Secondary Route Bridge Design Plan Guidelines

Introduction

Background

Approximately 7000 Michigan roadway bridges are owned by local agencies, and nearly 90% of these are managed by county highway agencies. Most local agency bridges are smaller structures that carry lower traffic volumes; about 60% of local agency bridges are single span structures less than 50 ft long, and average fewer than 1000 vehicles per day. About 70% of these structures have deck widths no greater than 40 ft.

Over half of these bridges were built prior to 1980, while one-fourth were built prior to 1960. This advancing age leads to increasing maintenance concerns. 17% have superstructures and substructures rated less than satisfactory, and in the near future, many of these bridges will require replacement.

MDOT has a variety of standard plans and details readily available for its structures. However, these existing plans are not always best suited for local agency use. As many MDOT bridges are built for higher traffic volume roads, they tend to be wider and longer than the typical local agency bridge, and may use girder types meant for larger spans.

To address this concern, this document provides a set of bridge plans meant to facilitate construction of new structures suitable for local agency use. The designs specifically address common local agency road, span, and site conditions, to enable development of low cost, low maintenance, readily constructible bridges.

The purpose of the plans is to provide design guidance. These plans are not meant to prescribe MDOT standards or requirements, but represent recommendations for design. They are meant to be used as templates for the designer, where some information can be used as-is, while other portions of the plans must be customized and developed by the engineer for the specific structure considered. Due to the variability of local site conditions, the plans address superstructure details only. Even here, not all elements can be used without adjustment, as local conditions will impact the design. Such details must be addressed by suitable engineering professionals.

These plans were developed over a two year period based on input from a variety of sources, including MDOT bridge engineers, local agencies, designers, and contractors. They represent recommendations for best practices that are suitable for local agency use.

Anticipated benefits from implementing the bridge plans include reduced design and construction uncertainties; bridges that are simpler and faster to design and construct; improved quality control; and lower life cycle costs.

Design Considerations
In general, a desirable structure is cost effective, constructible, functional, durable, and aesthetically appropriate. However, a large number of factors will influence bridge selection which are beyond the scope of this document to address.

Some general site concerns include topography, horizontal and vertical road alignments, required horizontal and vertical clearances, the presence of utilities, and potential pedestrian traffic.

Foundation design is a major component, but requirements vary greatly from one site to another. Other design considerations include potential for settlement, the presence of groundwater, the possibility for future bridge widening, and the need for a shallow or deep foundation. Additional geotechnical and foundation-related design items include how end and side slope overall stability, the abutment and wing wall design, construction staging, and required skew angle of the bridge.

Hydraulic concerns occur both on the bridge, in terms of how deck drainage is handled, as well as below the bridge. The latter includes various issues of consideration including the presence of a waterway and required clearance; possible channel drift; the passage of debris and possible pier obstruction for some foundation types; and possible scour of the foundation.

Construction concerns will also influence the bridge design. Prime among these is the availability and cost of the desired materials and workforce, though other concerns include the available space on-site and access to the site for personnel and equipment. How the construction will impact detoured traffic also bears consideration.

**Bridge Type Selection**

Design guidance provided by this document is summarized in the following steps:

1) Determine acceptable superstructure depth.
2) Estimate costs.
3) Consider alternatives.
4) Select bridge.
5) Prepare plans.

1) **Determine acceptable superstructure depth.**

Necessary clearances are generally determined from a hydraulic analysis for bridges spanning waterways, or vertical clearance requirements for bridges spanning roadways. Once required clearances are determined and corresponding allowable bridge girder depths found, Table 1 or Figure 1 can be consulted to select initial bridge types that meet the required girder depth limit. The girder depths presented in Table 1 and Figure 1 are based on the girder spacing, material strengths, and other assumptions described in the plan set accompanying this document.
Table 1. Typical Beam Depth Requirements

<table>
<thead>
<tr>
<th>Span (ft)</th>
<th>Bulb Tee</th>
<th>SBB</th>
<th>SSBB</th>
<th>Steel</th>
<th>Timber</th>
<th>Fold Plate</th>
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</table>

*Although these depths are reasonably achievable, a minimum girder depth of 21” is recommended for these span lengths.

Figure 1. Typical Beam Depth Requirements for Bridge Types. Note a minimum beam depth of 21” is recommended for steel girders spanning 30’ or more, while a minimum depth of 14” is recommended for girders spanning 20’.

Table 1 and Figure 1 present girder depth only. In addition to girder depth, the deck and beam haunch must be considered to determine total bridge depth. Recommended deck thickness (including wearing surface) is 9” for spread box beam (SBB), bulb-tee, and steel girder bridges; 6” for side by side box beams (SSBB), and 8” for folded plate type steel tub-beam bridges. A beam haunch is typically provided and adds additional variable depth, depending on bridge slope.
and capacity requirements. Typical haunch depths range from 1-4”. The timber bridge depths provided are based on the assumption of a slab-bridge (i.e. a single deck spanning in the traffic direction) rather than a girder-deck configuration. This depth shown does not include an additional wearing surface. Culvert structures, not appearing on Figure 1, are not easily comparable as they often have a variable beam depth and may arch over the gap, providing more clearance than a typical prismatic girder bridge. Thus, these should be considered when structures shown in Figure 1 cannot meet depth requirements or if they can provide a more economic option.

2) Estimate costs.

Costs are highly variable and depend on local conditions. Specific estimates can be obtained from the engineer and contractor. However, a preliminary estimation of superstructure costs for some bridge types is given in Figure 2. These costs include the construction of all superstructure elements, including beams, deck, diaphragms, and railings. Figure 3 represents an estimate of superstructure costs in addition to substructure costs (abutment and wing wall elements). In the figures, solid lines indicate a 34 ft clear bridge width; top and bottom dashed lines indicate costs for 40 and 30 ft clear widths, respectively. These estimates do not include foundation costs, which are usually substantial. Although foundation cost varies considerably according to site conditions, for a particular site, it is unlikely to vary significantly among the different bridge types shown in the Figures. Assumptions used to estimate these costs are given in MDOT Research Report SPR-1669, which is available on-line. Alternative structure types not appearing on the figures, including folded plate girders, timber, and culverts, are often sold as an assembly for which initial costs can be obtained directly from suppliers.

At the time of publication of this document (March 2018), not including roadway surfacing, traffic control, and other associated costs, prefabricated culverts may be roughly estimated at $350/SF of deck area, while material-only costs (not including installation, traffic control, wearing surface, barriers, substructure and foundation) for folded plate girder superstructures range from approximately $60/SF for spans up to 50’ and $70/SF for spans up to 70’, while material-only costs of timber superstructures range from approximately $90/SF for a 20’ span to $180/SF for a 40’ span. Note that these costs are rough approximations and should be obtained from the specific manufacturer considered.

Figures 4 and 5 illustrate life cycle cost (LCC) estimates, which account for the costs of expected maintenance over the lifetime of the structure. The LCC includes costs for initial construction, inspection, repair and maintenance, demolition, and replacement. Assumptions used to estimate these costs are given in MDOT Research Report SPR-1669.
Figure 2. Estimate of Initial Superstructure Cost.

Figure 3. Estimate of Initial Superstructure + Substructure Cost.
Figure 4. Estimate of Superstructure Life Cycle Costs.

Figure 5. Estimate of Superstructure + Substructure Life Cycle Costs.
3) Consider alternatives.

Some bridge types are better-suited to a particular set of conditions than others. The range of spans and beam depths addressed in this guide are summarized in Table 1. A summary of considerations is given below.

3a) Spread box beam (Fig. 4). Spread box beam bridges are widely familiar and significant experience exists with these structures. Standard sections are readily available from fabricators, and range in size from 12”- 60” in height with widths either 36” or 48” in most cases. These structures are generally well-performing. Design guidance is given for spans from 20 to 110 ft, although longer spans are possible.

![Figure 4. Spread Box Beam Bridge.](image)

3b) Side-by-side box beam (Fig. 5). This system is particularly useful when small beam depths are required and spread boxes or other options cannot meet the required clearance. Appropriate detailing, such as spreaded in the accompanying bridge plans, can mitigate potential deck deterioration concerns. Due to the larger number of beams than the spread box design, this tends to be a more expensive alternative. Design guidance is given for spans from 20 to 110 ft.

