

CHAPTER 4 SUPERSTRUCTURES

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4.2 Steel Girders

4.2.1 Introduction

This section deals with the detailing of a structure consisting of a cast-in-place concrete deck on steel stringers.

4.2.2 Prerequisites

4.2.2.1 To Get Started (30% Superstructure Plans)

The 30% Superstructure plans show beam sizes, beam layout, and superstructure concrete limits.

❶ It is important to not begin detailing reinforcing steel until the 30% superstructure plans have been checked by the designer/checker.

To draw the superstructure up to this level of completion, the detailer requires the following information:

- 1) CL Bearings Abutment and Pier Stations
- 2) Substructure Skew Angle
- 3) Span Lengths (Pay attention to relationship of CL Construction and Working Line of a curved bridge. Refer to Chapter 2 for guidance.)
- 4) Joint Locations (Construction & Contraction)
- 5) Roadway width and cross-slope
- 6) Curb/Sidewalk widths
- 7) Wearing Surface Type and Thickness
- 8) Slab Thickness
- 9) Rail Type
- 10) Rail Post Locations (can be developed by detailer from standard detail information.)
- 11) Girder Spacing & Slab Overhang
- 12) Beam Type/Size
- 13) Beam Blocking Height
- 14) Diaphragm Type and Spacing
- 15) Bearing Types
- 16) Field Splice Locations

4.2.2.2 To Finish Up (100% Superstructure Plans)

The following items are required to finish detailing a superstructure:

- 1) Completed and checked 30% superstructure plans.
- 2) Completed and checked reinforcing scheme (designer will communicate reinforcing scheme to detailer via sketches)
- 3) Superstructure and Structural Steel Notes
- 4) Bridge Drain Type & Locations
- 5) Beam Overhangs
- 6) Stiffener Sizes and Locations
- 7) Weld Sizes and Types
- 8) Beam Splice Details
- 9) Shear Stud Layout
- 10) Sketch of Beam Stress-Type Diagram
- 11) Lateral Bracing size and location (where req'd)
- 12) Sketch of Camber Diagram and Table
- 13) Bottom of Slab Grades
- 14) Dead Load Deflections
- 15) Sketch of Blocking Point Layout Diagram
- 16) Utility Size, Type, and Location
- 17) For Steel Bearings, Expansion Pedestal Bearing Chart

4.2.3 Detailing

Steel Girder Superstructures require explicit rather than performance-based detailing. Some details are developed primarily for the Fabricator (camber diagram, stress-type diagram) and some are developed primarily for the Contractor (superstructure plan, transverse section, bottom of slab grades.) Some details are required equally by both Fabricator and Contractor (structural steel framing plan, beam elevation.)

4.2.4 Typical Sheet Names and Contents

4.2.4.1 STRUCTURAL STEEL

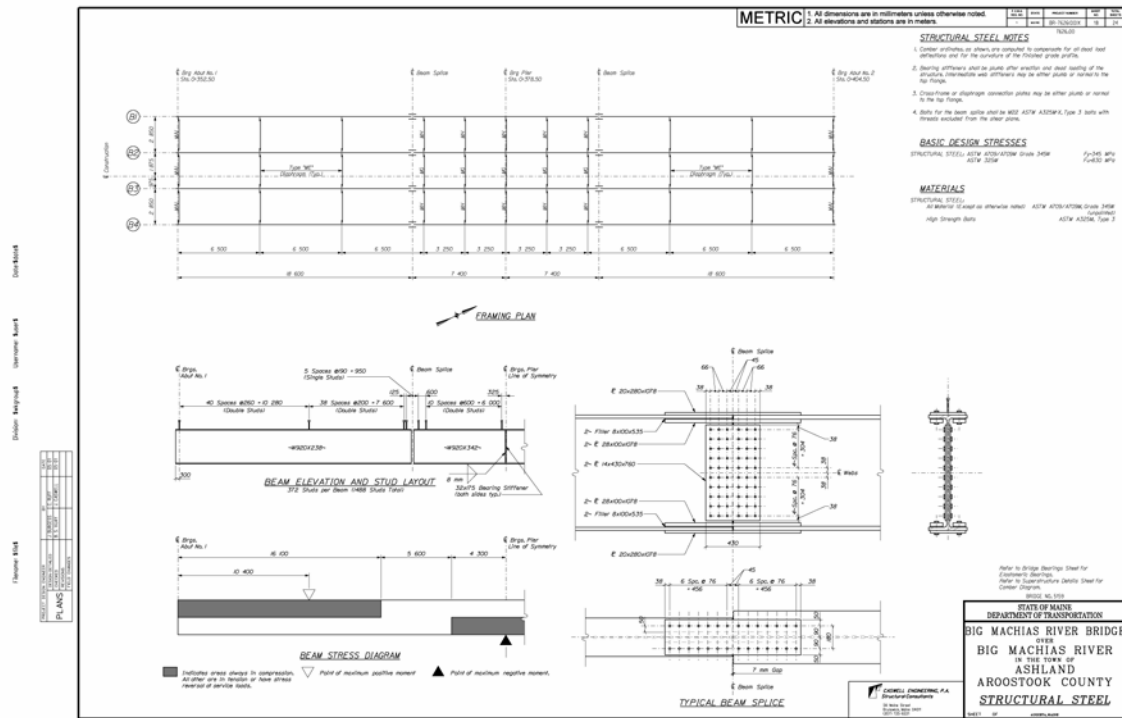


Figure 4-1 Steel Girder Structural Steel Sheet

Will Contain:

- 1) Framing Plan
- 2) Girder Elevation and Stud Layout
- 3) Structural Steel Notes
- 4) Basic Design Stresses (Note)
- 5) Materials (Note)

May Contain:

- 1) Camber Diagram
- 2) Beam Stress Diagram
- 3) Splice Details

4.2.4.2 SUPERSTRUCTURE

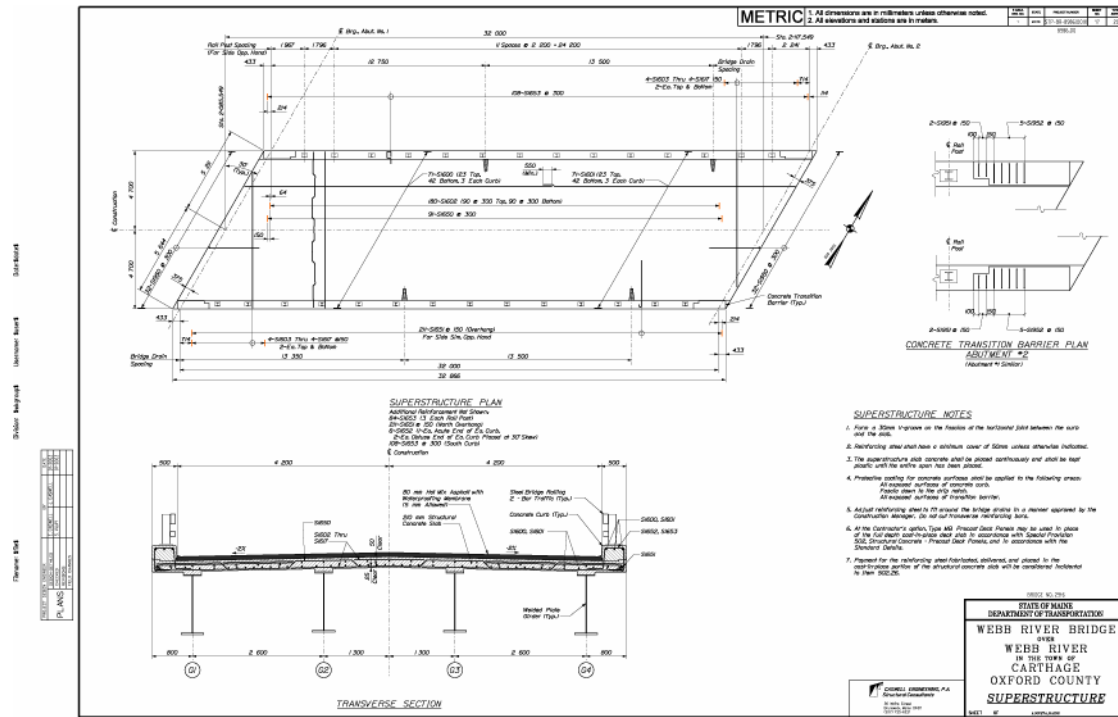


Figure 4-2 Steel Girder Superstructure Sheet

Will Contain:

- 1) Superstructure Plan
- 2) Transverse Section
- 3) Superstructure Notes

May Contain:

- 1) Slab Haunch and Blocking Detail
- 2) Barrier Plan End Details (to show reinforcing in the ends of concrete barriers)
- 3) End of Slab Sections

4.2.4.3 SUPERSTRUCTURE DETAILS

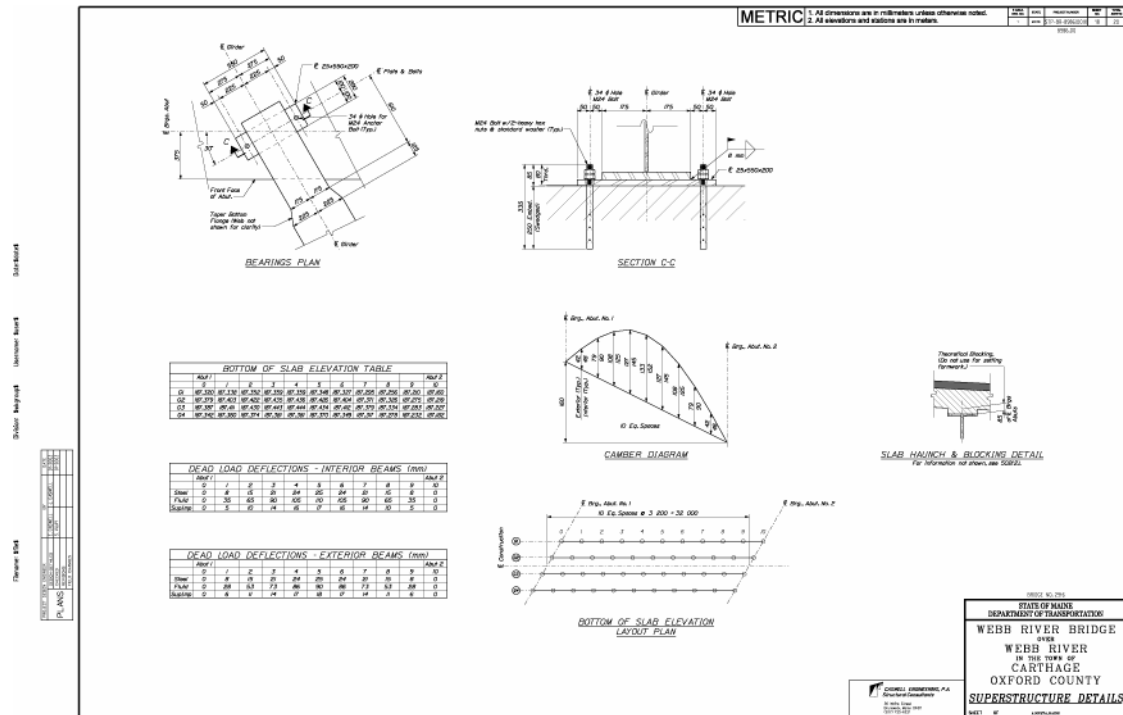


Figure 4-3 Steel Girder Superstructure Details

Will Contain:

- 1) Bottom of Slab Elevation Table
- 2) Dead Load Deflection Tables
- 3) Bottom of Slab Elevation Layout Plan

May Contain:

- 1) Camber Diagram & Camber Table
- 2) End of Slab Sections
- 3) Slab Haunch and Blocking Detail
- 4) Bearing Details
- 5) Rail Details
- 6) Fascia Offsets (curved bridges only)

