# NORTHEAST SOLID DECK BEAM GUIDE DETAILS

These guidelines and guide details have been developed for the purpose of addressing bridge owner needs and for promoting a greater degree of uniformity among owners, engineers, and industry with respect to planning, designing, fabricating, and constructing the Northeast SOLID DECK BEAM (SDB) for bridges.

The PCI Northeast Bridge Technical Committee Members:

| | |
|---|---|
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| Michael Culmo | CHA Consulting, Inc. |
| Raymond Basar | Connecticut DOT |
| Richard Myers | Maine DOT |
| Taylor Clark | Maine DOT |
| Alex Bardow | MassDOT |
| Edmund Newton | MassDOT (Ret.) |
| Michael Merlis | MassDOT |
| Richie Mulcahy | MassDOT |
| David Scott | New Hampshire DOT |
| Jason Tremblay | New Hampshire DOT |
| Duane Carpenter | NYSDOT |
| Ramiz Turan | NYSDOT |
| Adrienne LiBritz-Cooley | NYSDOT |
| Stephen Coley | VTRANS |
| Rob Young | VTRANS |
| John Preiss | Rhode Island DOT |
| Keary LeBeau | Rhode Island DOT |
| Scott Harrigan | The Fort Miller Co., Inc. |
| Joe Carrara | J. P. Carrara & Sons |
| Troy Jenkins | Northeast Prestressed Products |
| Chris Moore | United Concrete Precast |
| Bill Augustus | United Concrete Precast |
| Eric Calderwood | Calderwood Eng. |
| John Byatt | BETA Group |
| Joe Gill | Gill Engineering |
| Darren Conboy | Jacobs Engineering |
| Ed Barwicki | Lin Associates |
| Sergio Brena | University of Mass. |

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Precast/Prestressed Concrete Institute Northeast Covering New England and New York

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By: Precast/Prestressed Concrete Institute Northeast

Northeast Solid Deck Beam Guide Details
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# Solid Deck Beam Frequently Asked Questions

**General Questions**

1. **Is the Solid Deck Beam Proprietary?**
   Solid deck beams are a regional standard that was developed by the northeast state departments of transportation, consultants, and fabricators. Similar to other standard bridge sections, it is available from multiple fabricators, and it is not proprietary.
2. **Who supplies the Deck Beams?**
   These beams are produced by many PCI Certified precast producers. Contact your local PCI Regional Association or local producer.
3. **Is the Solid Deck Beam acceptable to northeast bridge owner agencies?**
   Yes. The Solid Deck Beam was developed by a consortium of state bridge engineers from all six New England states and New York and members of the Northeast region of PCI.
4. **Is the Solid Deck Beam more economical than other bridge systems?**
   The Solid Deck Beam is designed to minimize labor at the job site and to reduce the overall structure thickness. The lack of draped (harped) strands and internal voids is a significant benefit during fabrication. The elimination of most of the deck forming in the field saves significant time during construction.
5. **How do I handle utilities on my bridge?**
   Most states have details for accommodation of utilities on slab bridges. The same details would be applicable to Solid Deck Beam bridges. Typically, utilities can be placed under a sidewalk where deck beam can be spread using the sidewalk as a composite deck, or mounted on the side of the fascia beams.
6. **Are diaphragms required?**
   Intermediate diaphragms are not required for the Solid Deck Beams.
7. **What is the recommended bearing type?**
   Solid Deck Beams can be supported on standard reinforced elastomeric bearing pads that are used for slab and deck beam bridges. A three-bearing configuration is recommended for beams with skews in excess of 20 degrees. This configuration has two bearings at one end of each beam and one bearing at the other end, creating a determinate support condition that will not rock. Information on this configuration can be found at the PCI Northeast website (www.pcine.org).

**Bridge Geometry Questions**

1. **What are the typical maximum span lengths and widths?**
   The solid deck beams maximum spans range from a length of 19' to 56'. These span ranges are approximate since they are based on certain design parameters such as parapet weight and overlay options. Actual span capabilities should be checked for each situation based on the actual design parameters. Please consult the Detail Sheet SDB 05.
2. **Can solid deck beams be used for a skewed bridge?**
   Yes. PCI Northeast recommends a maximum skew of 45 degrees, but it may be possible to exceed this value.
3. **Can solid deck beams be used for a curved bridge?**
   No. The fascia beam is straight. The bridge would need to be detailed as a tangent section, similar to conventional adjacent deck slabs and deck beams.
4. **Can solid deck beams be used for a variable-width bridge?**
   In theory, the width of the closure joints could be varied to produce a variable width bridge. This would require special design and detailing of the beams and joints.
5. **How do you accommodate roadway profiles with cambered deck beams?**
   The accommodation of roadway profiles with a cambered deck beam can be handled in several ways. The depth of the deck beams can be varied; however, this comes at a higher cost due to the need for more complex forming in the fabrication plant. Another option is to vary the thickness of the overlay (if allowed by state standards) to provide the desired profile. See Profile Details on Detail Sheet SDB 02.
6. **How do you accommodate roadway cross slopes and crowns?**
   The beams can be set to match the roadway cross slope. Roadway crowns can be accommodated at the joints between the beams, or within the topping or overlay. See Detail Sheet SDB 04.
7. **What widths are available?**
   Four standard beam widths are recommended. 35.5", 39.5", 43.5" and 47.5". Special widths between these values can be used with permission from the owner.
8. **Can a specific bridge width be accommodated?**
   Unlike typical slab and deck beam bridges, solid deck beams can accommodate custom bridge widths. This can be done by varying the width of the beams, varying the width of the joints, or a combination of both. PCINE has developed a spreadsheet that can be used to explore these options. Refer to www.pcine.org to download this spreadsheet.
9. **Can multiple beam widths be used within a bridge cross-section?**
   The variability of beam widths and joint widths should provide flexibility to meet a desired bridge width with all beams of the same width in most cases. In certain circumstances (staged construction, etc.), it may be necessary to mix different beam widths within a bridge cross-section. Detail Sheet SDB 01 contains information on calculating live load distribution factors for this situation. It should be noted that this approach comes at a cost as the fabricator will need to cast the odd-width beam separately, which is not as efficient as casting multiple beams within a casting bed.

# Solid Deck Beam Frequently Asked Questions

**Design Questions**

1. **What bridge software can be used to design a solid deck beam bridge?**
   Any software developed to design prestressed concrete beams can be used. Many programs can calculate dead loads and live load distribution factors. Solid deck beams are detailed to emulate a solid slab bridge, therefore typical distribution factors do not apply. It is recommended that designers input dead loads and live load distribution factors. See Detail Sheet SDB 01 for guidance on calculating live load distribution factors.
2. **Are the span charts on Detail Sheet SDB 05 acceptable for preliminary design?**
   The values shown are not guaranteed and should be considered approximate. They are intended to be used as a starting point for preliminary layout. The actual maximum span lengths are affected by a number of assumptions, some of which are listed in the notes on Detail Sheet SBD 05. Check the assumptions against your project design requirements before selecting a beam size. During preliminary design and structure type studies, the beams should be checked to ensure that a section will work.
3. **How do I distribute dead and live load to the solid deck beams?**
   The 9th Edition of the AASHTO LRFD Bridge Design Specifications have provisions for the design of cast-in-place solid slab bridges. The closure joint details were developed to emulate a cast-in-place slab, therefore the AASHTO specifications can be followed. See Detail Sheet SDB 01 for more information on calculating live load distribution factors. The distribution of barrier dead loads varies from State to State. Refer to state standards for the distribution of barrier dead loads.
4. **Can I design the beams for continuity?**
   Yes. This would be done the same way as any prestressed concrete beams. Mechanical couplers could be considered. The top flange could be dapped (cast short of the beam end) with projecting reinforcing which is then connected to the adjacent beam flange with mechanical couplers and a cast closure joint after erection. Care shall be taken with dapping beams. The designer should check stresses in the dapped area due to the reduced beam section without a top flange. The positive moment reinforcement could be strand extensions or mild reinforcement projecting from the stem.
5. **How do I design the connection between the solid deck beams?**
   The size of the bars should be based on the 9th Edition of the AASHTO LRFD Bridge Design Specifications for distribution reinforcement in Article 5.12.2.1 for solid slab superstructure bridges, which is a percentage of the main reinforcing. The spacing of these bars should be kept at 6” on center. See Detail Sheet SDB 03 for additional guidance for this connection.
6. **How do I design integral abutments using the solid deck beams?**
   The design of integral abutment bridges using solid deck beams is the same as any stringer bridge.
7. **Is post-tensioning required to connect solid deck beams (similar to adjacent deck beams)?**
   The details contained in these guide details have been developed with reinforced closure joints, which eliminates the need to use transverse post-tensioning to connect the beams.
8. **What options are available for connecting the solid deck beams?**
   The details provided allow for several options and fill materials. The most common reinforcing and fill materials are shown on Detail Sheet SDB 03. There is also guidance on how to design and detail the connection with alternate materials, which is based on the 9th Edition of the AASHTO LRFD Guide Specifications for Accelerated Bridge Construction. Note that the width of the joint will affect the beam spacing.
9. **How do you accommodate top tension stresses at the beam ends after release?**
   First and foremost, the design of the beam needs to conform to individual state design requirements. Some states require a design with zero tension at release. Others limit the stress in accordance with the 9th Edition of the AASHTO LRFD Bridge Design Specifications. It is important to note that the AASHTO LRFD Bridge Design Specifications require longitudinal reinforcing in the top flange at beam ends if the top fiber stresses exceed certain specified allowable values. These bars are used to “control” transverse cracking in the top of the beam at release. This reinforcing is for crack width and length control, not prevention. It is recommended that if fully tensioned top strands are included in the design, they should not be used to meet these AASHTO provisions.
10. **Is confinement reinforcement as specified in the AASHTO LRFD Bridge Design Specifications required for solid deck beams?**
    Yes. The details contained in these guide details are consistent with the requirements in the 9th Edition of the AASHTO LRFD Bridge Design Specifications.