![Figure 5. Side by Side Box Beam Bridge.](image)

3c) Galvanized steel (Fig. 6). Although painting steel girders is possible, to enhance corrosion resistance and lower long term maintenance costs, hot-dip galvanization is recommended for steel girders. Here, a limitation is the size of available galvanization vats, which may commonly accommodate beams up to about 58 ft in length if progressive dipping is used. Such girders offer good long-term maintenance performance and typically lower girder weights than prestressed concrete sections. Design guidance is given for spans from 20 to 60 ft. Within this span range, beam depths commonly range from 21” – 36”, although smaller depths are possible for short spans. To decrease beam depth and weight for longer spans, a cover plate may be used. Generally, steel beams are more expensive compared to concrete beams and require longer lead time for fabrication.

![Figure 6. Galvanized Steel Girder Bridge.](image)

3d) Folded plate (Fig. 7). Prefabricated, tub-shaped folded plate steel girders by various manufacturers are available up to about 80 ft. These girders are typically available with a precast concrete deck attached, then the slab/girder system is joined on site by grouted keyways. These systems are often relatively fast to construct and can provide lower dead loads than precast concrete. As with concrete box sections, the section interior is not visible for inspection.
Reasonable beam depths for this system range from about 20” – 36”. Design guidance is available from suppliers.

Figure 7. Folded Plate Steel Bridge.

3e) Bulb tee (Fig. 8). Available in relatively larger sections, bulb tees are usually best suited for spans greater than about 70 ft, where these sections are most efficiently used. An advantage of this girder is that its surfaces are exposed and accessible for inspection and maintenance, if needed. Commonly available bulb tees range in depth from 36” – 72”.

Figure 8. Bulb Tee Bridge.

3f) Timber (Fig. 9). Timber is most applicable to shorter spans, with practical applications potentially up to about 40 ft. These structures are relatively inexpensive, quick and easy to construct, and have high aesthetic quality in natural settings. However, these structures have different mechanisms of deterioration, wearing surface concerns, and maintenance strategies from those of steel and concrete bridges. Timber is recommended for particular consideration on roads with relatively low traffic volumes. Deck thicknesses range from about 14” - 20” for the span range considered. Standard plans are readily available from timber bridge suppliers.

Figure 9. Timber Bridge.

3g) Culvert (Fig. 10). Culverts are well suited for short spans, but may reach up to about 40 ft in multi-cell or special arched configurations. The latter may require a significant change in roadway elevation, however. Culverts may provide clearances that other bridge types cannot. They are often associated with fast installation time and low long term maintenance costs. Various types of culverts are available, including U-shaped (no bottom) and box-shaped, although culverts with bottoms crossing riverbeds often require additional environmental consideration. Prefabricated culverts are available in precast concrete, steel, and aluminum. Cast-in-place options are also possible. Standard plans are readily available from manufacturers.

Figure 10. Culverts.
4) Select bridge.

Based on considerations such as those summarized above, along with feedback from an engineer, an appropriate bridge type can be selected. Determining the best choice may also involve a more detailed economic analysis of viable alternatives.

5) Prepare plans.

For culverts, timber, folded plate, or other types of structures for which standard plans exist, regional suppliers of these specific structures can be consulted for guidance. For spread box, side-by-side box, steel, or bulb tee girder bridges, design guidance is provided in the accompanying documents. For these bridge types, a set of superstructure plan templates is available, and are described below.

**Bridge Plan Recommendations**

**Plan Assumptions**

The plans provided with this document present design information for simple span structures of three widths and variable lengths in 10’ increments designed to the 7th Edition of the AASHTO LRFD Specifications (2014), but using the HL-93-mod live load. Decks are designed using the strip method, while girder shear design is based on the General Procedure. The designs are valid for skews from 0-30 degrees (i.e. angle of crossing from 60-90 degrees), and satisfy Strength I, Service I and III (for prestressed concrete), Service II (for steel), and Fatigue I limit states, and meet a deflection limit of L/800. Note that these plans are for superstructures only and will require design for the substructure, foundation, and potentially other components as needed.

Clear widths are based on AASHTO 2011 (A Policy on Geometric Design of Highways and Streets), as a function of average daily traffic (ADT). Width requirements are based on design speed (assumed to be 55 MPH) and ADT. Although very low ADT roads (<400) can use a two-lane bridge width of 26’, most local agencies specify a minimum deck width of 30’ to accommodate agricultural equipment; this width assumes two 11’ lanes with 4’ shoulders, and can be used for ADT up to 1500. From ADT of 1500-2000, the minimum bridge width is 34’ (two 11’ lanes and 6’ shoulders); for ADT over 2000, a width of 40’ is specified (12’ lanes and 8’ shoulders). All girder bridges have approximately 2.5’ overhang, except the 30’ clear steel beam bridge (all spans) and the 40’ clear, 110’ span bulb tee, which have approximately 3.5’ overhang, measured from the center of the girder to edge of the deck.

Designs are provided for span lengths in increments of 10’ within the range given in Table 1 shown for each bridge type. For spans between the increments provided, it is generally conservative to use the beam design provided for the upper span increment. It is suggested that both the lower and upper span increment section designs presented are checked for applicability, in order to select a more optimally sized section. Such cases must be verified by the design engineer.
When specifying beam sizes and girder spacing, the plans were prepared to provide a balance between economy and maximizing vertical clearance. The latter is often a critical consideration for Michigan local agency bridges, for which the large majority pass over waterways and must meet design flood flow capacity requirements. Maximizing economy and clearance generally align for side-by-side box beam structures, for which the minimum feasible beam depth is provided based on the material strengths specified. For spread box and bulb tee structures, the most economic sections also generally aligned with those of minimum depth. In a few cases, moving to a slightly larger section allowed widening girder spacing and use of one less beam in the design, resulting in a more economic outcome. These resulted in spread box beam designs with 4-6 beams spaced from approximately 6.9-9.4’ and bulb tee designs with 4-5 beams spaced from 7.9-9.4’, depending on bridge span and width. For steel girder bridges, cost was directly influenced by girder spacing as a function of girder weight, and final designs used 5-7 beams spaced at approximately 6.3’.

Beam sizes and material strengths are based on commonly available selections. Steel girder sizes range from W14x120 - 36x170 (30x173 heaviest). Spread box beam sizes are 21” x 36” for spans from 20-40’ and have a width of 48” and range from depths of 21”, 27”, 33”, 39”, and 48” for greater spans. Side by side box beam designs have beam sizes of 17” x 36” for spans from 20-50’ and are 48” wide with the same depths given for spread box for longer spans. Bulb tees are 42” x 49” for spans from 70-90’ and 48” x 49” for spans from 100-110’.

Steel diaphragms are used throughout, which contractors have often found to be more convenient to install than pouring concrete. No diaphragms are specified for spread box beam bridges, which are not required for the geometries considered.

All bridges have a reinforced concrete composite deck with f’c = 4 ksi, that is 7.5” thick, with an additional 1.5” wearing surface (9” total depth), except for side by side box beam bridges, which have a 4.5” deck thickness with an additional 1.5” wearing surface (6” total depth). For girder design, a beam haunch of 4” is assumed for dead load, but no haunch was included in calculation of composite beam section properties. Decks are reinforced with 60 ksi, #5 bars throughout, where top bars are spaced 12” and bottom bars are spaced 8” on center. All bars are assumed to be epoxy coated.

For prestressed concrete girders, f’c = 7 ksi at release and 8 ksi in service. Prestress tendons are taken as 0.6” nominal diameter low relaxation strands, with ultimate strength 270 ksi. Stirrups are #4, and were designed as 40 ksi steel in 17” and 21” box beam sections in order to meet lap length requirements. Recognizing that the availability of 40 ksi bars is limited, it is common practice to allow the use of 60 ksi bars in construction; however, such changes must be reviewed and approved by the design engineer.

Reactions are supplied on the plans to aid substructure design. Dead loads are given per beam, while live loads are given per AASHTO LRFD design lane. For a particular span and structure type, reactions represent the highest values of the different bridge widths shown in the plans. Caution must be used if referencing reaction values in the tables for beam lengths not corresponding to the span increments shown; in such cases, a more precise analysis is recommended.
Plan Use

Details presented in the plans may be used as a guide, or directly as a template for the bridge designer, where information applicable for the structure considered may be extracted as used if deemed appropriate. Much of the design information presented on the plans, such as some geometric dimensions and material properties, are constant values; these details were designed to be applicable throughout the range of structures considered. Other information is given as a variable which will depend on the specific structure considered and must be input by the designer. Many of the values for these variables may be read from tables given on the plans. However, as the information presented cannot cover all possibilities, modification may be necessary to meet the requirements of a particular site and structure.

