges carrying traffic other than that of the Tollway shall also be provided with approach pavement at each end of the structure. The approach pavement shall be 30 feet long as detailed in the latest IDOT Highway Standards.

Existing approach slabs and shoulders shall be widened, where required, in kind. The new expansion joints at the roadway end of the approach slab shall match the existing joints unless they are in poor condition, in which case the existing joint shall be reconstructed as part of the approach slab widening.

19.2 Approach Slabs for Tollway Bridges

19.2.1 Integral and Semi-Integral Abutments

The first 30 feet of the approach slab is designed as a one-way structural slab simply supported on a 10-inch-wide seat at the end diaphragm and an approach slab bent at the other end. The next 70 feet of approach slab is a reinforced concrete slab on grade, used as a transition between the one-way slab and the roadway pavement.

Cast-in-place approach slabs will be permitted by the Tollway. The one-way slab shall be anchored to the end diaphragm as shown in the IDOT All Bridge Designers Memorandum 12.3, “2012 Integral Abutment Bridge Policies and Details”, dated July 25, 2012. The other end shall be separated from the transition slab with an expansion joint located over the approach slab pile bent as shown in Tollway Base Sheets M-RDY-408 and M-RDY-409.

Cast-in-place approach slabs will be permitted by the Tollway. In accordance with IDOT All Bridge Designer Memorandum 12.3, for integral and semi-integral abutment bridges with a contributory expansion length greater than 130 feet, precast concrete approach slabs shall be used. The slabs shall be constructed partial depth in accordance with IDOT base sheets.

19.2.2 Vaulted Abutments

The first 30 feet of the approach slab is designed as a one-way slab, simply supported on a 6 inch seat at the abutment end bent and the approach slab bent at the other end. Approach slabs for vaulted abutment bridges shall be detailed in accordance with IDOT base sheets for Vaulted Abutment Approach Spans. The next 70 feet of approach slab is a reinforced concrete slab on grade, used as a transition between the one-way...
structural approach slab and the approach roadway pavement and shall be detailed in accordance with the Tollway Base Sheets M-RDY-408 and M-RDY-409 for non-integral bridges.

19.2.3 Pile Bent/Stub Abutments

The first 30 feet of approach slab is designed as a one-way structural slab, simply supported on a 6-inch seat at the abutment and an approach slab bent at the other end. The next 70 feet of approach slab is a reinforced concrete slab on grade, used as a transition between the one-way structural approach slab and the roadway pavement.

The one-way slab shall be anchored to the abutment per Figure 10.3.6. The joints between the abutment and the one-way slab and the one-way slab and the transition slabs shall be constructed without any expansion material. The top of these joints shall be tooled or sawed and sealed with hot poured low modulus polymer sealant as shown in Base Sheets M-RDY-408 and M-RDY-409.

19.3 Approach Pavement for IDOT, County, Township or Municipal Structures

19.3.1 Integral and Semi - Integral Abutments

The approach pavement shall be detailed and anchored to the abutment in accordance with the IDOT ABD Memorandum 12.3.

19.3.2 Vaulted Abutments

The approach pavement shall be detailed and anchored to the approach bent and span per IDOT Highway Standard 420401 and Subsection 3.8.9 of the latest IDOT Bridge Manual.

19.3.3 Pile Bent/Stub Abutments

The approach pavement shall be detailed and anchored to the abutment per IDOT Highway Standard 420401 and Section 3.8.5 of the latest IDOT Bridge Manual.

19.4 Approach Bent

All approach bents shall be supported by piles in accordance with Base Sheets M-RDY-408 and M-RDY-409. They should be designed to support longitudinally reinforced slab like bridge structure. The grade beam/ sleeper slab shall no longer be used.

19.5 Approach Slab and Pile Bent Pay Items

The pay items associated with installation of approach pile bent and reinforced concrete approach slab should be organized as follows:

- The installation of piles should be divided into furnishing, driving and test pile pay items.
• The pile cap may be paid for as concrete structures and reinforcement bars.

• Approach slab and barrier walls shall be measured and paid for as typical IDOT approach slab pay items.

• 1/8” Neoprene Sheet shall be included in the cost of Bridge Approach Slab or Transition Approach Slab, depending on which item is constructed first.
SECTION 20.0 SOIL BORING LOGS

The boring locations shall be shown on the plan view sheet entitled, "General Plan and Elevation", and keyed by a numbering system as described in the Tollway Geotechnical Engineer's Manual. The boring logs shall be included with the Final Plans and placed on the last sheets for each structure. Bottom of footings shall be indicated on the appropriate boring logs and identified as "Bottom of Footing-Pier No.1, etc." Ground water elevations shown on the boring logs should state "Elevation at time boring was taken." An example Soil Boring Log is shown in Figure 20.1.
<table>
<thead>
<tr>
<th>BORENG NO.</th>
<th>STA.</th>
<th>O/S</th>
<th>DEPTH</th>
<th>QU</th>
<th>W</th>
<th>SURF. WATER EL.</th>
<th>GRNDRWATER EL. AT COMPLETION</th>
<th>AT 24 HRS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>702-59-2</td>
<td>44+47</td>
<td>27'</td>
<td></td>
<td></td>
<td></td>
<td>678.0</td>
<td></td>
<td>710</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>QU</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>713.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>711.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>704.5</td>
<td>4</td>
<td>0.7</td>
</tr>
<tr>
<td>699.5</td>
<td>14</td>
<td>2.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>QU</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>711.4</td>
<td>B</td>
<td>4.5</td>
</tr>
<tr>
<td>707.0*</td>
<td>B</td>
<td>3.5</td>
</tr>
<tr>
<td>704.5</td>
<td>B</td>
<td>2.5</td>
</tr>
<tr>
<td>699.5</td>
<td>B</td>
<td>2.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>QU</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>711.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>707.0*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>704.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>699.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = STANDARD PENETRATION TEST; 2" OD SAMPLER,
140# HAMMER FALLING 30" (TYPE FAIL, B-DIGE, S-SHEAR, E-ESTIMATED P-PENETROMETER)
SECTION 21.0 CULVERTS

21.1 General

Culverts shall be designed in accordance with the latest AASHTO LRFD specifications and IDOT Culvert Manual, except as herein modified.

Box culverts may be single or multi-cell box, three-sided box or three-sided arch sections constructed of cast-in-place or precast concrete. Culverts are most commonly used to carry water under roadways, but they are also used for pedestrian/bicycle underpasses. The minimum size for a pedestrian/bicycle underpass is 10 feet high by 10 feet wide. Typical sections for the most frequently used box culverts are shown in Figure 21.1.1.

For culverts over waterways, a type study shall be performed in accordance with the Tollway Drainage Design Manual Article 8.1 to ensure that the type selected is in accordance with United States Army Corps of Engineers permits.

Corrugated metal arch or box culverts are not permitted for new or replacement structures.

Hydraulic and geometric requirements of the site will determine the area and maximum height of the culvert. Once the maximum height and required area are determined, the selection of the type of culvert, its construction and number of cells is determined by economics and site conditions. Barrel lengths are computed to the nearest 6 inch. The designer shall determine the end of the barrel based on a barrier warrant analysis. For multi-cell culverts, the cell widths shall be kept equal.

Wingwalls shall be designed according to the IDOT Culvert Manual. Horizontal Cantilever Wingwalls shall be used for wingwall lengths less than or equal to 14 feet. T-Type or L-Type Vertical Cantilever Wingwalls will be used when the length of wingwall is greater than 14 feet. Reinforced concrete aprons between the wingwalls and safety end treatments shall be placed at both ends of the culvert. The barrel section of a culvert used for a pedestrian/bicycle underpass shall be covered with a waterproof membrane system, in accordance with Section 581 of the latest IDOT Standard Specifications.

21.1.1 Cast-In-Place Concrete Culverts

All designs shall be in accordance with the latest version and interims of the AASHTO LRFD Bridge Design Specifications. The Unit Weight of Backfill ($\gamma_s$) shall be taken as 120 lbs/cu ft. The lateral earth pressure acting on the sidewalls shall be assumed as an equivalent fluid pressure of 40 lbs/cu ft for the depth of the fill and 50 lbs/cu ft for the height of the barrel. A surcharge of 2 feet shall be added to the fill, when live load is considered in the design of the barrel. Refer to Figure 21.1.1.1 for illustration.
The minimum cross-sectional dimensions of a cast-in-place concrete box culvert are as follows and are increased in increments of ½ inch as required:

<table>
<thead>
<tr>
<th>Component</th>
<th>Minimum Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Slab</td>
<td>6 inches</td>
</tr>
<tr>
<td>Bottom Slab</td>
<td>Top Slab Thickness plus 1 inch</td>
</tr>
<tr>
<td>Side Walls</td>
<td>The larger of 6 inches or 1 inch per foot of clear height “H”</td>
</tr>
</tbody>
</table>

All reinforcement bars for box culverts shall be epoxy coated.

21.1.2 Precast Concrete Culverts

Precast concrete culverts are used where labor and materials are not readily available, and when the duplication and installation of identical precast culvert sections would be more economical than cast-in-place construction. Precast concrete culverts are not suitable in areas where the supporting soils are susceptible to excessive or differential settlements, unless they are supported by a reinforced concrete slab or strip footing founded on piles.

21.2 Plan Preparation

Plan sheets for culverts shall contain the following information:

21.2.1 General Plan and Elevation

The general plan and elevation sheet shall include the following information:

- Roadway alignment data, both horizontal and vertical
- Roadway and embankment slopes
- Station and elevation at the centerline of the culvert, showing locations of the joints, if any
- Culvert and wingwall lengths, dimensions and reinforcement bar details
- Barrel invert elevations
- Slope and direction of flow
- Section thru barrel showing all concrete dimensions and reinforcement bar details
- Headwall dimensions and reinforcement bar details
- General Notes
21.2.2 Design Criteria

- The latest version and interims of the AASHTO LRFD Bridge Design Specifications
- AASHTO Materials Specifications M259 and M273 for precast concrete culverts
- IDOT All Bridge Designers (ABD) Memorandum 11.3 (Rev) dated November 2, 2011, (revised January 27, 2012)
- IDOT 2012 Standard Specifications for Road and Bridge Construction and all subsequent revisions
- The latest Tollway Supplemental Specifications to the IDOT Standard Specifications for Road and Bridge Construction

21.2.3 Bill of Material

Regardless of the placement of a coded “Summary of Quantities” on any other plan sheet. There shall be a “Total Bill of Material” shown in the plans for each box culvert.

21.2.4 Construction Staging

If the culvert is to be constructed in stages, the plans must clearly identify and show all stages of construction. Construction staging lines must be shown on all views. The staging plans shall also include the location and details of the temporary concrete barriers.

21.2.5 Concrete Reinforcement Details

A Bar List shall be prepared for each culvert and shown along with bending diagrams of each bent bar on the appropriate plan sheet. See Figure 6.7.1 for the Bar List format.

In no case shall the same designation be used for reinforcement bars of a different size, length and shape when they are employed in other culverts. When detailing lengths of reinforcement bars, consideration must be given to transportation and handling and, where extremely long lengths are contemplated, to availability and special orders.

All sizes of bars are readily available in lengths up to 60 feet. However, sizes #3, #4, and #5 of more than 40 feet tend to bend in handling and should be avoided.
Bars shall be detailed to the nearest inch of length and the weight of reinforcement bars shown in the Bill of Material shall be to the nearest ten (10) pounds.