# Solid Deck Beam Frequently Asked Questions

**Deck and Wearing Surface Questions**

1. **How do you seal the longitudinal joints between beams?**
   The solid deck beams have reinforced joints. The design of these joints (lap lengths) should be in accordance with the 2018 AASHTO LRFD Guide Specifications for Accelerated Bridge Construction. The details shown on Detail Sheet SDB-03 are based on this recommendation and are considered to fully develop the bars on the deck.
2. **Why is the side of the keyway detailed with an exposed aggregate surface?**
   The exposed aggregate surface of the faces of the keys is recommended to improve the bond of the filler material and minimize the potential for leakage of the joint. This is consistent with the provisions of the 2018 AASHTO LRFD Guide Specifications for Accelerated Bridge Construction. Note that there is no amplitude requirement for the roughness of the surface, as long as the aggregate is visible on the surface. Surface profile amplitude is an AASHTO LRFD Bridge Design Specification provision for connecting a precast beam to a cast-in-place deck (interface shear). The shape of the shear keys on the solid deck beams provides the mechanical shear transfer mechanism, therefore a specific amplitude is not required.
3. **What is the recommended wearing surface?**
   The solid deck beams were developed to support wheel loads. While not necessarily required, a wearing surface (either thin concrete or bituminous) is recommended in order to provide the smoothest riding surface and to provide the required roadway profile. If bituminous wearing surfaces are used, a waterproofing membrane should be applied prior to paving. Refer to agency standards for acceptable wearing surface options.
4. **Can solid deck beams be used without an overlay?**
   Overlays or reinforced concrete toppings are not required. If a bare deck is desired, the beam depths would need to be varied to accommodate the roadway profile (see Sheet SDB 02). Profile grinding may also be used to achieve a smooth roadway. Skewed beams present problems with deck grinding. The skewed and cambered beams can lead to additional differential elevations across the joints between the adjacent beams brought on by the offset of the camber ordinate between beams. This situation may require grinding, which could reduce the top cover to unacceptable levels. Due to this phenomenon, it is recommended that bridges with skews greater than 20 degrees not be detailed with a bare deck.

**Railing Questions**

1. **How are concrete railings (parapets) handled?**
   The use and details of concrete railings should conform to state standards for adjacent deck beams. The connection reinforcement for the barrier or railing can be cast into the fascia beam.
2. **Can metal bridge railings be used without a cast in place curb?**
   The use and details of metal railings, with and without curbs, should conform to state standards. Designers should verify that the standard railing embedments can fit within the beam and do not interfere with the beam strands and reinforcement.
   The 9th Edition of the AASHTO LRFD Bridge Design Specifications Article 5.12.2.1 notes that edge beams are required for slab bridges. This article refers designers to Article 9.7.1.4. That article notes that edge beams are not required for bridges with structurally continuous concrete barriers. The PCI northeast bridge technical committee recommends that designers consider that typical concrete barriers and curbs used in the northeast meet this requirement, therefore designing the fascia beam as an "edge beam" is not required.
   The provisions of 9th Edition of the AASHTO LRFD Bridge Design Specification Article 9.7.1.4 should be followed for bridges that do not have a structurally continuous concrete barrier or curb. An example would be a bridge with a deck-level metal railing or edge mounted metal railing. For this situation, the fascia beam should be designed as an edge beam in accordance with 9th Edition of the AASHTO LRFD Bridge Design Specifications, Article 9.7.1.4.
3. **How is the variable height of the concrete railing or curb calculated as shown on Detail Sheet SDB 02?**
   This is a relatively complicated calculation. The designer needs to calculate the estimated heights based on at least the following variables:
   - Roadway profile (tangent, crest vertical curve. or sag vertical curve)
   - Estimated beam camber
   - Beam seat elevations
   - Dead load deflection of the beam

   The calculations are similar to those used to calculate beam haunches on prestressed girders with cast-in-place concrete decks. As with beam haunches, the designer can specify that the beam edges be surveyed after erection and the barrier or curb heights adjusted based on camber and construction tolerances.

## GENERAL NOTES

THE BASIS FOR THESE GUIDE DETAILS IS THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (9TH EDITION) AND THE AASHTO LRFD GUIDE SPECIFICATIONS FOR ACCELERATED BRIDGE CONSTRUCTION (1ST EDITION).

REINFORCING STEEL: fy = 60,000 PSI (COATING AS PER AGENCY STANDARDS)

PRESTRESSING STRAND: LOW RELAXATION STRAND, 0.6" DIAMETER, AASHTO M 203 GRADE 270

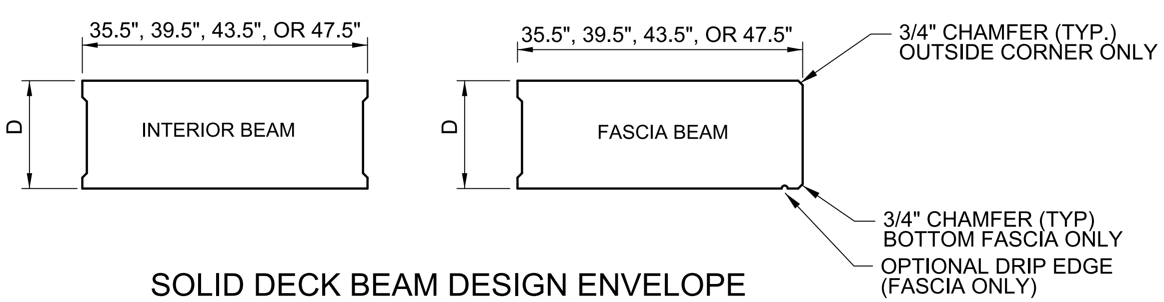
A ½" CONCRETE GRINDING ALLOWANCE FOR CORRECTING UNEVEN ROADWAY SURFACES AT LONGITUDINAL JOINTS MAY BE USED. TO ACCOUNT FOR THIS IN DESIGN, ASSUME LOSS OF ½" OF BEAM TOP IN THE SECTION PROPERTIES, HOWEVER INCLUDE FULL BEAM THICKNESS FOR BEAM WEIGHT.

A DECK OVERLAY COMBINED WITH WATERPROOFING MEMBRANE IS RECOMMENDED FOR THE FOLLOWING REASONS:
- ELIMINATES THE NEED FOR DECK GRINDING
- ACCOUNTS FOR DIFFERENTIAL CAMBER
- PROVIDES ADDITIONAL DECK PROTECTION

## DESIGN AND IMPLEMENTATION GUIDELINES

IT IS THE DESIGNER'S RESPONSIBILITY TO:

1. DESIGN THE BEAM ACCORDING TO THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND THE REQUIREMENTS OF THE OWNER, INCLUDING:
   - NUMBER OF STRAIGHT STRAND AND LAYOUT
   - CHECK REINFORCING IN THE CLOSURE POURS ACCORDING TO THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS. USE THE PROVISIONS FOR DISTRIBUTION REINFORCING FOR CAST-IN-PLACE SOLID SLAB BRIDGES.
   - SIZE AND SPACING OF SHEAR REINFORCING
   - BEAM END REINFORCING
   - BARRIER AND SIDEWALK REINFORCING EMBEDDED IN THE BEAMS
2. CREATE SPECIAL BEAM END DETAILS AS NEEDED, SUCH AS VARYING GEOMETRIC END TREATMENTS, EXTENSIONS OF PRESTRESSING STRAND FOR BEAM ENDS FOR CONTINUITY OF LIVE LOAD, SPECIAL DETAILS FOR INTEGRAL ABUTMENTS, ETC.
3. SPECIFY THE REQUIRED CONCRETE STRENGTHS:
   - RELEASE STRENGTH
   - FINAL STRENGTH
   - STRENGTH OF CONCRETE IN CLOSURE POURS
   - SPEED OF SET
4. CALCULATE CAMBERS AND NOTE THEM ON THE PLANS AT THE FOLLOWING INTERVALS:
   - AT RELEASE
   - 30 DAYS (OR ASSUMED DATE OF INSTALLATION)
   - FINAL