Once a given structure type, span, skew, and width is selected, the specific information relevant to those selections can be extracted from the plans, and the remaining information discarded. To avoid confusion during construction, it is important that unused information does not appear on the construction drawings, and that other necessary information, such as that within the title of each sheet, is provided by the designer.

The sheet numbers that are needed for a particular bridge type can be found in the lower right of the sheet title block and are given in Table 2. Each structure is documented with 10-11 sheets, depending on type, as shown below.

Table 2. Sheet Numbers Per Bridge Type.

<table>
<thead>
<tr>
<th>Sheet Name</th>
<th>Steel</th>
<th>Spread Box</th>
<th>SBS Box</th>
<th>Bulb Tee</th>
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<td>Deck plan &amp; haunch detail</td>
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<td>DECK 001</td>
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*For steel, a deflection diagram is given in place of beam section & strand diagram.

Below, a list of information is provided summarizing what each plan sheet contains, which items are variable parameters that need input from the designer, and any additional explanatory notes. A set of plans where input parameters that are represented as variables are highlighted is given in Appendix A. As the plans also contain multiple selections of details and other generic diagrams not explicitly represented as variables, the highlighted items do not represent all items which must be removed, changed, or modified.

An example of a steel bridge design using the plans is given in Appendix B.
**DECK 001: Deck Plan**

This sheet is applicable to all structure types.

Contains: Deck plan, haunch detail.

Variable items: Span length (L), out-to-out bridge width (a), angle of crossing, fascia depth (F), haunch detail. Note that the bridge span length is measured between construction reference lines, which are typically taken from the back walls of the abutments; bridge span length is not the same as the beam span length, taken center to center of the bearings.

Select: Haunch detail (for concrete or steel beams), angle of crossing case, deck reinforcement case.

Notes: The left side of the deck plan applies to angles of crossing from 70-90°, while the right side applies to angles of crossing from 60-70°. Deck plan should be redrawn to appropriately match the required angle of crossing. Redraw north arrow direction to correspond to correct orientation.

**DECK 002: Abutment Backwall**

This sheet is applicable to all structure types except side by side box.

Contains: Abutment backwall elevation and section.

Variable items: Backwall width (D).

Select: Backwall type (spread box, steel beam, or bulb tee beam) and fixity (fixed or expansion).

Notes: Aesthetic parapet shown. Alternatives are possible as detailed in MDOT Standard Plan B-25 Series. For concrete girders spanning up to 50’ or steel girders spanning up to 25’, fixed abutments generally may be used. For longer girders, one abutment is generally taken as fixed while the other abutment is an expansion type.

**DECK 003: Approach Slab**

This sheet is applicable to all structure types.

Contains: plan and section of approach and sleeper slab.

Variable items: Approach slab width (a), angle of crossing.

Select: Plan and section type for approach slab and sleeper slab (HMA or concrete); angle of crossing case.
Notes: Details are limited to angles of crossing 60-90°. Bridge spans contributing to expansion at an abutment that are less than 50 ft for concrete beam bridges and less than 25 ft for steel beam bridges should refer to MDOT Standard Road Plan No. R-45-1. Approach slab plan should be redrawn to appropriately match the required angle of crossing.

**DECK 004: Barrier and End Wall**

This sheet is applicable to all structure types.

Contains: Barrier plan, end wall elevation and plan.

Variable items: Barrier length (L_B).

Select: Barrier plan (based on angle of crossing), end wall elevation (for side by side box beam or all other beam types).

Notes: Typical details for aesthetic parapet are shown. Alternatives are possible as detailed in MDOT Standard Plan B-25 Series. The left side of the deck plan applies to an angle of crossing of 90°, while the right side applies to angles of crossing from 60-89°. Barrier plan should be redrawn to appropriately match the required angle of crossing. Other options are possible. Post locations to be redrawn to match that needed.

**DECK 005: Bridge Section for Spread Box Beams**

This sheet is only applicable to a spread box beam bridge. Discard for other bridge types.

Contains: Bridge section, deck section, railing section, beam size and spacing table.

Variable items: Bridge span, out-to-out bridge width (a), clear roadway width (b), half of roadway clear width (c), number of beam bays (d), beam spacing (e), bridge width center-to-center of edge beams (f), beam size (g), center of edge beam to bridge fascia (h), edge of beam to edge of fascia (j).

Select: Bridge span, bridge width.

Notes: Based on a bridge span and width selection, the beam dimension table can be consulted to select an applicable beam size and beam spacing; variables a-j are specified in the selection tables. The selection table is for reference only and should not appear on the construction plans. Beam size and spacing selections may be used for spans less than or equal to the provided span increment. The section should be redrawn to match the beam size, spacing, and number of beams selected. Typical details for an aesthetic parapet are shown. Other options are possible.

**DECK 006: Bridge Section for Side by Side Box Beams**

This sheet is only applicable to a side by side box beam bridge. Discard for other bridge types.
Contains: Bridge section, deck section, railing section, beam size and spacing table.

Variable items: Bridge span, out-to-out bridge width (a), clear roadway width (b), half of roadway clear width (c), number of beams (d), beam width (e), bridge width center-to-center of edge beams (f), center of edge beam to bridge fascia (g), edge of beam to edge of fascia (h).

Select: Bridge span, bridge width.

Notes: Based on a bridge span and width selection, the beam dimension table can be consulted to select an applicable beam size and beam spacing; variables a-h are specified in the selection tables. The selection table is for reference only and should not appear on the construction plans. Beam size selection may be used for spans less than or equal to the provided span increment. The section should be redrawn to match the beam size, spacing, and number of beams selected. Typical details for an aesthetic parapet are shown. Other options are possible.

DECK 007: Bridge Section for Bulb Tee Girders

This sheet is only applicable to a bulb tee girder bridge. Discard for other bridge types.

Contains: Bridge section, deck section, railing section, beam size and spacing table.

Variable items: Bridge span, out-to-out bridge width (a), clear roadway width (b), half of roadway clear width (c), number of beam bays (d), beam spacing (e), bridge width center-to-center of edge beams (f), beam size (g), center of edge beam to bridge fascia (h), edge of beam to edge of fascia (i).

Select: Bridge span, bridge width.

Notes: Based on a bridge span and width selection, the beam dimension table can be consulted to select an applicable beam size and beam spacing; variables a-j are specified in the selection tables. The selection table is for reference only and should not appear on the construction plans. Beam size and spacing selections may be used for spans less than or equal to the provided span increment. The section should be redrawn to match the beam size, spacing, and number of beams selected. Typical details for an aesthetic parapet are shown. Other options are possible.

DECK 008: Bridge Section for Steel Beams

This sheet is only applicable to a steel beam bridge. Discard for other bridge types.

Contains: Bridge section, deck section, railing section, beam size and spacing table.

Variable items: Out-to-out bridge width (a), clear roadway width (b), half of roadway clear width (c), number of beam bays (d), beam spacing (e), bridge width center-to-center of edge beams (f), beam size (g), center of edge beam to bridge fascia (h).

Select: Bridge span, bridge width.
Notes: Based on a bridge span and width selection, the beam dimension table can be consulted to select an applicable beam size and beam spacing; variables a-h are specified in the selection tables. The selection table is for reference only and should not appear on the construction plans. Beam size and spacing selections may be used for spans less than or equal to the provided span increment. The section should be redrawn to match the beam size, spacing, and number of beams selected. Typical details for an aesthetic parapet are shown. Other options are possible.

**SBB 001: Erection Diagram for Spread Box Beams**

This sheet is only applicable to a spread box beam bridge. Discard for other bridge types.

Contains: Erection diagram, superstructure reactions, lifting device detail, strand detail table for lifting device.

Variable items: Bridge span (L), angle of crossing (θ), number of beam bays (d), beam spacing (e), bridge width center-to-center of edge beams (f), beam size (g), center of bearing to reference line (X), distance from center of nearest beams to bridge construction centerline (A, B), multiple values within notes, strand size and number for lifting device.