4.2.4.4 BRIDGE BEARINGS

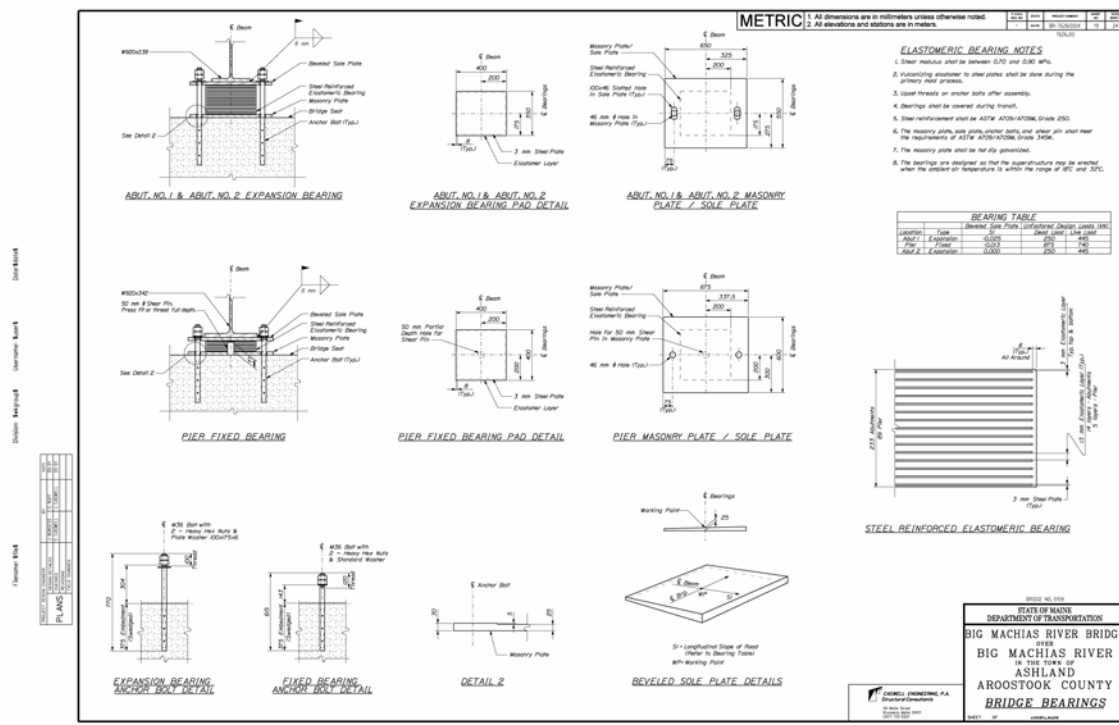


Figure 4-4 Steel Girder Bridge Bearings Sheet

Will Contain:

- 1) Bearing Notes
- 2) Bearing Details/Sections

May Contain:

- 1) Bearing Table
- 2) Plate Details/Sections

4.2.5 Standard Notes

4.2.5.1 Superstructure Notes

- 1) Form a 1 inch V-groove on the fascias at the horizontal joint between the curb and slab.
- 2) Reinforcing steel shall have a minimum cover of 2 inches unless otherwise noted or shown.
- 3) Adjust reinforcing steel to fit around the bridge drains in a manner approved by the Resident. Do not cut transverse reinforcing bars.
- 4) The Contractor shall install Transition Barrier vertical closed stirrups, as shown in the Standard Details Section 526 prior to the placement of the curb or sidewalk concrete.

(The following note is used for simple span structures.)

- 5) The superstructure slab concrete for each span shall be placed in one continuous operation and shall be kept plastic until the entire placement has been made.

(The following note is used for multiple span continuous structures with less than 250 yd³ of deck concrete.)

- 6) The superstructure slab concrete shall be placed in one continuous operation and the concrete shall be kept plastic one complete span behind the span being placed.

(The following note is used for multiple span continuous structures with more than 250 yd³ of deck concrete.)

- 7) Unless the superstructure slab concrete is placed in one continuous operation, the initial placement shall start at a simply supported end of the deck slab and shall terminate at the completion of a positive moment section. Successive placements shall proceed from the end of the previous placement, terminate at the completion of a positive moment section, and include two or more spans. Concrete in a placement shall be kept plastic one complete span behind the span being placed. A minimum of 5 days shall elapse between successive partial placements. The Resident shall approve the placement sequence of the superstructure slab concrete.

(The following note is used with staged construction of CIP structural slabs.)

- 8) The formwork and its supports, over the full width of the structural slab, shall remain in place until a minimum of 48 hours has elapsed after placement of the final section of the slab. After this period, removal of formwork for sections may then proceed and shall meet the requirements for form removal in Standard Specifications Section 502, Structural Concrete.
- 9) Mortar for bedding and for joints in the granite curb shall contain an approved non-shrink additive.

(The following notes are used when Precast Deck Panels are allowed)

- 10) At the Contractor's option, Precast Deck Panels may be used in place of the full depth cast-in-place deck slab, in accordance with special provisions Section 502, Structural Concrete – Precast Deck Panels, and in accordance with the Standard Details.
- 11) Payment for reinforcing steel fabricated, delivered and placed in the cast-in-place portion of the structural concrete slab will be considered incidental to the appropriate Section 502 pay item.

4.2.5.2 Structural Steel Notes

- 1) Camber ordinates as shown are computed to compensate for all dead load deflections and for the curvature of the finished grade profile.
- 2) No transverse butt-weld splices will be allowed in the flange plates or web plates within 10 feet or 10% of the span length (whichever is greater) from the points of maximum negative moment or maximum positive moment. Butt-weld splices in flanges shall be not less than 3 feet from transverse butt-welds in the web plates and no transverse web or flange butt-welds shall be located within 3 feet of other transverse welds (e.g. connection plates to web welds) on either flange or web. No transverse butt-weld splices will be allowed in areas of stress reversal.

- 3) Sections of flange plates or web plates between transverse shop splices or between a transverse shop splice and a field splice shall be not less than XX feet in length unless otherwise shown on the plans.
- 4) One longitudinal butt weld splice will be allowed in the web of the haunched sections of the girders. Feather edges between the longitudinal welds and the bottom flanges will not be allowed.
- 5) Bearing stiffeners shall be plumb after erection and dead loading of the structure. Intermediate web stiffeners may be either plumb or normal to the top flange.
- 6) Cross-frame or diaphragm connection plates may be either plumb or normal to the top flange.

(The following note is used only with designs using A709, Grade 50 or painted Grade 50W.)

- 7) Filler plates may be steel conforming to the requirements of A709, Grade 36.
- 8) The dimensions and elevations omitted from the Bottom of Slab Elevations table, the Camber Diagram, and the Stress Diagram will be provided to the Contractor for the structural steel option that has been selected.
- 9) At locations marked with an asterisk (*), the designated diaphragms shall be changed to a Type A (C) (D) diaphragm as required to accommodate the Contractor's deck placement sequence. No extra compensation will be allowed for any diaphragms so substituted, and any additional costs will be considered incidental to the Contract items.
- 10) Theoretical blocking used for design of the structure is XX inch(es) at the centerline of bearing at the abutments and piers. Refer to *Standard Details* 502 (02) for blocking details.

(The following note is used when web depth is 6 feet or greater.)

- 11) Handhold bars shall be installed in accordance with the Plans and Standard Detail 504 (21-24).

(The following note is used when a single span rolled beam with 3" or more camber is used.)

- 12) The Contractor may substitute welded plate girders in place of the rolled beams shown on the plans, as approved by the Resident. The fabricator shall determine the plate thicknesses based upon the depth and moment of inertia of the rolled section.

4.2.5.3 Elastomeric Bearings Notes

- 1) The shear modulus shall be between 80 and 175 psi.
- 2) Vulcanizing of the elastomer to the steel plates shall be done during the primary mold process.

(The following two notes are used when anchor rods are required.)

- 3) Upset the threads on the anchor rods after assembly of the bearing.
- 4) Bearings shall be covered during transit.
- 5) The masonry plate, sole plate, and shear pin shall meet the requirements of ASTM A709/A709M, Grade 50 or 50W. Anchor rods shall meet the requirements of ASTM F 1554, Grade 105 and shall be swaged on the embedded portion of the rod.

- 6) The bearings are designed so that the superstructure may be erected when the ambient air temperature is within the range of 65°F and 90°F. If the ambient air temperature is outside of this range, the bearings shall be reset as directed by the Resident.
- 7) The masonry plate shall be hot dip galvanized in accordance with Section 506. Sole plates for steel superstructures shall be treated in the same manner as the structural steel. Anchor rods, washers, nuts, and shear pins shall be galvanized to ASTM A 153 or ASTM B 695, Class 50, Type 1.
- 8) All bearings shall be marked prior to shipping. The marks shall include the bearing location on the bridge, and a direction arrow which points up-station. All marks shall be permanent and shall be visible after the bearing is installed.

(Use the following note when bearings are to be welded to steel girders)

- 9) All necessary precautions shall be taken to protect bearing components from field weld flash and splatter. Heat from welding operations shall be controlled such that steel adjacent to the elastomer does not exceed 200 °F. The temperature shall be verified by the use of temperature indicating crayons or other suitable means.

4.2.5.4 HLMR Bearings Notes

- 1) Refer to the Special Provisions for design, materials, fabrication, and general construction requirements.
- 2) The actual dimension “H” shall be the responsibility of the Contractor. Dimensions and sizes of plates not shown are dependent on design loads, bearing type, capacity, and the manufacturer of the bearings. The shop drawings, prepared by the manufacturer, shall provide all pertinent bearing information. The final bridge seat elevations shall be determined by the Contractor and submitted with the shop drawings for approval prior to construction of the substructure units.
- 3) Masonry plates shall be placed on 1/4” thick preformed pads in accordance with the specifications.

(Edit the following note to “Grade 55” if a higher strength anchor rod is required)

- 4) All steel, except anchor rods, shall be AASHTO M270, Grade 70W.
- 5) Anchor rods shall meet the requirements or ASTM F1554, Grade XX, and swedged on the embedded portion of the rod.
- 6) Anchor bolt spacing shall be coordinated with the bearing manufacturer.
- 7) Bearing installation shall be in strict conformance with the Special Provisions and the manufacturer’s recommendations.
- 8) The abbreviation “PTFE” indicates polytetrafluoroethylene.
- 9) The design temperature range shall be 150 °F (-30 °F to 120 °F)
- 10) At abutment bearings only, all steel located below the PTFE sliding surface shall be coated in accordance with Special Provision, Section 506, Protective Coating-Steel (Thermal Spray

Coating). All remaining steel at abutment bearings shall be coated in accordance with Special Provision, Section 506, Protective Coating-Steel (Zinc Rich System).

- 11) All bearings shall be marked prior to shipping. The marks shall include the bearing location on the bridge, and a direction arrow that points up-station. All marks shall be permanent and shall be visible after the bearing is installed.

(The following note is used if applicable.)

- 12) Bearings need not be designed with hold-downs.