To provide uniformity on all culvert plans, bar designations used shall be as follows:

a – Top Slab (Transverse)  
b – Top Slab (Longitudinal)  
h – Barrel Walls and/or Wing Walls (Horizontal)  
n – Footing to Wall (Dowels)  
s – Stirrups  
t – Bottom Slab and/or Footing (Transverse)  
v – Barrel Walls and/or Wing Walls (Vertical)  
w – Bottom Slab and/or Footing (Longitudinal)
ACTIVE EARTH PRESSURE ON SIDEWALLS

MARCH, 2015  FIGURE 21.1.1.1  ILLINOIS TOLLWAY
SECTION 22.0 RETAINING WALLS

Retaining walls shall be designed in accordance with Section 11 of the 2012 AASHTO LRFD Bridge Design Specifications.

22.1 Wall Types

Retaining wall structures are used to hold back soil or loose material where an abrupt change in ground elevation occurs. There are several types of retaining wall structures. Depending on the application, certain wall types are more advantageous than others.

- The designer should generalize the site as being either a fill wall location or a cut wall location.

- A fill wall location is characterized by a substantial increase in the ground elevation behind the wall. Fill walls are also appropriate when excavation for the wall can be made without: disruption to traffic lanes that will not be replaced, the need for temporary soil retention or excessively steep or unsafe cut slopes.

- A cut wall location is characterized by a reduction in the ground elevation in front of the wall with minimal or no increase in ground elevation behind the wall.

<table>
<thead>
<tr>
<th>Fill Walls</th>
<th>Cut Walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast-in-Place T-shaped or L-Shaped</td>
<td>Soldier Piles</td>
</tr>
<tr>
<td>Mechanically Stabilized Earth</td>
<td>Sheet Pile</td>
</tr>
<tr>
<td>Precast Modular</td>
<td>Soil Nails</td>
</tr>
<tr>
<td>Gabion</td>
<td>Tangent Drilled Shafts</td>
</tr>
</tbody>
</table>

22.2 Retaining Wall Selection Process

For discussion of the retaining wall selection process, refer to Sections 2.3.5.5 and 2.3.12 in the IDOT Bridge Manual.

The designer shall submit a feasibility study to the Tollway prior to preparation of TS&L plans. The purpose of the feasibility study is to select the most cost effective retaining system for advancement to the TS&L Phase. As part of the feasibility study, the designer should investigate a “no wall” option. This may often require additional right-of-way, earth work and/or relocation of existing utilities and existing structures. If the “no wall” option is not feasible, the designer must study a combination of slopes and wall types to minimize the wall length and height, while remaining aesthetically acceptable and cost effective.

The feasibility study shall include the following items:

- Introduction – Discussion of the project and location of the retaining wall.

- Reason for Retaining Wall – Discussion of the improvement, including impact on adjacent property or structures.
• Retaining Wall Criteria – Design loads, allowable soil pressures, site constraints and design requirements for the retaining wall.

• Retaining Wall Description – Discussion of the location, geometry and other physical features of the retaining wall.

• Structural Alternates – Description and cost estimate for each of the wall types investigated including “No Wall” option.

• Discussion and Recommendation – Summary of findings for each of the wall types along with a recommendation of which alternate to advance to the TSL Phase.

The feasibility study shall also include the following exhibits:

• Proposed alignment and roadway plan

• Proposed roadway cross sections

• Preliminary general plan and elevation sketch

• Retaining wall typical sections

• Retaining wall cost estimates

• Soil boring location map

• Soil boring logs

22.3 Plan Preparation

22.3.1 Plan Sheet Organization

Each retaining wall shall consist of a set of sequentially numbered plan sheets. Plan sheets shall be organized in such a manner as to facilitate construction. The first sheet shall be a plan and elevation view of the entire wall showing its alignment including stations and offsets to each end of the wall and intermediate control points. The location of all lighting, signing, fencing, drainage structures and utilities located under, on, or adjacent to, or passing through the wall shall be shown. Also, all design criteria shall be listed.

The TS&L and final plans shall include a true wall section(s) which shows wall offsets to base line(s) and R.O.W.

The second sheet shall contain an index of sheets, general notes, abbreviations, total bill of material, typical wall section and drainage details.
Subsequent sheets shall completely detail and dimension each succeeding section of the retaining wall in plan and elevation views. Wall sections and details shall be included on each sheet. See Figures 22.3.1.1 through 22.3.1.7 for retaining wall details.

Each retaining wall plan set shall include pile driving record tables and boring log sheets for the data that pertains to the retaining wall. The bottom of footing elevation shall be shown on the appropriate boring log and identified as “Bottom of Retaining Wall Footing.”

22.3.2 Naming Convention

Retaining walls shall be identified on the plans using the following format:

Tollway, Milepost, Wall Type, Direction, Ramp location

**TOLLWAY:**
- EW = Reagan Memorial Tollway (I-88)
- NS = Veterans Memorial Tollway (I-355)
- NW = Jane Addams Memorial Tollway (I-90)
- TS = Tri-State Tollway (I-294 & I-294/I-80)
- TN = Tri-State Tollway (I-94)
- ES = Edens Spur (I-94)
- EO = Elgin-O’Hare Expressway (IL 390)
- WA = West O’Hare Access Bypass (I-490)

**MILEPOST:** Two-decimal lowest wall milepost to the tenth or hundredth if a ¼ mile post (i.e. 14.75)

**WALL TYPE:** R = Retaining Wall

**DIRECTION:** EB, SB, WB, NB - Inventory direction of the mainline roadway

**RAMP:** (R) = if lowest milepost is along ramp (omitted if not along ramp)

**EXAMPLE:** TS38.40R,NB(R) for a retaining wall located along the Tri State Tollway (I-294) northbound at milepost 38.4 on a ramp

If two walls of the same type have identical starting mileposts, the inventory milepost of one of the walls shall be shifted by one hundredth of a mile to create unique names.

22.4 Wall Design Criteria

22.4.1 Design Specifications

See Article 5.1.

22.4.2 Design Loads

- Dead Loads
See Article 5.1.

- **Live Loads**

  See Article 5.1.

- **Earth Pressure**

  See Section 5.1. The formula to compute lateral earth pressure is Coulomb's equation for the resultant parallel to the backfill slope. The maximum angle of internal friction for granular material shall be $\theta = 30$ deg.

  The formula to compute lateral earth pressure for sloping backfill assumes the mass of earth behind the wall extending to the point of intersection of the two planes (slope plane and failure plane of soil). In many cases the sloping backfill ends at a certain height above the wall where a roadway is intersected. The formula gives conservative results for this case. See Figure 22.4.2.1 for details.

- **Wind Loads**

  A wind load on the parapet and/or noise abatement wall shall be applied to the exposed surface area in any direction.

**22.4.3 Design Stresses**

See Article 5.1.

**22.4.4 Wall Layout**

Slopes in front of all wall types should not be continued into or away from the wall. A minimum 2 feet flat area should be provided in front of the wall for maintenance and to ensure adequate frost line clearance.

**22.5 Cast-in-Place T-Shaped or L-Shaped Walls**

Cast-in-place T-shaped and L-shaped walls shall be designed in accordance with Sections 3.10 and 3.11 of the latest IDOT Bridge Manual except as amended herein.

**22.5.1 Description**

In general, the Tollway utilizes cantilever T-shaped retaining walls in fill locations up to a height of 25 feet. For details of a T-shaped wall see Figures 22.5.1.1 thru 22.5.1.3. Counterforted I-walls and/or I-shaped walls may also be used for special cases.

Typically, a T-shaped wall is more economical than an L-shaped wall. L-shaped walls are utilized in cases where the face of the wall is located adjacent to or right on the ROW, property line or obstruction.
22.5.2 Stem

The minimum thickness at the top of the stem is 12 inches. For stems requiring thickness greater than 12 inches at the base, batter is provided on the back face of the stem (the face in contact with the earth) in increments of ¼ inch per foot up to a maximum of ¾ inch per foot. The batter shall be held constant for the entire length or section of the retaining wall where it is required.

The stem shall be designed to accommodate crash Test Level 5 (TL-5). See latest AASHTO LRFD Table A.13.2-1 for loading details. The stem shall have sufficient resistance to force the yield line failure pattern to remain within the parapet and shall be designed for the full dynamic load. Drainage behind the stem shall consist of a geocomposite wall drain and porous granular backfill, consistent with Section 3.11.2.3 of the IDOT Bridge Manual, except as modified herein. The geocomposite wall drain shall be continuous. Refer to Figures 22.3.1.2 and 22.5.1.1 for illustration.

22.5.3 Footing

The bottom of footing shall be set below the frost penetration depth, which is generally 4 feet below the top of finished grade. The minimum spread footing thickness shall not be less than 18 inches or the stem thickness at the base plus 3 inches.

For pile supported footings, the minimum thickness shall be 2’-6” and the piles shall be embedded 12 inches. The front row(s) shall be battered if the piles' lateral resistance to sliding is not adequate. The maximum pile spacing shall be as specified in Section 3.10 of the IDOT Bridge Manual. For walls with pile footings it is usually more economical to use the minimum width of footing where feasible rather than to increase the footing width to reduce the number of piles.

If the top of finished ground is sloped along the face of wall, a stepped footing should be considered. For details of stepped footings and minimum thickness requirements, see Figures 22.5.3.1 and 22.5.3.2.

The footing shall be designed to accommodate crash Test Level 5 (TL-5). See latest AASHTO LRFD Table A.13.2-1 for loading details. Guidance on the magnitude of force applied to the footing is limited; however, a reduction in energy will occur as the yield line develops within the parapet and forces are transferred through the stem. The footing and piles shall be designed for the equivalent static load of 23 kips applied over 8 feet at the top of the parapet.

22.5.4 Stability

For spread footings on soil, the vertical resultant must fall within the middle 1/3 of the footing width. For spread footings founded on rock, the vertical resultant must fall within the middle 1/2 of the footing width.

The safety factor against sliding shall be 1.5 or greater for spread footings.
Factors resisting sliding for spread footings:

- Friction Between Soil and Concrete

  For Clay: \( \text{Resisting Force} = (\text{Unconfined compressive strength}) \times 0.5 \)
  
  For Sand: \( \text{Resisting Force} = W \times \tan \phi \)

  Where: \( W = \text{Vertical Load} \)  
  \( \phi = \text{Internal Angle of Friction} \)

  \( \tan \phi = 0.45 \) is a conservative value

- Shear Key.

  The shear key shall be located in line with the front face of the stem except under severe loading conditions. The width of the shear key shall be 1'-0" minimum and the minimum depth is 1'-0". The shear key shall be placed against undisturbed material.

  The total resistance to sliding is based on the soil strength in front of the shear key and adhesion between the footing and soil behind the key.

- Spread footings on rock. The width of the key shall be 1'-0" minimum. Key the footing a minimum depth of 6" into the rock.

- Pile Footings.

  The maximum slope to be used for determining the horizontal resistance of a battered pile shall be 3 inches horizontal per foot vertical.

  For the lateral resistance of battered or vertical piles, in addition to horizontal component of battered piles, consult the structural geotechnical report.

### 22.6 Flexible Retaining Walls

Flexible retaining walls include; Mechanically Stabilized Earth (MSE), Block, Soldier Pile, Sheet Pile, Soil Nail and Gabion.

Retaining walls that require the use of ground reinforcement straps shall not utilize straps that extend under Tollway lanes carrying mainline traffic. In this case, ground reinforcement may extend under the shoulders only. For collector-distributor roads and ramps with two lanes, the ground reinforcement may extend under the shoulder and one of the two lanes. For collector-distributor roads and ramps with single lanes, the ground reinforcement shall not extend under the traffic lane.

The required design life for all elements of retaining wall structures is 75 years. A design life of 100 years is required for bridge abutment walls.

Provide full height expansion joints in the gutter and parapet every 90 feet. The expansion joints shall be detailed as shown in Figures 22.12.1 and 22.14.1. Provide...
partial height parapet joints in the upper portion of the parapet at 15 foot centers. These partial height joints should be ½-inch open joints.