Select: Angle of crossing case, strand size and number for lifting device.

Notes: The left side of the erection plan applies to a 90° angle of crossing, while the right side applies to angles of crossing from 60° ≤ θ < 90°. Erection plans should be redrawn to appropriately match the number of beams and required angle of crossing. Reactions are given per beam for dead load and per lane for live load and are intended to be used to aid substructure design. Values given as:  are to be filled in by the designer.

**SBB 002: Shear Reinforcement for Spread Box Beams**

This sheet is only applicable to a spread box beam bridge. Discard for other bridge types.

Contains: Stirrup plan, slab tie plan, beam section, end block section, beam dimension table.

Variable items: Length of beam (W), number of stirrups near beam center (g), stirrup spacing near beam center (k), total length of stirrup region near beam center (h), number of stirrups in skew-to-normal transition zone (m), total length of stirrup region in skew-to-normal transition zone (n), number of slab ties (s), total length of slab tie region (u), angle of crossing (θ).

Select: Beam size, angle of crossing.

Notes: The left side of the stirrup and slab tie plan applies to a 90° angle of crossing, while the right side applies to angles of crossing from 60° ≤ θ < 90°. Once a spread box beam size is selected, the beam dimension table can be consulted to select appropriate stirrup spacing and slab tie input parameters g-W. The selection table is for reference only and should not appear on
the construction plans. The beam plan should be redrawn to appropriately match the angle of crossing.

**SBB 003: Spread Box Beam Sections**

This sheet is only applicable to a spread box beam bridge. Discard for other bridge types.

**Contains:** Spread box beam sections.

**Variable items:** Beam size, strand location and number.

**Select:** Beam cross-section.

**Notes:** The required beam section is selected on DECK 005. Then, SBB 004 is consulted to determine the required strand layout. Once the beam size and strand layout is known, the appropriate section can be redrawn with the correct number of strands and placement. Only the beam section(s) used should appear on the construction plans.

**SBB 004: Spread Box Beam Strand Layout**

This sheet is only applicable to a spread box beam bridge. Discard for other bridge types.

**Contains:** Strand layout and debonding table, corner blocking detail, beam end detail.

**Variable items:** Backwall thickness (D), angle of crossing (θ), strand layout and debonding, location of backwall inserts.

**Select:** Strand layout case (from table).

**Notes:** The strand/debonding table is consulted for the bridge span and beam size used. The table provides the number of strands per layer, the number of debonding strands, and the length of debonding. The debonding length is given in the format: (n₁)x₁, (n₂)x₂, ..., nᵢ(xᵢ), and/or [n₁]x₁, [n₂]x₂, ..., nᵢ[xᵢ], where nᵢ refers to the number of strands debonded and xᵢ is the debonding length (ft); ( ) refers to strands in the first layer while [ ] refers to strands in the second layer. The selection table is for reference only and should not appear on the construction plans.

**SSBB 001: Erection Diagram for Side by Side Box Beams**

This sheet is only applicable to a side by side box beam bridge. Discard for other bridge types.

**Contains:** Erection diagram, superstructure reactions, lifting device detail, strand detail table for lifting device, location of transverse post-tensioning strands.

**Variable items:** Bridge span (L), angle of crossing (θ), number of beams (d), beam size (e), bridge width edge to edge of exterior beams (f), center of bearing to reference line (X), distance
from center of nearest beams to bridge construction centerline (A, B), post-tensioning strand location, multiple values within notes, strand size and number for lifting device.

Select: Angle of crossing case, post tensioning strand locations, size and number for lifting device.

Notes: The left side of the erection plan applies to a 90° angle of crossing, while the right side applies to angles of crossing from $60^\circ \leq \theta < 90^\circ$. Erection plan should be redrawn to appropriately match the number of beams and required angle of crossing. Reactions are given per beam for dead load and per lane for live load and are intended to be used to aid substructure design. Values in the notes given as: [XX] are to be filled in by the designer.

**SSBB 002: Shear Reinforcement for Side by Side Box Beams**

This sheet is only applicable to a side by side box beam bridge. Discard for other bridge types.

Contains: Stirrup plan, slab tie plan, beam section, end block section, beam dimension table.

Variable items: Length of beam (W), number of stirrups near beam center (g), stirrup spacing near beam center (k), total length of stirrup region near beam center (h), number of stirrups in skew-to-normal transition zone (m), total length of stirrup region in skew-to-normal transition zone (n), number of slab ties (s), total length of slab tie region (u), angle of crossing (\(\theta\)).

Select: Beam size, angle of crossing.

Notes: The left side of the stirrup and slab tie plan applies to a 90° angle of crossing, while the right side applies to angles of crossing from $60^\circ \leq \theta < 90^\circ$. Once a spread box beam size is selected, the beam dimension table can be consulted to select appropriate stirrup spacing and slab tie input parameters g-W. Beam plan should be redrawn to appropriately match the angle of crossing. The selection table is for reference only and should not appear on the construction plans.

**SSBB 003 & SSBB 004: Side by Side Box Beam Sections**

These sheets are only applicable to a side by side box beam bridge. Discard for other bridge types.

Contains: Side by side box beam sections.

Variable items: Beam size, strand location and number.

Select: beam cross-section.

Notes: The required beam section is selected on DECK 6. Then, SSBB 005 is consulted to determine the required strand layout. Once the beam size and strand layout is known, the
appropriate section can be redrawn with the correct number of strands and placement. Only the beam section(s) used should appear on the construction plans.

**SSBB 005: Side by Side Box Beam Strand Layout**

This sheet is only applicable to a side by side box beam bridge. Discard for other bridge types.

**Contains:** Strand layout and debonding table, corner blocking detail, post-tensioning details.

**Variable items:** location of post-tensioning tendon (X), strand layout and debonding, angle of crossing (θ).

**Select:** Post tensioning detail.

**Notes:** The strand/debonding table is consulted for the bridge span and beam size used. The table provides the number of strands (all in one layer), the number of debonding strands, and the length of debonding. The debonding length is given in the format: \((n_1)x_1, (n_2)x_2, \ldots n_i(x_i)\), where \(n_i\) refers to the number of strands debonded and \(x_i\) is the debonding length (ft); The post tensioning detail (single or multiple duct) is to be selected based on the requirements determined from the tendon location tables on SSBB 001. Stress pocket and corner blocking details should be redrawn to appropriately match the angle of crossing.

**BTB 001: Erection Diagram for Bulb Tee Girder**

This sheet is only applicable to a bulb tee girder bridge. Discard for other bridge types.

**Contains:** Erection diagram, superstructure reactions, lifting device detail, strand detail table for lifting device.

**Variable items:** Bridge span (L), angle of crossing (θ), number of beam bays (d), beam spacing (e), bridge width center-to-center of edge beams (f), beam size (g), center of bearing to reference line (X), distance from center of nearest beams to bridge construction centerline (A, B), multiple values within notes, strand size and number for lifting device.

**Select:** Angle of crossing case, strand size and number for lifting device.

**Notes:** The left side of the erection plan applies to a 90° angle of crossing, while the right side applies to angles of crossing from 60° ≤ θ < 90°. Erection plan should be redrawn to appropriately match the number of beams and required angle of crossing. Reactions are given per beam for dead load and per lane for live load and are intended to be used to aid substructure design.

**BTB 002: Bulb Tee Girder Sections**

This sheet is only applicable to a bulb tee girder bridge. Discard for other bridge types.
Contains: Bulb tee girder sections, draped strand layout.

Variable items: number of EL05 bars near beam center (c), number of EA04 bars near beam center (c1), left end of beam to center of bearing (E), right end of beam to center of bearing (G), left end beam slope offset (L), right end beam slope offset (L'), left end of beam to pipe sleeves (M), right end of beam to pipe sleeves (N), position of strand hold down points (R), distance, center to center of bearings (T), number of EF03 bars near beam center (g), length of region of EF03 bars (U), vertical position of insert/sleeves (A, B), total beam length (Y).

Select: Beam cross-section.

Notes: The required beam section is selected on DECK 007. Then, BTB 003 is consulted to determine the required strand layout. Once the beam size and strand layout is known, the appropriate section can be redrawn with the correct number of strands and placement. The sole plate tilt table is to be filled in by the designer.

