Chapter 4
Bridge Program Drawings

Section 4.13-Slab

Introduction

The slab, or bridge deck, is the element that provides the finished riding surface for vehicles and distributes loads to the girders. Reinforced concrete slabs are designed according to deck thickness and girder spacing. Concrete curbs, bridge railing, concrete barrier, raised medians, sidewalks, girder soffits, and slab supports are placed in conjunction with bridge slabs. Slabs may be curved, skewed, and of various widths and thicknesses.

The typical slab used by the Bridge Program uses bent transverse reinforcing steel (crank bars) alternated with straight reinforcing steel and placed in conjunction with separate mats of longitudinal reinforcing steel.

When a crank bar cannot be used, the slab has separate mats of reinforcing steel, one mat in the top face and one mat in the bottom face of the slab. Each mat contains transverse and longitudinal reinforcing steel.

General Design and Detail

CLASS A CONCRETE shall be used for all elements. All **REINFORCING STEEL** in slabs, curbs, sidewalks, concrete barrier, and raised medians shall be coated.

LONGITUDINAL JOINTS in the slab may be required and are dependent on common screed machine widths, construction staging requirements, and/or concrete placement rate. Consideration should be given to showing longitudinal joints on bridge deck widths exceeding 50'-0". The optional longitudinal joint should be placed at the crown if possible, otherwise it should be placed at centerline of bridge roadway.

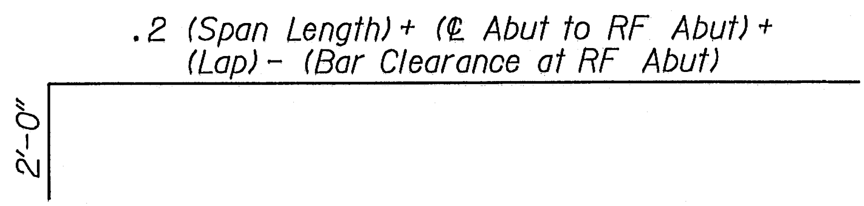
TRANSVERSE JOINTS in the slab should be avoided due to their high maintenance and leakage problems. A transverse **SLAB CONSTRUCTION JOINT** is shown on the plans in case of a construction emergency. Depending on bridge length and concrete placement rate, transverse joints may also be required.

SUPERELEVATION, **CROWN**, or the transverse slope of the roadway shall match that shown on Project Development Program sheets.

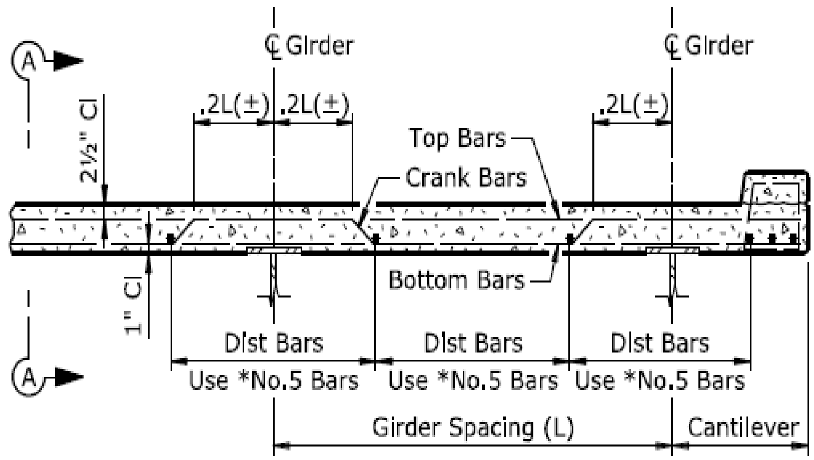
Longitudinal reinforcing steel provided in the top layer of the slab over the intermediate supports will typically be No. 6 bars spaced at approximately 7" to 8". These bars will extend to the quarter point of the longer span, and shall be placed symmetrically about the centerline of the support. The top layer of longitudinal reinforcing steel in the remainder of the deck will typically be No. 4 bars and shall be lapped with these bars.

For composite structures, longitudinal reinforcing steel will need to be designed by the engineer.