Design loads for retaining walls with moment slabs shall include the provisions of the AASHTO LRFD Bridge Design Specifications, Section 11.10.10.2 and Test Level 5 (TL-5). In order to achieve TL-5 crash force protection, all designers shall increase the specified horizontal load applied to the top of the soil mass from 0.5 kip per foot, developed for TL-4, to 1.15 kips per foot (for TL-5). The magnitude of the 1.15 kips per foot force was determined by multiplying the ratio of the TL-5 crash force (124 kips) over the TL-4 crash force (54 kips) by 0.5 kip per foot.

When structural steel is in contact with the ground, the effects of corrosion shall be included in the design. The specification and accommodation for the length of the corrosion are the responsibility of the designer with approval of the Tollway. Paint used shall be specified by the designer and shall be consistent with Section 506 of IDOT Specifications. The IDOT Bridge Manual also references concrete encasement and use of additional sacrificial steel section. Paint or concrete in exposed conditions shall generally extend to 3 feet beyond expected exposure line including the fully exposed length. Section 506 of the Standard Specifications for paint shall be used in corrosive soils with or without exposure. If protection is not specified for exposed or corrosive conditions, additional steel section shall be supplied to compensate for losses due to corrosion.

22.6.1 Mechanically Stabilized Earth (MSE) Retaining Walls

Generally MSE walls should only be utilized for fill locations or where part of the existing side or foreslope can be removed without compromising the stability of the embankment. MSE walls should not be utilized where a Temporary Earth Retention System would be required to construct the reinforced wall mass except in special cases.

22.6.1.1 Location

MSE wall should be located a minimum of 10'-0" inside of the Tollway's right of way. MSE Wall is not allowed at water crossings or adjacent to water where hydraulic draw down within the wall limits is possible.

22.6.1.2 Plans and Specifications

The Contractor shall be provided with plans showing a line diagram envelope (Elevation View) of the proposed wall location, grades, and dimensions. Specifications shall be furnished covering the work requirements for design, construction plans, materials procurement, and wall construction. The prequalified retaining wall supplier selected by the Contractor must submit a complete set of design calculations, detailed plans, and explanatory notes for the designer's review and acceptance prior to ordering any material. The design must be in accordance with the 2012 AASHTO LRFD Bridge Design Specifications and the special provisions. All costs for performing the work shall be included in the price bid by the Contractor.
The designer shall prepare plan sheets containing the following information:

- Site plan with boring locations
- Wall plan with stations and offsets
- Top of wall elevations (located at the top of exposed panel line)
- Top of ground elevations at front and back face of wall
- Safety-barrier railing, or fence requirements
- Special coping requirements
- Utility accommodations
- Drainage requirements
- All special design features
- Subsurface information (the proprietary wall companies must be informed of all geotechnical stability and settlement concerns)
- Wall surface textures
- Wall design criteria
- Minimum footing depth (generally 4'-0", which is considered to be the frost penetration depth)

22.7 Precast Modular Walls

Block retaining walls shall be designed in accordance with the applicable parts of Section 3.11.1 of the IDOT Bridge Manual and the 2012 LRFD AASHTO Bridge Design Specifications except as amended herein.

When specifying a proprietary block retaining wall, the special provisions shall state that the wall shall be built according to the manufacturer's specifications. The manufacturer's specifications generally need to be supplemented. Material specifications for backfill, leveling pad, drainage systems, fill for hollow blocks, geotextile fabrics or any other special requirements should be clearly stated in the special provisions.

Modular block retaining walls shall be designed and sealed by the manufacturer's Illinois licensed Structural Engineer. Soil reinforcement shall be either galvanized or coated steel or polypropylene or polyester geogrids. In the absence of more accurate data, design loads on the wall shall be based on a non-cohesive material with an angle of internal friction of 34 deg. The minimum size of the concrete leveling pad shall be 6 inches deep by 12 inches wide. All steel components of a system shall be hot dipped galvanized in accordance with the AASHTO M111 (ASTM A123).
22.8 **Soldier Pile Retaining Walls**

Soldier pile walls shall be designed in accordance with Section 3.11.3 of the latest IDOT Bridge Manual and the 2012 AASHTO LRFD Bridge Design Specifications except as amended herein. Timber lagging is not permitted as a facing material for permanent soldier pile walls.

22.9 **Permanent Sheet Pile Retaining Walls**

Permanent sheet pile retaining walls shall be designed in accordance with Section 3.11.4 of the latest IDOT Bridge Manual.

22.10 **Soil Nailed and Other Specialized Wall Systems**

Soil nailed and other specialized wall systems shall be designed in accordance with Section 3.11.6 of the latest IDOT Bridge Manual.

22.11 **Temporary Soil Retention Systems**

Temporary soil retention systems, including temporary sheet piling, wire-faced MSE walls, braced excavations and other temporary construction works shall be designed in accordance with Section 3.13 of the latest IDOT Bridge Manual.

22.12 **Snow Storage Area**

The need for and design of the snow storage area shall be according to the latest version of the Tollway Roadway Design Criteria. When snow storage is required, the retaining wall and parapet should move away from the edge of shoulder to create a place to store the snow in front of the parapet. If a noise abatement wall will be required at the location, the parapet should not move away from the edge of shoulder and snow storage should be accommodated between the parapet and the noise abatement wall. Figure 22.12.1 shows the configuration of the parapet and noise abatement wall when a moment slab is used.

22.13 **Parapet Shape**

The Tollway uses two parapet shapes for retaining walls – 42" F-shape and 42" single slope. Both types should be designed to accommodate crash Test Level 5 (TL-5). See latest AASHTO LRFD Table A.13.2-1 for loading details.

**F-Shape**

The F-shape shall be used on the front (traffic side) of the parapet whenever a moment slab is used to counteract forces applied to the parapet. When a moment slab is used, the expected settlement adjacent to the wall should be minimal. The 3" vertical face at the bottom of the F-shape barrier is a maximum dimension and any settlement would make the safety shape unacceptable. See Figure 22.5.1.3 for an example using F-shape.
Single Slope
The single slope shall be used on the front (traffic side) of the parapet whenever a moment slab is not used. The single slope parapet shall have a 6:1 (V:H) slope, which shall extend 6” below finished grade. The crashworthiness of the parapet is unaffected by settlement adjacent to the wall because the slope extends below grade. Therefore, a single slope parapet shall be used whenever an asphalt snow storage area is located in front of the wall. See Figure 22.5.1.3 for an example using single slope parapets.

22.14 Moment Slab on Retaining Wall Design Guides

A moment slab includes both the horizontal slab and the 42” F-Shape vertical barrier that is attached to the slab. Design loads for strength that include flexure, shear and torsion are applied in accordance with the AASHTO LRFD Bridge Design Specifications, Section 13, Table A13.2, Test Level 5 (TL-5). Design loads for global stability including sliding and overturning shall follow recommendations of NCHRP 663. Prior to this change, walls and moment slabs were designed in accordance with AASHTO Standard Specifications Load Factor Design (LFD) methodology.

A 6” thick layer of CA-6 aggregate shall be placed beneath the moment slab to develop friction.

Structural Capacity – The structural capacity of the barrier and concrete moment slab shall be designed using dynamic TL-5 loads in accordance with Sections 5 and 13 of the AASHTO LRFD Bridge Design Specifications.

Global Stability – Sliding and overturning stability of the moment slab shall be based on an Equivalent Static Load (ESL) applied to the top of the traffic barrier. For TL-5 barrier systems, the ESL shall be 23 kips.

Rigid Body Definition – Moment slabs that have a minimum width of 4'-0” measured from the point of rotation to the heel of the slab and a minimum average depth of 10” are assumed to provide rigid body behavior up to a length of 60’ for end barrier and interior barrier impacts. Rigid body behavior may be increased from 60’ to a maximum of 120’ if the torsional rigidity constant of the moment slab is proportionately increased and the reinforcement bars are designed to resist combined shear, moment, and torsion from impulse loads.

Sliding of the Barrier – The factored static resistance to sliding (φP) of the barrier-moment slab system along its base shall satisfy the following condition (See Figure 22.14.1).

\[ φP ≥ γLs \]

\[ Ls = \text{equivalent static load (23 kips for TL-5)} \]
\[ φ = \text{resistance factor (1.0) [AASHTO 10.5.5.3.3—Other Extreme Limit States]} \]
\[ γ = \text{load factor (1.2 for TL-5)} \]
\[ P = \text{static resistance (kips)} \]
P shall be calculated as:
\[ P = W \tan \varphi_r \]

\( W \) = weight of the monolithic section of barrier and moment slab between joints or assumed length of rigid body behavior, whichever is less, plus any material laying on top of the moment slab
\( \varphi_r \) = friction angle of the soil on the moment slab interface (°)

If the soil-moment slab interface is rough (e.g., cast in place), \( \varphi_r \) is equal to the friction angle of the soil \( \varphi_s \). If the soil-moment slab interface is smooth (e.g., precast), \( \tan \varphi_r \) shall be reduced accordingly to \( 0.8 \tan \varphi_s \).

**Overturning of the Barrier** – The factored static moment resistance (\( \varphi M \)) of the barrier-moment slab system to over-turning shall satisfy the following condition (See Figure 22.6.1).

\[ \varphi M \geq \gamma L_s h_a \]

\( A \) = point of rotation, where the toe of the moment slab makes contact with compacted
\( L_w \) = width of moment slab
\( L_s \) = equivalent static load (23 kips for TL-5)
\( \varphi \) = resistance factor (0.5) [Supersedes AASHTO 10.5.5.3.3—Other Extreme Limit States and NCHRP Report 663]
\( \gamma \) = load factor (1.2 for TL-5)
\( h_a \) = moment arm taken as the vertical distance from the point of impact due to the dynamic force (top of the barrier) to the point of rotation \( A \)
\( M \) = static moment resistance (kips-ft)

\( M \) shall be calculated as:
\[ M = W (L_a) \]

Figure 22.14.2 illustrates typical reinforcement bar details for a moment slab.

\( W \) = weight of the monolithic section of barrier and moment slab between joints or assumed length of rigid body behavior, whichever is less, plus any material laying on top of the moment slab
\( L_a \) = horizontal distance from the center of gravity of the weight \( W \) to point of rotation \( A \)

The moment contribution due to any coupling between adjacent moment slabs, shear strength of the overburden soil, or friction which may exist between the backside of the moment slab and the surrounding soil should be neglected.

Figure 22.14.2 illustrates typical reinforcement bar details for a moment slab.
CONSTRUCTION JOINT DETAIL

RETAINING WALL
STEM OR FACING
MANDATORY UNBONDED CONSTRUCTION JOINT
LAP LENGTH
FRONT FACE
3/4" CHAMFER

EXPANSION JOINT DETAIL

RETAINING WALL
STEM OR FACING
2" CL. (TYP.)
1/2"
6" HOLLOW BULB DUMBBELL TYPE, NONMETALLIC WATER SEAL
2 3/4"
CEMENT NAILS FLAT HD. C.S. 1" LONG AT 12" CTS. VERTICAL EACH FACE (COST INCLUDED WITH CONCRETE STRUCTURES)
FRONT FACE
3/4" CHAMFER
1/2" PREFORMED JOINT FILLER

RETAINING WALL JOINT DETAILS

MARCH, 2015
FIGURE 22.3.1.1
ILLINOIS TOLLWAY
SUBDRAIN THRU RETAINING WALL DETAILS

SUBDRAIN

1/2" MIN. NON-SHRINK CROUT

NON METALLIC SLEEVE THROUGH RETAINING WALL
NOTES:
1. BASE PLATES, STIFFENERS AND EXPANSION ANCHORS FOR MOUNTING FENCE ON RETAINING WALLS SHALL BE INCLUDED IN THE COST OF CHAIN LINK FENCE.
2. IF NECESSARY THE SIZE OF THE BASE PLATE AND LOCATION OF THE EXPANSION ANCHORS MAY BE ADJUSTED TO MISS THE WALL REINFORCEMENT.
3. BASE PLATES AND STIFFENERS SHALL BE FABRICATED FROM MATERIAL MEETING THE REQUIREMENTS OF AASHTO M270 GRADE 36.
4. BASE PLATES, STIFFENERS AND POSTS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH AASHTO.

