BRIDGE ALTERNATIVE REPORT

Stinson Bridge and Roadway Improvements from Bristol Park to Bentwater Drive

City of Lucas

Prepared for:
City of Lucas

Prepared by:

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1. EXECUTIVE SUMMARY

Lakes Engineering, Inc. has prepared this Bridge Alternative Report (BAR) for the proposed Stinson Bridge and Roadway Improvements from Bristol Park to Bentwater Drive The intent of this report is to give the City of Lucas a comprehensive analysis of the different options and costs to replace Stinson Road crossing over Muddy Creek. It provides our recommendations of the best alternative that will deliver, to the City of Lucas residents, the most value, best economy, and least impact to the public for these improvements.

Stinson Road Culvert over Muddy Creek is located approximately 1 mile north of Parker Rd. This crossing is currently in a floodplain and below the flood elevation. Muddy Creek has historically frequently overtopped Stinson Road Culvert, which is comprised of a double-barrel steel pipe each with a 78-inch diameter opening. The aging culvert opening is not adequate for larger storm events, gets clogged with debris easily, and has caused closure of the road many times. This is a problem that the City must monitor after heavy rains and causes recurring maintenance. Flooding and overtopping of Stinson Road is a safety hazard for the residents and road users of the vicinity area. Replacing the culvert with a bridge that is above the flood elevation will provide adequate opening, which will resolve the clogging and overtopping issues and may lower the water surface elevations locally. Replacing the existing crossing with a new culvert and roadway above the flood elevation does not solve the clogging issue and could potentially raise the water surface elevations upstream if clogging occurred. For these reasons, a culvert replacement option was not evaluated. We have evaluated many bridge constructions types and materials in the development of this report, provide a comparison and recommend solutions.

This report identifies the project in terms of needs, purpose, and recommended solution. It also provides design criteria and parameters, description of bridge superstructure options, and evaluates the alternatives according to the following:

A. Horizontal/Vertical Alignments
B. Right-of-Way/Easement
C. Access Impact
D. Bridge Superstructure Options
E. Method of Construction
F. Cost

The major elements discussed above are summarized below:

A. Two (2) Horizontal Alignments are presented.
    - ***Horizontal Alignment 1***, Stinson Road Bridge over Muddy Creek will match existing horizontal alignment.
    - ***Horizontal Alignment 2***, Stinson Road Bridge over Muddy Creek will be <u>shifted to the east of the existing Stinson Road</u> alignment introducing curves before and after the bridge.

  Horizontal Alignment 2 is recommended due to benefits in method of construction, it may reduce speeding, and less impact to driveways.

B. Both Horizontal Alignments require right-of-way acquisition as most of the road is on prescriptive right-of-way.
    - Horizontal Alignment 1 will require a total of 47,518 square feet right-of-way acquisition from 8 parcels along Stinson Road.

- Horizontal Alignment 2 will require total of 55,240 square feet right-of-way acquisition from 7 parcels along Stinson Road.

C. Both Horizontal Alignments will need easement acquisition along the east side for future utilities or any relocation needed.

- Horizontal Alignment 1 will require total of 25,645 square feet easement acquisition from 9 parcels along Stinson Road.
- Horizontal Alignment 2 will require total of 28,440 square feet easement acquisition from 9 parcels along Stinson Road.

D. There is a total of nine (9) driveways within the project limits on Stinson Road that may be impacted. Two driveways nearest the crossing will be significantly impacted due to the necessary raise of existing elevation should Horizontal Alignment 1 be employed, and work on private property would be required. Horizontal Alignment 2 will have less impact to driveways.

E. Seven (7) bridge superstructure alternatives are presented for each alignment. We have found option 2 to be the most cost-effective superstructure option considered for the most beneficial alignment, Horizontal Alignment 2. Option 2 offers an overall cost-savings, construction schedule advantages, and the lowest vertical profile raise compared to the other options. Therefore, option 2 with Horizontal Alignment 2 is the most feasible and is the recommended bridge superstructure alternative. This recommended bridge has the following characteristics:

- 80ft single-span bridge with 0-degree skew,
- Six (6) TxDOT Prestressed Concrete Box Beams (5B28)
- 5in thick cast-in-place reinforced concrete deck.
- Aesthetics similar to the Blondy Jhune bridges.
- Vertical alignment associated with option 2/alignment 2 will raise the bridge 5 feet from the existing top of pavement and will have retaining walls northeast and southeast of the bridge.