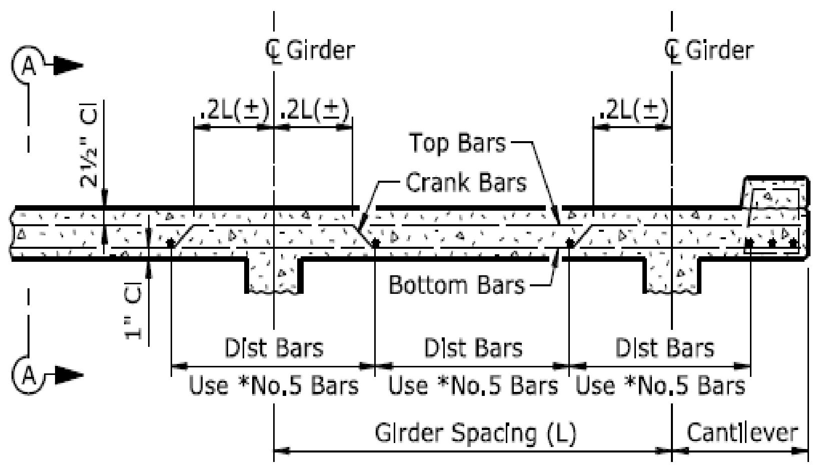
For slabs that are integral with the abutments, a bent bar is provided between the abutment and the slab. Its length is based on the following formula.



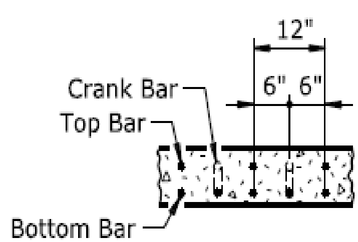
DISTRIBUTION REINFORCING STEEL (No.5 bars) is the longitudinal reinforcing steel placed in the bottom of the slab and is based on the following diagrams.



STEEL GIRDER



CONCRETE GIRDER



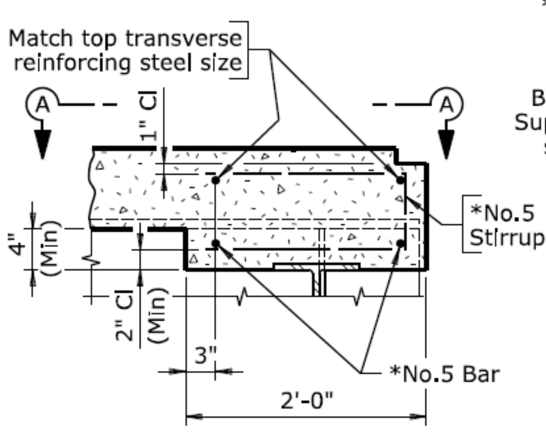
SECTION A-A

For slabs that have **SKEWS LESS THAN OR EQUAL TO 20 DEGREES**, the transverse reinforcing steel shall be placed parallel with the substructure and dimensioned along the edge of the slab.

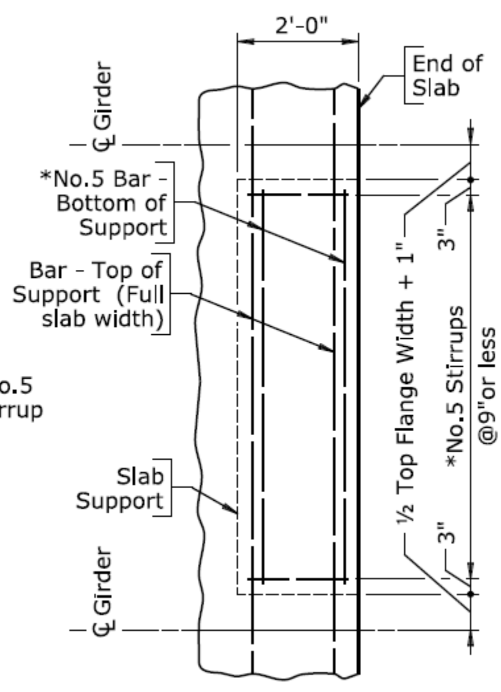
For slabs that have **SKEWS GREATER THAN 20 DEGREES**, the transverse reinforcing steel shall be placed perpendicular to the centerline of the structure or to the girders.