DETAIL FOR MOUNTING FENCE POST ON CONCRETE RETAINING WALL

MARCH, 2015

FIGURE 22.3.1.4

ILLINOIS TOLLWAY
NOTES:
1. BASE PLATES, STIFFENERS AND EXPANSION ANCHORS FOR MOUNTING FENCE ON RETAINING WALL SHALL BE INCLUDED IN THE COST OF CHAIN LINK FENCE.
2. IF NECESSARY THE SIZE OF THE BASE PLATE AND LOCATION OF THE EXPANSION ANCHORS MAY BE ADJUSTED TO MISS THE WALL REINFORCEMENT.
3. BASE AND STIFFENERS SHALL BE FABRICATED FROM MATERIAL MEETING THE REQUIREMENTS OF AASHTO M270 GRADE 36.
4. BASE PLATES, STIFFENERS AND POSTS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH AASHTO.

DETAIL FOR MOUNTING FENCE
POST ON CONCRETE BARRIER WALL

MARCH, 2015  FIGURE 22.3.1.5  ILLINOIS TOLLWAY
10" Ø ALUMINUM POLE BY OTHERS
THREAD AND CAP END OF CONDUIT. WHEN READY FOR WIRING REPLACE CAP WITH BUSHING
STAINLESS STEEL MESH
3–#6 V(E) BARS

8" 4" 8"
8"

2.5" 2.5"
4.5" 4.5"
6–#6 V(E) BARS

1" Ø x 5'–9" ANCHOR BOLTS PROVIDE 2 FLAT WASHERS, 1 LEVELING NUT & 1 LOCKNUT FOR EACH BOLT. ALL NUTS & WASHERS MUST BE GALVANIZED. SEE FIGURE 22.3.1.7 FOR ANCHOR BOLT DETAIL.
3–#6 V(E) BARS

15" Ø BOLT CIRCLE
16" x 16" BASE P (BY OTHERS)

A

-2" Ø PVC CONDUIT (TYP.)

1'–8"
1′–0"
8"

1'–3"
1'–3"
2′–6"

10°/8

10°/8

MIN.

MIN.

(2) SEE FIGURE 22.3.1.7 FOR BAR DETAILS.

NOTE:
COST OF ANCHOR BOLTS IS INCLUDED IN THE COST OF CONCRETE STRUCTURES PAY ITEM. 2" Ø PVC CONDUIT SHALL BE PAID FOR SEPARATELY.

SECTION A–A

STAINLESS STEEL STANDARD GRADE WIRE CLOTH – TYPE 304, 4x4 MESH, 0.047" WIRE DIAMETER

LIGHT STANDARD ON RETAINING WALL DETAILS

MARCH, 2015

FIGURE 22.3.1.6

ILLINOIS TOLLWAY
1" DIA. ANCHOR BOLT

BAR v(E)  BAR d(E)

LIGHT STANDARD ON RETAINING WALL DETAILS

MARCH, 2015  FIGURE 22.3.1.7  ILLINOIS TOLLWAY
\[ P = \frac{WH_1^2}{2} \cos d \left( \frac{\cos d - \sqrt{\cos d^2 - \cos F^2}}{\cos d + \sqrt{\cos d^2 - \cos F^2}} \right) \]

WHERE

- \( P \) = TOTAL ACTIVE EARTH PRESSURE, KIPS PER FOOT OF WALL LENGTH.
- \( H_1 \) = TOTAL WALL DEPTH AS SHOWN IN SKETCH, FEET.
- \( F \) = ANGLE OF INTERNAL FRICITION OF SOIL, DEGREES.
- \( d \) = ANGLE OF SLOPE OF BACKFILL, DEGREES.
- \( W \) = UNIT WEIGHT OF SOIL, KIPS PER CUBIC FOOT.

RANKINE OR COULOMB FORMULA FOR ACTIVE EARTH PRESSURE

EXAMPLE FOR \( F = 30^\circ \) AND \( d = 0^\circ \).

\[ P = \frac{WH_1^2}{2} \left( \frac{1. - \sqrt{1. - 0.86603^2}}{1. + \sqrt{1. - 0.86603^2}} \right) = \frac{WH_1^2 (0.333)}{2} = \frac{H_1^2 (0.04)}{2} \]

DESIGN LOADS

MARCH, 2015

FIGURE 22.4.2.1

ILLINOIS TOLLWAY
* For exposed wall height greater than 4'-0", extend top of wall 4'-0" above gutter or provide standard R.O.W. fencing if maintenance personnel will have access to side slope of embankment.

**Typical Section Thru Retaining Wall**

- **6 Mil. Polyethylene Bond Breaker**
- **Existing or Proposed Ground Line in Back of Wall**
- **Geocomposite Wall Drain Continuous on Back Face (See Fig. 22.31.2)**
- **Porous Granular Backfill**
- **Back Face**
- **Structural Subdrain 6"Ø, Wrapped in Filter Fabric in Accordance with Section 606 of the Standard Specifications**
- **Varies**
- **1'-0" (Typ. All Around) Limits of Structure Excavation**
- **Backfill Below This Line with Impervious Clay 1'-6" Wide, Cost to Be Included in the Unit Price Per Cubic Yard for Structure Excavation.**

---

**ILLINOIS TOLLWAY**

**SLOPED HEADWALL**
Type III TYP, Each Outlet Subdrain, (See STD. B9 & B10)

**Rodent Shield**
(See STD. B24)

**Prop. Ground Line in Front of Wall**

---

**FRONT FACE**
Gutter W/C-2 Frame and Grate at Drainage Structures
* BACK FACE SLOPE = ZERO TO 3/4" PER FOOT MAXIMUM.

#4h (E) AT 1'-0" CTS.

"4h (E) AT ± 2'-0" CTS.

2" CL.

#4v (E) AT 1'-0" CTS.

2" CL.

1½"x3½" KEYWAY
CONSTRUCTION JOINT

TYPICAL CANTILEVER RETAINING WALL
REINFORCEMENT BAR DETAILS

MARCH, 2015

FIGURE 22.5.1.2

ILLINOIS TOLLWAY
CANTILEVER RETAINING WALL DETAILS
WITH INTEGRAL SINGLE BARRIER

MARCH, 2015

FIGURE 22.5.1.3

ILLINOIS TOLLWAY
BEND TOP BARS AND EXTEND TO BOTTOM OF LOWER FOOTER (TYP.)
NORMAL REINFORCING STEEL TOP AND BOTTOM (TYP.)

ADDITIONAL #5 BARS (MAXIMUM VERTICAL SPACING OF 1'-0'"

BEND BOTTOM BARS AND EXTEND TO TOP OF UPPER FOOTER (TYP.)

SLOPE AS STEEP AS SOIL CONDITIONS WILL ALLOW

STEPPED FOOTING DETAILS
**STEPPED FOOTING DETAILS WITH PILES**

*To Center Line of Pile and End of Lower Footing*
** DRAINAGE STRUCTURE SPACING TO BE DESIGNED AS NEEDED. LOCATION OF THE MOMENT SLAB DRAINAGE STRUCTURE SHALL BE COORDINATED WITH THE ROADWAY DRAINAGE STRUCTURE.

** NON-STAINING GRAY ONE COMPONENT NON-SAG ELASTOMERIC GUN GRADE POLYURETHANE SEALANT WITH BACKER ROD AS PART OF FILLER.

MOMENT SLAB FOR NOISE ABATEMENT WALL AND SNOW STORAGE
MOMENT SLAB STABILITY AND EXPANSION JOINT DETAIL

PLAN DETAIL A

SHOULDER RUMBLE STRIP DETAILS

FIGURE 22.14.1
MOMENT SLAB REINFORCEMENT

NOTES:
1. MINIMUM LENGTH OF MOMENT SLAB SHALL BE 20'-0"
   BETWEEN EXPANSION JOINTS FOR THIS CONFIGURATION.
2. DESIGNER SHALL PROVIDE DETAILS AT DRAINAGE STRUCTURES.
3. LOCATIONS OF BARRIER WALL JOINTS SHALL MATCH LOCATIONS OF MOMENT SLAB JOINTS.

* USE 1'-0" FOR CERTAIN WALL TYPES TO ENSURE DRAINAGE CAN BE LOCATED AT THE FRONT FACE OF THE BARRIER WALL.
* * THICKNESS MAY BE MODIFIED TO ACCOMMODATE ADJACENT PAVEMENT.
SECTION 23.0 NOISE ABATEMENT WALLS AND RAILROAD BRIDGE FENCING

23.1 General

Noise abatement walls shall be designed in accordance with the latest AASHTO Guide Specifications for Structural Design of Sound Barriers and interims, AASHTO LRFD Bridge Design Specifications, Sections 13 and 15 at Test Level 4 or 5 (TL-4 or TL-5) as applicable and as amended herein.

The noise abatement wall shall be designed to attenuate the sounds generated by highway traffic and achieve a minimum noise reduction of 5 decibels.

The noise abatement wall material shall be manufactured from fire retardant material that meets State and local requirements. Structure mounted or ground mounted Noise Abatement Wall types shall be one of the following:

- Precast Concrete – The precast concrete noise abatement wall shall consist of either separate panels, or posts and panels spanning between vertical posts. The precast concrete panels of the noise abatement wall may be conventionally reinforced, pre-stressed, post-tensioned, or any combination thereof. The posts of the noise abatement wall may be constructed of precast concrete or galvanized, structural steel. If precast concrete posts are chosen, they may be conventionally reinforced, pre-stressed, post-tensioned, or any combination thereof.

- Concrete Masonry – This system consists of a noise abatement wall constructed of manufactured masonry block units. Masonry block walls shall be hand-laid. The posts of the noise abatement wall may be constructed of precast concrete, galvanized steel encased in masonry, or masonry block pilasters. If precast concrete posts are chosen, the posts may be conventionally reinforced, pre-stressed, post-tensioned, or any combination thereof. Concrete Masonry panels shall not be used as bridge or retaining wall mounted noise abatement walls.

- Brick Masonry – This system consists of a sound barrier constructed of manufactured brick masonry units. Brick masonry walls shall be hand-laid. The Brick Masonry Noise Abatement Wall shall consist of either separate panels, or posts and panels spanning between vertical posts. The posts of the Noise Abatement Wall may be constructed of precast concrete, galvanized steel, or brick masonry pilasters. If precast concrete posts are chosen, the posts may be conventionally reinforced, pre-stressed, post-tensioned, or any combination thereof. Brick Masonry panels shall not be used for bridge or retaining wall mounted or crashworthy ground mounted noise abatement walls.
• Composite – The composite noise abatement walls shall be a composite plastic extruded material. The composite noise abatement wall shall consist of separate panels, or posts and panels spanning between vertical posts. The posts of the composite noise abatement wall may be constructed of composite material, precast concrete or galvanized steel. If precast concrete is chosen, the posts may be conventionally reinforced, pre-stressed, post-tensioned, or any combination thereof.

• Wood – This system consists of a domestic or Canadian wood sound barrier constructed of treated wood posts, vertically oriented wood panels of tongue and groove construction, and a wood cap board to protect end grain.

• Alternate Material Noise Abatement Wall – This system allows the Contractor to bid an alternate material noise wall system that meets the requirements stated in this section and as accepted by the Tollway.

Wooden noise abatement wall shall be designed for a minimum service life of 25 years; precast concrete and alternate material noise abatement walls shall be designed for a minimum service life of 50 years. The design shall be based on the consideration of the potential long-term effects of weathering, corrosion, spray from de-icing chemicals, and other potentially deleterious environmental factors on each of the material components comprising the Noise Abatement Wall.