F. The construction for Horizontal Alignment 1, which matches the existing alignment, would require complete road closure. For Horizontal Alignment 2, due to the offset to the east from the existing road, provides an opportunity for traffic access with at least one lane open for a majority of the project duration. Both alignments will provide a detour option for drivers to use Lewis Lane as an alternate route.

G. The recommended bridge superstructure alternative, option 2, is the most economical option for Horizontal Alignment 2.

2. INTRODUCTION

This Bridge Alternatives Report (BAR) is developed to define the parameters which affect the selection of the superstructure and substructure for the proposed bridge and provide alternatives. Issues addressed herein include geometric constraints, horizontal and vertical clearance requirements, utility conflicts, drainage issues, evaluation of span arrangements, evaluation of different superstructure and substructure alternatives, aesthetics, traffic control and construction sequencing and construction cost.

It is not the intent for this BAR to define the precise geometry of all structural elements, but rather to provide information in sufficient detail to fairly assess the relative impacts of the various alternatives and establish basic parameters needed to proceed to the final design phase.

2.1. Project Background

Stinson Road crosses Muddy Creek approximately 1 mile north of Parker Road and approximately 3 miles west of Lavon Lake within the City of Lucas located in Collin County, Texas. The existing culvert is comprised of a double-barrel steel pipe each with a 78-inch diameter opening and approximately 29.6 feet long with 3 feet of fill and an asphalt roadway on top. It is estimated that the culvert was constructed around 1980 with a timber headwall and was later reconstructed to a concrete headwall with the two-barrel steel pipe remaining in place. The culvert does not appear to have ever been rehabilitated since the reconstruction. The culvert has a roadway width of approximately 21 feet and carries two lanes of traffic with no shoulder width on either side.

Based on an inspection report performed by Lakes Engineering on June 26, 2019 (refer to Appendix B), the current condition of the culvert is structurally deficient and functionally obsolete with a sufficiency rating of 63 (rated by NBIS procedure). It is important to note that structurally deficient does not carry the meaning of structurally unsafe, at the time of this report. The field inspection found the following deficiencies:

- Marginal and substantial longitudinal cracking on the top of the asphalt roadway
- Asphalt pavement edge failure in all four corners
- Spalls and cracks on various locations on the headwalls and wingwalls
- Evidence of flooding
- Headwall 2 (downstream) is out of plumb
- 1-foot scour at outfall and exposed encased utility at headwall 2 (downstream) under culvert 2
- Scour/erosion at outlet of headwall 2 (downstream) above culvert 2 and loss of backfill
- Undermining of headwall 1 (upstream)
- Substandard railing type, height, openings and crashworthiness

The waterway opening appears to be inadequate. It is reported that Muddy Creek overtops Stinson Road multiple times a year, causing traffic delays and disruptions. A gate with a “ROAD FLOODED” sign is posted on each approach of the culvert that is closed by the City of Lucas when overtopping occurs.

Existing condition photos are shown below.

Approach- Looking North

Approach - Looking South

Downstream Headwall

Upstream Headwall

Downstream – During A Storm Event

Upstream – During A Storm Event

2.2. Project Objective

The intent of this project is to address the existing and future operational and safety conditions of Stinson Road culvert over Muddy Creek. Because the age and current condition, the project proposes to replace the culvert with a new structure that is sufficiently durable and resilient to environmental effects and flooding. The structure must be sustainable, minimize maintenance requirements and provide a safe and rideable corridor for the traveling public.

The project will involve the construction of a new bridge to carry Stinson Road over Muddy Creek located in the City of Lucas, Collin County, Texas. See **Figure 1 – Project Location Map.**

Figure 1 – Project Location Map

3. GEOMETRIC DESIGN

3.1. Geometric Criteria

Stinson Road is a low-speed, local road. It is classified as a low-speed, major collector and is under the jurisdiction of the City of Lucas. Stinson Road has a posted speed limit of 40 mph. Stinson road narrows at the culvert over Muddy Creek and has an advisory speed of 15 mph.