For slabs that are **CURVED**, the transverse reinforcing steel may be placed perpendicular to and dimensioned along the long chord or working line, or placed radially and dimensioned along the centerline or working line of the structure. Transverse reinforcing steel may also be dimensioned along the outside edges of the slab. Typically, crank bars are not used with curved slabs.

SLAB SUPPORTS are used when a deck joint is required for bridge movement. These areas are reinforced to withstand traffic loads and tie in the anchorage system of the expansion device. Expansion devices are covered in Section 4.09 - Superstructure. Reinforcing steel in the slab support areas of steel girder bridges shall be as shown in the following examples.



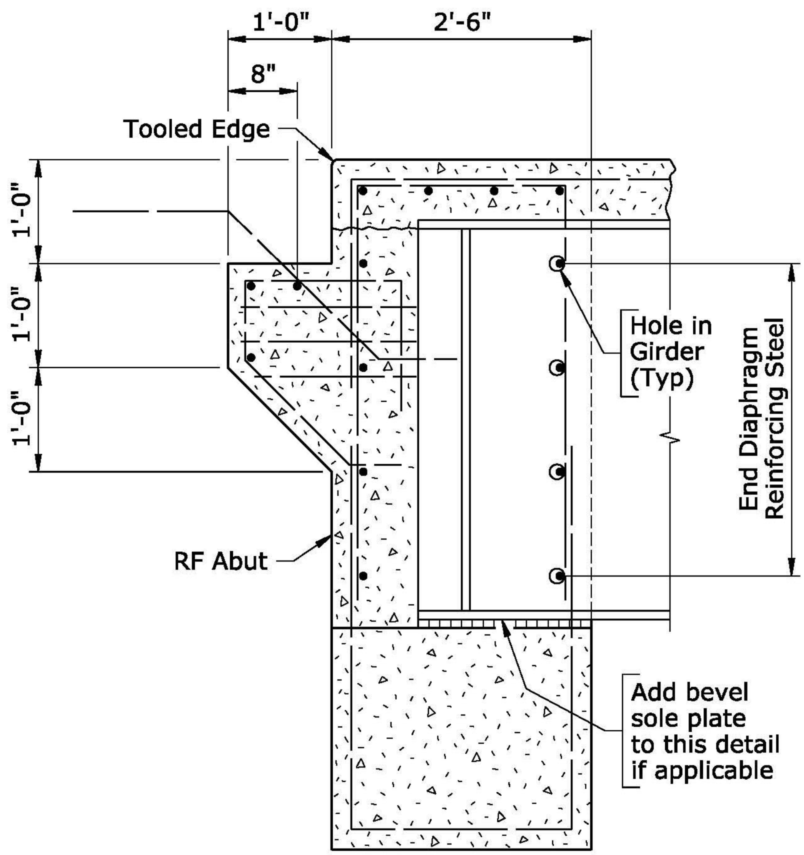
SLAB SUPPORT REINFORCING



VIEW A-A

For bridges with integral or semi-integral abutments, the details for **END DIAPHRAGMS** and **CORBELS** are included in the Slab Details. End diaphragms and corbels are constructed with class A concrete and uncoated reinforcing steel, with the exception of the end diaphragm reinforcing steel that extends into the slab. Typical end diaphragm details for an integral abutment are provided below. Corbels are provided to support approach slabs and are covered in Section 4.07 - Abutments. In new bridges, a bent #6 bar typically extends out of the corbel for the purpose of connecting the approach slab.

End diaphragm reinforcing steel size and spacing will be determined in design. Girder ends are encased in end diaphragms. Spacing and number of reinforcing steel located in the end diaphragm need to be coordinated with both the Superstructure Details and the Abutment Details including the dimension from top of abutment cap to reinforcing steel. Corbel reinforcing steel is standard and can be referenced from the standard cell library.



SECTION THRU END DIAPHRAGM
(Dimensions are perpendicular to RF Abut)

For structure continuity, the Contractor should be compelled to place concrete in the slab in **ONE CONTINUOUS OPERATION**. The following note shall be placed on the slab detail sheet that includes the plan.