### SOLID DECK BEAM DESIGN ENVELOPE

NOTES:
1. THE PURPOSE OF THIS DETAIL IS TO DEFINE THE ENVELOPE THAT CAN BE USED TO DESIGN A TYPICAL SPREAD DECK BEAM. MAXIMUM WIDTH OF THE 47.5" WIDE BEAM SHOULD NOT BE EXCEEDED.
2. VARIABLE BRIDGE WIDTHS SHOULD BE ACCOMMODATED BY VARYING THE WIDTH OF THE CLOSURE JOINTS. SPECIAL NARROWER WIDTH BEAMS CAN BE SPECIFIED. VERIFY THIS APPROACH WITH THE OWNER.
3. STANDARD BEAM DEPTHS "D" INCLUDE: 12", 15", 18", AND 21" CUSTOM BEAM DEPTHS CAN BE USED WITH PERMISSION FROM THE OWNER.
4. STANDARD BEAM WIDTH IS 47.5". NARROWER BEAMS (43.5", 39.5", AND 35.5") CAN BE USED FOR CUSTOM BRIDGE WIDTHS
5. DEPTH VARIATIONS ACCOMMODATED THROUGH THE USE OF DIFFERENT SIDE FORMS.

## LIVE LOAD CALCULATIONS

LIVE LOAD ON BEAMS:
USE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS ARTICLE 4.6.2.3 EQUIVALENT STRIP WIDTH FOR SLAB-TYPE BRIDGES (CROSS SECTION a).

THIS IS BASED ON THE ASSUMPTION THAT SOLID SLAB BRIDGES PROPERLY CONNECTED WITH DISTRIBUTION REINFORCEMENT WILL EMULATE A SLAB-TYPE BRIDGE. THE FOLLOWING APPROACH SHOULD BE USED:

1. CALCULATE THE EQUIV. WIDTH OF LONGITUDINAL STRIP PER LANE OF LOADING (E).
2. THE LIVE LOAD DISTRIBUTION FACTOR (LLDF) FOR INTERIOR BEAMS CAN THEN BE CALCULATED AS FOLLOWS:

   LLDF = (BEAM SPACING) / E

3. THE LIVE LOAD DISTRIBUTION FACTOR FOR FASCIA BEAMS CAN BE TAKEN AS THE TRIBUTARY WIDTH OF THE EQUIVALENT STRIP SUPPORTED BY THE FASCIA BEAM AND HALF THE JOINT WIDTH BETWEEN THE FASCIA BEAM AND THE FIRST INTERIOR BEAM WITH THE STRIP LOCATED AT THE INSIDE FACE OF THE BARRIER OR CURB.

   LLDF = X / E

   THE DESIGNER MAY ALSO ELECT TO USE THE INTERIOR LLDF FOR THE FASCIA BEAM.

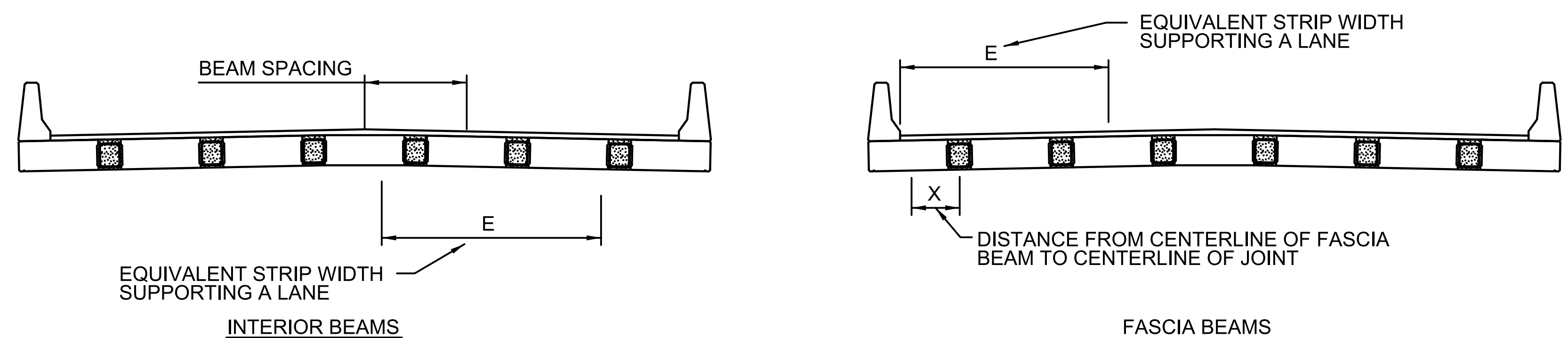
THESE LLDFs SHOULD BE USED FOR BOTH MOMENT AND SHEAR DESIGN.

THE ADJACENT DETAIL DEPICTS THE BASIS FOR THESE RECOMMENDATIONS.

MIXING OF MULTIPLE BEAM WIDTHS WITHIN A BRIDGE CROSS SECTION
THE FOLLOWING APPROACH CAN BE USED TO CALCULATE LIVE LOAD DISTRIBUTION FACTORS.

LLDF FOR ODD BEAM:
1. CALCULATE THE EQUIVALENT WIDTH OF LONGITUDINAL STRIP
2. CALCULATE THE CENTER TO CENTER SPACING FROM THE ODD BEAM TO THE ADJACENT BEAM.
3. USE THAT SPACING FOR THE CALCULATION OF THE LLDF

LLDF FOR OTHER BEAMS:
1. CALCULATE THE EQUIVALENT WIDTH OF LONGITUDINAL STRIP
2. CALCULATE THE CENTER TO CENTER SPACING BETWEEN THE OTHER BEAMS
3. USE THAT SPACING FOR THE CALCULATION OF THE LLDF




### BASIS FOR LIVE LOAD DISTRIBUTION FACTOR CALCULATIONS

### INDEX OF DETAIL SHEETS



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GENERAL NOTES

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NORTHEAST SOLID DECK BEAM DETAILS



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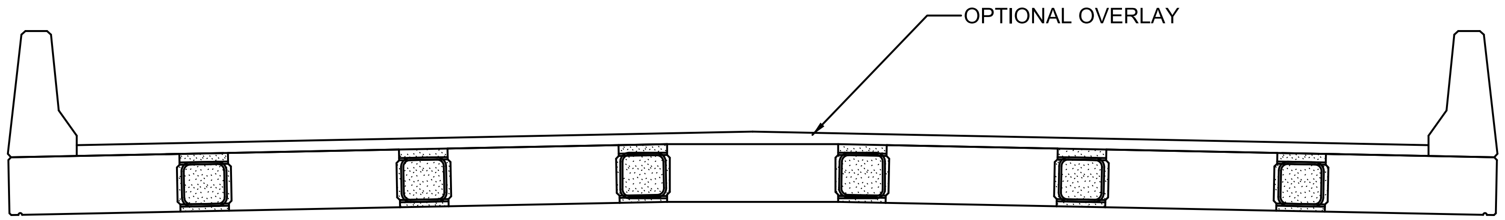
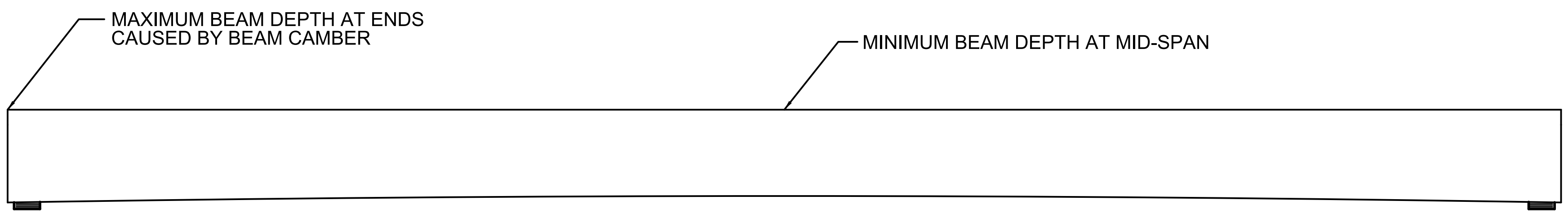
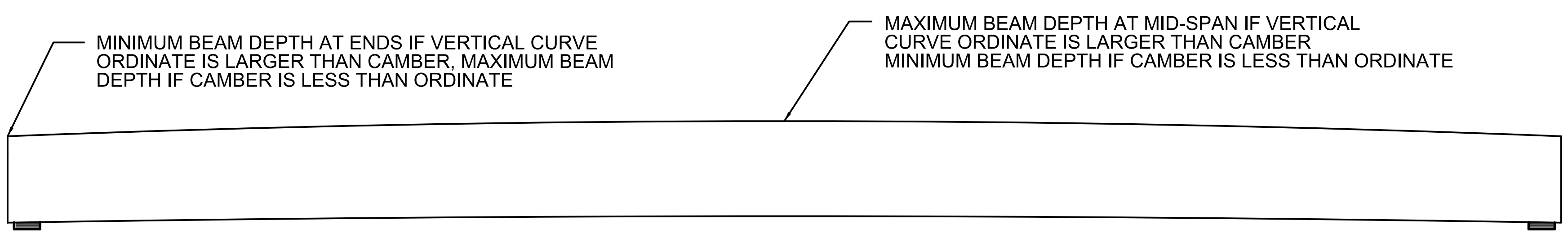