4.2.6 Checklists

4.2.6.1 Superstructure Plan

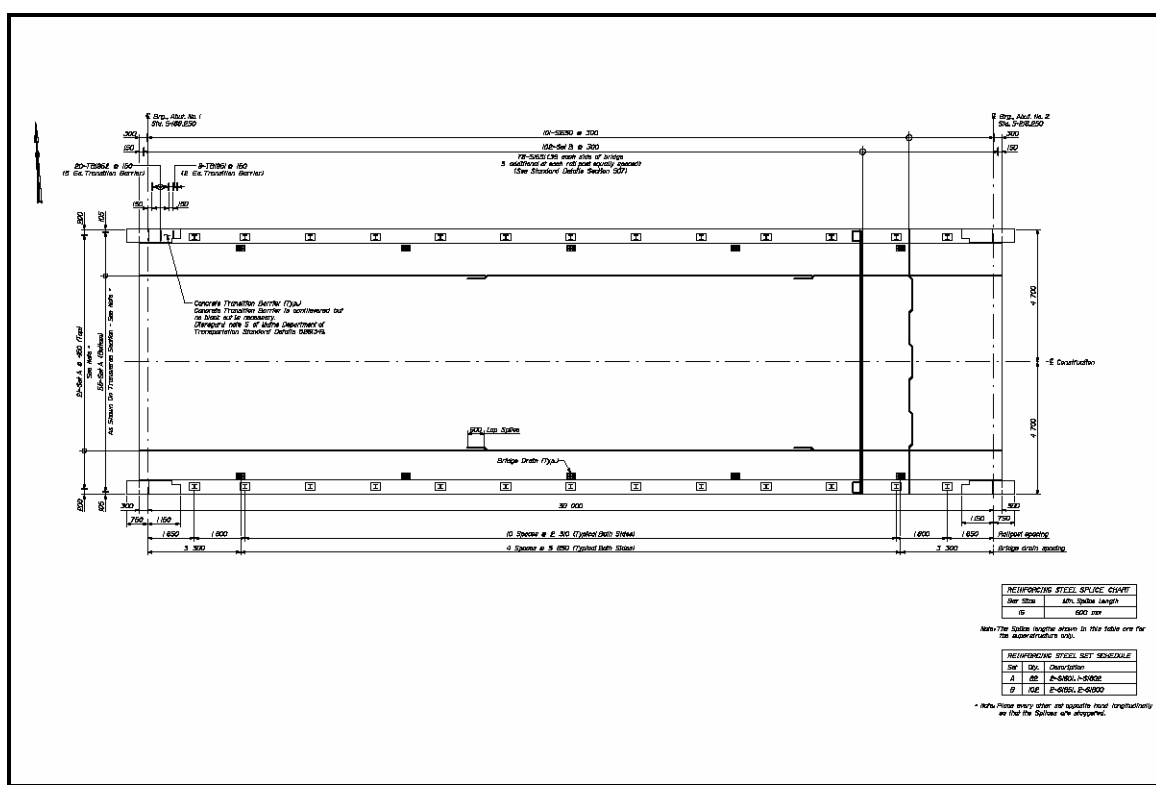


Figure 4-5 Steel Girder Superstructure Plan

Intro: Top view, shows relationship of superstructure limits to substructure centerlines. Also used to communicate reinforcing layout and rail system.

Sheet-up: Belongs on top left of superstructure sheet. Sometimes it is necessary to cut the plan and show on more than one sheet.

- ♪ When cutting is required, make sure to include an element in both plans, i.e. cut near a pier and show the pier on both plans.

① Make sure to not label the same reinforcing bar(s) twice – if any bar is shown on both plans, only label it on one plan.

Scale: 1/4". You may need to reduce the size of the plan to help fit it on the sheet. 3/16" or 1/8" are not out of the question. Bear in mind that you'll be detailing reinforcing steel on the section, however, and consider splitting a superstructure that is too long to fit on one sheet.

Draw:

- 1) Limits of concrete (show fascia, don't show beam blocking or hidden lines for shear keys under curbs)
- 2) Centerlines of bearing of substructures
- 3) Centerline of Construction / Working Lines
- 4) Face of curb
- 5) Rail System (Bridge Rail, Rail Posts & Centerline of Rail Posts, Concrete Transitions Barriers, Concrete Barriers, etc.)
- 6) Bridge Drains & Centerline of Bridge Drains
- 7) Reinforcing Steel
- 8) Construction Joints

Dimension:

- 1) Spans (CL Bearing Abut to Pier and/or Abut, along working line)
- 2) Rail Post Spacing (dimensioned along face of rail, tied to intersection of CL Bearing Abut with fascia) Note: This is a curved dimension on a curved superstructure.
- 3) Skew of substructures
- 4) Bridge Drain Spacing (dimensioned along fascia, tied to intersection of CL Bearing Abut to fascia)
- 5) End of slab (limits of concrete, dimensioned parallel to CL Bearing Abut, tied to intersection of CL Construction and CL Bearing Abut)
- 6) Reinforcing steel (laps & locations)
- 7) Distance from CL Bearing Abut to End of Slab (show on integral abutments only, dimensioned perpendicular to CL Bearing)

Label:

- 1) CL of substructure bearings
- 2) Centerline of construction/working line
- 3) Stations at CL of Bearings of substructures
- 4) Stations of Working Points
- 5) Detail Name "SUPERSTRUCTURE PLAN"
- 6) North
- 7) Section/Detail Cuts
- 8) Rail Post Spacing

- 9) Rail System (Bridge Rail, Concrete Barrier, CL of Rail Post, End Treatments, etc.)
- 10) Bridge Drains
- 11) Reinforcing Steel

4.2.6.2 Transverse Section

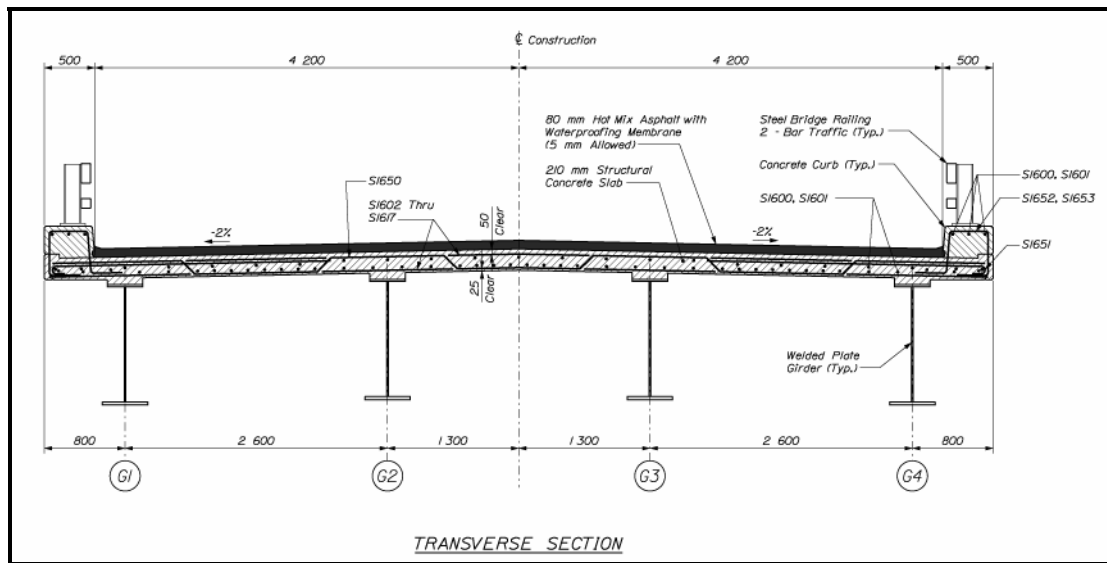


Figure 4-6 Steel Girder Transverse Section

Intro: A section cut through the superstructure normal to the centerline of construction, cut looking upstation. This section shows the relationship of the cast-in-place slab with the girders, plus the roadway elements and reinforcing steel.

Sheet-up: Belongs on the superstructure sheet below the plan.

Scale: 1/2". Wide bridges (40'±) might require 3/8" scale.

Draw:

- 1) Centerline of Construction / Working Line
- 2) Centerline of Beams
- 3) Finished grade
- 4) Bottom of pavement/top of slab
- 5) Bottom of slab w/beam haunches
- 6) Pavement should be shaded
- 7) Concrete should be hatched with adjacent placements showing alternating hatching from 45 to 135 degrees.
- 8) Steel beams (w/steel hatching)
- 9) Curbs
- 10) Rail system (bridge rail, barriers, etc.)

- 11) Reinforcing Steel
- 12) Utilities (i.e. conduits suspended from structure)
- 13) Bridge Drains
- 14) Lighting
- 15) Construction Joints

Dimension:

- 1) Overall superstructure width
- 2) Centerline to curb width
- 3) Face of curb to fascia width
- 4) Girder spacing & overhang (overhang should be dimensioned as “varies” on a curved bridge with straight girders)
- 5) Reinforcing cover (top and bottom)
- 6) Construction Joints

Label:

- 1) Centerline of Construction/Working Line
- 2) Slab Thickness
- 3) Reinforcing steel
- 4) Rail System
- 5) Wearing Surface and Membrane
- 6) Cross-slope
- 7) Curb
- 8) Beams
- 9) Utilities
- 10) Detail Name “TRANSVERSE SECTION”
- 11) Construction Joints

4.2.6.3 End of Slab Sections

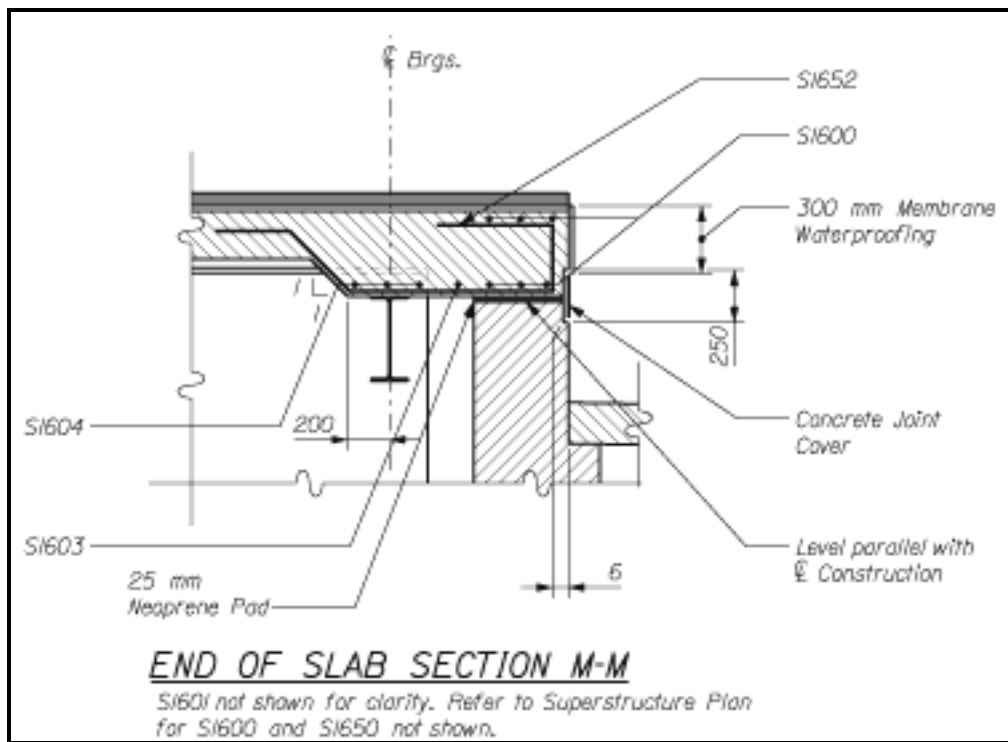


Figure 4-7 Steel Girder End of Slab Section

Intro: End of Slab Sections are cut perpendicular to CL Bearing Abutment. They are typically required when you need to show end of slab haunches, slab over backwall, or joints. The section is primarily required to show reinforcing steel, but also helps clarify joint treatments.

Sheet-up: End of Slab Sections should be put on the Superstructure sheet along with the Superstructure plan and the transverse section. They may also be included on a superstructure details sheet.

Scale: 1/2"

Draw:

- 1) Superstructure concrete
- 2) Abutment concrete
- 3) Wearing Surface
- 4) Concrete Joint Cover
- 5) Steel Girder
- 6) Centerline Bearings Abutment
- 7) Reinforcing Steel (typically you only show the additional end-of-slab steel and omit bars that are clearly denoted by the superstructure plan/transverse section)
- 8) For slab over backwall, show any materials that may be present in the superstructure/abutment interface (neoprene pad, etc.)