> "Place concrete in one continuous operation at the minimum rate of __ feet per hour."

The **MINIMUM RATE** of concrete placement shall be determined by the lesser rate derived from the following formulas.

1. Converting a volume of concrete (to a maximum of 25 cubic yards per hour) to an equivalent length of bridge deck; or

$$\frac{25\ CY}{Hr} \times \frac{1}{\text{Thickness (Ft)}} \times \frac{1}{\text{Width (Ft)}} \times \frac{27\ Ft^3}{CY}$$

2. Using an 8-hour maximum time period for the duration of continuous placement; or

$$\frac{\text{Slab Length}}{8\ Hr}$$

3. The size and configuration of the particular bridge deck (consult with Bridge Staff for determination of minimum rate).

A **SLAB PLACEMENT DIAGRAM** showing the slab placement sequence will be placed on the slab detail sheets, when necessary, to provide a guide for safe placement of the bridge slab during construction. Long span bridges and bridges with unusual span ratios may require slab placement diagrams. Transverse construction joint will be required for phased slab placements.

A **CLOSURE POUR** may be needed for slabs that are constructed in two stages. The squad team leader will determine if a closure pour is necessary.

SLAB ORDINATES are shown on the slab detail sheets of a curved bridge deck to provide the offsets from the working line or from the centerline of a bridge to the outside edges. The ordinates are spaced at 10'-0" intervals along the length of the working line or centerline and measured normal to these lines.

A **SLAB THICKNESS DIAGRAM** is used for all rolled beam girder structures. It represents the actual deck thickness above the top flange of the girder and is based on dead load deflection, grade, and vertical curvature. The values should not exceed the design slab thickness plus 1" minus the top flange thickness, nor should they be less than the design slab thickness minus the top flange thickness. If either situation occurs, a **BLOCKING DIAGRAM** will be required. Blocking Diagrams are covered in Section 4.09 - Superstructure.

SCREED ELEVATIONS are given for both rolled beam and welded plate girder structures, but not prestressed-precast concrete girder structures. They represent the elevation to which the deck will need to be placed to account for dead load deflection, grade or vertical curvature, and slope. A screed line is required above each girder, along the exterior edges of the deck, and at any change in superelevation. A screed line is required at any longitudinal construction joints if a girder is not present beneath the joints.

FLANGE EMBEDMENT details are shown on the plans to indicate how far a girder flange is to be embedded in the slab. These are shown in the typical section of slab when flanges are fully embedded or not embedded. **FLANGE EMBEDMENT DETAILS** are required when flange thickness changes or partial embedment is required. This detail is used for non-composite girders, when the top flanges vary in thickness, through non-composite regions of a composite girder, or if the bridge slab has a large superelevation. **SOFFITS** are typically not required on bridges but may be used at the discretion of the Squad Team Leader. The design engineer will provide information if a soffit is required. The top flange for non-composite girders should be embedded full depth into the bridge deck, when possible or ¾" at centerline girder, whichever is less. For composite girders, the flange should not be embedded into the deck except at flange transitions where partial embedment is required. See Appendix A for Flange Embedment Details.

CANTILEVER dimensions need to be shown on the typical section of the slab sheet for straight bridges and for curved bridges with curved girders. Do not show cantilever dimensions on chorded girder bridges or curved bridges with straight girders.