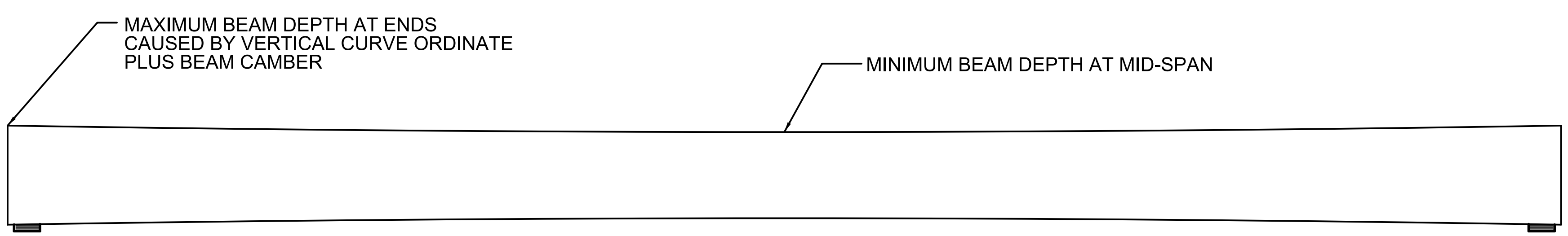

SOLID DECK BEAMS




TANGENT PROFILE



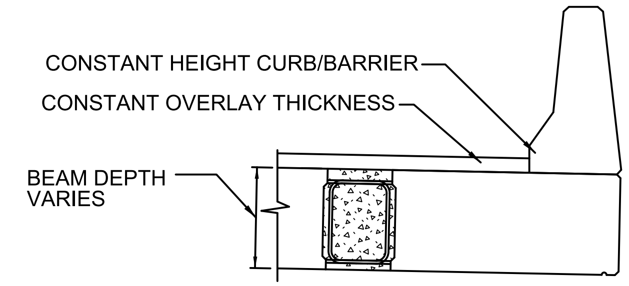

CREST VERTICAL CURVE PROFILE



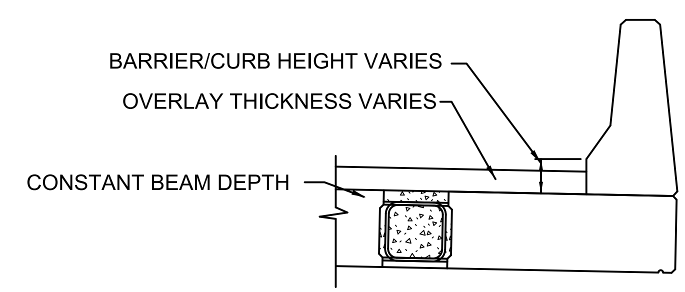

SAG VERTICAL CURVE PROFILE

NOTES

1. THE DETAILS SHOWN DEPICT VARYING THE BEAM DEPTH. ANOTHER OPTION IS TO VARY THE THICKNESS OF THE OVERLAY. NOTE THAT THE HEIGHT OF THE CURB OR PARAPET WILL STILL VARY.
2. CREST VERTICAL CURVES: IF THE CAMBER IS LESS THAN THE CURVE ORDINATE, THE DETAILS WILL BE SIMILAR TO THE TANGENT PROFILE DETAILS.
3. THE ENGINEER SHOULD DETAIL THE ANTICIPATED VARIABLE BEAM DEPTH OR OVERLAY ON THE PLANS BASED ON THE ESTIMATED CAMBER. THE PLANS SHOULD INCLUDE NOTES REQUIRING SURVEY OF THE BEAMS AFTER ERECTION, AND THEN ADJUSTMENT OF THE OVERLAY THICKNESS MAY BE REQUIRED. THE SAME APPLIES TO THE HEIGHT OF THE CURB OR BARRIER.
4. THE ENGINEER SHOULD ACCOUNT FOR THE ESTIMATED VARIABLE BEAM DEPTH AND/OR OVERLAY THICKNESS IN THE DESIGN OF THE BEAM.
5. THE ESTIMATED CAMBER USED FOR THE VARIABLE NOTED ABOVE SHOULD BE BASED ON THE ESTIMATED CAMBER AT ERECTION.
6. FOR MORE INFORMATION ON ACCOMMODATION OF PROFILES AND CAMBER, SEE PCI NORTHEAST DOCUMENT ENTITLED GUIDELINES FOR CAMBER AND PROFILE MANAGEMENT IN ADJACENT BEAMS (PCINE-18-GCPMAB).




OPTION 1: VARY BEAM DEPTH




OPTION 2: VARY OVERLAY THICKESS

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| PROFILE ACCOMMODATION DETAILS | | |

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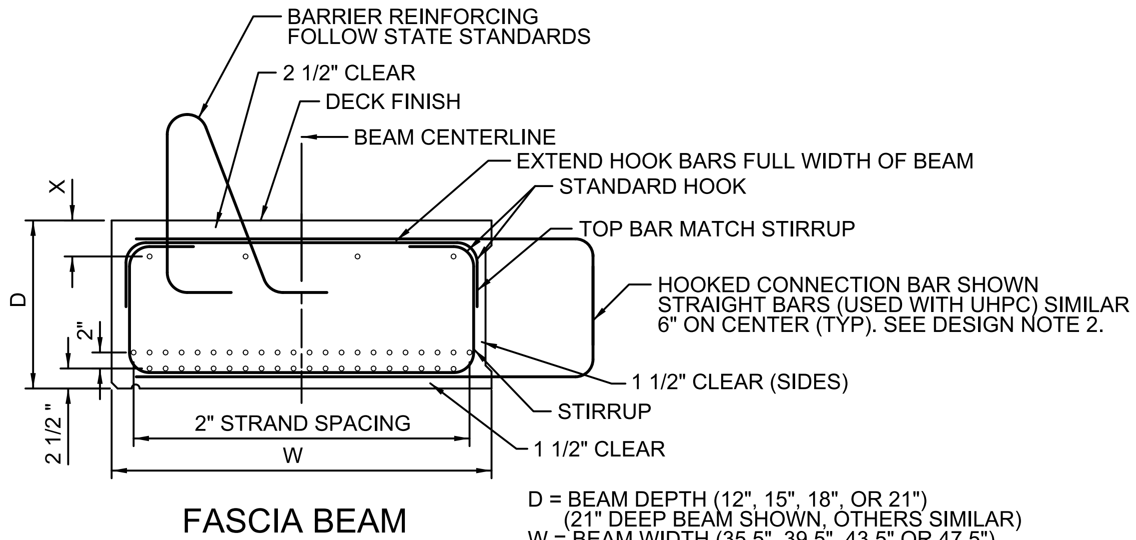
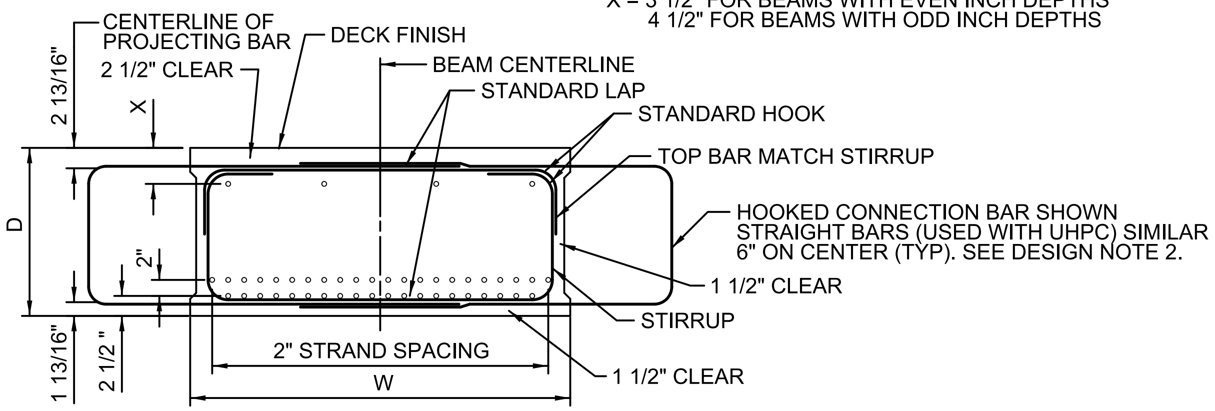