Expansion and Contraction Devices

The Noise Abatement Wall shall be designed with consideration of the movements in the wall due to temperature changes, dead loads and wind loads. Locations and spacing of expansion devices shall be as designed by the Contractor and approved by the Tollway.

Stabilizers

Permanent stabilizers are required between posts and panels to maintain the vertical positions of the panel while resisting the lateral loading primarily due to wind and vehicle impact. The stabilizers shall be spaced at intervals not to exceed 4 feet, and shall have a minimum height of 4 inches.

23.2 Design Criteria

23.2.1 Design Specifications

See Article 5.1.

23.2.2 Design Loads

All Loading and Geometric requirements as specified in the 2014 AASHTO LRFD Bridge Design Specifications and interims shall be satisfied.
• Dead Load

Dead Load for wood noise abatement walls mounted on bridges and retaining walls shall be a maximum 20 psf of vertical wall surface.

The dead load shall consist of the weight of all the component materials making up the Noise Abatement Wall. For structure-mounted Noise Abatement Walls, the point of action of the weight of the individual components shall be their respective centers of gravity.

• Wind Loads

The minimum design wind load for structure-mounted noise abatement walls shall be 35 psf. For ground-mounted noise abatement walls, the minimum design wind load shall be 25 psf, or as determined by Articles 3.8.1. and 15.8.2 of the AASHTO LRFD Bridge Design Specifications, whichever is greater.

Design horizontal wind pressures shall account for the direction of wind, height, and elevation of the wall, topography and gust factors. The noise abatement wall shall be designed to withstand wind pressure, applied perpendicular to the wall and separately in each direction.

The maximum allowable panel deflection for wind loads shall be no more than the panel length (L) divided by 240 (L/240) for ground-mounted panels and panel length (L) divided by 180 (L/180) for structure-mounted panels, where L is the length between panel supports. The vertical posts shall have a maximum deflection of (H/180), where H is the height of the post above the foundation or anchors.

• Seismic Loads

In accordance with Subsection 1-2.1.3 of the AASHTO LRFD Bridge Design Specifications.

• Vehicle Impact Loads

Crashworthy walls shall be specifically identified in the plans and must meet the National Cooperative Highway Research Program (NCHRP) Report 350, “Recommended Procedures for the Safety Performance Evaluation of Highway Features”, “Application of AASHTO LRFD Specifications to Design of Sound Barriers” and the AASHTO LRFD Bridge Design Specifications.

The following crash test levels shall be used to determine vehicle impact loads applied to noise abatement walls located within the clear zone or otherwise requiring shielding as determined by a barrier warrant analysis:

- Structure Mounted
  - Shielded: TL-5, applied in accordance with AASHTO 15.8.4 – Cases 1 through 4
Unshielded: TL-5, applied in accordance with AASHTO 15.8.4 – Case 1

- Ground Mounted
  - Shielded: TL-4, applied in accordance with AASHTO 15.8.4 – Cases 1 through 4
  - Unshielded: TL-4, applied in accordance with AASHTO 15.8.4 – Case 1

The following crash test levels shall be used to determine vehicle impact loads applied to noise abatement walls located well outside the clear zone as identified in a barrier warrant analysis:

- Structure Mounted
  - Shielded: TL-4, applied in accordance with AASHTO 15.8.4 – Cases 1 through 4
  - Unshielded: TL-4, applied in accordance with AASHTO 15.8.4 – Case 1

- Ground Mounted
  - Not applicable

- In addition, for all shielded noise abatement walls, noise abatement wall components with a setback less than 4.0 feet behind a barrier shall be designed to resist a collision force of 4.0 kips applied at the highest point up to 14.0 feet above the surface of the pavement in front of the traffic railing. This load shall be checked independently from the Impact loads specified in the AASHTO LRFD Bridge Design Specifications.

- Unbalanced Soil Loads

  If a noise abatement wall is to account for lateral earth pressure due to unequal ground lines, that requirement shall be shown in the Plans.

23.2.3 Design Height

The design height shall be determined by the designer in conjunction with the noise mitigation study for each location.

23.2.4 Stresses

Allowable design stresses for individual materials comprising the different wall types are covered in the Performance Based Special Provision for Noise Abatement Wall.

23.3 Plan Preparation

23.3.1 General

The designer shall indicate the location of all required noise walls on the appropriate roadway and structure plans. Sufficient information shall be shown on the plans and
cross sections so that the manufacturer can design and detail the noise wall to accommodate each: ground-to-structure transition, overlap, obstruction and utility or drainage interference. The designer shall locate the beginning and end of the noise wall including overlaps and directional changes by station and offset on the appropriate roadway, drainage and lighting plans including cross sections. See Figure 23.3.1.1 for typical details.

An elevation view of each noise wall shall be included in the plans. Each elevation shall show top of noise wall and proposed grade. The location of transitions, overlaps, obstructions, utility or drainage interferences and changes in noise wall height shall also be shown. Changes in noise wall height shall be accomplished in 2 foot increments. The top of wall shall remain horizontal between steps. For an elevation view example, see Figures 23.3.1.2 and 23.3.1.3. The top of the wall shall remain above the Acoustical Profile Line.

23.3.2 Naming Convention

Noise abatement walls shall be identified on the plans using the following format:

Tollway, Milepost, Wall Type, Direction, Ramp location

TOLLWAY:  
EW = Reagan Memorial Tollway (I-88)  
NS = Veterans Memorial Tollway (I-355)  
NW = Jane Addams Memorial Tollway (I-90)  
TS = Tri-State Tollway (I-294 & I-294/I-80)  
TN = Tri-State Tollway (I-94)  
ES = Edens Spur (I-94)  
EO = Elgin-O’Hare Expressway (IL 390)  
WA = West O’Hare Access Bypass (I-490)

MILEPOST:  Two-decimal lowest wall milepost to the tenth or hundredth if a ¼ mile post (i.e. 14.75)

WALL TYPE: N = Noise Abatement Wall

DIRECTION: EB, SB, WB, NB - Inventory direction of the mainline roadway

RAMP:  
(R) = if lowest milepost is along ramp (omitted if not along ramp)

EXAMPLE:  TS38.40N,NB(R) for a noise abatement wall located along the Tri State Tollway (I-294) northbound at milepost 38.4 on a ramp

If two walls of the same type have identical starting mileposts, the inventory milepost of one of the walls shall be shifted by one hundredth of a mile to create unique names.

23.3.3 Ground Mounted Noise Abatement Wall

For all Ground Mounted Noise Abatement Walls, a Level-3 Barrier Warrant Analysis
shall be performed to determine the wall location with the highest benefit/cost ratio. Variations in noise abatement wall height based on the location of the wall shall be included in the benefit/cost analysis. The traffic face of the noise wall shall be placed well outside the clear zone, unless the wall is crashworthy. Refer to the Tollway Traffic Barrier Guidelines and Base Sheet M-RDY-406.

A 5-foot minimum clearance between the proposed R.O.W. line and the centerline of the noise abatement wall shall be maintained. No utilities shall be located between the noise abatement wall and the proposed R.O.W. line.

Overlapped sections of noise abatement walls shall be separated by a minimum of 9 feet to provide access to the area behind the walls. A section of the wall shall be overlapped for a minimum length of four times the separation or gap distance. See Figure 23.3.3.1 for a typical plan. Overlaps shall also be located at ground to structure transitions. See Figure 23.3.3.2 for details.

A swale shall be provided on the side of the noise abatement wall that will keep surface water from running under the wall. Field inlets shall be located at low points and connected to the side slope ditch or storm sewer. The designer is responsible for designing and detailing all swales, ditches, field inlets and storm sewers on the drainage plans and profiles.

Foundations for Ground Mounted Noise Abatement Walls: The bottom of any foundation shall be a minimum of 4 feet below finished grade, unless solid competent rock strata is encountered. If a drilled foundation is used, it shall be a minimum of 6 feet below finished grade line or two times the shaft diameter, whichever is greater, unless solid competent rock strata is encountered.

Structure borings shall be taken at each end of the noise abatement wall and every 100 feet thereafter along the proposed alignment. The boring locations shall be shown on the roadway noise wall plans and the resulting logs shall be plotted on sheets and included in the Plans.

Borings shall extend to a depth of twice the height of the wall below footing/proposed grade level, but not less than 15 feet. Borings shall extend at least 10 feet below compressible soils \((N < 10 \text{ bpf}, Qu < 1.0 \text{ tsf})\). If bedrock is encountered within the normal depth of the boring, at least half of the borings shall be cored to a depth of 10 feet into bedrock. If hard drilling \((N > 60 \text{ bpf})\) is encountered at the termination of a boring to required depth, that boring shall be extended a minimum of 10 feet through such deposit.

23.3.4 Structure Mounted Noise Abatement Wall

Noise abatement walls on retaining walls shall be mounted as shown in Figure 22.6.3. Noise abatement walls on bridges shall be designed for the specific site conditions.

23.4 Specifications

The designer shall modify the performance based special provisions furnished by the
Tollway to suit their particular location and conditions.

### 23.5 Railroad Bridge Fencing for New Tollway Structures over Railroads

The Tollway crosses several railroads that have specific guidelines and drawings for fencing requirements. The DSE shall coordinate with the railroads regarding the need for fencing as early in the design stage as possible.

#### 23.5.1 Waivers

The placement of fencing on top of the bridge parapet is not desirable because of traffic safety concerns and inspection access limitations. The DSE shall propose the following waivers to the railroad prior to initiating modifications to the standard bridge rail:

**Waiver Alternative I**

Request a waiver from the Railroad’s standards to provide a 42-inch high F-shape parapet according to the Illinois Tollway’s Structure Design Manual. A waiver should be warranted since the Illinois Tollway does not allow pedestrian traffic or sidewalks on the Tollway system. Also, the Illinois Tollway provides an 11-foot to 12-foot shoulder between the edge of traveled way and bridge parapet to minimize the likelihood of objects being thrown onto railroad property. The 42-inch high F-shape parapet meets criteria for a Test Level 5, according to AASHTO’s LRFD Bridge Design Specifications, which satisfies freeway and large truck requirements.

**Waiver Alternative II**

Should Alternative I be found unacceptable by the railway, the DSE shall propose that a 72-inch barrier wall be provided to control the amount of snow and debris falling onto the track. This will provide for “splash boards” being provided on structures where switching or other frequent railroad activities are performed. According to AASHTO LRFD Bridge Design, parapet that are 6.0 feet above the surface of the pavement must meet crash Test Level 5. For this design scenario the bridge deck overhang shall be limited to 2'-0”.

#### 23.5.2 Fence Installation

Where a requirement for fencing on mainline structures has not been waived by the railroad, details for the fence shall be developed in accordance with Tollway Base Sheets M-BRG-521.

Fencing with parapet shall be provided on both sides of all overhead structures crossing Railroad right-of-way. It shall be designed to prevent climbing and provide positive means of protecting the Railroad facility and the safety of Railroad employees below from objects released from the bridge deck above.

The limits of the fencing with parapet shall extend to the limits of the Railroad right-of-
way or a minimum of 25 feet beyond the centerline of the outermost existing track, future track or Access Road, whichever is greater. All parallel Overhead Structures that have a gap of 2 feet or more shall be protected with fencing. Structures with a gap of 2 feet or less shall either have the gap covered or be fenced on both sides.

The minimum combined height of a parapet with curved fencing shall be 8 feet or with straight fencing shall be 10 feet. On sidewalk or trail facilities the top of the fencing should be curved to discourage climbing. A minimum 8-foot vertical clearance should be provided for the full clear width of the trail or sidewalk. To prevent surface water from draining onto the railroad right of way, a one-foot parapet is required. Fencing is also requested by the railroads on top of parapet on overhead structures without sidewalks or trails.
PROPOSED NOISE WALL

OVERHEAD SIGN STRUCTURE AND/OR OBSTRUCTION FOUNDATION

© NOISE WALL FOUNDATIONS

ELEVATION

NOISE WALL

STATION AND OFFSET (TYP.)