9) End Diaphragms

Dimension:

- 1) Haunch location
- 2) Extension of Membrane down back of slab
- 3) Width and depth of concrete joint cover

Label:

- 1) Centerline of Bearings
- 2) Detail Name
- 3) Reinforcing Steel
- 4) Joint Cover
- 5) Neoprene Pad
- 6) Membrane
- 7) Slope of Haunch (Rise/Run)

4.2.6.4 Camber Diagram

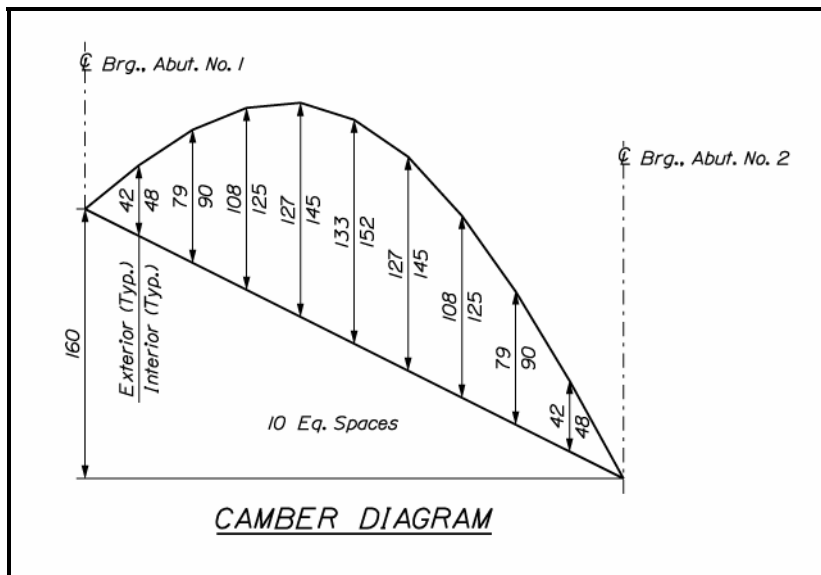


Figure 4-8 Camber Diagram

Intro: This diagram is a structural steel fabrication detail. It is cut parallel to the girders and shows an elevation-type view of the girder, abutment to abutment. It is used to communicate deflection information to the fabricator to assist in the manufacture of welded girders. It is sometimes accompanied by a Camber Table.

Sheet-up: This detail belongs on either the Framing or the Superstructure Details sheets.

Scale: Starting Point/Rule of Thumb: Horizontal Scale 1/16", Vertical Scale 1 1/2" to 3". This detail is diagrammatic in nature and there is no need to draw either horizontally or vertically to scale.

Draw:

- 1) Centerlines of bearing of substructure
- 2) Centerlines of splices
- 3) Working Line
- 4) Vertical Centerline of Beam

Dimension:

- 1) Locate all camber points relative to centerlines of bearing of substructure and splices (horizontal dimension)
- 2) Vertical offset of Centerline of beam from the working line at each camber point (this is the camber ordinate) The old common practice was to set the camber ordinates at 10 foot increments, but the ASSHTO/NSBA Steel Bridge Collaboration recommends 10 equal spaces on short span bridges. If these spaces exceed twelve feet, then increase the number of spaces.
- 3) Vertical offset of working line to lowest point at centerlines of splices and bearings.

Label:

- 1) Centerlines of bearings
- 2) Centerlines of splices
- 3) Centerline of beam
- 4) Working line
- 5) Detail Name ("CAMBER DIAGRAM")

4.2.6.5 Slab Haunch and Blocking Detail

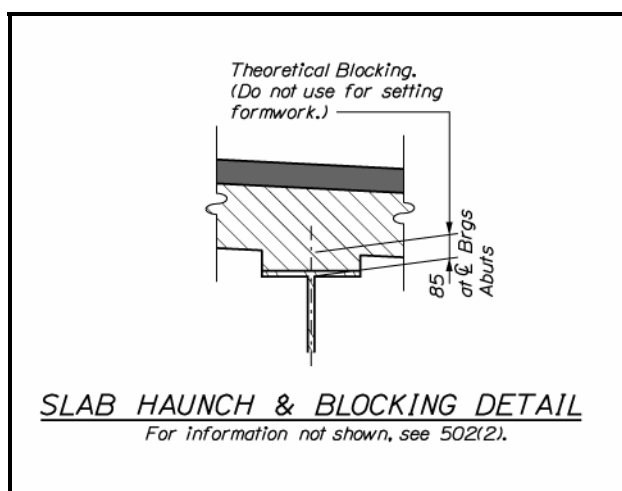


Figure 4-9 Steel Girder Slab Haunch and Blocking Detail

Intro: This detail is cut normal to the centerline of the steel girders. It shows the theoretical blocking thicknesses at the bearing lines.

Sheet-up: This detail belongs either on the Superstructure sheet or on a superstructure details sheet.

Scale: 1/2"

Draw:

- 1) Top of Slab
- 2) Bottom of slab
- 3) Hatch concrete
- 4) Wearing Surface (Shaded)
- 5) Centerline of Girder
- 6) Top flange and web of girder
- 7) Haunch

Dimension:

- 1) Theoretical blocking

Label:

- 1) "Theoretical Blocking. Do not use for setting formwork."
- 2) Detail Name

4.2.6.6 Bottom of Slab Elevation Layout Plan

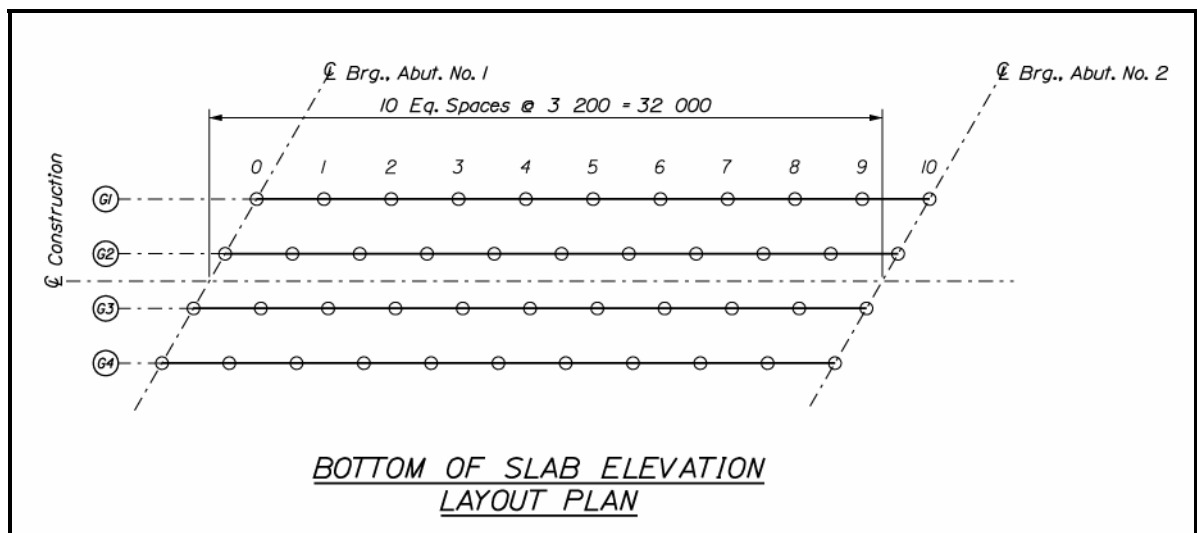


Figure 4-10 Steel Girder Bottom of Slab Elevation Layout Plan

Intro: This plan is a companion to the Bottom of Slab Elevation Table and the Dead Load Deflections Tables. These tables reference blocking points, and this plan helps clarify the location of these blocking points.

Sheet-up: This plan and the companion tables belong on a Superstructure Details Sheet

Scale: 1/16", but this detail is diagrammatic, and doesn't need to be to scale.

Draw:

- 1) Centerline of construction / Working Line
- 2) Centerline of substructure bearing
- 3) Centerlines of girders
- 4) Girders
- 5) Blocking Points

Dimension:

- 1) Blocking point spacing, referenced to Centerlines of bearing of substructures.

Label:

- 1) Centerline of construction / Working Line
- 2) Centerlines of girders
- 3) Centerlines of substructure bearing
- 4) Detail Name "BOTTOM OF SLAB ELEVATION LAYOUT PLAN"
- 5) Blocking Points

4.2.6.7 Framing Plan

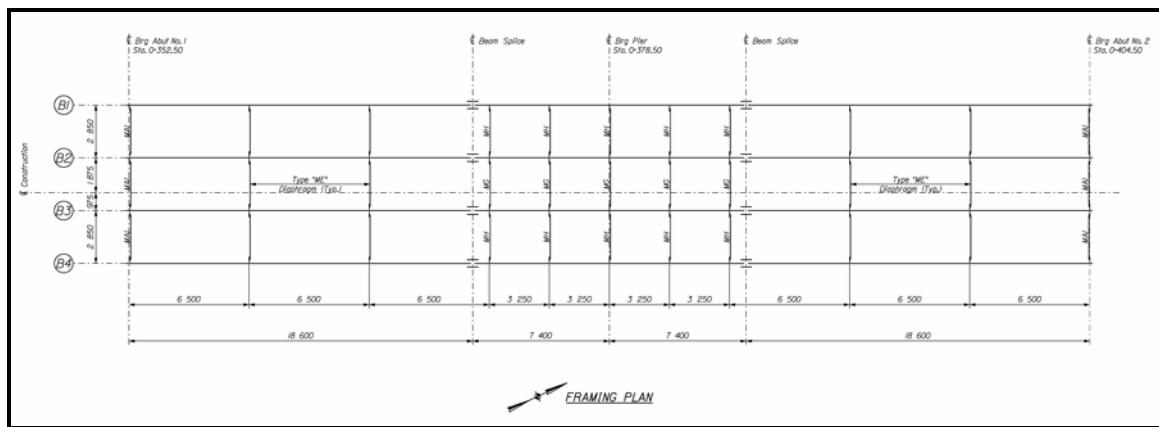


Figure 4-11 Steel Girder Framing Plan

Intro: This is a top view of the structural steel. It shows the spacing of the girders and the locations of splices, diaphragms, pedestals, etc.

- ♪ Many of the elements shown in the Framing plan (i.e. diaphragms, stiffeners, and bracing) are drawn diagrammatically only.

Sheet-up: Belongs on a Framing Plan Sheet

Scale: 1/4" Usually the same as the superstructure plan, but since it shows less detail, it may be shown smaller than the superstructure if necessary: 3/16" or 1/8"

Draw:

- 1) Centerline of Construction/Working Line
- 2) Centerlines of Bearing of Substructure
- 3) Centerlines of Girders
- 4) Centerlines of Beam Splices
- 5) Girders
- 6) Diaphragms
- 7) Diaphragm connection plates
- 8) Transverse stiffeners
- 9) Lateral bracing
- 10) Longitudinal Stiffeners
- 11) Splices

Dimension:

Transverse dimensions tied to intersection of CL Brg. Abuts and CL Construction/Working Line (Working Point), longitudinal dimensions tied to CL Bearing Abut.

- 1) Span Lengths
- 2) Girder Spacing (& Girder-to-girder skewed dimension for skewed bridge)
- 3) Diaphragm Locations.
- 4) Splice Locations.
- 5) Longitudinal Stiffener length and location
- 6) Skew
- 7) Transverse Stiffener Locations

Label:

- 1) Detail Name "FRAMING PLAN"
- 2) North
- 3) Centerline of Construction/Working Line
- 4) Centerlines of Substructure
- 5) Bearing Type (for steel bearings only)
- 6) Centerlines of Splices
- 7) Girder Number/Designation (i.e. B1, B2, etc.)