Roadway Design Parameters

- Functional Classification: Rural/Major Collector
- Design Speed: 45 mph
- Minimum Travel Lane Width: 11 ft

Design Specifications

- American Association of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highways and Streets "The Green Book" (2018), 7th Edition with latest Interim Revisions
- Texas Manual on Uniform Traffic Control Devices (October 2014)
- TxDOT Roadway Design Manual (April 2018)
- TxDOT Hydraulic Design Manual (September 2019)
- TxDOT Environmental Handbook (November 2019)
- TxDOT Bridge Project Development Manual (March 2018)

Horizontal Clearance (waterway)

In accordance with the TxDOT Bridge Project Development Manual, Chapter 3, Section 1, bridges over water shall have substructure supports located within the horizontal clearance requirements as follows:

- A maximum of 2:1 embankment slope in a direction normal to the abutment cap.
- Side slopes should be normal to the roadway and no steeper than 3:1.
- Use stone riprap (preferred) or concrete riprap under the bridge and wrap around the abutment.

Embankment slope and stone riprap will be considered for the proposed bridge evaluation.

Vertical Clearance

According to Federal Emergency Management Agency (FEMA), the Base Flood Elevation (BFE), which is the current flood elevation, is at EL. 568.73. Based on TxDOT Hydraulic Design Manual a minimum 2'-0" freeboard, additional clearance above the flood elevation, is required. In order to prevent Stinson Road from future flooding, providing a minimum 2'-0" above the BFE should be provided. The minimum Low Member Elevation (bottom of the bearing pad) shall equal or exceed the BFE EL. 570.73. However, by replacing the culvert with a bridge, the current flood elevation is expected to be lower. An in-depth Hydrology and Hydraulic study shall be performed in the design process.

The intent of the design is to provide the minimum vertical clearance. This is proposed to be achieved by a combination of minimization of the proposed structure depth and raising the vertical profile.

3.2. Horizontal and Vertical Alignment

Horizontal Alignment

The existing horizontal alignment of Stinson Road, within the limits of the culvert over the Muddy Creek is on a tangent segment. Two alternatives are presented for the proposed alignment.

Horizontal Alignment 1:

Proposed alternative horizontal alignment 1, Stinson Road Bridge over Muddy Creek will match existing horizontal alignment.

Horizontal Alignment 1 is shown in **Figure 2 – Horizontal Alignment 1** below.