STATION AND OFFSET (TYP.)

OVERHEAD SIGN STRUCTURE FOUNDATION

© OVERHEAD SIGN STRUCTURE AND/OR OBSTRUCTION FOUNDATION

PLAN

TYPICAL OBSTRUCTION DETAILS

MARCH, 2015

FIGURE 23.3.1.1

ILLINOIS TOLLWAY
NOISE WALL OVERLAP DETAILS
(FOR GROUND MOUNTED)
SECTION 24.0 OVERHEAD SIGN SUPPORTS

24.1 Design Specifications

- Tollway Standard Drawings, March 2015, and all subsequent revisions.
- Tollway Base Sheets, M-OHS-720-728, March 2015, and all subsequent revisions.
- Existing overhead sign structures shall be analyzed using the design methodology of the original design. The Load Resistance Factor Design (LRFD) Method shall be used to design or analyze all new span, butterfly, monotube or cantilever type, overhead sign structures not covered by Section F of the latest Tollway Standards Drawings (Non Standard sign structures).

24.2 Sign Structure Type Selection

Sound engineering judgment is required in the selection of the appropriate sign structure type following the parameters described in the Manual on Uniform Traffic Control Devices (MUTCD). The sign size and location are chiefly governed by the location of the traffic lanes.

Economy should also be considered. Consideration should be given to utilizing a structure mounted sign if within a reasonable distance of the MUTCD stipulated distance. When several sign locations are included in a single contract, utilizing groups of sign structures of the same length should be considered. When evaluating Span Type verses Cantilever, Cantilever Type should be considered approximately 4 times as expensive per foot length as the Span Type.

24.3 Overhead Sign Structure Clearance

Overhead sign structures for static signs without sign lighting (span and cantilever) shall be designed to provide 26'-5" from the high point of the roadway beneath the sign structure to the centerline of the truss, which includes an allowance for 9’ from the centerline of the truss to the bottom of an 18’ tall sign panel, regardless of the size of the panel required for that particular location. This will usually provide extra clearance when constructed and allow for either lighting or a larger panel to be added in the future. Taller panels can be accommodated provided that the overall maximum sign area is not exceeded and the vertical sign panel supports are checked for adequacy.
Sign structures that require lighting, such as those approaching a toll plaza, shall be designed with a 17'-5" vertical clearance to the bottom of the 2' luminaires and with the sign panel(s) sized to accommodate the legend required for that particular location. For structures with multiple signs, the sign with the largest vertical dimension shall be used to determine the structure height. The height from the high point of the roadway beneath the sign structure to the centerline of the truss shall not be less than 26'-5".

Overhead sign structures for Dynamic Message Signs (DMS) shall be designed to provide 22'-5" from the high point of the roadway beneath the sign structure to the centerline of a cantilever, butterfly or span-type sign structure that is intended only for installation of DMS. This includes an allowance for 5' from the centerline of the truss to the bottom of a 10’ tall DMS, regardless of the size of the DMS required for that particular location.

24.4 Span Type

Overhead Sign Structures shall be selected and detailed in accordance with Standard F1 of the latest Tollway Standard Drawings. The Structure Details have incorporated new truss span lengths: 130’, 140’ and 150’, providing more flexibility for designers in providing Tollway Standard Options. In the past, only IDOT Standards could be used for these span lengths. This will facilitate the ability to position the structures foundation well outside of the clear zone, minimizing the need to shield the foundation with guardrail.

The Tollway’s sign structure-span type is an aluminum trichord truss supported by steel pipe columns, while IDOT’s sign structure-span types are aluminum and steel box, four chord span system.

The steel pipe column support has been designed to accommodate maximum heights as shown in the table on Sheet 1 of Standard F1.

Tollway Standard F1 includes the foundations for the Span Type Sign Structures. The foundations have been revised as follows:

- The shoulder foundation has been redesigned, consisting of a grade beam (3'-6" width x 18'-0" length) supported on two 3'-0" diameter drilled shafts for all size truss spans. This design replaces the individual 4'-0" diameter drilled shaft foundations. This change provides constructability improvements to the foundation system. The new detail establishes a standard size grade beam for all span truss sizes, and eliminates the constructability issues related to tight spacing between the caissons. This feature will also simplify the Traffic Barrier Warrant analysis by having a fixed dimension for any size truss span type structure.

- The median foundations also have a new grade beam design and details to match the new 7'-0" wide concrete barrier base, supported on two 3'-0" diameter drilled shafts.
The foundations are designed to accommodate the maximum column support heights shown on Sheet 1. In addition, the foundation can accommodate an increase in the depth of the grade beam by up to 2'-0", if additional sign structure height is required.

24.5 Cantilever Type

Cantilever Type Sign Structures are intended to support either static signs or DMS. Static signs in combination with the DMS units are not allowed on overhead sign structures.

Cantilever Type Sign Structures shall be selected and detailed in accordance with Standard F4 of the latest Tollway Standard Drawings. The standard drawings incorporate a concrete and steel post column support system. This detailing enables the maximum steel post to have a 24" diameter with a nominal wall thickness of 1" for cantilever design spans up to 50 feet in length. Also provided are alternate steel grades for the steel support post; API 5L, Grade B, X42 or X52, ASTM 106, Grade B or C and ASTM A53, Type E or S, Grade B.

24.6 Monotube Type

The Overhead Sign Structure-Monotube Type shall be selected and detailed in accordance with Standard F13, F15 or F16 of the latest Tollway Standard Drawings depending on the span length and application. Details have been developed for a new steel frame design for mainline and ramp toll plazas. These structures are to support electronic toll collection equipment.

A Tollway Base Sheet, Overhead Sign Structure-Monotube Type, Summary and Total Bill of Material have also been developed.

The foundations have been designed for both single and double face barrier walls, supported by individual drilled shaft foundations of 3'-6" diameter minimum.

24.7 Butterfly Type

The Overhead Sign Structure-Butterfly Type shall be selected and detailed in accordance with Standard F14 of the latest Tollway Standard Drawings. Details have been developed for median and shoulder applications. These structures are intended to support dynamic message signs.

Minimum clearances for overhead sign structures shall be as specified in Article 5.2.

Additional static signs in combination with the DMS units are not allowed on overhead sign structures.

24.8 Bridge Mounted Sign Structures

Bridge Mounted Sign Structures shall be designed and detailed in accordance with the latest IDOT Sign Structures Manual.
In cases where the depth of the fascia beam is shallow and/or the profile grade approaches 5%, the location of the horizontal WF member between the web of fascia beam and the back of the sign support may vary vertically in order to maintain the luminaire supports in a level position (see Base Sheets M-BRG-503 and M-BRG-504). Alternatively, the location of the horizontal leg of luminaire support could also be varied to keep the luminaire supports level (see Figure 24.8.1).

24.9 Span Type (Steel)

The Overhead Sign Structure, Span Type (Steel) shall be selected and detailed in accordance with Standard F17 of the latest Tollway Standard Drawings.

Additional static signs in combination with the DMS units are not allowed on overhead sign structures.

24.10 ITS Gantry Frame (Steel)

ITS Gantry Frame (Steel) shall be designed in accordance with Base Sheets M-OHS-729 and M-OHS-730. These structures shall be used to support lane control signs and DMS units.

24.11 Overhead Sign Structures with End Cantilever(s)

Span Type, overhead sign structures required to cantilever or overhang the supports at one or both ends shall utilize a standard IDOT (box) truss, support legs and foundations. The selected truss shall be analyzed for the proposed end conditions and loads. The truss member sizes may be modified, if necessary, to accommodate the proposed overhang(s) and sign(s). The designer shall modify and complete required information in the latest IDOT base sheets for the selected overhead truss, supports and foundations for inclusion in the Contract plans.

24.12 Non-Standard Sign Structures

Sign structures that do not fall within the criteria of the latest Tollway Standard Drawings and/or the latest IDOT Sign Structures Manual shall be designed in accordance with the latest AASHTO Standard Specifications (LRFD) for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
The designer must notify the Tollway in writing prior to beginning the design of a non-standard sign structure.

24.13 Naming Convention

Overhead sign structures shall be identified on the plans using the following format:

Tollway, Milepost, Structure Type, Direction, Ramp location

TOLLWAY:  EW = Reagan Memorial Tollway (I-88)
NS = Veterans Memorial Tollway (I-355)
NW = Jane Addams Memorial Tollway (I-90)
TS = Tri-State Tollway (I-294 & I-294/I-80)
TN = Tri-State Tollway (I-94)
ES = Edens Spur (I-94)
EO = Elgin-O’Hare Expressway (IL 390)
WA = West O’Hare Access Bypass (I-490)

MILEPOST:  Two-decimal milepost to the tenth or hundredth if a ¼ mile post (i.e. 14.75)

SIGN TYPE:  T = Span Type Truss
C = Cantilever Type Truss
B = Bridge Mount
M = Monotube
D = Dynamic Message Sign
G = ITS Gantry Monotube

DIRECTION:  EB, SB, WB, NB - Inventory direction of the mainline roadway

RAMP:  (R) = sign is over a ramp (omitted if not along ramp)

EXAMPLE:  TS38.40T,NB(R) for a span type truss located along the Tri State Tollway (I-294) northbound at milepost 38.40 on a ramp
ALTERNATE BRIDGE MOUNTED SIGN AND LUMINAIRE SUPPORT DETAIL

MARCH, 2015  FIGURE 24.8.1  ILLINOIS TOLLWAY
SECTION 25.0 SHOP DRAWINGS

25.1 General

Shop drawings are detailed fabrication and erection plans prepared by the fabricator, supplier or Contractor which are interpreted from the engineering drawings in the Contract plans. When contracted, the designer shall be responsible for reviewing the shop drawings for compliance with the design plans and project specifications only.

It is the responsibility of the CM to ascertain that the fabricator is supplying the items specified, while it is the Contractor's responsibility to verify that all items are per contract plan and specifications and fabricated to the correct dimensions. See Article 105.04(d) of the latest Tollway Supplemental Specifications. Approved shop drawings shall be archived with the as-built plans for each project.

25.2 Required Shop Drawings

Shop drawings are required for the following items:

- Plate Girders
- Wide Flange Beams
- Miscellaneous Structural Steel
- PPC Bulb–T Beams
- PPC I–Beams
- PPC Deck Beams
- Precast Concrete Box Culverts
- Three Sided Precast Concrete Structures
- Cantilever Sign Structures
- Overhead Sign Structures
- Modular Expansion Joints
- Bridge Mounted Sign Structures
- Elastometric Bearings
- Temporary Shoring, Jacking and Cribbing
- Anchor Rods
- Fixed Bearings
- Precast Deck Planks
- Pins and/or Link Plates
- Precast Deck Forms
- Precast Fascia Panels
- Mechanically Stabilized Earth Walls
- Metal Deck Forms
- Temporary Soil Retention Systems
- Noise Walls and Foundations
- Temporary Sheet Piling
- Prefabricated Pedestrian/Bicycle Trusses

Other project-specific items not included in this list may also require approved shop drawings.
drawings.

25.2.1 Structural Steel and Expansion Joints

At a minimum the following information shall be reviewed:

- Framing plan, showing general layout of the steel beams, cross-frames, location of field splices and marking scheme for identifying members.

- The number and size of all members.

- The details of all splices, showing the number, size and type of bolts, hole diameters, the type, size and length of all welds and a section showing the size of all splice materials.

- The details of all field connections, showing number, size and type of bolts, hole diameters, and the locations where reaming is required.