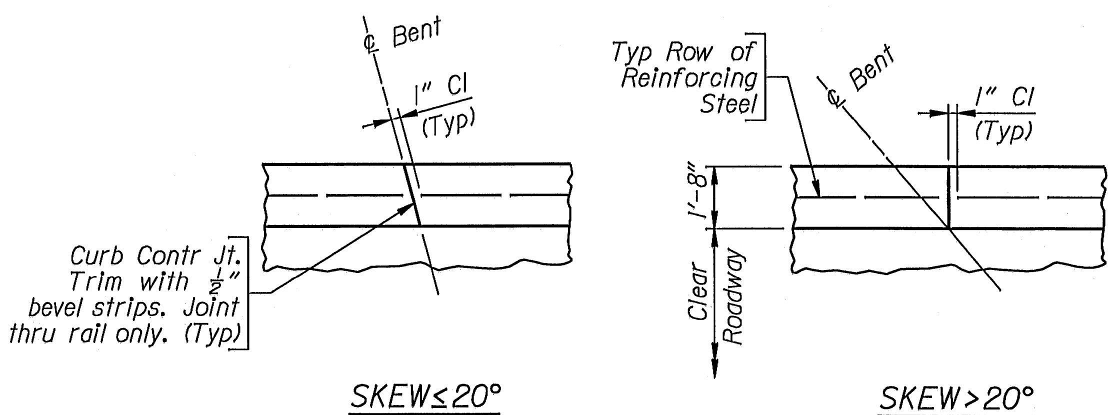
STANDARD CURB DIMENSIONS are 6" high measured at the front face of the curb and 1'-8" wide for TL3BRGRAIL NCHRP 350 railing. The standard curb dimensions for TL4RBRGRAIL MASH railing is 9" high measured at front face of the curb and 1'-2" wide with 1 ½" offset from edge of deck. In the case of rehabilitation work, the curb widths and heights may vary slightly. For new bridges with overlays, the height may be increased slightly. See Section 4.10 - Bridge Railing for additional information. For railroad structures, the curb width shall be increased to 2’-2” to accommodate fencing. For MASH railing, the 1 ½” offset from edge of deck to curb shall not be included when curb widths are 2’-2”.

A **CURB RADIUS** of 10" shall be placed at the end of the curb for bridges without approach slabs that utilize NCHRP 350 railing. Special curb end details are required for MASH railing, see Section 4.14 - Approach Slabs for additional information.

If there is no approach slab, **TRANSVERSE CURB REINFORCING STEEL** shall be spaced at 4" in an area 2'-0" minimum in each direction from the centerline of each bridge railing end post to help reinforce the railing anchorage system for NCHRP 350 railing.

CURB REINFORCEMENT DETAILS for MASH railing require special configuration. See Appendix B for MASH Curb Details.

CURB CONTRACTION JOINTS shall be constructed at bents and piers as shown. See Section 4-10 - Bridge Railing for requirements of bridge rail post spacing adjacent to contraction joints.



DECK DRAINS, if needed, will be identified in the design. Avoid placing drains where water will spill onto bent/pier caps, railroads or roadways below, or over slopes where drainage could cause erosion. A deck drain collection system may be required for railroad structures.

Cells

Name	Description
CORBEL	Corbel Details for Slab
CURBRAD	Curb Radius Details
DEDRCU	Curb Deck Drains
DEDRDETAILS	Deck Drain Details Sheet
RECRK4	Crank Bar for 4 Girders
RECRK5	Crank Bar for 5 Girders
RECRK6	Crank Bar for 6 Girders
SCREED1	Screed Table for 1 Span
SCREED2	Screed Table for 2 Spans
SCREED3	Screed Table for 3 Spans
SLABJT	Slab Const Joint

Deck Drain Checklist

Deck Drain Plan

- ❑ Centerline Deck Drain/Bent/Pier
- ❑ Longitudinal Dimensions
- ❑ Deck Drain Spacing
- ❑ North Arrow
- ❑ RF Abutment/End of Slab Call-outs
- ❑ Section Symbols
- ❑ Line Styles
- ❑ Number Required (under title)

Miscellaneous

- ❑ Deck Drain Details
- ❑ Bracket Detail
- ❑ Bracket Bar Detail
- ❑ Section Thru Slab

Notes

- ❑ Spacing of 1" Holes in Bracket Bar May Vary
- ❑ Shift Locations of Deck Drains as Necessary
- ❑ Before Placing Slab, Install and Properly Align