- 8) Diaphragm Types
- 9) Transverse Stiffeners
- 10) Longitudinal Stiffeners
- 11) Lateral Bracing

4.2.6.8 Beam Elevation and Stud Layout

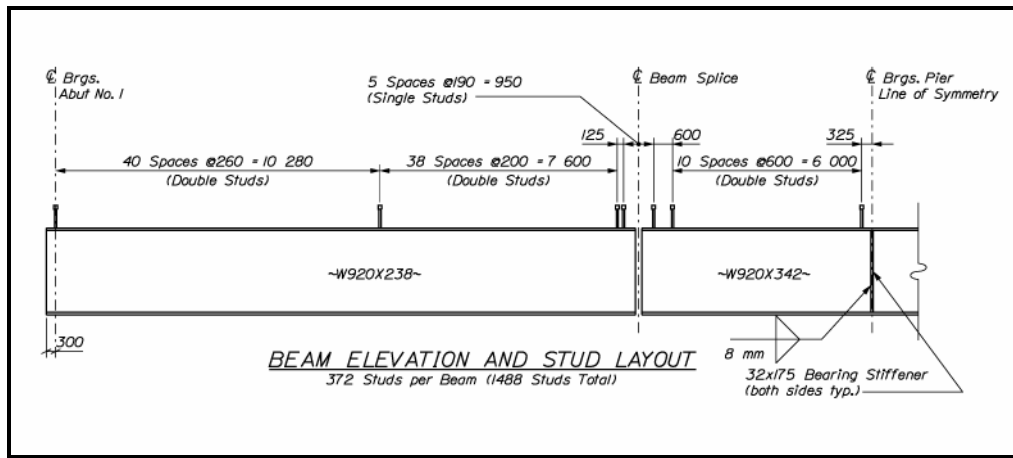


Figure 4-12 Steel Girder Beam Elevation and Stud Layout

Intro: Side view of beam. Primarily serves to show beam size. Also used to clarify stiffeners, splices, and shear connector studs.

❶ Shear studs interfere with the bottom mat of superstructure rebar. This reinforcing steel can be adjusted in the field to clear the studs. Make sure that double or triple studs are oriented parallel to the direction of the reinforcing steel, which will be either normal to the girders or parallel to the skew. This should be noted on the plans.

Sheet-up: Belongs on framing plan sheet, directly below framing plan.

Scale: Horizontal scale equal to framing plan, typically $\frac{1}{4}$ "', but possibly as small as $\frac{1}{8}$ ". Vertical direction doesn't need to be to scale, but is typically shown as $\frac{3}{8}$ " or greater.

Draw:

- 1) CL Brg. Substructures
- 2) CL Splices
- 3) Beam
- 4) Shear studs
- 5) Stiffeners
- 6) Cover Plates

Dimension:

- 1) Shear stud layout
- 2) Beam overhang (length of beam beyond CL Bearing Abuts)
- 3) Haunch length (haunched girder only)
- 4) Cover Plate Locations
- 5) Difference in flange plate thicknesses at shop splices (welded girders only.)

Label:

- 1) CL Brg. Substructures
- 2) Detail Name "BEAM ELEVATION AND STUD LAYOUT"
- 3) Beam sizes (flange and web plate sizes of welded girders)
- 4) Stiffener sizes
- 5) Cover Plate Sizes
- 6) Welds
- 7) Total Number of Studs Per Girder and per project (noted under the detail name).

4.2.6.9 Field Splice Details

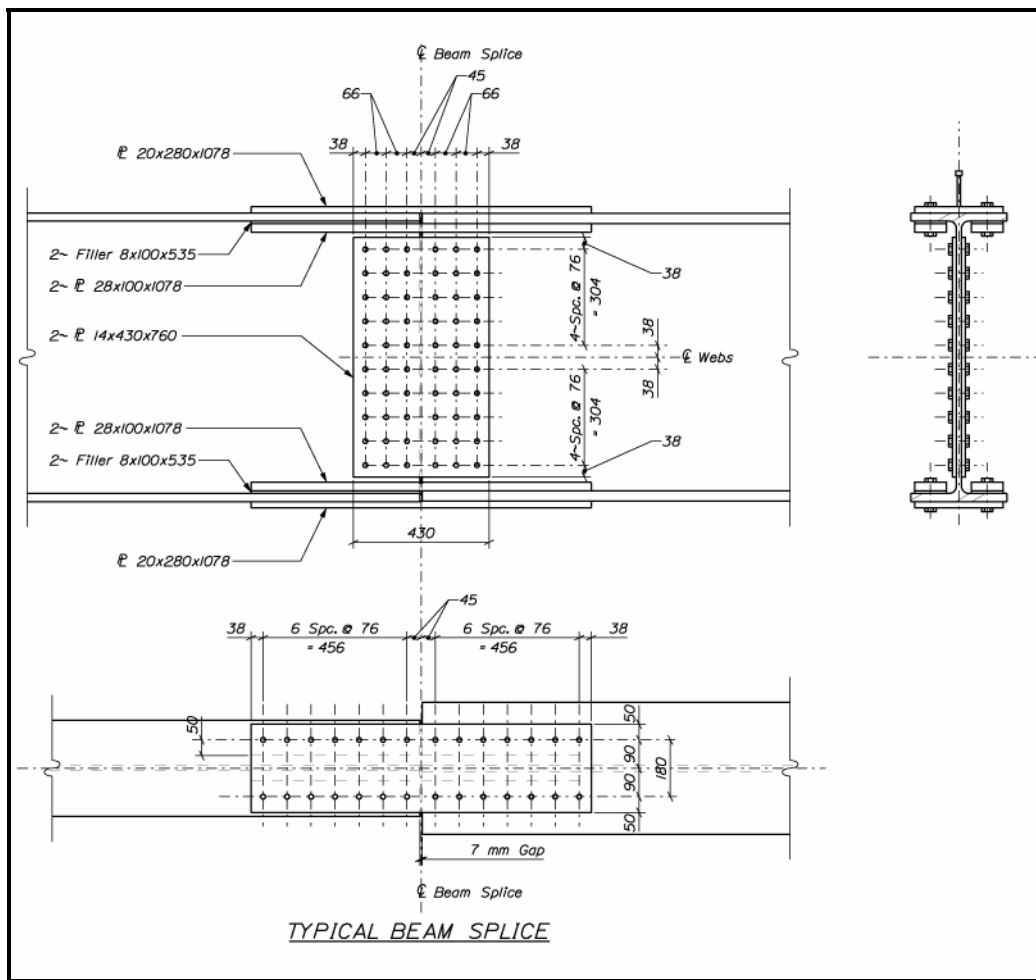


Figure 4-13 Steel Girder Field Splice Details

Intro: This is a three-for-one detail, including a plan, section, and elevation of a field splice. The purpose of these details is to clearly denote all steel plate and bolt sizes and locations.

♪ If top and bottom flange splices are different, a top view and a bottom view are both required.

Sheet-up: Belongs on a Framing Plan Sheet. The plan and elevation should be shown one on top of the other with CL of Splices aligned, while the Section and Elevation should be shown to the left and right of each other with the CL of Webs aligned.

Scale: 1" or 1 1/2"

Draw:

- 1) CL of Beam Splice
- 2) CL of Webs of Beams (both horizontal and vertical)
- 3) Beams

- 4) Plates
- 5) Bolts

Dimension:

Each dimension should be shown in only one view (no duplications) All dimensions should be tied to the Beam Splice and to the CL of Web. Where possible, bolt location should be tied to the ends of plates as well. Dimensions are typically not shown in the section view.

- 1) Gap between beams (typically 1/4")
- 2) Flange bolt locations
- 3) Web bolt locations

Label:

- 1) CL of Beam Splice
- 2) CL of Web
- 3) Plate sizes

① **Filler Plate Thicknesses Should Not Be Given**

- 4) Detail Name "TYPICAL BEAM SPLICE"

4.2.6.10 Beam Stress Type Diagram

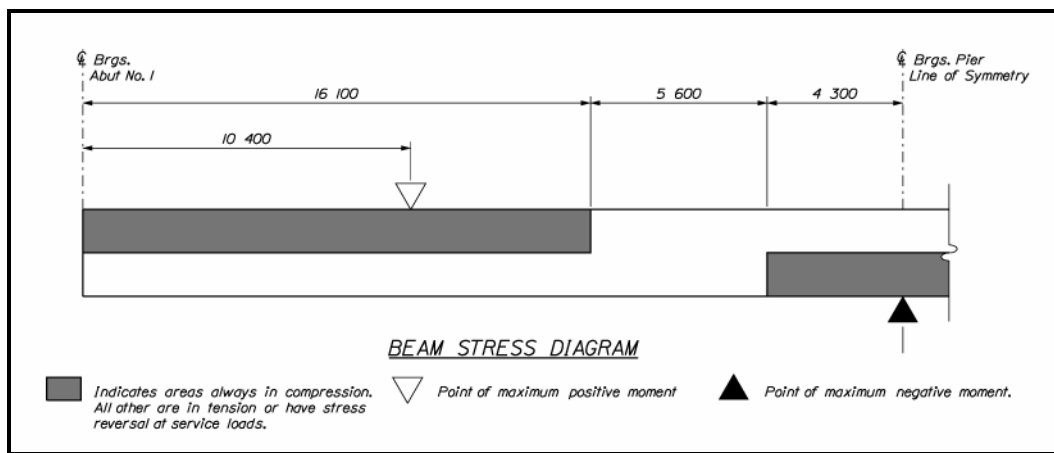


Figure 4-14 Steel Girder Beam Stress Type Diagram

Intro: This detail is a diagrammatic side/elevation view of continuous beams. It shows which portions of the beam are in compression, tension, or stress reversal. It also shows the points of maximum negative and positive moment. All of this information is used by the fabricator to design connections along the length of the girder.

↪ Refer to Notes 4, 5 and 7 of the *Standard Details* Page 504(22) and Standard Structural Note 2 of *Bridge Design Guide* Page D-10.

Sheet-up: Belongs on the Framing Plan

Scale: Not to scale. Draw the same as the Beam Elevation and Stud Layout plan (Section 4.2.6.8, above)

Draw:

- 1) Beam
- 2) CL Bearings Substructure
- 3) Shade areas always in compression

Dimension:

- 1) Limits of areas always in compression
- 2) Locations of points of maximum positive and negative moment

Label:

- 1) Detail Name
- 2) CL Bearings Substructure
- 3) Points of Maximum Positive and Negative Moment
- 4) Legend

4.3 Precast Voided Slab/Box

4.3.1 Introduction

This section deals with the detailing of precast voided slabs and precast boxes. The superstructure may be comprised of a cast-in-place deck on spread boxes, a topping slab on butted boxes/slabs, or neither.

4.3.2 Prerequisites

The Superstructure plans show precast unit details, layout, and superstructure C.I.P. concrete leveling slab, wearing surface, bridge rail, drains.

To draw the superstructure up to completion, the detailer requires the following information:

- 1) CL Bearings Abutment and Pier Stations
- 2) Substructure Skew Angle
- 3) Span Lengths (Pay attention to relationship of CL Construction and Working Line of a curved bridge. Refer to Chapter 2 for guidance.)
- 4) Joint Locations (Construction & Contraction)
- 5) Roadway width and cross-slope
- 6) Curb/Sidewalk widths
- 7) Wearing Surface Type and Thickness
- 8) Slab Type & Thickness (Topping vs. Structural Slab)
- 9) Rail Type
- 10) Rail Post Locations (can be developed by detailer from standard detail information.)
- 11) Panel Spacing & Slab Overhang (spread panels only)
- 12) Precast Unit Type and nominal size
- 13) Precast Unit Layout
- 14) Panel length and relationship of end-of-panel to CL Bearings Substructure
- 15) Blocking Height (spread panels only)
- 16) Diaphragm Spacing (spread panels only)
- 17) Bearing Type and thickness
- 18) Completed and checked reinforcing schemes:
 - a. Curbs and Sidewalks
 - b. Superstructure Slab (spread panels only)
 - c. Precast Shear Reinforcing Sets
 - d. Precast End-of-panel hairpins

- e. Top Slab Reinforcement for Box Beams (for Strength and Distribution)
 - f. Pier Continuity Reinforcement (as req'd)
 - g. Post-tensioning lock-off reinforcement (as req'd)
 - h. Dowel Size and Spacing (to anchor to substructure)
- 19) Completed and checked prestressing scheme (strand number, location, debonding limits, etc.)
 - 20) Completed and checked post-tensioning scheme
 - 21) Void geometry (size, location, length)
 - 22) Superstructure and Precast Notes
 - 23) Bridge Drain Type & Locations
 - 24) Bottom of Slab Grades (spread panels only)
 - 25) Sketch of Blocking Point Layout Diagram (spread panels only)
 - 26) Utility Size, Type, and Location

4.3.3 Detailing

Precast Voids Slabs/Boxes require explicit rather than performance-based details. A vast majority of the details are to serve the needs of the Fabricator rather than the Contractor. The Superstructure Plan and Transverse Section are used by the Contractor to erect the structure. The precast sheets and their details are provided for the Fabricator.