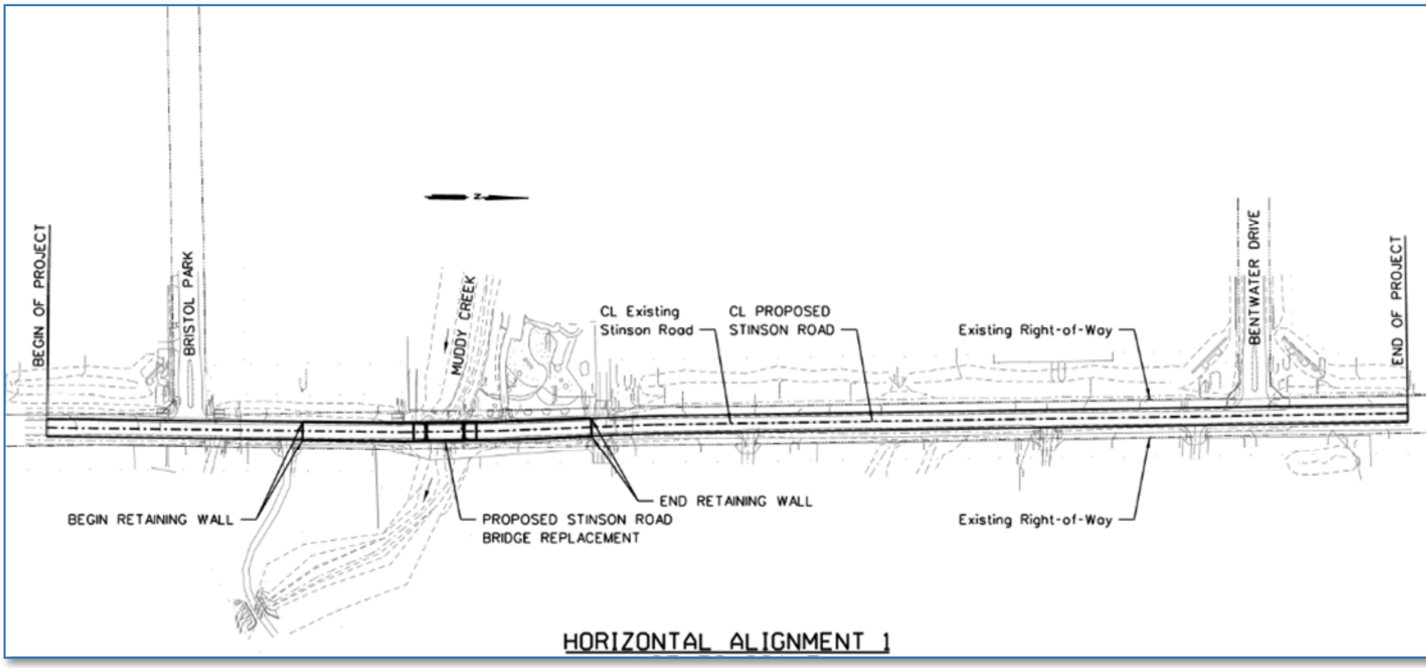


Figure 2 - Horizontal Alignment 1

Horizontal Alignment 2:

Proposed horizontal alignment 2, Stinson Road bridge over Muddy Creek will be shifted to the east of the existing Stinson Road alignment introducing curves before and after the bridge.

Horizontal Alignment 2 is shown in **Figure 3 – Horizontal Alignment 2** below.

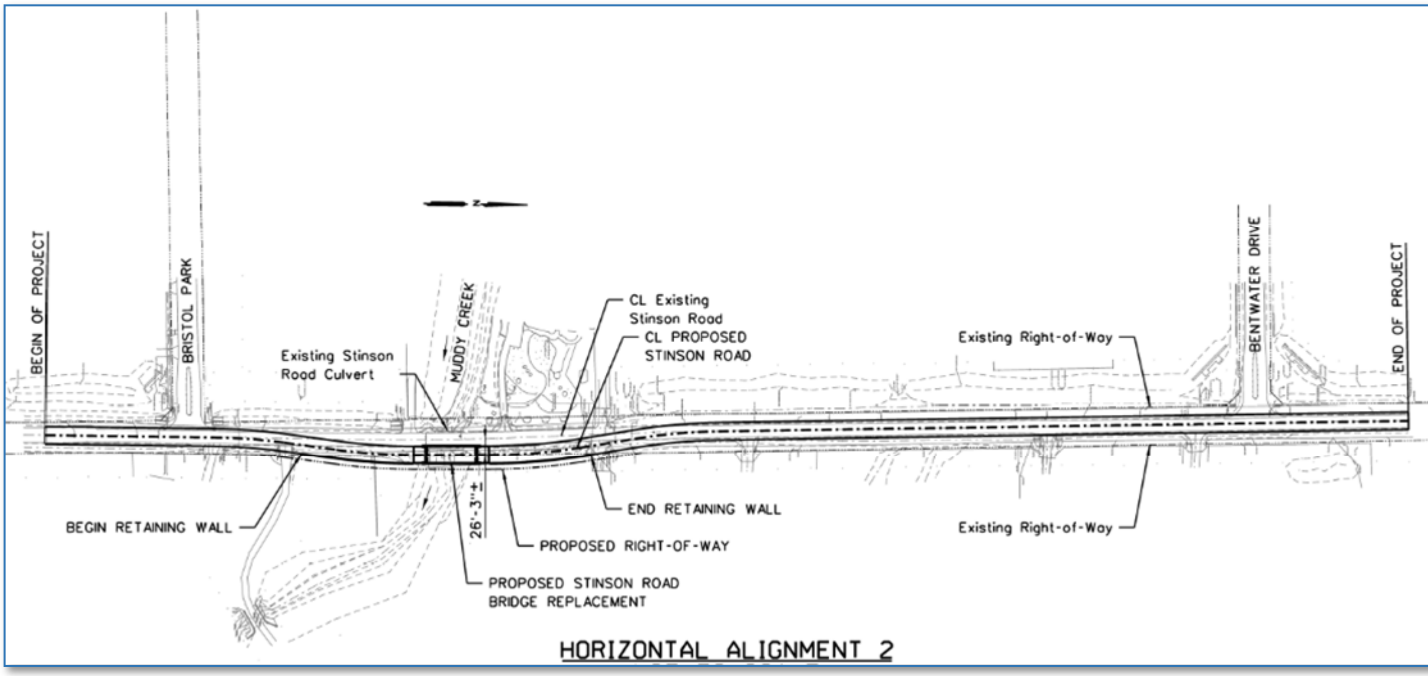


Figure 3 - Horizontal Alignment 2

Recommendation

The advantages of Horizontal Alignment 2 over Horizontal Alignment 1 are listed below.