**BTB 003: Bulb Tee Girder Strand Layout and Diaphragms**

This sheet is only applicable to a bulb tee girder bridge. Discard for other bridge types.

Contains: Strand layout and debonding table, diaphragm details.

Variable items: strand layout and debonding, diaphragm support height (C), center-to-center distance of support bolt holes (B), angle of crossing (θ), vertical position of first (A) diaphragm support bolt.

Select: Diaphragm connection detail, diaphragm plan, concrete insert detail, diaphragm type.

Notes: The strand table is consulted for the bridge span and beam size used. The table provides the number of strands per layer, the number of strands, the number of draped strands, and the height of the draped strands. The draped strand height is given in the format: \( n_i, \ (m_i), \ [e_i] \); \( n_2, \ (m_2), \ [e_2] \); ... \( n_i, \ (m_i), \ [e_i] \), where \( i \) is the strand layer, \( n_i \) refers to the number of draped strands, \( (m_i) \) is the height of the strand at midspan, and \( [e_i] \) is the height of the strand at the beam end (inches). The diaphragm connection detail, plan, and concrete insert detail is selected based on skew angle (either \( \theta \leq 10^\circ \) or \( \theta > 10^\circ \)). Diaphragm shape type is either an angle (shown in Section A-A) or channel (shown in the Alternate Diaphragm detail). Either alternative diaphragm types may be used, at the preference of the contractor.

**STEEL 001: Erection Diagram for Steel Beam**

This sheet is only applicable to a steel beam bridge. Discard for other bridge types.

Contains: Erection diagram, superstructure reactions.

Variable items: Bridge span (L), beam span center-to-center of bearings (S), angle of crossing (θ), number of beam bays (d), beam spacing (e), bridge width center-to-center of edge beams (f),
beam size (g), center of bearing to reference line (X), distance from center of nearest beams to bridge construction centerline (A, B).

Select: Angle of crossing case.

Notes: The left side of the erection plan applies to a 90° angle of crossing, while the right side applies to angles of crossing from 60° ≤ θ < 90°. Erection plan should be redrawn to appropriately match the number of beams and required angle of crossing. Reactions are given per beam for dead load and per lane for live load and are intended to be used to aid substructure design. Quantity of structural steel is to be specified by the designer in the construction notes.

STEEL 002: Steel Beam Dimensions and Shear Studs

This sheet is only applicable to a steel beam bridge. Discard for other bridge types.

Contains: Beam elevation and shear stud plan and elevation details, beam dimensions table.

Variable items: Beam length (W), number of shear studs (a), total length of region with studs (b), number of spacings of beam end holes (c), spacing of beam end holes (d), total length of end holes (e), distance from beam end to center of bearing (f).

Select: Beam size, shear stud developer plan.

Notes: Girder size is selected based on bridge span, as given in the Beam dimension table. Shear stud details are selected based on beam size and angle of crossing (based on either a 90° angle of crossing or angles of crossing < 90°). Shear stud plan should be redrawn to appropriately match the required angle of crossing.

STEEL 003: Steel Beam Diaphragm

This sheet is only applicable to a steel beam bridge. Discard for other bridge types.

Contains: Diaphragm details, stiffener detail.

Variable items: Beam spacing (a), number of spaces between holes (# of holes -1) (b); vertical hole spacing (c); total distance between holes (d), diaphragm depth (e), angle of crossing (θ).

Select: Diaphragm size and type (typical, alternate, or both).

Notes: Diaphragm size and fastener hole locations are based on girder type, as given in the Diaphragm dimension table. Section and elevations should be redrawn to match the specified bridge geometry and diaphragm size.

STEEL 004: Deflection Diagram

This sheet is only applicable to a steel beam bridge. Discard for other bridge types.
Contains: Camber diagram, camber value tables.

Variable items: Number of ordinates (a), ordinate spacing (b), length of beam (c), camber values.

Select: Bridge span.

Notes: Based on bridge span, ordinate location and camber values are read from the Ordinate dimension and Theoretical camber tables.

**BRG 001: Box Beam Bearing Pads**

This sheet is only applicable to a box beam bridge. Discard for other bridge types.

Contains: Bearing plan, bearing section, bearing pad dimension table.

Variable items: Bearing pad width (W), bearing pad length (L), bearing pad thickness (J), number of shim plates (s), number of interior elastomer layers (n), interior elastomer layer thickness (t).

Select: Angle of crossing case, bearing type (fixed or expansion).

Notes: Based on bridge span, bearing pad parameters are read from the Bearing pad dimension table. Plan and section should be redrawn to match the specified beam width, angle of crossing, and bearing pad dimensions.

**BRG 002: Bulb Tee Bearing Pads**

This sheet is only applicable to a bulb tee bridge. Discard for other bridge types.

Contains: Bearing plan, bearing section, bearing pad dimension table.

Variable items: Bearing pad width (W), bearing pad length (L).

Select: --

Notes: Based on bridge span, bearing pad parameters are read from the Bearing pad dimension table. Plan and section should be redrawn to match the specified beam width and bearing pad dimensions.

**BRG 003: Steel Beam Bearing Pads**

This sheet is only applicable to a steel beam bridge. Discard for other bridge types.

Contains: Bearing pad and sole plate details, bearing pad dimension table.
Variable items: width of bearing pad (B), sold plate width (D), distance from retainer bolt to center of beam (E), length of bearing pad (G), length of sole plate (H), bearing pad thickness (J), number of shim plates (s), number of interior elastomer layers (n), interior elastomer layer thickness (t), height of side retainer (L), thickness of sole plate (N).

Select: Bearing type (expansion or fixed).

Notes: Based on bridge span, bearing pad parameters are read from the Bearing pad dimension table. Bearing type (expansion or fixed) should match the abutment type, as selected on DECK 002.

**EXPJT 001: Expansion Joints**

This sheet is applicable to all structure types.

Contains: Expansion joint plan and sections.

Variable items: --

Select: --

Notes: The designer must select an appropriate expansion joint type to accommodate the total bridge movement. These selections are not provided on this sheet.

Values in the table within the Notes section are to be filled in by the designer.
Appendix A: Highlighted Plans

The set of plans in Appendix A has all variable terms highlighted in yellow for identification.
**NOTES:**

- EL04 BARS: See Detail B
- END WALL ELEVATION: See detail for details.
- END WALL PLAN: See detail for details.
- Plan of Barrier
  - Angle of crossing less than 90°
    - (Aesthetic Parapet Tube)
  - Angle of crossing greater than or equal to 90°
    - (Aesthetic Parapet Tube)
- Plan of Barrier
  - Lap with EL06 BARS in box beam
- Plan of Barrier
  - Lap with EL04 BARS in box beam
- Plan of Barrier
  - Lap with EL04 BARS in box beam

**FINISH LINES:**

- 2'-11" Lap
- 5'-4" Lap
- 2'-8" Lap

**REFERENCES:**

- DECK SUPERSTRUCTURE DETAILS
- Section 004
- Date: 05/09/18
- Design Unit: DRAWING SHEET NO SCALE
- File: Deck_004.dgn
- Sheet: 04

**DETAIL B:**

- Place 2 additional EL04 BARS AT EACH RAILING POST AS SHOWN. ADJUST SPACING OF ADJACENT REINFORCEMENT IF NECESSARY.

**OTHER DETAILS:**

- CONC BOX BEAM
- SIDE BY SIDE BOX BEAM
- SPREAD BOX BEAM, BULB T BEAM, ROLLED STEEL BEAM

**ELEVATIONS:**

- END WALL ELEVATION
  - Dimensions: 1'-0" 2'-8" 5'-4" 8'-0"
FOR INFORMATION ONLY:

DECK CROSS SECTION IS SHOWN WITH BRIDGE RAILING AESTHETIC PARAPET TUBE. FOR SUPERELEVATED SECTIONS REFER TO MDOT DESIGN GUIDES FOR DETERMINING THE DISTANCE BETWEEN THE END BARS AND THE BEAM. DOES NOT EXCEED 1'-0".

DISTRIBUTION STEEL FOR BULB TEE BEAMS SHALL BE EQUALLY SPACED SUCH THAT THIS NOTE IS FOR INFORMATION ONLY AND SHOULD NOT BE INCLUDED ON OTHER RAILINGS ARE AVAILABLE. SEE MDOT BRIDGE DESIGN GUIDE.