There are standards developed for the northeastern United States by the Precast Concrete Institute which should be used for designing and detailing plans. Consult the Bridge Program concrete Technical Resource person for more information.

4.3.4 Typical Sheet Names and Contents

4.3.4.1 PRECAST VOIDED SLAB/BOX

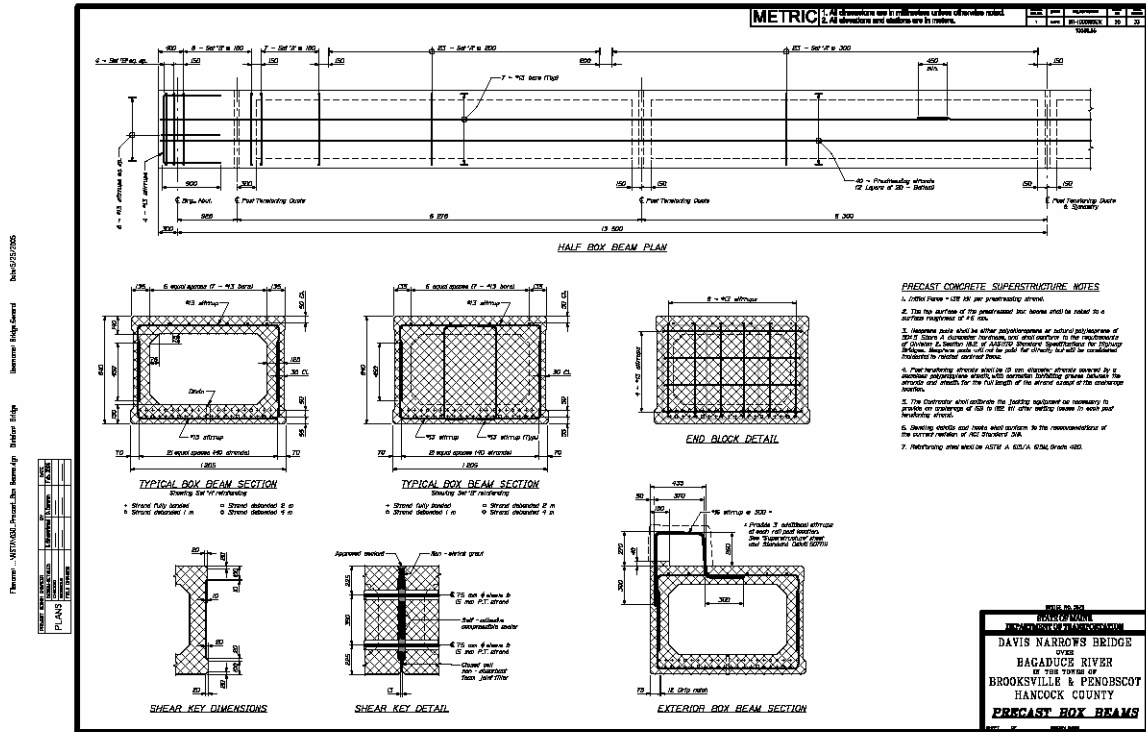


Figure 4-15 Precast Box Sheet

Will Contain:

- 1) Precast Voided Slab/Box Plan
- 2) Typical Sections

May Contain:

- 1) Notes
- 2) Longitudinal Section
- 3) Reinforcing Steel Schedule

4.3.4.2 PRECAST VOIDED SLAB/BOX DETAILS

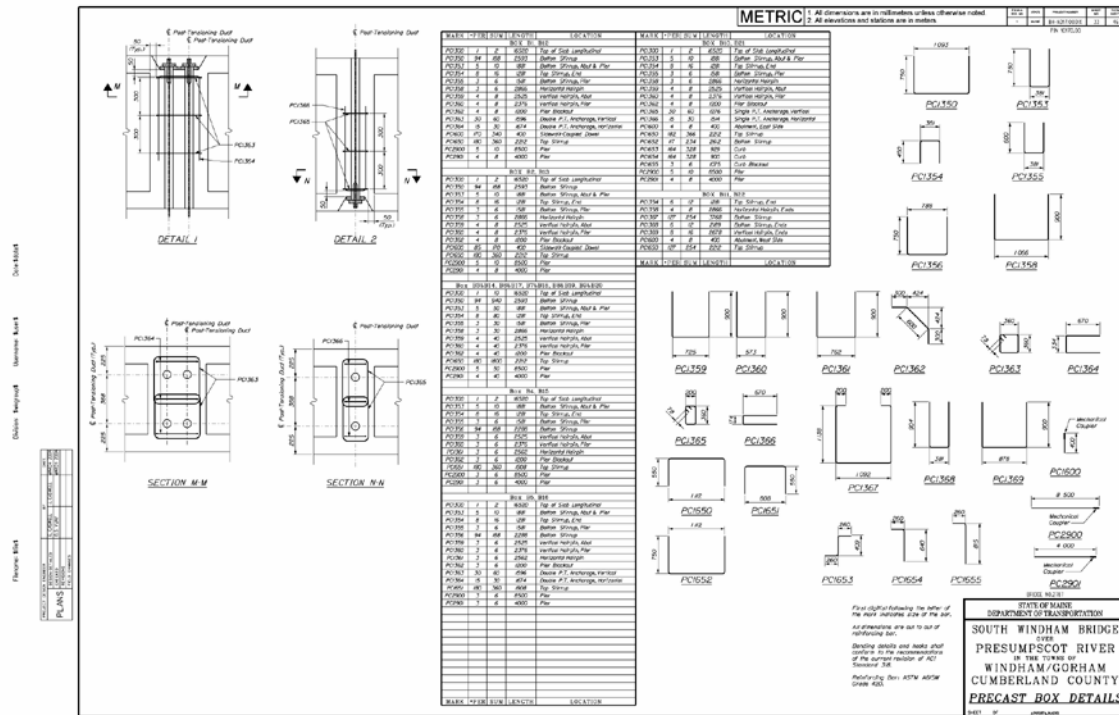


Figure 4-16 Precast Box Details Sheet

Will Contain:

- 1) Reinforcing Steel Schedule

May Contain:

- 1) Post-tensioning details and sections
- 2) Longitudinal Section
- 3) Other details/sections
- 4) Notes

4.3.4.3 SUPERSTRUCTURE

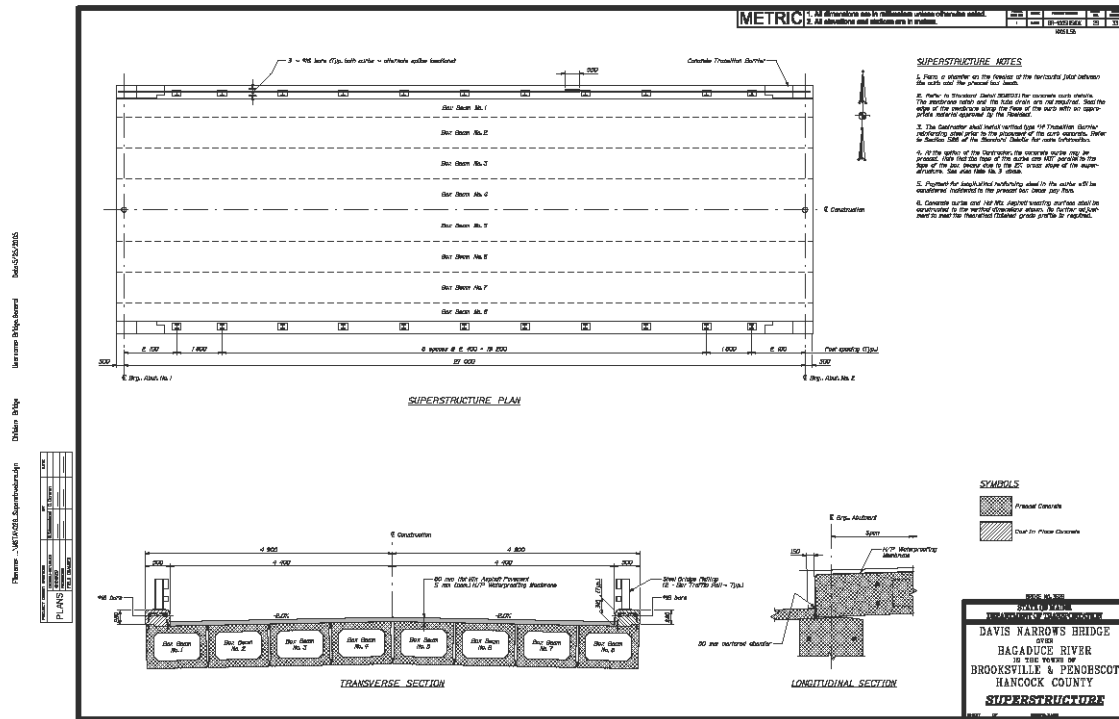


Figure 4-17 Precast Superstructure Sheet

Will Contain:

- 1) Superstructure Plan
- 2) Transverse Section

May Contain:

- 1) Notes
- 2) Other Details

4.3.4.4 SUPERSTRUCTURE DETAILS

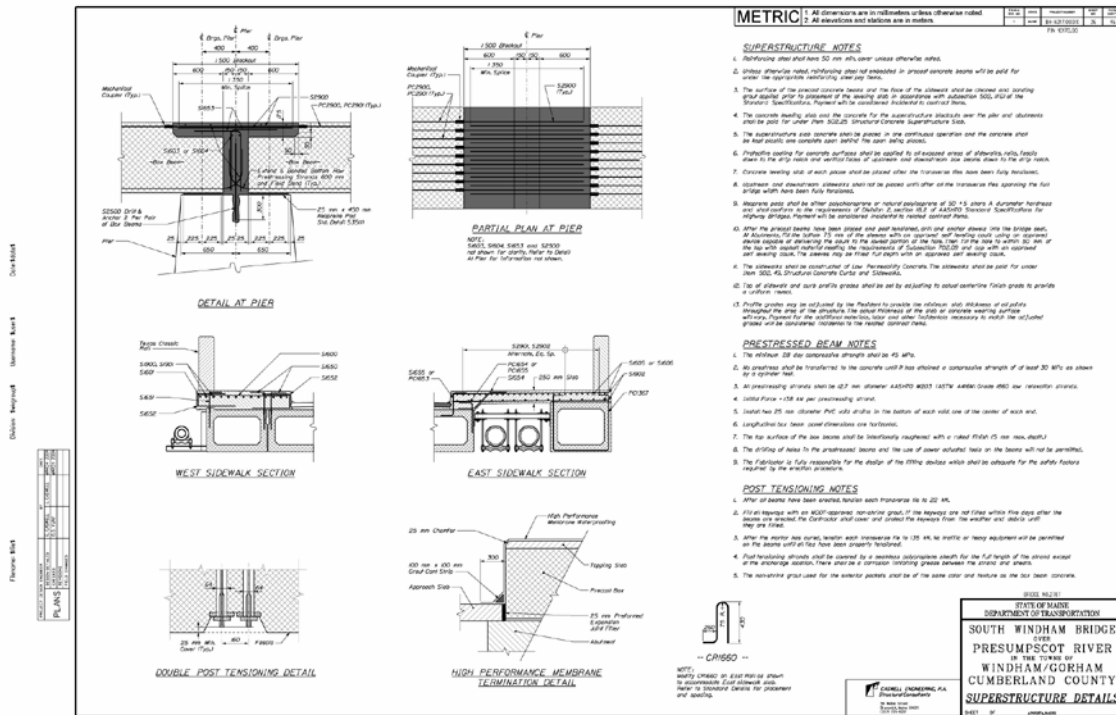


Figure 4-18 Precast Superstructure Details

May Contain:

- 1) Notes
- 2) Bottom of Slab Elevation Table/Layout Plan (spread boxes)
- 3) Bridge Drain Details
- 4) Slab End Details
- 5) Bearing Layout Details
- 6) Post-tensioning Details
- 7) Utility attachments
- 8) Beam Splice Details

4.3.5 Standard Notes

4.3.5.1 Precast Concrete Superstructure Notes

- 1) Prestressing strands shall be 0.5 inch diameter. The tensioning force is 31 kips per prestressing strand.
- 2) Prestressing strands shall be 0.6 inch diameter. The tensioning force is 44 kips per prestressing strand.