- Allows construction in phases and at least one lane open to traffic
- Curvature may help reduce speeding along Stinson Road
- Less impact to driveways
- Minimize costs by reducing the length of retaining walls

The disadvantages of Horizontal Alignment 2 over Horizontal Alignment 1 are listed below.

- Requires Right-of-Way acquisition from 3 parcels on the east side of Stinson Road
- Longer bridge span
- Limited shallow superstructure types
- 11.5" higher profile due to deeper superstructure section
- Higher cost compared to Decked Slab Beams recommended for Horizontal Alignment 1

Horizontal Alignment 2 requires right-of-way acquisition and increased span length. A significant key advantage of the Horizontal Alignment 2 is that it offers added safety to the traveling to the public and residents along Stinson Road by encouraging reduced speed. Many advantages are realized by Horizontal Alignment 2 as presented above. The recommended proposed alignment is Horizontal Alignment 2.

Vertical Alignment/Profile
Muddy Creek has historically frequently overtopped Stinson Road. Raising the top of the road to be above the designated flood elevation is recommended. It is also recommended that the low member elevation should be a minimum of 2'-0" above the current flood elevations. Several bridge superstructure alternatives (see section 5.4) were evaluated with the intent to minimize raising the vertical profile, which reduce the limits of the project, impact to property driveway access, and additional roadway embankment.

3.3. Right-of-Way

The City of Lucas has established a 50 feet prescriptive right-of-way being 25 feet offset each side of the existing centerline of the road. There are one (1) parcel on the west and five (5) parcels on the east of Stinson Road that have a 25 feet prescriptive right-of-way from the centerline of Stinson Road within the project limits. There are six (6) parcels that have a 30 feet permanent right-of-way and one (1) parcel that have a 20 feet permanent right-of-way on the west of Stinson Road from the centerline of Stinson Road within the project limits. Also, there are three (3) parcels that have a 30 feet permanent right-of-way on the east of Stinson Road from the centerline of Stinson Road within the project limits. Both Horizontal Alignment 1 and 2 will require right-of-way acquisition from a total of eight (8) and nine (9) parcels, respectively, see Appendix A for reference. Therefore, the proposed right-of-way acquisition will be a 25 feet offset from the centerline of Stinson Road each side. The proposed improvements will be within the acquired right-of-way.

3.4. Easement

The City of Lucas has established a 20 feet water/utility easement offset from the existing right-of-way on both sides of Stinson Road. There are eight (8) parcels on the west and two (2) parcels on the east of Stinson Road that have a 20 feet water/utility easement from the right-of-way of Stinson Road within the project limits. There are two (2) parcels on the east of Stinson Road that have a 10 feet water/utility easement from the right-of-way of Stinson Road within the project limits. Also, there is one (1) parcel on the west of Stinson Road that does not have a water/utility easement. Both Horizontal Alignment 1 and 2 will require easement acquisition from a total of nine (9) parcels, see Appendix A for reference. Therefore, the proposed easement acquisition matches the typical 20 feet offset.

3.5. Access Impact

There is a total of nine (9) driveways within the project limits on Stinson Road that may be impacted. For Horizontal Alignment 1, two driveways will be significantly impacted due to the proposed profile raise. The driveway just south of the proposed bridge and west of Stinson Road where there is an existing concrete culvert that was recently constructed will need approximately 50 feet in length from the edge of the pavement to tie into the existing ground. And the driveway just north of the bridge and west of Stinson Road will need approximately 40 feet in length from the edge of the pavement to tie into the existing ground. Both driveways will require work to be perform on the owners' properties. However, Horizontal Alignment 2 will be less of an impact to the driveways compared with Horizontal Alignment 1. Access must be provided for all property owners during the duration of construction. Temporary driveways may be required.