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FOR INFORMATION ONLY

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THE CONCRETE SURFACE COATINGS APPLY THE COATING ACCORDING TO THE SPECIAL PROVISION. COAT THE ENTIRE OUTSIDE AND BOTTOM OF THE FASCIA BEAM USING A MATERIAL SELECTED FROM THE SPECIAL PROVISION. COAT THE ENTIRE OUTSIDE AND BOTTOM OF THE FASCIA BEAM USING A MATERIAL SELECTED FROM THE SPECIAL PROVISION. COAT THE ENTIRE OUTSIDE AND BOTTOM OF THE FASCIA BEAM USING A MATERIAL SELECTED FROM THE SPECIAL PROVISION.

ITEMS CAST INTO STRUCTURAL PRECAST CONCRETE TO FACILITATE BRIDGE CONSTRUCTION (FORMING, FINISHING, ETC.) SHALL BE GALVANIZED OR EPOXY COATED. ITEMS CAST INTO THE BEAMS TO FACILITATE BRIDGE CONSTRUCTION (FORMING, FINISHING, ETC.) SHALL BE GALVANIZED OR EPOXY COATED. ITEMS CAST INTO THE BEAMS TO FACILITATE BRIDGE CONSTRUCTION (FORMING, FINISHING, ETC.) SHALL BE GALVANIZED OR EPOXY COATED.

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**PRESTRESSED BEAM DETAILS**

**FILE:** 003

**prest_SBB_003.dgn**

### 17" X 36" OR 21" X 36" BEAM

- **Depth (Min):** 27" X 48" OR 33" X 48" (TYP)
- **Concrete Cover:** 2" (TYP)
- **Strand Diameter:** 8" (TYP)
- **Length:** 2" (TYP)

### 21" X 48" BEAM

- **Depth (Min):** 36" or 48" (TYP)
- **Concrete Cover:** 2" (TYP)
- **Strand Diameter:** 8" (TYP)
- **Length:** 2" (TYP)

### 27" X 48" OR 33" X 48" BEAM

- **Depth (Min):** 36" OR 21" X 36" (TYP)
- **Concrete Cover:** 2" (TYP)
- **Strand Diameter:** 8" (TYP)
- **Length:** 2" (TYP)

### 39" X 48" OR 48" X 48" BEAM

- **Depth (Min):** 48" (TYP)
- **Concrete Cover:** 2" (TYP)
- **Strand Diameter:** 8" (TYP)
- **Length:** 2" (TYP)

**NOTES:**

**Strand Information.** See debonding table on dwg "SBB 004" for strand information.
**PRESTRESSED BEAM DETAILS**

**SPREAD BOX BEAM**

**FILE:** prest_SBB_004.dgn

**PREVIOUS SHEET NO.** 004

**PREVIOUS SUBMITTAL DATE:** 05/09/18

---

**PLAN ELEV**

**EA04 BARS (TYP)**

**FOR THREADED É 1" Ø INSERTS**

**WITH É 1" Ø JOINT FILLER**

**BLOCK OUT BOTTOM OF BEAM É BEAM END OF BEAM**

**EA08 BARS (TYP)**

**FOR THREADED É 1" Ø INSERTS**

**WITH É 1" Ø JOINT FILLER**

**BLOCK OUT BOTTOM OF BEAM É BEAM END OF BEAM**

---

**PLAN ELEV**

**INSERT DETAIL @ BEAM END (EXPANSION ABUTMENT)**

**SEE DECK 002 FOR BACKWALL DETAILS**

**INSERT DETAIL @ BEAM END (FIXED ABUTMENT)**

**SEE DECK 002 FOR BACKWALL DETAILS**

---

**FOR INFORMATION ONLY:**

**NO SCALE**

**NOTE: USE CORNER BLOCKING DETAIL WHEN < 70°**

---

**TABLE: STRAND/DEBONDING LAYOUT**

<table>
<thead>
<tr>
<th>BEAM SPAN</th>
<th>BEAM DIMENSIONS</th>
<th>1ST LAYER 2&quot; PIN BOTTOM</th>
<th>2ND LAYER 2&quot; PIN BOTTOM</th>
<th>3RD LAYER 6&quot; PIN BOTTOM</th>
<th>TOTAL NO. OF STRANDS</th>
<th>NO. OF DEBONDING LENGTHS</th>
<th>STRAND DEBONDING LENGTHS (FT)</th>
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<tr>
<td>50</td>
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<td>12</td>
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<td>36</td>
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<tr>
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<td>36 21 12</td>
<td>12</td>
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<td>36</td>
<td>12</td>
<td>36</td>
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<tr>
<td>100</td>
<td>36 21 12</td>
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<tr>
<td>110</td>
<td>36 21 12</td>
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<td>36</td>
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<td>36</td>
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</tbody>
</table>

---

**NOTE:**

- **FOR INFORMATION ONLY:**
  - **BE INCLUDED ON THIS SHEET.**
  - **THE ABOVE NOTES ARE FOR INFORMATION ONLY AND SHOULD NOT BE INCLUDED ON THE FINAL DESIGN DRAWINGS.**

---

**PLAN ELEV**

**INSERT DETAIL @ BEAM END (EXPANSION ABUTMENT)**

**FOR INFORMATION ONLY:**

- **NO STRAND/DEBONDING LAYOUT TABLE**
- **NO SCALE**
- **NO DESIGN DRAWINGS**
- **SHOULD NOT BE INCLUDED ON THE FINAL DESIGN DRAWINGS.**

---

**NOTE:**

- **PLACE SPREAD BOX BEAM BACKWALL INSERTS AT 5" OR 7" UP FROM BOTTOM OF BEAM TO AVOID INTERFERENCE WITH STRANDS. (5" FOR 21" BEAMS) (7" FOR >21" BEAMS)**
- **PLACE SPREAD BOX BEAM BACKWALL INSERTS AT 3" OR 5" DOWN FROM TOP OF BEAM TO AVOID INTERFERENCE WITH STRANDS. (3" FOR 21" BEAMS) (5" FOR >21" BEAMS)**

---

**NOTE:**

- **THE ABOVE NOTES ARE FOR INFORMATION ONLY AND SHOULD NOT BE INCLUDED ON THE FINAL DESIGN DRAWINGS.**

---

**NOTE:**

- **NO STRAND/DEBONDING LAYOUT TABLE**
- **NO SCALE**
- **NO DESIGN DRAWINGS**
- **SHOULD NOT BE INCLUDED ON THE FINAL DESIGN DRAWINGS.**

---

**NOTE:**

- **PLACE SPREAD BOX BEAM BACKWALL INSERTS AT 5" OR 7" UP FROM BOTTOM OF BEAM TO AVOID INTERFERENCE WITH STRANDS. (5" FOR 21" BEAMS) (7" FOR >21" BEAMS)**
- **PLACE SPREAD BOX BEAM BACKWALL INSERTS AT 3" OR 5" DOWN FROM TOP OF BEAM TO AVOID INTERFERENCE WITH STRANDS. (3" FOR 21" BEAMS) (5" FOR >21" BEAMS)**

---

**NOTE:**

- **THE ABOVE NOTES ARE FOR INFORMATION ONLY AND SHOULD NOT BE INCLUDED ON THE FINAL DESIGN DRAWINGS.**
27" X 48" OR 33" X 48" BEAM (INTERIOR)

17" X 36" BEAM (INTERIOR)

17" X 36" BEAM (FASCIA)

21" X 48" BEAM (INTERIOR)

21" X 48" BEAM (FASCIA)

NOTES:

27" X 48" OR 33" X 48" BEAM (FASCIA)
39' X 48' BEAM (INTERIOR)

39' X 48' BEAM (FASCIA)

NOTES:
- STRAND INFORMATION.
- SEE DEBONDING TABLE ON DWG "SSBB 005" FOR
- USED (TYP)
- STRAND NOT
- IN CORNER IF
- PLACE A04 BAR
- DEPTH (MIN)
- EQUAL TO THE BEAM
- STRANDS FOR A LENGTH
- SHALL ENCLOSE
- AT ENDS, D05 BARS
- (TYP)
- 2"
- 8"
- ROW 2
- ROW 1
- 2 "
- 6 "
- (TYP)
- 2"
- 4"
- 1 '- 9 " MIN LAP
- 48"
- 6 "
- (TYP)
- 2"
- 4"
- 1 '- 6 " EMBED
- 2 2"
- 2"
- 2 "
- ED05 BARS
- 2 2"
- (TYP)
- HOLES AT ENDS
- É PREFORMED 2" Ø
- 3 EQ SPA - EA06 BARS
- 6 EQ SPA - EA04 BARS OR
- (TYP)
- 3"
- 9"
- PLACED UNDER STRANDS)
- IN CENTER (MAY BE
- ED05 BARS @ 12" MAX
- 3 9 "
- (TYP)
- (IF REQUIRED)
- CUT STRAND
- (IF REQUIRED) (TYP)
- "EA" BAR OR CUT STRAND
- SLAB TIE
- ED04 BAR
- 39" X 48" BEAM (INTERIOR)
- 39" X 48" BEAM (FASCIA)
**POST-TENSIONING DETAIL**

Note: Stress pockets, anchor plates, and tendon couplers shall be as required for the post-tensioning system provided. See Detail A for tendon coupler details.