## FASCIA BEAM

D = BEAM DEPTH (12", 15", 18", OR 21")
(21" DEEP BEAM SHOWN, OTHERS SIMILAR)
W = BEAM WIDTH (35.5", 39.5", 43.5" OR 47.5")
X = 3 1/2" FOR BEAMS WITH EVEN INCH DEPTHS
4 1/2" FOR BEAMS WITH ODD INCH DEPTHS




## INTERIOR BEAM

### REINFORCING NOTES

1. SHEAR REINFORCING SHOULD BE KEPT TO #4 BARS IN ORDER TO MAXIMIZE THE COVER ON THE SIDE OF THE BEAM. BARS SHOWN WITH SMALL GAPS SHALL BE PLACED IN THE SAME PLANE.
2. MINOR ADJUSTMENT OF THE SPACING OF THE TOP LONGITUDINAL REINFORCEMENT IS ALLOWABLE TO FACILITATE THE INSTALLATION OF THE STIRRUPS.

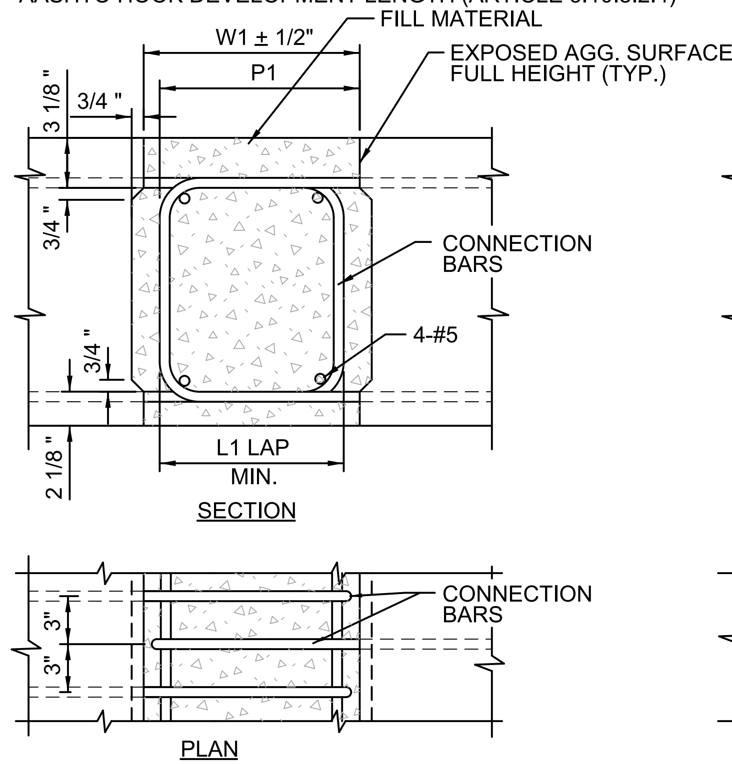
### DESIGN NOTES

1. THE REINFORCING SHOWN IS PRELIMINARY AND NOT GUARANTEED. DESIGNERS MUST VERIFY THE REINFORCING FOR EACH DESIGN BASED ON THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS OR STATE STANDARDS.
2. THE HOOKED REINFORCING BARS SHOWN SHOULD BE DESIGNED TO MEET THE REQUIREMENTS FOR DISTRIBUTION REINFORCEMENT AS SPECIFIED IN AASHTO ARTICLE 5.12.2.1. IN MOST CASES, #5 BARS SPACED AT 6" SHOULD SUFFICE. THE CLOSURE JOINT DETAIL MEETS THE REQUIREMENTS OF THE AASHTO LRFD GUIDE SPECIFICATIONS FOR ABC AND CAN BE CONSIDERED TO BE FULLY DEVELOPED. THESE BARS SHOULD ALSO BE FULLY DEVELOPED WITHIN THE BEAM.
3. THE DESIGNER SHALL DETAIL ADDITIONAL TOP LONGITUDINAL REINFORCING IN THE TOP FLANGE AT BEAM ENDS IF THE TOP FIBER STRESSES EXCEED 200 PSI. THESE BARS ARE USED TO CONTROL TRANSVERSE CRACKING IN THE TOP FLANGE AT RELEASE. THIS REINFORCING SHALL BE DESIGNED IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS. THIS REINFORCING IS FOR CRACK WIDTH AND LENGTH CONTROL, NOT PREVENTION. IT IS RECOMMENDED THAT IF FULLY TENSIONED TOP STRANDS ARE INCLUDED IN THE DESIGN, THEY SHOULD NOT BE USED TO MEET THESE AASHTO PROVISIONS, SINCE THEY ARE ALREADY BEING USED TO CONTROL STRESS IN THE BEAM.

### STRAND LAYOUT NOTES

1. STRAIGHT STRANDS ONLY. DRAPED STRANDS ARE NOT PERMITTED.
2. DEBONDING OF STRANDS IS ALLOWED. FOLLOW THE LATEST PROVISIONS FOR DEBONDING IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (ARTICLE 5.9.4.3.3).
3. AASHTO PROVISIONS FOR DEBONDED STRANDS (ARTICLE 5.9.4.3.3) REGARDING LONGITUDINAL LIMITS OF DEBONDING SHALL ALSO BE FOLLOWED.
4. DEBONDING SHOULD BE SYMETRICAL ABOUT THE CENTERLINE OF THE BEAM.
5. STRANDS SHALL BE PLACED WITHIN THE 2"x2" GRID. THE PATTERN MAY BE RAISED IN 2" INCREMENTS FOR DESIGNS THAT REQUIRE PRESTRESS AT A HIGHER ELEVATION. THE NUMBER AND LOCATION OF STRANDS SHALL BE AS REQUIRED BY DESIGN.
6. THE PATTERN SHOWN DEPICTS THE MAXIMUM NUMBER OF STRANDS ALLOWED.
7. THE TWO BOTTOM CORNER STRANDS ARE OMITTED TO PROVIDE ROOM FOR THE SHEAR REINFORCEMENT BAR BENDS.
8. ALL PRESTRESSING STRAND SHALL BE 0.6" DIAMETER, UNCOATED SEVEN WIRE, LOW RELAXATION STRANDS CONFORMING TO AASHTO M203. THE ULTIMATE STRENGTH OF THE STRANDS SHALL BE 270 KSI.
9. ADDITIONAL STRAND TENSIONED TO A NOMINAL VALUE MAY BE ADDED IN THE BEAM TOP TO SUPPORT THE TOP REINFORCING.

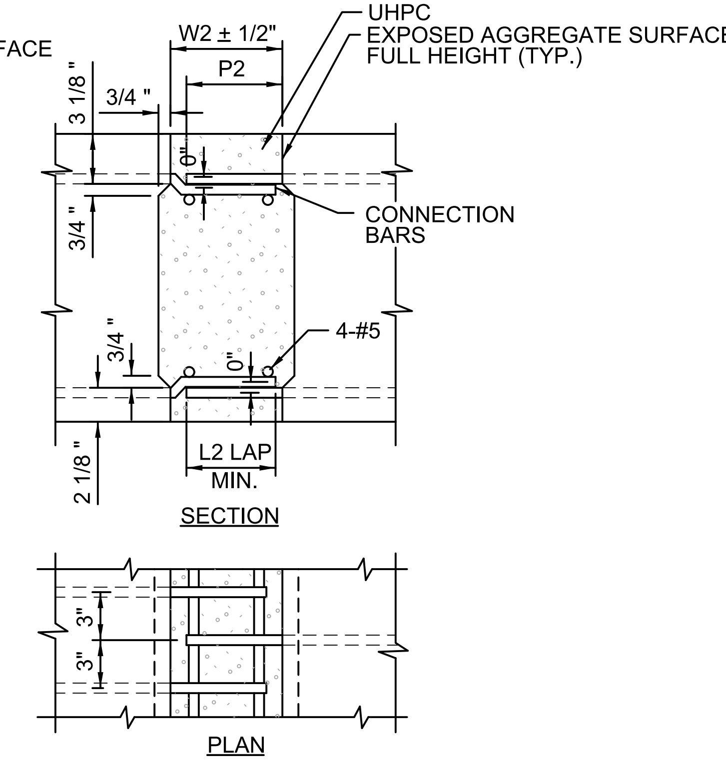
T = RECOMMENDED TOLERANCE = 0.5" (SEE NOTE 7)
W1 = SPECIFIED JOINT WIDTH, MINIMUM=L1+T+1.5 (SEE NOTE 9)
P1 = HOOK BAR PROJECTION FROM PANEL EDGE = 0.5(W1+L1)+T
L1 = AASHTO HOOK DEVELOPMENT LENGTH (ARTICLE 5.10.8.2.4)




| MINIMUM WIDTH |
|---|
| FOR f'c = 4KSI |
| #5 BARS<br>W1 = 13 1/2"<br>P1 = 13"<br>L1 = 11 1/2" |