4. STRUCTURAL DESIGN CRITERIA

4.1. Specifications

The design of the structural elements of this project shall be in full compliance with AASHTO and TxDOT Bridge Design Manual - LRFD. The structure shall be designed in accordance with the TxDOT standard practices and procedures. The design shall comply with the latest edition of the following design specifications:

General Specifications:

- Texas Department of Transportation (TxDOT) Standard Specifications for Construction and Maintenance of Highways, Streets and Bridge, 2014

Design Standards and Specifications:

- American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications (2017), 8th Edition with latest Interim Revisions
- TxDOT Bridge Project Development Manual (March 2018)
- TxDOT Bridge Design Manual - LRFD (July 2018)
- TxDOT Bridge Railing Manual (September 2019)
- TxDOT Bridge Standard Drawings

Design Methodology

All structural components shall be designed in accordance with Load and Resistance Factor (LRFD) design methodology. The design life for bridge structures is 75 years per AASHTO LRFD and TxDOT design criteria.

4.2. Bridge Loading

The following design loads were utilized in the evaluation of the superstructure and substructure alternatives:

Dead Loads:

Unit weights in accordance with the TxDOT Standards and the AASHTO LRFD Bridge Design Specifications were utilized.

Concrete, Structural .... 150 pcf
Asphalt Concrete Pavement Overlay .... 150 pcf (Applicable to prestressed slab unit alternative)
Future Wearing Surface .... 25 psf

Soil, Compacted .... 120 pcf

Vertical-Faced Concrete Parapet .... 270 plf (TxDOT Traffic Railing Type T411)

Bridge Deck Sacrificial Thickness ....½ in. (½" sacrificial deck thickness for grinding and grooving was accounted for as dead load but was not utilized for bridge deck section properties).

Live Loads
Vehicular Loading: HL-93

Wind Loads
Wind loads will be calculated in accordance with AASHTO LRFD Bridge Design Specifications.

Vessel Collision
Not applicable.

Seismic Criteria
According to TxDOT Bridge Design Manual, bridges and structure in Texas do not require analysis for seismic loading due to the low seismic hazard as shown in AASHTO Article 3.10.2. TxDOT Bridge Standards and conventional bridge configurations have been evaluated for seismic effects and do not require further analysis.

4.3. Environmental Classification

Non-Severe: De-icing agents are not frequently used and contact with salt-water spray is not possible.

4.4. Materials

The following material properties shall be utilized in the design of the structures:

Concrete
Concrete shall be specified in accordance with TxDOT Standard Specifications.

Class	Minimum 28-day Compressive Strength (psi)	Location
Superstructure		
C (HPC if needed)	3,600	Traffic Railings
S (HPC if needed)	4,000	Decks and Approach Slabs,
H (HPC if needed)	5,500	Prestressed Deck Slab Units
Substructure		
C	3,600	Abutments, Bent and Wingwalls
C (Drilled Shaft)	3,600	Drilled Shafts
C (Driven Pile)	3,600	Driven Piles

Reinforcing Steel
Reinforcement shall be ASTM A615, Grade 60 deformed carbon-steel bar. All superstructure reinforcement shall be epoxy coated or galvanized.

Prestressing Steel

Prestressing strands shall conform to ASTM A416, Grade 270, low-relaxation strands. Stress-relieved strands will not be used.

4.5. Permit

The following regulatory and permitting agencies may have interest and/or jurisdiction requiring permits to perform the proposed bridge replacement:

- City of Lucas
- Texas Commission on Environmental Quality (TCEQ)
- United States Environmental Protection Agency (EPA)
- Federal Emergency Management Agency (FEMA)

4.6. Aesthetics

The proposed bridge will not have any non-standard aesthetic requirements. As reference, the bridge aesthetics will be similar to the Blondy Jhune bridges.