Slab Checklist

Plan

- ❑ Centerline Bridge Roadway/Bent/Pier
- ❑ Centerline Survey (curved deck)
- ❑ Working Line/Construction Line Call-out (curved deck)
- ❑ Skew and Complement
- ❑ Longitudinal Dimensions
- ❑ RF Abutment to End of Slab Dimension (other than cap-type abutments)
- ❑ Clear Roadway/Curb/Sidewalk/Out-to-Out/Centerline Roadway Dimensions
- ❑ Corbel Length Dimensions
- ❑ Corbel Reinforcing Size/Spacing/Call-out
- ❑ Curb/Sidewalk Tie Bar Size/Spacing/Location
- ❑ Transverse Reinforcing Size/Spacing/Location
- ❑ Longitudinal Reinforcing Size/Location/Lap/Typ Row/Call-outs
- ❑ Curb/Sidewalk Contraction Joints/1" Clearance/Trim with Bevel Strips
- ❑ RF Abutment/End of Slab Call-outs
- ❑ See Corbel Detail Call-out
- ❑ See End Curb Detail Call-out (if no approach slab)
- ❑ Section Symbols (at slab support)
- ❑ Line Styles
- ❑ Longitudinal Dimensions Note (under title)

Typical Section

- ❑ Centerline Bridge Roadway/Girder
- ❑ Clear Roadway/Centerline Roadway/Curb/Sidewalk/Cantilever Dimensions
- ❑ Slab Thickness
- ❑ Cross Slope(s) in Percent
- ❑ Longitudinal Reinforcing Spacing
- ❑ Transverse Reinforcing Size/Clearance/Call-outs
- ❑ Curb/Sidewalk Dimensions/Radius/Slope/Level/Construction Joint/ Tie Bar Clearance (if not shown in separate detail)
- ❑ Continuous Notch Location/Call-out
- ❑ End Diaphragm Call-out
- ❑ Flanges Embedded/Not Embedded
- ❑ Line Styles/Patterning
- ❑ Looking Ahead/Back Station (under title)

Slab Thickness Diagram (wide flange girders)

- ❑ Centerline Abutment/Bent/Pier
- ❑ RF Abutment to RF Abutment Dimension
- ❑ Ordinate Spacing/Location/Dimensions
- ❑ RF Abutment/Top of Top Flange Call-outs
- ❑ Line Styles
- ❑ Dimensions at Centerline Girder Note (under title)
- ❑ Dimensions Along Finished Grade Note (under title)
- ❑ Includes Dead Load Deflection Note (under title)

Slab Layout (curved bridges)

- ❑ Centerline Survey/Bridge Roadway/Bent/Pier
- ❑ Skew and Complement
- ❑ Longitudinal Dimensions
- ❑ Ordinate Spacing/Location/Dimensions
- ❑ End of Slab Dimensions
- ❑ RF Abutment/End of Slab/Edge of Slab Call-outs
- ❑ Working Line/Slab Ordinate Call-outs
- ❑ Line Styles
- ❑ Longitudinal Dimension Note (under title)
- ❑ Slab Ordinates Note (under title)
- ❑ End of Slab Dimensions Note (under title)

Plan at Slab Support (other than cap-type abutments)

- ❑ Centerline Girder
- ❑ Girder Spacing
- ❑ Slab Support Length/Location
- ❑ Reinforcing Size/Spacing/Location/Call-outs
- ❑ End of Slab Call-out
- ❑ Section Symbols
- ❑ Line Styles

Section thru Slab Support (other than cap-type abutments)

- ❑ Width
- ❑ Slab Thickness
- ❑ Slab Support Thicknesses
- ❑ Reinforcing Size/Spacing/Location/Clearance/Call-outs
- ❑ End of Slab Call-out
- ❑ Line Styles/Patterning

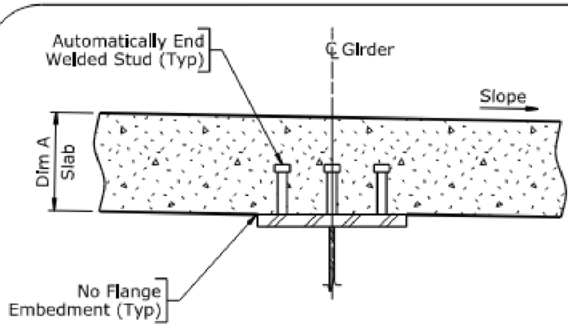
Miscellaneous

- ❑ Table of Screed Elevations
- ❑ Typical Sections Thru End Diaphragms
- ❑ Slab Construction Joint Detail
- ❑ Flange Embedment Detail
- ❑ Slab Placement Diagram
  Curb Radius Detail (if no approach slabs NCHRP 350 Rail)
- ❑ Curb End Detail (if no approach slabs MASH Rail)
- ❑ Typical Curb/Sidewalk Section (if not in Typical Section)
- ❑ Weep Hole Assembly Detail (if no approach slabs)
  Bill of Reinforcement
- ❑ Typical Curb Details (MASH Railing)