**DIMENSION TABLE**

<table>
<thead>
<tr>
<th>Beam Depth (in)</th>
<th>x1</th>
<th>x2</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>2, 4</td>
</tr>
<tr>
<td>27</td>
<td>2, 4, 10</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>2, 4</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**STRAND/DEBONDING LAYOUT TABLE**

<table>
<thead>
<tr>
<th>Beam Span (ft)</th>
<th>FIRST LAYER DEPTH</th>
<th>SECOND LAYER DEPTH</th>
<th>TOTAL NO. OF STRANDS</th>
<th>NO. OF DEBONDING LAYERS</th>
<th>DEBONDING LENGTH (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>7</td>
<td>7</td>
<td>13</td>
<td>4</td>
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<td>7</td>
<td>7</td>
<td>13</td>
<td>4</td>
<td>14</td>
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</tr>
<tr>
<td>15</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>12</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>8</td>
<td>30</td>
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<td>8</td>
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<td>8</td>
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<td>8</td>
<td>25</td>
<td>25</td>
<td>50</td>
<td>8</td>
<td>50</td>
</tr>
</tbody>
</table>

**FILE:** prest_SBS_005.dgn

**PRESTRESSED BEAM DETAILS**

**SIDE BY SIDE BOX BEAM**

**005**

**DATE:** 05/09/18

**NOTE:** STRESS POCKETS, ANCHOR PLATES AND TENDON COUPLERS SHALL BE AFTER GROUT CURES (TYP) TYPE R-2 GROUT. REMOVE FORM AS REQ'D TO CONTAIN FASCIA BEAM POST-TENSIONING (TYP) FILL W/ TYPE H-1 MORTAR AFTER REQUIRED FOR POST-TENSIONING. PERPENDICULAR TO TENDONS AS STRESS POCKETS, PLACE 

**NO. OF DEBONDING DEBONDING LOCATION
dimensions
beam
bottom
1'-1"
8"
1'-1"
10"
8"
17"
17"
17"
17"
48"
48"
48"
48"
48"
48"
36"
36"
36"
36"
15"
15"
17"
9"
11"
3"
19"
19"
19"
19"
19"
20"
13"
9"
7"
7"
34"
34"
36"
28"
30"
20"
16"
9"
7"
7"
### Strand/Debonding Layout Table

<table>
<thead>
<tr>
<th>Beam Span (in)</th>
<th>Beam Dimensions</th>
<th>No. of Layers</th>
<th>No. of Strands</th>
<th>No. of Straps</th>
<th>Beam Spans (in)</th>
<th>Date (EB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>36 x 36</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>1'-9&quot;</td>
<td>05/09/18</td>
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<tr>
<td>92</td>
<td>42 x 42</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>1'-11&quot;</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>54 x 54</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>1'-14&quot;</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>66 x 66</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>1'-17&quot;</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- **BEAMS:** FASCIA BEAMS
- **INSERT (TYP):** FERRULE LOOP
- **CONNECTION DETAIL:** FORM 1" Ø HOLES IN WEB WITH PIPE SLEEVE, 2" Ø ELECTROPLATED CAP SCREW

### Dimension Table

<table>
<thead>
<tr>
<th>Beam Spans (in)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'-5&quot;</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
</tr>
<tr>
<td>1'-5&quot;</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
</tr>
<tr>
<td>1'-5&quot;</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
</tr>
<tr>
<td>1'-5&quot;</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
<td>2&quot; Ø ELECTROPLATED CAP SCREW</td>
</tr>
</tbody>
</table>

---

**Intermediate Diaphragm (D1) Elevation**

- **Connection Details:**
  - For a continuous line of Diaphragms
  - For a continuous line of Diaphragms

**Diaphragm Support**

- **Alternate Diaphragm**

**Plan for Skew Angle ≤ 10°**

**Plan for Skew Angle > 10°**

---

**Concrete Insert Details**

- **CONCRETE INSERT DETAILS:**
  - For a continuous line of Diaphragms
  - For a continuous line of Diaphragms

---

**Pre-Cast Beam Details**

- **Pre-Cast Beam Details:**
  - NO SCALE
  - NO SCALE
  - NO SCALE
  - NO SCALE
FOR INFORMATION ONLY:

THE DESIGN OF THESE STRUCTURES IS BASED ON 1.2 TIMES THE CURRENT SERVICE LOADS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE.

NO INTERMEDIATE DIAPHRAGMS REQUIRED FOR 20' SPANS.

PLACE DIAPHRAGMS PARALLEL TO REF LINES.

LENGTH.

DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF SPAN LENGTH.

THE CAMBER SHOWN IS TO BE MEASURED WITH THE BEAMS LYING ON THEIR SIDES. HEATING IS TO BE USED, IF NECESSARY, TO PROVIDE THE CAMBER WITHIN THE TOLERANCE SPECIFIED IN THE AWS SPECIFICATIONS. THE CAMBER SHOWN IS TO BE MEASURED WITH THE BEAMS LYING ON THEIR SIDES.

SHEAR DEVELOPERS SHALL BE \( \frac{1}{2} '' \) DIAMETER STUDS.

ALL HOLES SHALL BE \( \frac{1}{4} '' \) Ø FOR \( \frac{1}{2} '' \) Ø H.S. BOLTS.

FIELD CONNECTIONS SHALL BE BOLTED WITH \( \frac{1}{2} '' \) Ø HIGH STRENGTH BOLTS (EXCEPT AS NOTED).

FIELD CONNECTIONS SHALL BE BOLTED WITH \( \frac{1}{2} '' \) Ø HIGH STRENGTH BOLTS (EXCEPT AS NOTED).

DIAPHRAGMS (EXCEPT CONNECTION PLATES).

50W. AASHTO M270, GRADE 36, STEEL MAY BE USED IN LIEU OF THESE STEELS FOR THE STRUCTURAL STEEL SHALL CONFORM TO AASHTO M270, GRADE 50, OR AASHTO M270, GRADE 36, AS NOTED.

ALL STRUCTURAL STEEL SHALL BE HOT-DIPPED GALVANIZED ACCORDING TO THE STANDARD SPECIFICATIONS.

STRUCTURAL STEEL SHALL CONFORM TO ASHRAE NOTES. SHEAR WALLS, DIAPHRAGMS, AND CONCRETE SHEAR WALLS MAY BE USED IN LIEU OF THESE STEELS FOR THE SUPPORTING STRUCTURAL CONNECTING STEEL.

FIELD CONNECTIONS SHALL BE BOLTED WITH \( \frac{1}{2} '' \) Ø HIGH STRENGTH BOLTS (EXCEPT AS NOTED).
**Intermediate Diaphragm D1 Elevation**

*Note: All dimensions are based on actual bridge design.*

**Section A-A**

For angle of crossing 70° to 90°

**Section A-A**

For angle of crossing < 70°

---

### Diaphragm Dimension Table

<table>
<thead>
<tr>
<th>Beam Span (in)</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note 1: Stop weld 'b' short of corner clips.*

*Note 2: Wrap weld around outside edge.*

---

### Typical Intermediate Diaphragm

**Intermediate Transverse Stiffener Detail @ Crossframe**

Bolt holes not shown for clarity.

Note 3: Cracks in area of inner crossframe.