- 3) The top surface of the upper flange of the prestressed beams shall be raked to a surface roughness of plus or minus 1/4", except at locations corresponding to the blocking points. At these locations a flattened area of sufficient size shall be left to facilitate taking elevations for setting bottom of slab elevations.
- 4) The drilling of holes in the prestressed beams and the use of power-actuated tools on the beams will not be permitted.
- 5) Neoprene pads shall be either polychloroprene or natural polyisoprene of 50 ± 5 Shore A durometer hardness, and shall conform to the requirements of Division 2, Section 18.2 of AASHTO Standard Specifications for Highway Bridges. Neoprene pads will not be paid for directly, but will be considered incidental to related Contract items.
- 6) Install a 1 inch diameter nonmetallic void drain in the bottom of each void at both ends.
- 7) Reinforcing steel shall have 2 inches minimum cover unless otherwise noted or shown.
- 8) Post-tensioning strands shall be covered by a seamless polypropylene sheath, with corrosion inhibiting grease between the strands and sheath, for the full length of the strand except at the anchorage location.
- 9) The Contractor shall calibrate the jacking equipment as necessary to provide an anchorage of 38 to 41 kips after setting losses in each 0.6" diameter post-tensioning strand.

(The following note is used for all voided slab and butted box beam structures.)

- 10) Screed rails shall be installed to the elevation shown on the profile, adjusted for wearing course thickness and cross slope.

4.3.6 Checklists

4.3.6.1 Precast Voided Slab/Box Plan

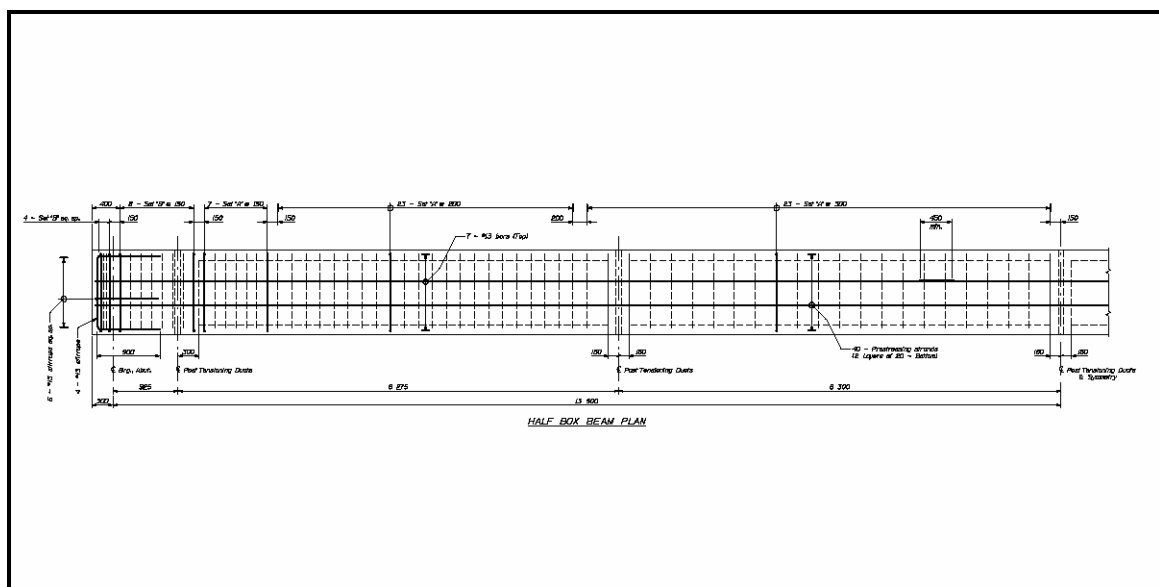


Figure 4-19 Precast Plan

Intro: Top view of precast deck panel.

Sheet-up: Belongs in upper left hand corner of Precast Voided Slab/Box Sheet

Scale: 1/4"

Draw:

- 1) CL of Brgs. Substructure
- 2) Limits of Concrete
- 3) Limits of Voids (show void drains)
- 4) CL of Post-Tensioning Ducts
- 5) Post-Tensioning Pockets (fascia side only)
- 6) End Hairpin Reinforcement (shear stirrups should be shown only in transverse and longitudinal sections)
- 7) PVC Sleeves for Dowels (into Abutment or Pier)
- 8) Pre-stressing strands (typically show 1 and annotate like rebar)

Dimension:

- 1) Overall Length of Panel
- 2) Panel Overhang (CL Brgs. To End of Panel)
- 3) Locations of Post-Tensioning Ducts
- 4) Location of PVC Sleeves (for dowels)
- 5) Void clearance from post-tensioning duct centerline
- 6) Skew angle

Label:

- 1) Detail Name
- 2) CL of Brg. Substructure
- 3) CL Post-Tensioning Ducts
- 4) PVC Sleeve
- 5) Post-Tensioning Pocket (fascia only)
- 6) Reinforcing
- 7) Section Cut (for Longitudinal Section / Elevation)
- 8) North
- 9) Voids
- 10) Void Drains

4.3.6.2 Transverse Sections

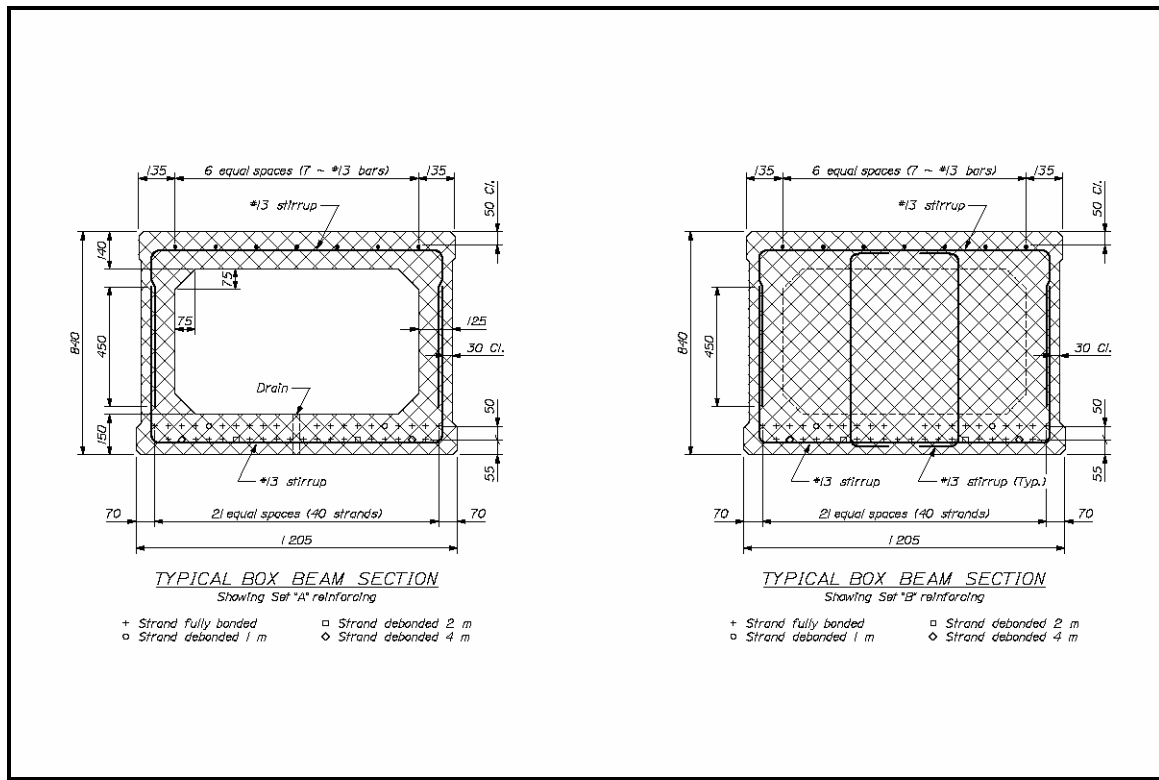


Figure 4-20 Precast Transverse Sections

Intro: Typically either two or three sections (for both the internal and external panels) are required to clearly show the critical locations along the panel. For a simple span with symmetric ends, only two sections are needed: an end section and a mid-span section. For a continuous span, the mid-span section is required, as are separate sections in the vicinity of the abutment and the pier.

Sheet-up: Belongs on the Precast Voids Slab/Box Sheet

Scale: Either 1" or 1 1/2"

Draw:

- 1) Limits of Precast Concrete
- 2) CL of Panel
- 3) CL of Voids
- 4) CL of Prestressing Strands
- 5) Voids (show hidden in end-span sections)
- 6) Curbs/Sidewalks (on exterior panels)
- 7) Prestressing Strands (show debonded strands solid, non-debonded strands hollow)
- 8) Reinforcing Steel

Dimension:

- 1) Width of panel
- 2) Location of Voids (horizontal and vertical)
- 3) Thickness of Panel
- 4) Location of Prestressing Mats (CL of top strands to top of panel, CL of bottom strands to bottom of panel.)
- 5) Spacing of prestressing strands
- 6) On a box, dimension thickness of top, bottom, and side walls, and void chamfer size
- 7) On a voided slab, dimension the diameter of the voids

Label:

- 1) Detail Name
- 2) CL Panel
- 3) CL Voids
- 4) Number of prestressing strands
- 5) Number of debonded strands and debonded length
- 6) Reinforcing Steel
- 7) Legend to differentiate debonded from non-debonded strands

4.3.6.3 Longitudinal Slab/Box Section

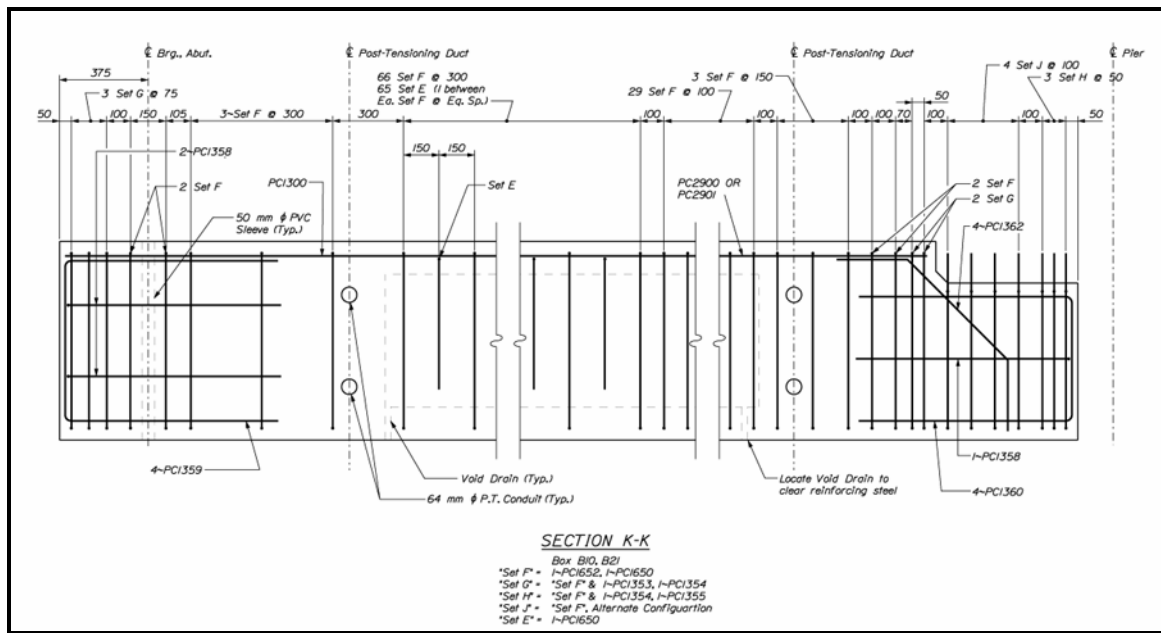


Figure 4-21 Precast Longitudinal Section

Intro: This side view shows the layout of shear stirrup spacing as well as end of slab hairpins. It also serves as the only side view of the panel.