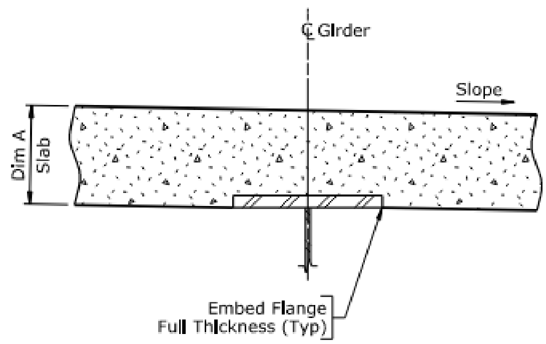
Notes

- ❑ Increase and Decrease Opening (other than cap-type abutments)
- ❑ Prefix Numbers
- ❑ Attain 80% of Ultimate Design Strength
- ❑ Transverse Reinforcing Placed Perpendicular to Working Line
- ❑ Place Concrete in One Continuous Operation
- ❑ Each Weep Hole Assembly Consists of (if no approach slabs)
- ❑ Quantity of Class A and B Concrete
- ❑ For Railing/Deck Drains/Utility Conduit Details
- ❑ For Deck Drain/Utility Conduit Details

APPENDIX - A
FLANGE EMBEDMENT

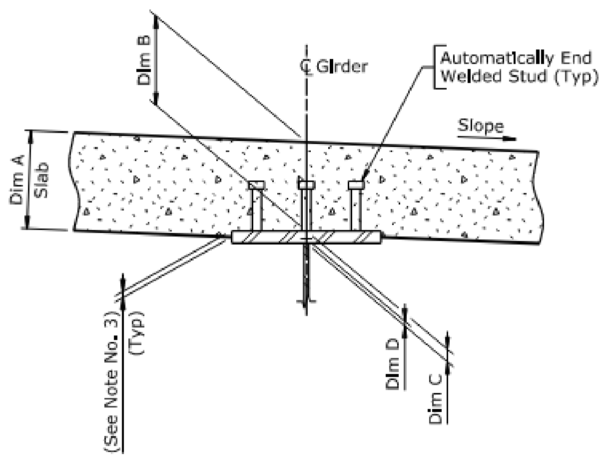


COMPOSITE FLANGE EMBEDMENT DETAIL

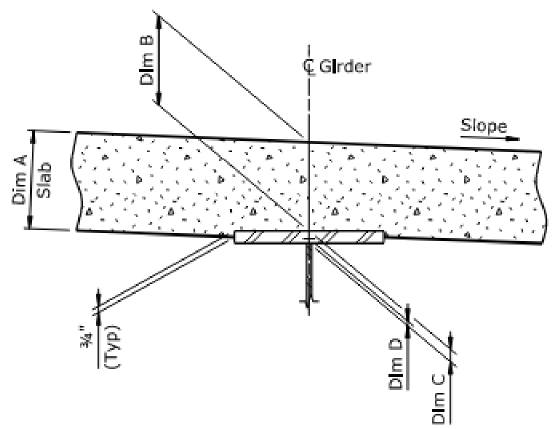


NON COMPOSITE FULL FLANGE EMBEDMENT DETAIL

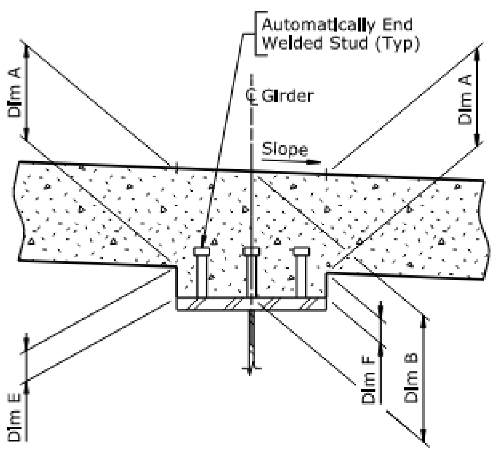
(See Note No. 1)