4.7. Utilities

Based on field surveying performed by Surveying and Mapping, LLC (SAM) in March 2020, existing overhead and underground utilities were noted at various locations. Further investigation will need to be conducted as the project progresses to identify the exact facility locations. The following companies operate within the project limits:

- City of Lucas Public Utilities – 12” water line located along the west side of Stinson Road and 8" sanitary sewer force main located along the east side of Stinson Road.
- North Texas Municipal Water District (NTMWD) Water – 42” water line located along the west side of Stinson Road.
- Oncor Electric – Aerial facilities on the west and east side of Stinson Road.
- CoServ Gas – 8” gas main near the beginning of project limit at Bristol Park.
- Frontier Fiber – Underground facilities located along the west and east side of Stinson Road.

There are five (5) Utility Agency Owners (UAO) with facilities within the project limits and additional utility coordination will be performed in preliminary and final design phases. The table below lists utility agency owners, utility contact data, and potential for required relocations.

Existing Utilities					
	Utility Agency Owner	Facilities	Contact Person	Phone	Relocation Potential
1	City of Lucas	Water	Jeremy Bogle	469-628-8586	Y
2	North Texas Municipal Water District (NTMWD)	Water	Ray Sikes	469-626-4569	N
3	Oncor	Electric	Chris Dulaney	972-569-1294	Y
4	CoServ	Gas	Shawn Mead	214-458-7851	N
5	Frontier	Fiber	David Lemons	972-578-3212	Y

Bridge Mounted Utilities
The existing culvert structure does not carry any utilities. No utilities are proposed for attachment to the bridge. It is recommended that conduit be placed in each bridge railing for future use of utility passthrough.

Overhead Utilities
Shared-use utility poles run longitudinally near the west and east fascia of the bridge, carrying likely electrical, and telephone/cable.

Construction activities will need to address temporary support or relocation of these utilities.

5. BRIDGE ALTERNATIVES

5.1. Span Arrangement Alternatives

An approximate minimum overall bridge length of 60’-0” for Horizontal Alignment 1 and 80’-0” for Horizontal Alignment 2 are required to span over Muddy Creek. This would locate the begin and end bridge outside of the Muddy Creek limits and would provide a 2H:1V slope embankment at each abutment. The proposed abutments would be placed approximately at the edge of Muddy Creek top embankment to minimize future scour potential. The proposed bridge replacement structure must comply with the vertical clearance requirement discussed in Section 3 above.

Single-Span Bridge Option
A single-span bridge option is considered for the culvert structure replacement to maximize the bridge opening for optimum hydraulics. This option is less likely to minimize vertical profile raise; however, it offers the most cost-effective option by minimizing substructure costs. As such, this option appears to be the most feasible.

The proposed Plan for Horizontal Alignment 1 is shown in **Figure 4 – Plan View** below.