HOOKED BARS WITH CONCRETE

T = RECOMMENDED TOLERANCE = 0.5" (SEE NOTE 7)
W2 = SPECIFIED JOINT WIDTH, MINIMUM=L2+T+1.5 (SEE NOTE 9)
P2 = BAR PROJECTION FROM PANEL EDGE = 0.5(W2+L2)+T
L2 = AASHTO LRFD GUIDE SPEC FOR ABC UHPC SPLICE LENGTH




| MINIMUM WIDTH |
|---|
| FOR #5 BARS<br>W2 = 7"<br>P2 = 6 1/2"<br>L2 = 5" |

STRAIGHT BARS WITH UHPC

## CLOSURE JOINT CONNECTIONS

18" DEEP BEAM SHOWN, OTHERS SIMILAR

### CLOSURE JOINT NOTES

1. CONNECTOR REINFORCING TO BE PLACED ALONG THE ENTIRE SPAN WITH 6" SPACING.
2. FOR SKEWED BRIDGES, PLACE CONNECTOR REINFORCING PERPENDICULAR TO BEAM EDGE. BEND CONNECTOR REINFORCING WITHIN THE BEAM IN ACUTE CORNERS TO PRODUCE A SQUARE PROJECTION.
3. METHOD OF FORMING CLOSURE POUR TO BE DETERMINED BY THE CONTRACTOR. THE FORMS NEED TO BE REMOVABLE AND ABLE TO ACCOMMODATE DIFFERENTIAL CAMBER. FORM SUPPORTS SHOULD NOT PENETRATE THROUGH TOP OF POUR UNLESS APPROVED BY THE ENGINEER.
4. EXPOSED AGGREGATE SURFACE OF THE FACES OF THE KEYS IS RECOMMENDED TO IMPROVE GROUT BOND AND MINIMIZE POTENTIAL FOR LEAKAGE.
5. DESIGNERS ARE RESPONSIBLE FOR THE VERIFICATION OF THE DESIGN OF THE REINFORCEMENT IN THIS JOINT. FOLLOW THE PROVISIONS OF THE 2018 AASHTO LRFD GUIDE SPECIFICATIONS FOR ABC. SAMPLE DESIGNS SHOWN IN BOXES.
6. THE WIDTH OF THE JOINT WILL AFFECT THE BEAM SPACING.
7. THE JOINT WIDTH TOLERANCE IS USED TO ACCOMMODATE THE FABRICATION AND ERECTION TOLERANCES.
8. THE AREA OF TRANSVERSE CONNECTION BARS IN THE CLOSURE JOINT SHOULD BE BASED ON 9TH EDITION OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATION EQUATION 5.12.2.1-2 (TRANSVERSE DISTRIBUTION REINFORCEMENT FOR CAST-IN-PLACE SOLID SLAB SUPERSTRUCTURES). SAMPLE DESIGNS HAVE SHOWN THAT #5 BARS @ 6" WILL WORK IN MOST SITUATIONS. THE WIDTH OF JOINTS SHOWN ON THESE RECOMMENDED GUIDE DETAILS ARE BASED ON #5 BARS, LARGER BARS WILL REQUIRE WIDER JOINTS. AND WIDER BEAM SPACING. THE SPACING OF THE BARS SHALL ALWAYS BE 6" ON CENTER.
9. THE RECOMMENDED MAXIMUM JOINT WIDTH IS 18" FOR HOOKED BAR JOINTS AND 12" FOR UHPC JOINTS.

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| TYPICAL BEAM REINFORCING | | |


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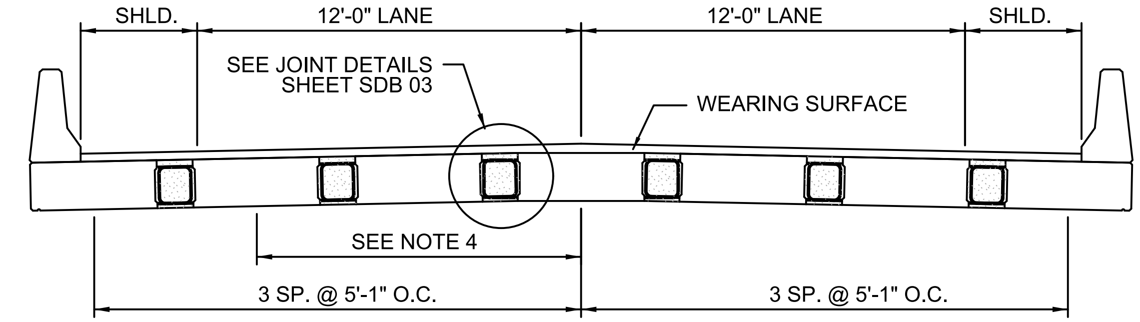
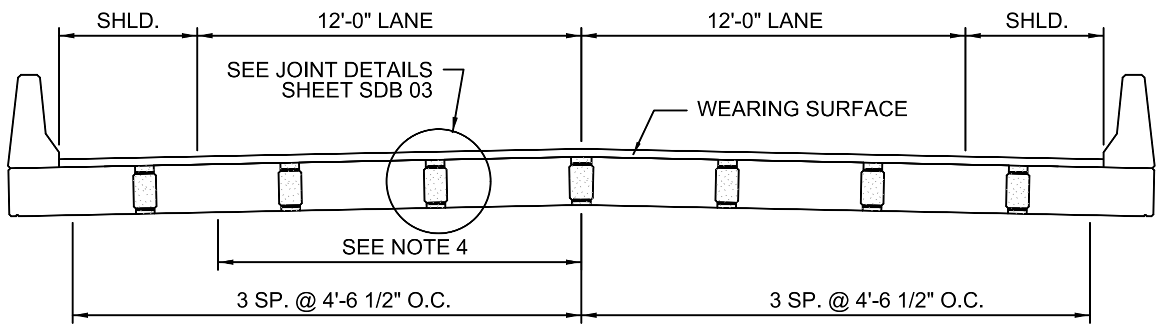



TYPICAL SECTION WITH 47.5" WIDE BEAMS AND 13.5" WIDE MINIMUM 4KSI CLOSURE JOINTS



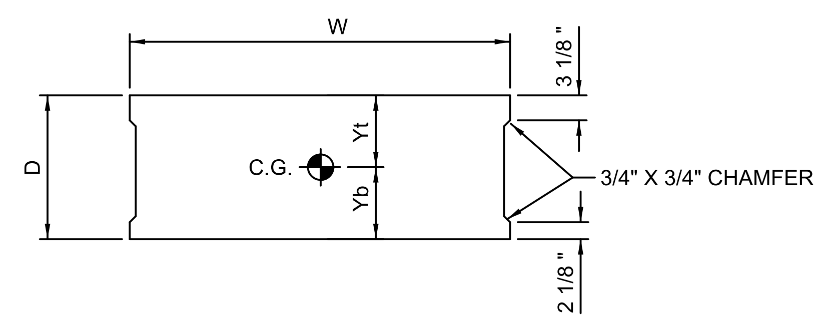

TYPICAL SECTION WITH 47.5" WIDE BEAMS AND 7" WIDE MINIMUM UHPC CLOSURE JOINTS

## BRIDGE SECTION NOTES

1. THE BRIDGE SECTIONS DEPICTED REPRESENT THE TYPICAL USE OF THE SPREAD BEAMS WITH MINIMUM WIDTH JOINTS AND THE MAXIMUM WIDTH BEAMS. OTHER BEAM WIDTHS WOULD BE SIMILAR. SEE SECTION PROPERTY TABLE FOR DIMENSIONS.
2. JOINT WIDTHS MAY BE INCREASED TO PROVIDE EXACT CROSS SECTION WIDTHS. SEE SHEET SDB 03 FOR MINIMUM AND MAXIMUM JOINT WIDTHS.
3. IN SPECIAL CASES, MIXED WIDTH BEAMS CAN BE USED TO ACCOMMODATE UNUSUAL BRIDGE WIDTHS.
4. OFFSET THE BEARING SUPPORT LOCATIONS FROM THE ROADWAY BASELINE ACCOUNTING FOR THE CROSS SLOPE AND ROTATION OF THE BEAMS RELATIVE TO THE LONGITUDINAL AXIS OF THE BEAM. THE DIMENSIONS OF ALL BEARING LOCATIONS ON THE PLANS SHOULD ACCOUNT FOR THIS ROTATIONAL OFFSET. THIS NOTE IS NOT APPLICABLE FOR STRIP BEARING PADS THAT ARE USED BY SOME AGENCIES FOR SHORT SPAN BRIDGES.