COMPOSITE PARTIAL FLANGE EMBEDMENT DETAIL
(See Note No. 3)



NON COMPOSITE PARTIAL FLANGE EMBEDMENT DETAIL

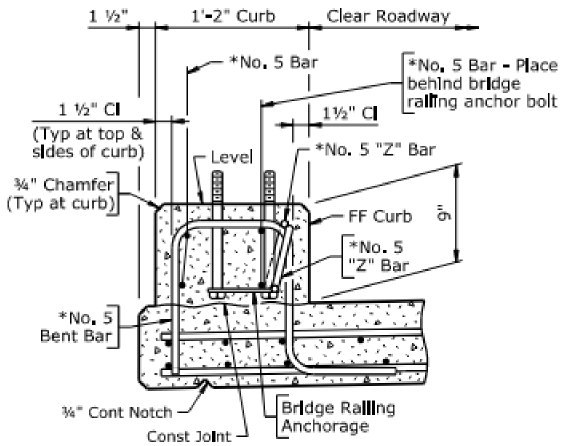


SOFFIT DETAIL

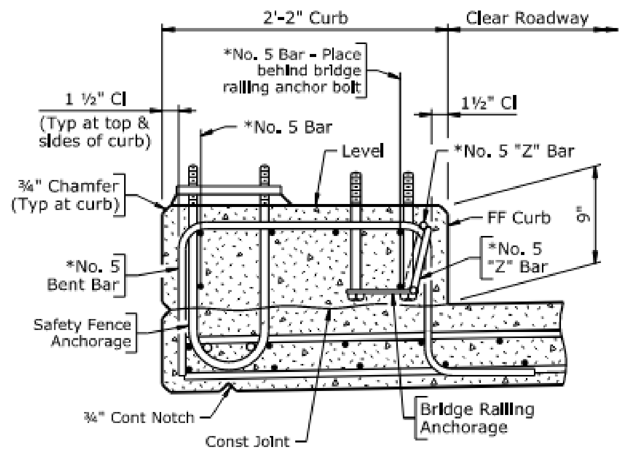
FLANGE EMBEDMENT	
CALLOUT	DESCRIPTION
Dim A	Slab Thickness
Dim B	Top of Slab to Top of Flange at ℄ Girder
Dim C	Flange Thickness
Dim D	Exposed Flange Dimension at ℄ Girder
Dim E	Soffit Dimension
Dim F	Soffit Dimension

Notes:
1) When possible, flange embedment may be shown on slab Typical Section and need not be detailed separately.
2) Applies when composite girder has varying top flange thickness.
3) Composite girder flange embedment will equal the difference between the two flange thicknesses.
4) Note callouts only intended for guidance, not to be detailed on project sheets.

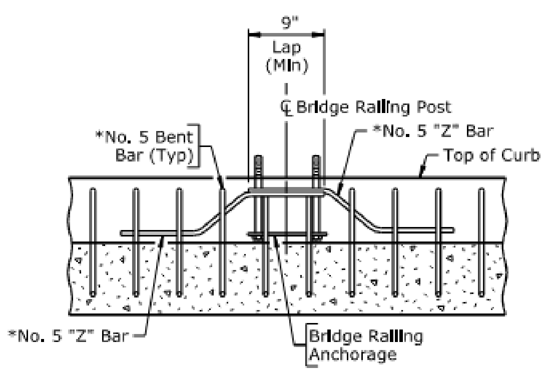
APPENDIX - B
MASH CURB DETAILS



TYPICAL SECTION THRU CURB



TYPICAL SECTION THRU CURB



ELEVATION
(Looking at front face curb)

*NO. 5 "Z" BAR PLACEMENT DETAIL