- The number, size and spacing of shear developers. The use of shop welded shear developers is acceptable for embedded bearing plates and expansion joints.

- Verify ordinates at abutments, field splices and interior at piers.

- The amount and location of camber and the permissible tolerances.

- Material specifications (AASHTO and/or ASTM designation) of the steel to be fabricated and any testing requirements.

- The steel surface preparation and the type of shop and/or field coating to be applied.

- All notes that appear on the design plans must be reflected on the shop drawings.

- Structural steel weights (shop bills) must be checked.

- Blocking and lifting diagrams.

- Check plate bending radiuses.

25.2.2 Prestressed Concrete

At a minimum the following information shall be reviewed:

- Erection diagram, showing the general layout of the concrete elements.

- The number and size of all members.
• The number, size and type of prestressing strands or rods, and the forces in these prestressing elements.

• Bearing details showing size, type, and materials.

• The location and the details of lifting devices and of support points, if the beam does not rest on its bearings while being transported.

• The location and type of any inserts required for attachments.

• The layout of the casting bed to be used for casting the prestressed beams.

• The location of hold-down devices for any draped strands.

• The location and length of any bond-breaker.

• The details and type of the reinforcement bars.

• All notes that appear on the design plans must be reflected on the shop drawings.

25.2.3 Bearings

At a minimum the following information shall be reviewed:

• Location diagram, showing the general layout of the structure and the locations of the bearings.

• The number, size and types of all bearings.

• The details of the bearings, showing all materials, dimensions and welding.

• The steel surface preparation and shop coating details.

• Notes listing the material specifications for all parts of the bearings, and the design and specifications used for the design of the bearings.

25.3 Special Requirement Items

The Contractor and/or his supplier -are responsible for designing and detailing the following items, which shall bear the seal and signature of an Illinois licensed Structural Engineer. Shop drawings and computations shall be submitted for review and acceptance by the designer. Approved shop drawings shall be archived with the as-built plans for each project.

• Mechanically Stabilized Earth (MSE) Retaining Walls, Soldier Pile and Lagging Retaining Walls with facing and Sheet Pile and Tie-Back Retaining Walls with facing.
• Precast Concrete Box Culvert and Three Sided Structures.

• Seismic Isolation Bearings.

• Pedestrian/Bicycle Truss designs and shop drawings for structures crossing over a state or federal route, placed on Tollway right-of-way, or having spans 150 ft. or longer, shall be submitted for review and approval. If these structures are constructed by another governmental unit (IDOT, county, municipality, park district, IL Dept. of Natural Resources, etc.), that agency is responsible for the review and approval of the designs and drawings.

• Noise Walls including their foundations.

• “Stay-In-Place” Metal or Precast Concrete Deck Forms.

• Temporary Shoring, Jacking and Cribbing.

25.4 Miscellaneous Items

Shop Drawings for the following items need not be submitted for review unless specified or special (non-standard) details are proposed for routine items:

Fabric Reinforced Elastometric Mats and/or steel anchor plates for the back of Integral Abutments:

The fabricator must furnish installation and detail drawings to the Contractor and CM for field verification of locations and dimensions. These drawings should be included in the project record. Shop fabrication inspection is not required, and the CM’s final acceptance may be based on proper fit and an overall visual inspection of the finished product. The material supplier is responsible for submitting samples to the BMPR for lot testing.

Bridge Railing & Drainage Systems:

• Steel Bridge Rail, Aluminum Bridge Rail, Pedestrian/Bicycle Railing, Pre-Fabricated Inspection Platforms, Scuppers, Drain Piping, Navigation Lights and Mounting Hardware.

• The fabricator must furnish installation and detail drawings to the Contractor and CM for field verification of locations and dimensions. These drawings should be included in the project record. Shop fabrication inspection is not required, and the CM’s final acceptance may be based on proper fit and an overall visual inspection of the finished product.

• Standard design base sheet notes require permanent tubular steel bridge traffic rail and rail posts to have Charpy-Vee Notch (CVN) toughness values certified by test. Test results, along with mill certification documentation, are to be submitted to the CM. CVN testing is not normally required for bicycle/pedestrian railing. All
steel for railing, bolts, anchor bolts and posts must be domestic. Any paint used must be accepted by the IDOT Bureau of Materials and Physical Research (BMPR). Current requirements of the BMPR concerning aluminum rail and posts must be satisfied.

Bridge Joint Seal System (Bonded Preformed Joint Seals) or Strip Seals:

- These joints may be prefabricated in convenient lengths, allowing subsequent shop or field cutting to meet project requirements. Since details will be generic, no project-specific review is required. An installation scheme should be provided by the fabricator to the Contractor and CM.

25.5 Erection Plan

25.5.1 General

The Contractor shall submit structural steel erection plan to the CM and designer for each structure in the Contract, in accordance with Article 7.2.2 of this Manual and Article 105.04 (c) of the Tollway Supplemental Specifications. Copies shall be sent to any railroad company or public agency affected by the proposed erection procedure for their review and comment. These plans must be received at least 60 days prior to the proposed beginning of erection. All comments or revisions required by the designer, railroad company, or public agency shall be incorporated in the final submission, for review and acceptance by the CM and designer.

25.5.2 Required Information

The following minimum information shall be placed on the erection drawings for each individual structure. Erection procedures for twin bridges may be shown on the same sheet:

- Title block with contract number, design project number, project and structure name and county.
- Plan of the work area showing support structures, roads, railroad tracks, canals or streams, utilities or any other information relative to erection.
- Erection sequence for main members and secondary members (crossframes, diaphragms, lateral bracing, portals, etc.), noting use of holding cranes or temporary supports, falsework, and bents.
- Delivery location of each beam.
- Location of each crane for each pick.
- Capacity chart for each crane and boom length used in the work. Cranes lifting over active railroad facilities shall have a minimum lifting capacity of 150 percent of the lift weight.
• Pick point location(s) on each member.
• Lifting weight of each member (including clamps, spreader beams, etc.).
• Lift and setting radius for each pick (or maximum lift radius).
• Description of lifting devices or other connecting equipment.
• Beam tie down details or other method of stabilizing erected beams.
• Bolting requirements, including the minimum number of bolts and erection pins required to stabilize members during the erection sequence.
• Blocking details for stabilizing members supported on expansion bearings and on bearings that do not limit movement in the transverse direction.
• The method and location of temporary support for field spliced or curved beams, including shoring, falsework, holding cranes, guys, etc. The designer will examine, but not approve details of temporary supports. The design, erection, and stability of these supports shall be the sole responsibility of the Contractor.
• Offsets necessary to adjust expansion bearings during erection to provide for temperature variance and dead load rotation.

The following notes shall be placed on the Erection Drawings:

• No crane will be operated in a manner that will exceed its rated capacity at any radius as specified by the crane manufacturer.
• The table or chart prepared by the crane manufacturer to describe the maximum lift at all conditions of loading shall be posted in each crane cab in clear view of the operator.
• The Contractor shall be responsible for verifying the weight of each lift and for insuring the stability of each member during all phases of erection.
• Members shall be subject to only light drifting to align holes. Any drifting that results in distortion of the member or damage to the holes will be cause for rejection of the member.
• Field reaming of holes shall not exceed the amount permitted in Article 505.08(l) of the Standard Specifications.
• The final alignment and profile of the erected steel shall conform to the requirements of the Contract Documents. Measurements and elevations shall be taken to verify the requirements of the Contract.
SECTION 26.0 REHABILITATION AND REPAIR

26.1 General

When extensive repairs to a structural member appear necessary, to the extent that the structural capacity of the member during construction may be in doubt, provisions shall be made to temporarily support the member during construction. This also applies to concrete member repairs, whether it is pneumatically applied mortar or formed concrete repairs. The location of proposed temporary supports shall be indicated on the plans.

Refer to the latest edition of the “Structural Services Manual” by the IDOT Bureau of Bridges and Structures. The manual contains information and guidelines for the types of repairs most often required to adequately maintain typical bridge structures during the service life. The designer and/or Contractor are encouraged to use guidelines provided in the above referenced manual in preparing final repair details associated with the rehabilitation project.

The most common types of repairs/rehabilitation tasks associated with Tollway projects are listed below, including applicable sections from the above referenced manual.

- Bridge Deck Overlay – Section 1.4
- Expansion Joint Replacement – Section 1.5
- Bridge Rails and Parapets – Section 1.7
- Bearing Replacement – Section 1.9
- Impact Repairs – Steel Beams – Section 1.13
- Impact Repairs – Concrete Beams – Section 1.14
- Steel Superstructure Repairs – Section 1.15
- Concrete Superstructure Repairs – Section 1.16
- Substructure Repairs – Section 1.17

26.2 Precast Concrete Repairs

Even though a higher quality of standards is maintained in a plant-cast prestressed concrete environment, damages or defects can still occur in such products. Examples include voids and cracks in concrete and improperly placed or damaged reinforcement and hardware. These products fall into one of the three following categories:

- Products that can be accepted without repair
- Products that can be accepted with repair
• Products that must be rejected

Refer to "Manual for the Evaluation and Repair of Precast, Prestressed Concrete Bridge Products" published by PCI. The Manual also addresses evaluation and repair for damage caused by imperfections or damage occurring during production, handling, transportation and erection. This Manual serves as a resource and a base for developing repair options. The designer and/or Fabricator is required to prepare repair procedures and details using guidelines provided in the above referenced manual while applying sound engineering judgment. The repair procedures and details shall be submitted to the Tollway for review and approval.

In addition to the types of damage discussed above and the normal deterioration due to aging, collisions between over-height vehicles and bridges are becoming more commonplace and can be catastrophic. Collision damage, however, is generally far from catastrophic although sound repair techniques are critical if additional damage (typically related to corrosion) is to be mitigated. A comprehensive study was recently completed by NCHRP to develop criteria to evaluate whether to repair or to replace a prestressed concrete girder damaged by a vehicular impact, identify the gaps in the available information and practices related to repair of collision damage of prestressed girders and prepare a recommended practice report guide. Results of the study are presented in the NCHRP 20-07/Task 307 report, entitled “Updated Research for Collision Damage and Repair of Prestressed Concrete Beams”, dated May 2012.

The primary deliverable of the NCHRP 20-07/Task 307 report is the Guide to Recommended Practice for the Repair of Impact-Damaged Prestressed Concrete Bridge Girders, which is included in Appendix A of the report. The Guide serves to update the 1985 NCHRP Report 280: Guidelines for Evaluation and Repair of Prestressed Concrete Bridge Members, which remains a primary reference for this topic.

Nine repair techniques are described in the Guide of the NCHRP 20-07/Task 307 report; four are generally recommended as being practical for repairing impact damaged prestressed concrete girders: externally bonded carbon fiber reinforced polymer (EBCFRP); externally bonded post-tensioned CFRP (bPT-CFRP); post-tensioned steel (PT-steel); and internal strand splicing. In addition, external repairs in combination with strand splicing are discussed. The designer is required to prepare repair procedures and details using guidelines provided in the NCHRP 20-07/Task 307 reference, while applying sound engineering judgment. The repair procedures and details shall be submitted to the Tollway for review and approval.

26.3 Aluminum Sign Truss Repairs

Refer to Figures 26.3.1 through 26.3.4 regarding suggested details for repairing existing aluminum sign trusses. These details are to be used as guidelines in preparing repair plans for sign trusses. Figure 26.3.5 provides guidelines for installing damping devices for existing aluminum trusses.
26.4 Approach Slab Resurfacing and Repairs

When resurfacing an existing approach slab, the surface of new overlay shall be string lined to provide a smooth transition from the ends of bridge to the existing road.