## SOLID DECK BEAM SECTION PROPERTIES

| BEAM DESIGNATION | BEAM WIDTH W INCHES | BEAM DEPTH D INCHES | AREA $IN^2$ | I $IN^4$ | Yb INCHES | Yt INCHES | St $IN^3$ | Sb $IN^3$ | WEIGHT PLF |
|---|---|---|---|---|---|---|---|---|---|
| SDB48-12 | 47.50 | 12.00 | 561 | 6810 | 6.01 | 5.99 | 1137 | 1133 | 584 |
| SDB48-15 | 47.50 | 15.00 | 699 | 13264 | 7.51 | 7.49 | 1771 | 1766 | 728 |
| SDB48-18 | 47.50 | 18.00 | 837 | 22864 | 9.01 | 8.99 | 2543 | 2538 | 872 |
| SDB48-21 | 47.50 | 21.00 | 975 | 36229 | 10.51 | 10.49 | 3454 | 3447 | 1049 |
| SDB44-12 | 43.50 | 12.00 | 513 | 6234 | 6.01 | 5.99 | 1041 | 1037 | 534 |
| SDB44-15 | 43.50 | 15.00 | 639 | 12139 | 7.51 | 7.49 | 1621 | 1616 | 666 |
| SDB44-18 | 43.50 | 18.00 | 765 | 20920 | 9.01 | 8.99 | 2327 | 2322 | 797 |
| SDB44-21 | 43.50 | 21.00 | 891 | 33142 | 10.51 | 10.49 | 3160 | 3153 | 928 |
| SDB40-12 | 39.50 | 12.00 | 465 | 5658 | 6.01 | 5.99 | 945 | 941 | 484 |
| SDB40-15 | 39.50 | 15.00 | 579 | 11014 | 7.51 | 7.49 | 1471 | 1466 | 603 |
| SDB40-18 | 39.50 | 18.00 | 693 | 18976 | 9.02 | 8.98 | 2112 | 2105 | 722 |
| SDB40-21 | 39.50 | 21.00 | 807 | 30055 | 10.52 | 10.48 | 2867 | 2858 | 841 |
| SDB36-12 | 35.50 | 12.00 | 417 | 5082 | 6.01 | 5.99 | 848 | 846 | 434 |
| SDB36-15 | 35.50 | 15.00 | 519 | 9889 | 7.51 | 7.49 | 1320 | 1317 | 541 |
| SDB36-18 | 35.50 | 18.00 | 621 | 17032 | 9.02 | 8.98 | 1896 | 1889 | 647 |
| SDB36-21 | 35.50 | 21.00 | 723 | 26968 | 10.52 | 10.48 | 2572 | 2565 | 753 |




DECK BEAM SECTION

## BEAM DIMENSION NOTES

1. THE WIDTH OF BEAMS SHOWN SHOULD NOT BE CHANGED WITHOUT PERMISSION FROM THE OWNER. VARY JOINT WIDTH IN ORDER TO CONSTRUCT A BRIDGE TO THE REQUIRED WIDTH.
2. THE SPACING OF BEAMS ON A TYPICAL BRIDGE SHALL BE THE WIDTH OF THE BEAM PLUS THE WIDTH OF THE JOINT (SEE EXAMPLE SECTIONS ON THIS SHEET).
3. MODIFY THE FASCIA BEAM DECK EDGE TO MATCH STATE STANDARDS.

| | | |
|---|---|---|
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| TYPICAL BRIDGE SECTIONS AND SECTION PROPERTIES | | |


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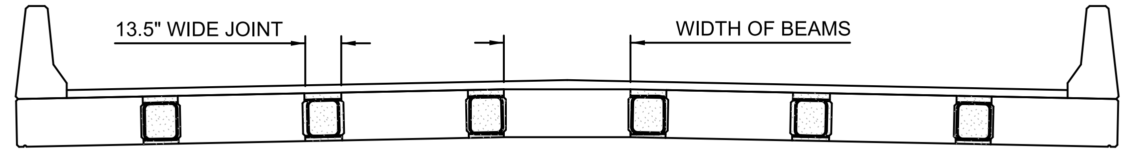
| APPROXIMATE MAXIMUM SPAN LENGTHS | | | | |
|---|---|---|---|---|
| BEAM TYPE (SEE NOTE 2) | JOINT WIDTH (INCHES) | BEAM SPACING | MAXIMUM SPAN LENGTH IN FEET (NUMBER OF STRANDS) | |
| | | | f'c = 6 ksi | f'c = 10 ksi |
| SDB48-12 | 13.5 | 5'-1" | 26 (18) | 37 (34) |
| SDB48-15 | | | 37 (22) | 49 (32) |
| SDB48-18 | | | 49 (28) | 56 (30) |
| SDB48-21 | | | 53 (26) | 56 (26) |
| SDB44-12 | 13.5 | 4'-9" | 24 (16) | 35 (34) |
| SDB44-15 | | | 34 (22) | 47 (32) |
| SDB44-18 | | | 46 (26) | 55 (30) |
| SDB44-21 | | | 52 (24) | 56 (26) |
| SDB40-12 | 13.5 | 4'-5" | 22 (16) | 32 (30) |
| SDB40-15 | | | 32 (22) | 45 (30) |
| SDB40-18 | | | 43 (24) | 54 (28) |
| SDB40-21 | | | 53 (24) | 55 (24) |
| SDB36-12 | 13.5 | 4'-1" | 19 (14) | 29 (26) |
| SDB36-15 | | | 29 (16) | 42 (30) |
| SDB36-18 | | | 41 (22) | 52 (26) |
| SDB36-21 | | | 50 (24) | 53 (22) |

NOTES

1. ALL OF THESE BEAMS EXCEED THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS RECOMMENDED CRITERIA FOR SPAN-TO-DEPTH RATIOS. IF THE BRIDGE OWNER REQUIRES A DESIGN TO MEET THIS CRITERIA, THEN THE MAXIMUM SPAN WOULD BE LIMITED TO THE AASHTO RECOMMENDED CRITERIA.

2. ACTUAL BEAM WIDTHS ARE 1/2" LESS THAN THE BEAM TYPE DESIGNATION. FOR EXAMPLE, SDB48-12 BEAM IS 47.5" WIDE AND 12" DEEP)




SECTION USED FOR SPAN LENGTH CALCULATIONS

## MAXIMUM SPAN LENGTH DESIGN ASSUMPTIONS

THE VALUES SHOWN ARE NOT GUARANTEED AND SHOULD BE CONSIDERED APPROXIMATE. THE ACTUAL MAXIMUM SPAN LENGTHS ARE AFFECTED BY A NUMBER OF ASSUMPTIONS.

THE FOLLOWING ARE THE DESIGN CRITERIA AND ASSUMPTIONS USED FOR THE DEVELOPMENT OF THESE MAXIMUM SPAN LENGTHS.

1. THE DESIGNS CORRESPOND TO THE CROSS SECTION GEOMETRY SHOWN ABOVE. DIFFERENT CONFIGURATIONS WILL PRODUCE DIFFERENT MAXIMUM SPAN LENGTHS.
2. THESE MAXIMUM SPAN LENGTHS ARE FOR BEAMS WITH REINFORCED CONCRETE CLOSURE JOINTS. BRIDGES WITH UHPC CLOSURE JOINTS WILL HAVE SLIGHTLY LONGER MAXIMUM SPAN LENGTHS DUE TO THE REDUCED BEAM SPACING.
3. THE STRUCTURAL CONTRIBUTION OF THE CLOSURE JOINT CONCRETE AND REINFORCEMENT IS NEGLECTED.
4. DESIGN SPECIFICATIONS: AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 9TH EDITION (2020)
5. BARRIERS: MASSDOT CF-PL2 BARRIER (457 PLF)
6. WEARING SURFACE: 3" THICK ASPHALT
7. UTILITY LOADS: NONE
8. DEBONDING: NO DEBONDING WAS ASSUMED FOR THESE CALCULATIONS. DEBONDING CAN BE USED TO INCREASE THE MAXIMUM SPAN LENGTHS.
9. RELEASE STRENGTH WAS ASSUMED TO BE 80% OF FINAL STRENGTH.
10. ALLOWABLE TENSILE STRESSES: BASED ON SEVERE EXPOSURE
11. BEAM DESIGNS ARE FOR SIMPLY SUPPORTED INTERIOR BEAMS
12. LIVE LOAD DISTRIBUTION FACTORS: AASHTO LRFD SPECIFICATION ARTICLE 4.6.2.3 EQUIVALENT STRIP METHOD
13. BARRIER WEIGHT AND WEARING SURFACE IS EVENLY DISTRIBUTED TO ALL BEAMS.
14. SUPPLEMENTAL BONDED LONGITUDINAL REINFORCEMENT MAY BE REQUIRED AT THE TOP OF BEAM ENDS TO MEET THE ALLOWABLE TEMPORARY TENSILE STRESS LIMIT REQUIREMENTS AT RELEASE.
15. AASHTO LRFD RECOMMENDED SPAN/DEPTH RATIOS WERE NOT CONSIDERED (SEE TABLE NOTE 1).