Sheet-up: Belongs either on Precast Voided Slab/Box Sheet or Detail Sheet

Scale: 1" or 1 1/2", this section must be cut into a minimum of 3 portions, showing the ends as well as the middle of the panel.

Draw:

- 1) CL of Brg. Substructures
- 2) CL Post-tensioning ducts
- 3) Limits of Concrete
- 4) Post-Tensioning Conduits
- 5) Voids and Void Drains
- 6) Reinforcing Steel

Dimension:

- 1) Reinforcing Steel

Label:

- 1) Section Name
- 2) CL Post-Tensioning Ducts
- 3) CL Substructures
- 4) Reinforcing Steel

♪ You may need to conserve space by combining rebar into sets, make sure to include a note or table to clearly define what steel is in what set.

- 5) Post-Tensioning Conduits
- 6) Void Drains
- 7) PVC Sleeves (for dowels)

4.3.6.4 Reinforcing Schedule

Intro: The reinforcing schedule for precast concrete is slightly different from the standard cast-in-place schedule, in that each individual bar is drawn, labeled and dimensioned right in the schedule.

Sheet-up: The Precast Reinforcing Schedule belongs either on a Precast Slab/Box or Details Sheet.

Scale: Not to scale, try 1/4" Feel free to draw bars out of scale to help fit them in the schedule.

4.3.6.5 Superstructure Plan

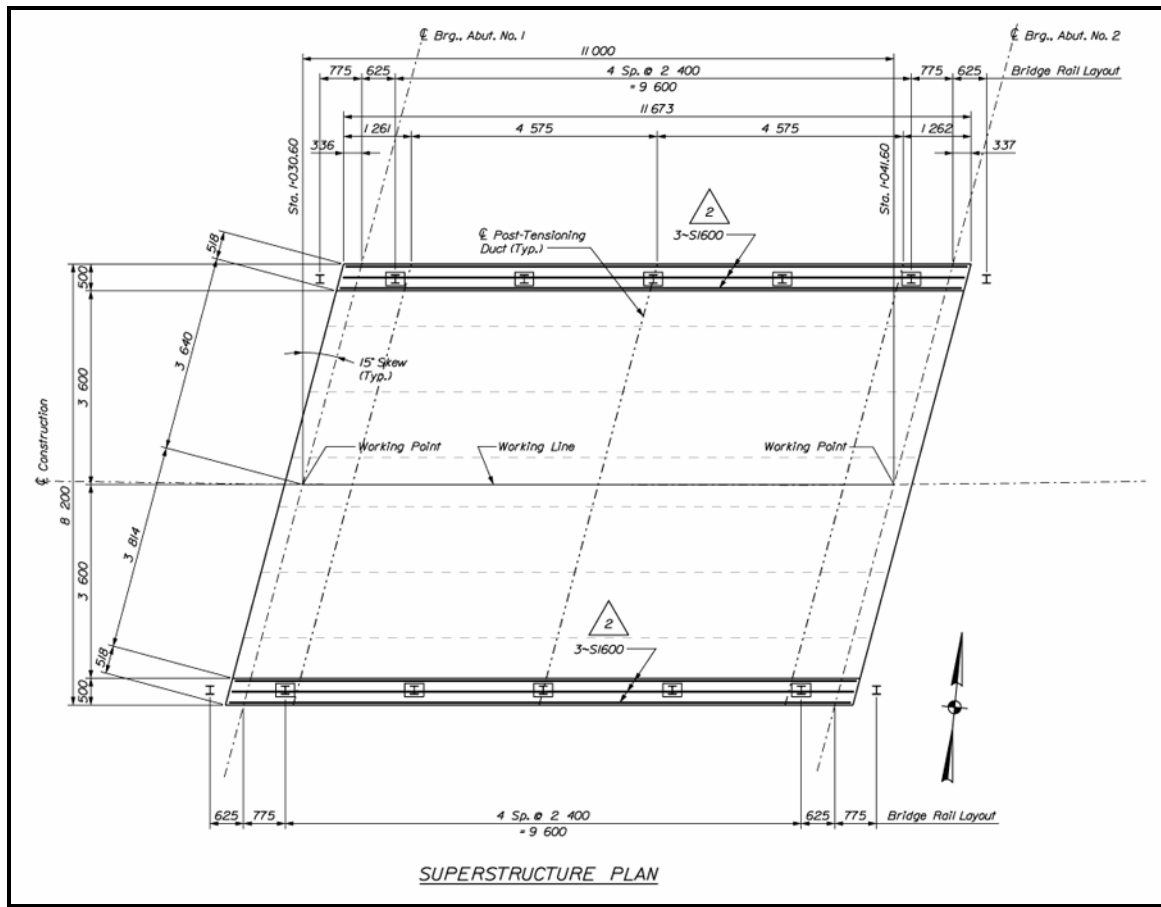


Figure 4-22 Precast Superstructure Plan

Intro: Top view, shows relationship of superstructure limits to substructure centerlines. Also used to communicate reinforcing layout and rail system.

Sheet-up: Belongs on top left of superstructure sheet. Sometimes it is necessary to cut the plan and show on more than one sheet.

♪ When cutting is required, make sure to include an element in both plans, i.e. cut near a pier and show the pier on both plans.

❗ **Make sure to not label the same reinforcing bar(s) twice – if any bar is shown on both plans, only label it on one plan.**

Scale: 1/4". You may need to reduce the size of the plan to help fit it on the sheet. 3/16" or 1/8" are not out of the question. Bear in mind that you'll be detailing reinforcing steel on the section, however, and consider splitting a superstructure that is too long to fit on one sheet.

Draw:

- 1) Limits of concrete (show fascia, don't show beam blocking or hidden lines for shear keys under curbs)

- 2) Centerlines of bearing of substructures
- 3) Centerline of Construction / Working Lines
- 4) Face of curb
- 5) Rail System (Bridge Rail, Rail Posts & Centerline of Rail Posts, Concrete Transitions Barriers, Concrete Barriers, etc.)
- 6) Bridge Drains & Centerline of Bridge Drains
- 7) Reinforcing Steel
- 8) Construction Joints
- 9) Post-tensioning duct locations
- 10) Hidden lines for edges of precast panels

Dimension:

- 1) Spans (CL Bearing Abut to Pier and/or Abut, along working line)
- 2) Rail Post Spacing (dimensioned along face of rail, tied to intersection of CL Bearing Abut with fascia) Note: This is a curved dimension on a curved superstructure.
- 3) Skew of substructures
- 4) Bridge Drain Spacing (dimensioned along fascia, tied to intersection of CL Bearing Abut to fascia)
- 5) End of slab (limits of concrete, dimensioned parallel to CL Bearing Abut, tied to intersection of CL Construction and CL Bearing Abut)
- 6) Reinforcing steel (laps & locations)
- 7) Distance from CL Bearing Abut to End of Slab (show on integral abutments only, dimensioned perpendicular to CL Bearing)

Label:

- 1) CL of substructure bearings
- 2) Centerline of construction/working line
- 3) Stations at CL of Bearings of substructures
- 4) Stations of Working Points
- 5) Detail Name "SUPERSTRUCTURE PLAN"
- 6) North
- 7) Panel Numbers
- 8) Section/Detail Cuts
- 9) Rail Post Spacing
- 10) Rail System (Bridge Rail, Concrete Barrier, CL of Rail Post, End Treatments, etc.)
- 11) Bridge Drains

12) Reinforcing Steel

4.3.6.6 Transverse Section

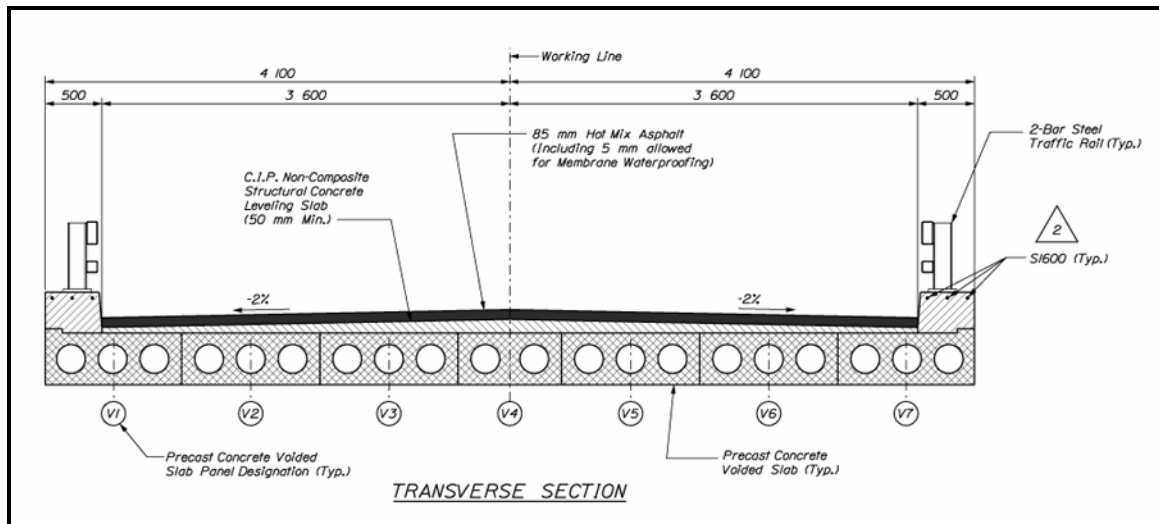


Figure 4-23 Precast Transverse Section

Intro: A section cut through the superstructure normal to the centerline of construction, cut looking upstation. This section shows the relationship of a cast-in-place or topping slab with the panels, plus the roadway elements and reinforcing steel.

Sheet-up: Belongs on the superstructure sheet below the plan.

Scale: 1/2". Wide bridges (40'±) might require 3/8" scale.

Draw:

- 1) Centerline of Construction / Working Line
- 2) Centerline of Panels
- 3) Pavement (should be shaded)
- 4) Topping Slab/Structural Slab (hatched)
- 5) Precast Panels (cross-hatched)
- 6) Curbs (hatched)
- 7) Rail system (bridge rail, barriers, etc.)
- 8) Reinforcing Steel
- 9) Utilities (i.e. conduits suspended from structure)
- 10) Bridge Drains
- 11) Construction Joints

Dimension:

- 1) Overall superstructure width

- 2) Centerline to curb width
- 3) Face of curb to fascia width
- 4) Nominal Panel Width
- 5) Panel spacing & overhang (for spread units only)
- 6) Reinforcing cover (top and bottom)
- 7) Construction Joints

Label:

- 1) Centerline of Construction/Working Line
- 2) Slab Type and Thickness
- 3) Reinforcing steel
- 4) Rail System
- 5) Wearing Surface and Membrane
- 6) Cross-slope
- 7) Curb
- 8) Panels
- 9) Utilities
- 10) Detail Name "TRANSVERSE SECTION"
- 11) Construction Joints