---

### Section A-A

For angle of crossing 70° to 90°

---

### Top Flange Clip Detail

Based on delivery and design geometry.

---

### Typical Intermediate Diaphragm

**Steel Structural Details**

*Note: All dimensions are based on actual bridge design.*

---

### Typical Intermediate Diaphragm
THEORETICAL CAMBER TABLE

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Spacing</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>W36 x 170</td>
<td>10</td>
<td>0.30</td>
<td>0.17</td>
<td>0.15</td>
<td>0.08</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>W30 x 173</td>
<td>10</td>
<td>0.56</td>
<td>0.33</td>
<td>0.28</td>
<td>0.15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>W24 x 117</td>
<td>10</td>
<td>0.76</td>
<td>0.45</td>
<td>0.39</td>
<td>0.20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>W21 x 93</td>
<td>10</td>
<td>0.90</td>
<td>0.52</td>
<td>0.46</td>
<td>0.24</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* CAMBER TABLE VALUES ONLY ACCOUNT FOR BEAM DEFLECTION DUE TO AEON WEIGHT, DECK & HAUNCH WEIGHT, DIAPHRAGMS AND SHEATHING ACCORDING TO THE VALUES SHOWN SME BEAM CAMBER VALUES ACCOUNT FOR THE ROADWAY PROFILE.
PRESTRESSED BULB-TEE BEAM BEARING DETAILS

PRESTRESSED BULB-TEE BEAM BEARING DETAILS

**NOTES:**

- DO NOT CONSTRUCT ANY ELASTOMERIC BEARINGS.
- ALL CONCRETE SHALL BE MIXED IN ACCORDANCE WITH AASHTO M 216. POSITION DOWELS ARE RECOMMENDED FOR PREVENTION OF CONCRETE BLOKING.
- ELASTOMERIC BEARINGS ARE INCLUDED IN PAYMENT FOR PRESTRESSED CONCRETE BEAMS.
- CONCRETE SHALL BE HOT-DIP GALVANIZED ACCORDING TO AASHTO M 252. POSITION DOWELS SHALL BE PLACED IN THE BASE OF THE BEARING TO Block OUT CONCRETE AT ELASTOMERIC BEARINGS.
- ELASTOMERIC BEARINGS ARE TYPED ALONG SIDES WITH 1" Ø HOLES AND 2" X 4" REINFORCEMENT WITHOUT INTERFERENCE TO HIGHEST ROW OF STRANDS.
- SHEAR STUDS SHOULD BE HEADED WITH 1" Ø HOLES AND 2" X 4" REINFORCEMENT WITHOUT INTERFERENCE TO HIGHEST ROW OF STRANDS.

**DIAMETER TABLE**

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Width</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>2-3/4&quot;</td>
<td>1-1/16&quot;</td>
</tr>
<tr>
<td>100</td>
<td>2-3/4&quot;</td>
<td>1-1/16&quot;</td>
</tr>
<tr>
<td>110</td>
<td>2-3/4&quot;</td>
<td>1-1/16&quot;</td>
</tr>
</tbody>
</table>

---

PLAN OF SOLE PLATE

PLAN OF ELASTOMERIC PAD

SECTION A-A

SECTION B-B

SECTION C-C
NOTES:

FOR INFORMATION ONLY:

ANCHOR BOLTS SHALL BE INSTALLED AFTER BEAMS ARE ERECTED IN PLACE.

ANCHOR BOLTS SHALL CONFORM TO SECTION 908.15.

TO MDOT STANDARD SPECIFICATION 707.03.C.16.

ANCHOR BOLT LENGTHS SHOWN ARE MINIMUM. BOLTS LONGER THAN THAT SHOWN MAY BE FURNISHED.

STEEL FOR SOLE PLATES AND OTHER BEARING COMPONENTS SHALL MEET THE REQUIREMENTS OF AASHTO M 111.

ELASTOMERIC BEARINGS FOR BEAM SPANS 20' AND 30' ARE PLAIN PADS WITH NO SHIMS PLATES.

FOR SINGLE SPAN STRUCTURES 25'-0" OR LESS IN LENGTH, ALLOWANCE FOR EXPANSION IS NOT REQUIRED.

ANCHOR BOLTS AND POSITION DOWELS SHALL BE GALVANIZED IN ACCORDANCE WITH AASHTO M 111.

USE NON-DEFORMED STEEL RODS IN ACCORDANCE WITH AASHTO M 270 GRADE 36.

ELASTOMERIC BEARING DETAILS - FIXED

SOLE PLATES ARE TO BE BEVELED WHEN THE CALCULATED BEVEL IS GREATER THAN 0.5%.

ELASTOMERIC BEARINGS FOR BEAM SPANS 20' AND 30' ARE PLAIN PADS WITH NO SHIMS PLATES.

THE ABOVE NOTES ARE FOR INFORMATION ONLY AND SHOULD NOT BE INCLUDED ON THIS SHEET.

THE ABOVE NOTES ARE FOR INFORMATION ONLY AND SHOULD NOT BE INCLUDED ON THE FINAL DESIGN DRAWINGS ONLY AND SHOULD NOT BE INCLUDED.

Diese Tabelle ist für Information und sollte nicht auf dieser Zeile enthalten werden.

Für militärische und andere Behörden kommen die folgenden Regeln zu:

1. Die Lagerplatten sind zu bevelen, wenn der berechnete Bevel größer als 0.5% ist.
2. Elastomerische Lager für Brückenabstände von 20' und 30' sind bloße Pads ohne Schiffsplatten.
3. Die hier erwähnten Anmerkungen sind nur für Information und sollten nicht auf der Zeichnung enthalten werden.

Die obigen Anmerkungen sind nur für Information und sollten nicht auf den finalen Entwurfzeichnungen enthalten werden.
**Plan at Flush Mount Parapet Railing**

**Section A-A**

**Section B-B**

**Notes:**

**Joint Type:**

The expansion joint device shall be of a type that includes a continuous seal across the deck. Details are drawn on the plans. The contractor shall consult the section of the standard specifications related to expansion joint devices for additional information.

**Manufacturer:**

<table>
<thead>
<tr>
<th>Device</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARD</td>
<td>WATSON-BOWMAN &amp; ACME, INC.</td>
</tr>
<tr>
<td>SOFT</td>
<td>STRUCTURAL PLUMBING PRODUCTS CO.</td>
</tr>
<tr>
<td>STEEL</td>
<td>D.S. BROWN</td>
</tr>
<tr>
<td>ONFLEX 40 SSA</td>
<td>STRUCTURAL RUBBER PRODUCTS CO.</td>
</tr>
<tr>
<td>ONFLEX 40 SS</td>
<td>STRUCTURAL RUBBER PRODUCTS CO.</td>
</tr>
<tr>
<td>STEELFLEX-SSCM</td>
<td>D.S. BROWN</td>
</tr>
<tr>
<td>STEELFLEX-SSA2</td>
<td>D.S. BROWN</td>
</tr>
<tr>
<td>WABO STRIP SEAL - TYPE A</td>
<td>WATSON-BOWMAN &amp; ACME, INC.</td>
</tr>
<tr>
<td>WABO STRIP SEAL - TYPE M</td>
<td>WATSON-BOWMAN &amp; ACME, INC.</td>
</tr>
</tbody>
</table>

**Notes:**

- The expansion joint device shall be of a type that includes a continuous seal across the deck. Details are drawn on the plans. The contractor shall consult the section of the standard specifications related to expansion joint devices for additional information.

- The expansion joint device shall be submitted for review in accordance with standard installation details. Approved standard installation details can be obtained from the design division.

**Examination and Installation:**

- The expansion joint shall be shop fabricated to conform to the contour of the bridge deck, soles, etc. It shall be installed in accordance with the plans and specifications subject to the approval of the engineer.

- The area at the bridge expansion and sealing head shall be kept free of debris and concrete dust. The top of the expansion joint device shall be set "" - "" below the bridge deck, soles, etc.

- The joint shall be spliced by an approved method (such as cold vulcanization) in the event that splicing is required of the sealing gland.

**Materials:**

- The cost of the materials and labor required for proper installation of the expansion joint device and the parapet railings in the parapet area are included in the price for the expansion joint device.

**For Information Only:**

- The above note is for information only and should not be included on this sheet.