Before resurfacing, the spalled areas of existing approach slabs will be repaired with partial-depth concrete patches and completely deteriorated areas will be repaired with full-depth patches. Top reinforcement bars exposed in repair areas that show a 50% loss of section due to corrosion or that were damaged during concrete removal shall be supplemented with additional bars equal to the area of the original deteriorated or damaged bar(s) (see Figure 26.4.1). Bottom reinforcement bars exposed in repair areas that show a 20% loss of section due to corrosion or that were damaged during concrete removal shall be supplemented with additional bars equal to the area of the original deteriorated or damaged bar(s).

Existing reinforcement bars that have been cut or damaged by the Contractor shall be provided with supplemental bars at no additional cost to the Tollway. Otherwise, supplemental bars shall be paid for as “Reinforcement Bars” or “Reinforcement Bars, Epoxy Coated”.

Those areas of approach slabs showing settlement at the abutment backwall will be removed and replaced in accordance with the details shown in Figure 26.4.2. Existing preformed filler joints at the bridge end of approach slabs shall be replaced wherever possible with the detail shown in Figure 26.4.3.

26.5 Aggregate Slope Paving Repairs

See Figure 26.5.1 for suggested details for repairing eroded or damaged slope paving.

26.6 Metal Culvert Temporary Repairs

See Figures 26.6.1 through 26.6.4 for suggested details to temporarily repair metal arch or half round culverts until they can be programmed for replacement or lining.

26.7 Bearing Repairs

Frequently, existing rocker bearings are found to be tilted and in need of adjustment. The magnitude of the adjustment is determined by comparing the measured horizontal displacement of the rocker with the theoretical displacement for similar temperature conditions. No adjustment is necessary unless the measured displacement exceeds the theoretical by ¾ inch or more. Adjustment is usually made by repositioning the sole plate; however, if a bearing stiffener is present, the stiffener should remain within the middle third of the repositioned sole plate.

26.8 Fiber Reinforced Polymer Repairs

Fiber Reinforced Polymer (FRP) shall be considered as a cost effective solution to increase structural capacity for various bridge elements.
The following guidelines are proposed:

FRP shall be considered by the Designer as one of the available repair methods for restoring structural capacity of PPC Beams and other reinforced concrete structural members. For guidance regarding selection of repair techniques including FRP, refer to the NCHRP 20-07/Task 307 report, entitled “Updated Research for Collision Damage and Repair of Prestressed Concrete Beams”, dated May 2012. Also, refer to “ACI 440.2R-08 Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures” for design guidance.

FRP shall be installed as the final external layer of any PPC Beam or outside face of parapet patching that is located over shoulders, traffic lanes or railroad tracks. The use of FRP over patch areas in locations other than over shoulders, traffic lanes and/or railroad tracks is not recommended.

Beam ends shall not be considered for repairs with FRP. In this situation, beam encasement is the preferred option.

FRP shall not be used in conjunction with patching of bridge deck underside. Such defects shall be scaled and left untreated, if they are minor and do not affect structural capacity or addressed with full depth patches, if there are concerns with structural capacity. Partial depth patching of bridge deck underside is not allowed.

26.9 Deck Drains

Repair plans for major maintenance projects on deck surface of a structure such as overlay projects should contain details to provide for elimination of existing deck drains, or adjustment of existing deck drains to direct drainage away from the main load-carrying member of the superstructure and substructure units.
GENERAL NOTES

Materials: Aluminum angles and plates shall be ASTM B221 alloy 6061 temper T6.

Fasteners: U-bolts shall be produced from ASTM A276 Type 304L, 304, 316L or 366L. Condition A, cold finish, or an equivalent material acceptable to the Engineer.

Hex head bolts shall be stainless steel conforming to ASTM A193, Grade B8 or B8m, Class 2. All nuts shall be stainless steel conforming to ASTM A194, Grade 8 (AISI Type 304 or grade BF (AISI Type 303). the nuts shall be "locknuts" with nylon or steel inserts and semifinished hexagonal heads equivalent to the finished hex series of the American National Standards. All washers shall be stainless steel conforming to ASTM A240, Type 302 or 304.

MARCH, 2015

FIELD DRILL holes in angle and tubes (Typ.)

4 x 3 x 3/8 Aluminum Angle

1/2" SS Hexhead Bolts

5/16" SS U-Bolts

Adjust as necessary to maintain clearance from interior diagonals.

U-BOLT DETAIL

R = D/2 + 1/4

2 1/2

2

1/2

0

1

0

1/2

2 1/2

3/8

SINGLE VERTICAL DIAGONAL REPAIR WITHOUT GUSSET
GENERAL NOTES

Materials: Aluminum angles and plates shall be ASTM B221 alloy 6061 temper T6.

Fasteners: U-bolts shall be produced from ASTM A276 Type 304, 304L, 316 or 316L.
Condition A, cold finish, or an equivalent material acceptable to the Engineer.
Hex head bolts shall be stainless steel conforming to ASTM A193, Grade B8 or B8m.
Class 2. All nuts shall be stainless steel conforming to ASTM A194, Grade 8 (AISI Type 304) or grade 8F (AISI Type 303), the nuts shall be "locknuts" with nylor or steel inserts and semifinished hexagonal heads equivalent to the finished hex series of the American National Standards. All washers shall be stainless steel conforming to ASTM A240, Type 302 or 304.

FIELD DRILL holes in angle and tubes (Typ.)

4 x 3 x 3/8 Aluminum Angle

2" (Typ.)

$5/16"$ SS U-Bolts

Adjust as necessary to maintain clearance from interior diagonals.

DOUBLE VERTICAL DIAGONAL REPAIR WITHOUT GUSSET
GENERAL NOTES

Materials: Aluminum angles and plates shall be ASTM B221 alloy 6061 temper T6.

Fasteners: U-bolts shall be produced from ASTM A276 Type 304, 304L, 316 or 316L.
Condition A, cold finish, or an equivalent material acceptable to the Engineer.
Hex head bolts shall be stainless steel conforming to ASTM A193, Grade BB or BBm.
Class 2. All nuts shall be stainless steel conforming to ASTM A194, Grade B (AISI Type 304 or grade BF (AISI Type 303), the nuts shall be "locknuts" with nylon or steel inserts and semifinished hexagonal heads equivalent to the finished hex series of the American National Standards. All washers shall be stainless steel conforming to ASTM A240, Type 302 or 304.
**GENERAL NOTES**

Materials: Aluminum angles and plates shall be ASTM B221 alloy 6061 temper T6.

Fasteners: U-bolts shall be produced from ASTM A276 Type 304, 304L, 316 or 316L, Condition A, cold finish, or an equivalent material acceptable to the Engineer.

Hex head bolts shall be stainless steel conforming to ASTM A193, Grade B8 or B8m, Class 2. All nuts shall be stainless steel conforming to ASTM A194. Grade B (AISI Type 304 or grade BF (AISI Type 303). The nuts shall be “locknuts” with nylon or steel inserts and semifinished hexagonal heads equivalent to the finished hex series of the American National Standards. All washers shall be stainless steel conforming to ASTM A240, Type 302 or 304.

---

**PLAN**

Field Drill holes in angle and tubes (Typ.)

4 x 3 x 3/8 Aluminum Angle

2" (Typ.)

5/16" SS U-Bolts

**DETAIL**

U-BOLT

\[ R = \frac{D}{2} + \frac{1}{4} '' \]

DOUBLE VERTICAL DIAGONAL REPAIR WITH GUSSET
**1 1/2" SAW CUT**

**ALL AROUND**

**LOCATION AND LIMITS**

SHALL BE DETERMINED IN FIELD BY THE ENGINEER DURING CONSTRUCTION

**PROPOSED OVERLAY**

- 4 1/8" MAX. CONCRETE REMOVAL AND REPLACEMENT
- IF BOTTOM OF REINFORCING IS EXPOSED
  REMOVE CONCRETE 1" BELOW REINFORCING

**PARTIAL DEPTH**

**1 1/2" SAW CUT**

**ALL AROUND**

**PROPOSED OVERLAY**

**CONCRETE REMOVAL AND REPLACEMENT**

- 4" GRANULAR SUB-BASE AS DIRECTED BY THE ENGINEER

**FULL DEPTH**

**APPROACH SLAB REPAIR DETAILS**
LIMITS OF REMOVAL

EXISTING REINFORCEMENT TO REMAIN

LIMIT OF EXCAVATION

REMOVE TO SOUND CONCRETE

EXISTING BACKWALL OR END DIAPHRAGM

LIMITS OF REMOVAL

HMA OVERLAY

RIGID CONCRETE OVERLAY

CONCRETE REPLACEMENT

SUPPLEMENT NEW #6 LONGITUDINAL BARS, LAP WITH EXISTING LONGITUDINAL REINFORCEMENT

SAW CUT & SEAL WITH HOT POURED LOW MODULUS POLYMER SEALANT

180° HOOK ON BOTTOM #6 BAR

NEW TRANSVERSE BARS

LIMITS OF REPLACEMENT

APPROACH SLAB REMOVAL AND REPLACEMENT AT ABUTMENT

NOTE:
EXISTING REINFORCEMENT TO REMAIN SHALL BE BRUSH-OFF BLAST CLEANED IN ACCORDANCE WITH SECTION SP7 OF THE SSPC SURFACE PREPARATION SPECIFICATIONS. EPOXY COAT CLEANED REINFORCEMENT

MARCH, 2015

FIGURE 26.4.2

ILLINOIS TOLLWAY
2'-0" REMOVE EXIST. CONCRETE

BITUMINOUS OVERLAY

1 1/8" SAW CUT
EXIST. APPROACH SLAB
EXIST. JOINT FILLER

LIMITS OF REMOVAL

SAW CUT & SEAL WITH HOT Poured RUBBER BASE JOINT SEALER WITHIN 3/4" OF FINISHED GRADE

PARTIAL-DEPTH REPAIR CONCRETE

NEW HMA OVERLAY

NEW CONCRETE BRIDGE DECK OVERLAY

EXISTING BACKWALL OR END DIAPHRAGM

LIMITS OF RECONSTRUCTION

APPROACH SLAB JOINT RECONSTRUCTED AT ABUTMENT

MARCH, 2015
FIGURE 26.4.3
ILLINOIS TOLLWAY
NOTES:

1. HORIZONTAL LIMITS OF SLOPE PROTECTION SHALL BE 2 FEET OUTSIDE OF THE OUTSIDE FACE OF PARAPET.

2. ALL RUBBISH AND LOOSE EARTH IN THE SLOPES SHALL BE REMOVED AND ANY ERODED PORTION OF THE SLOPES SHALL BE FILLED AND COMPACTED WITH SUITABLE MATERIALS TO THE LINE AND GRADES AS SHOWN ON THE PLANS AND/OR AS DIRECTED BY THE ENGINEER.
EXISTING CORRUGATED METAL PLATE

NEW C15x33.9 x 10' (TYP.)

4" Ø PIPE E.S.  12" (MIN.)  3" Ø PIPE E.S.

TYP. 5%

EXISTING GROUTED KEYWAY

12'-0''
MAX. SPAN

TYPICAL SECTION

EXISTING CORRUGATED METAL PLATE

NEW C15x33.9 x 10' (TYP.)

Ø 1/2" x 1/2" x 0'-3"
(SEE SECTION B-B)

EXISTING CURB WALL

GROUT SOLID FROM TOP OF CURB WALL TO TOP OF CHANNEL

SECTION A-A

2'-0''
(TYP.)

Ø 1/2" x 1/2" x 0'-3"

3" Ø or 4" Ø EXTRA STRONG PIPE

6''
(TYP.)

1'-0''

MAXIMUM SPACING 4'-0''

10'-0'' MAXIMUM

SECTION B-B

TEMPORARY BRACING DETAILS

MARCH, 2015

FIGURE 26.6.1

ILLINOIS TOLLWAY
TEMPORARY BRACING DETAILS

MARCH, 2015

FIGURE 26.6.4

ILLINOIS TOLLWAY