LARGER MAXIMUM SPAN LENGTHS CAN BE ACHIEVED BY:
- DEBONDING STRAND AT THE BEAM ENDS
- REDUCING THE WEIGHT OF BARRIER (METAL RAILING)
- USING HIGHER CONCRETE RELEASE AND FINAL STRENGTH

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| MAXIMUM SPAN TABLE | | |

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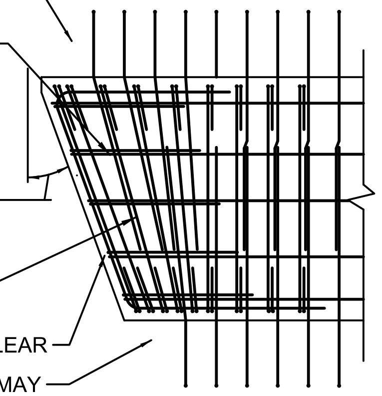
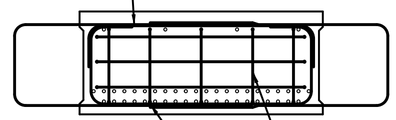
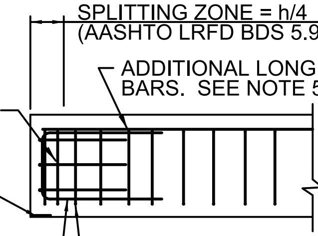



PLAN - SKEWED END




END ELEVATION

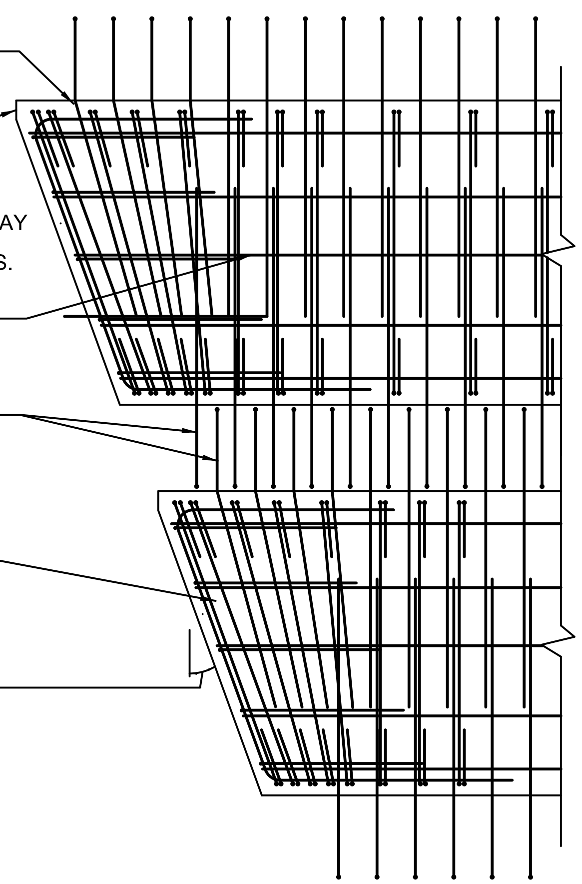
NOTE: h = TOTAL HEIGHT OF MEMBER




SIDE ELEVATION

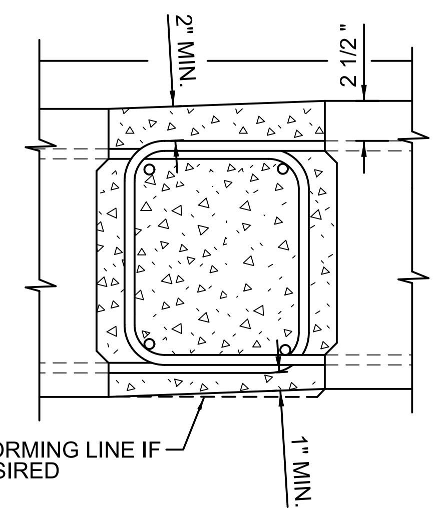
## END REINFORCING DETAILS

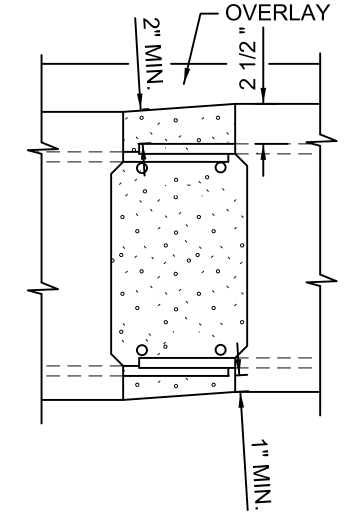
NOTES:
1. THE BARS SHOWN ARE APPROXIMATE. SOME OF THESE ADDITIONAL END VERTICAL AND HORIZONTAL BARS MAY NOT BE NECESSARY DEPENDING ON THE DESIGN.
2. THE AMOUNT OF SPLITTING REINFORCING MAY BE REDUCED BY DEBONDING STRAND IN THIS AREA. ADDITIONAL SPLITTING REINFORCING SHOULD BE PLACED IN AREAS WHERE DEBONDING IS TERMINATED.
3. BEAMS MAY BE FABRICATED WITH HIGHER SKEWS WITH APPROVAL OF THE OWNER.
4. THE DESIGNER SHALL DETAIL ADDITIONAL TOP LONGITUDINAL REINFORCING IN THE TOP OF THE BEAM ENDS IF THE TOP FIBER STRESSES EXCEED 200 PSI (NOTE THAT SOME BRIDGE OWNERS HAVE DIFFERENT STRESS LIMITS IN THIS PORTION OF THE BEAM). THESE BARS ARE USED TO CONTROL TRANSVERSE CRACKING IN THE BEAM TOP AT RELEASE. THIS REINFORCING SHALL BE DESIGNED IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (ARTICLE 5.9.2.3.1b). THIS REINFORCING IS FOR CRACK WIDTH AND LENGTH CONTROL, NOT PREVENTION. IF TOP LONGITUDINAL REINFORCING IS USED, THE ALLOWABLE TENSILE STRESSES MUST STILL BE LIMITED TO THE THE REQUIREMENTS SPECIFICED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.



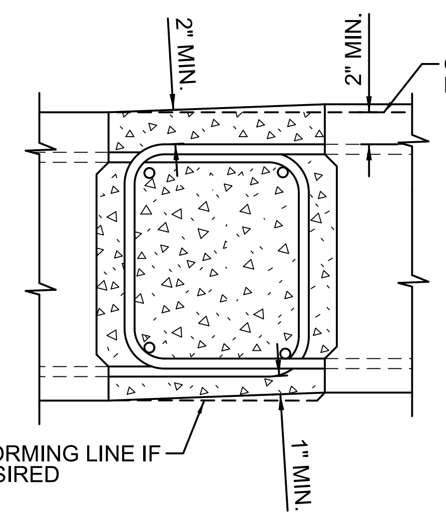

PLAN

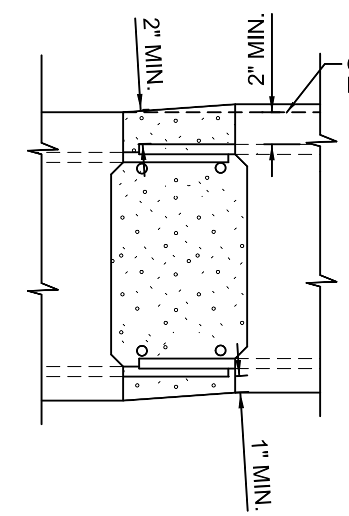
## SOLID DECK BEAMS - REINFORCING DETAILS
## SKEWED BEAM ENDS




½" MAXIMUM JOINT DIFFERENTIAL - OVERLAY DETAIL




½" MAXIMUM JOINT DIFFERENTIAL - BARE DECK DETAIL

REINFORCED CONCRETE JOINTS    UHPC JOINTS

## CAMBER DIFFERENTIAL DETAILS

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| BEAM END DETAILS | | |

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