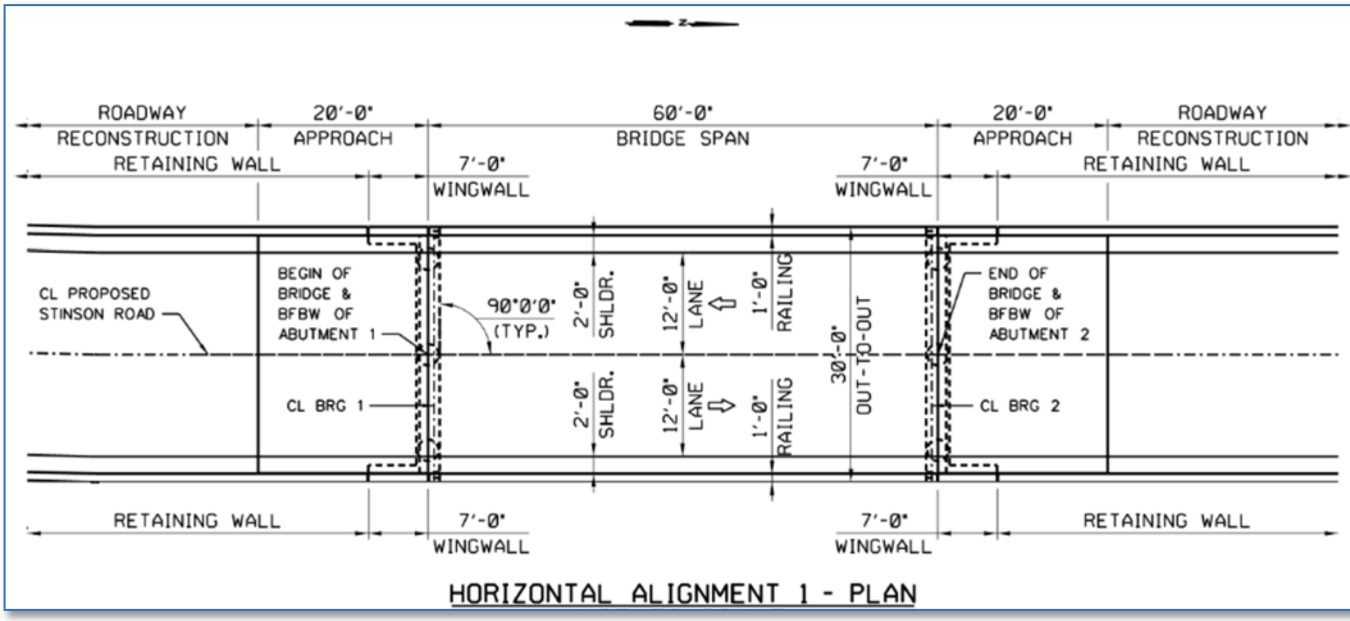


Figure 4 **- Bridge Plan (Alignment 1)**

The proposed Elevation for Horizontal Alignment 1 is shown in **Figure 5 – Elevation View** below.

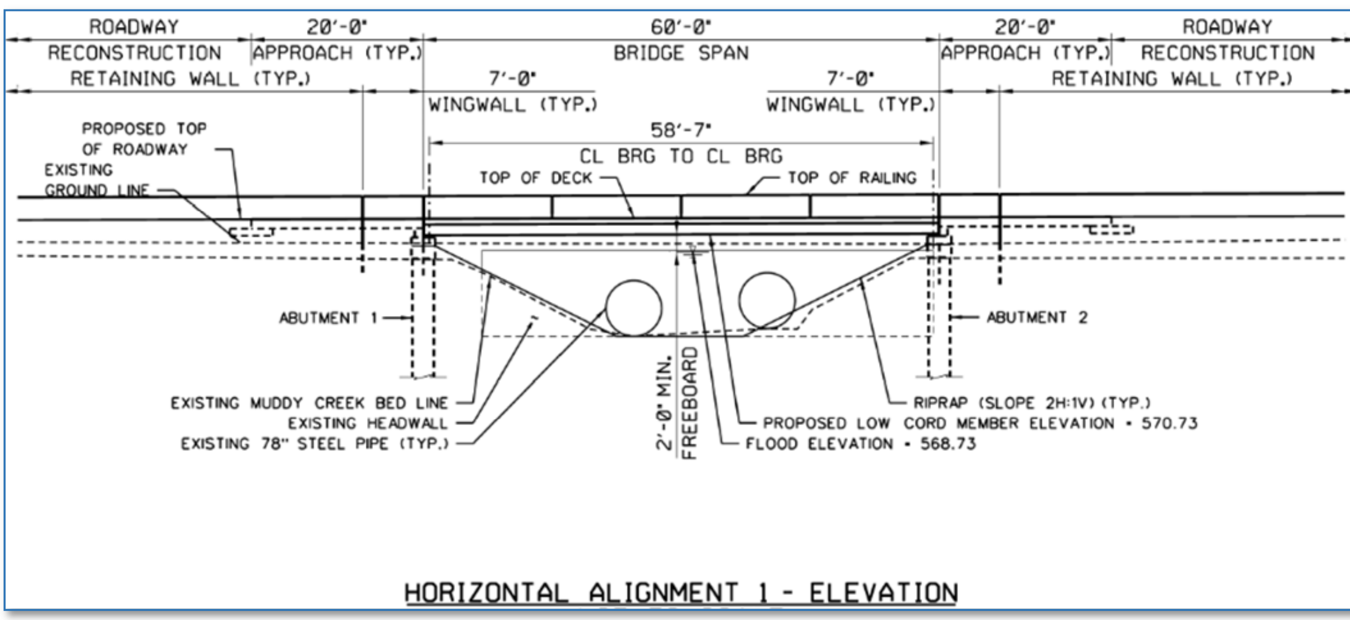


Figure 5 - Bridge Elevation (Alignment 1)

The proposed Plan for Horizontal Alignment 2 is shown in **Figure 6 – Plan View** below.

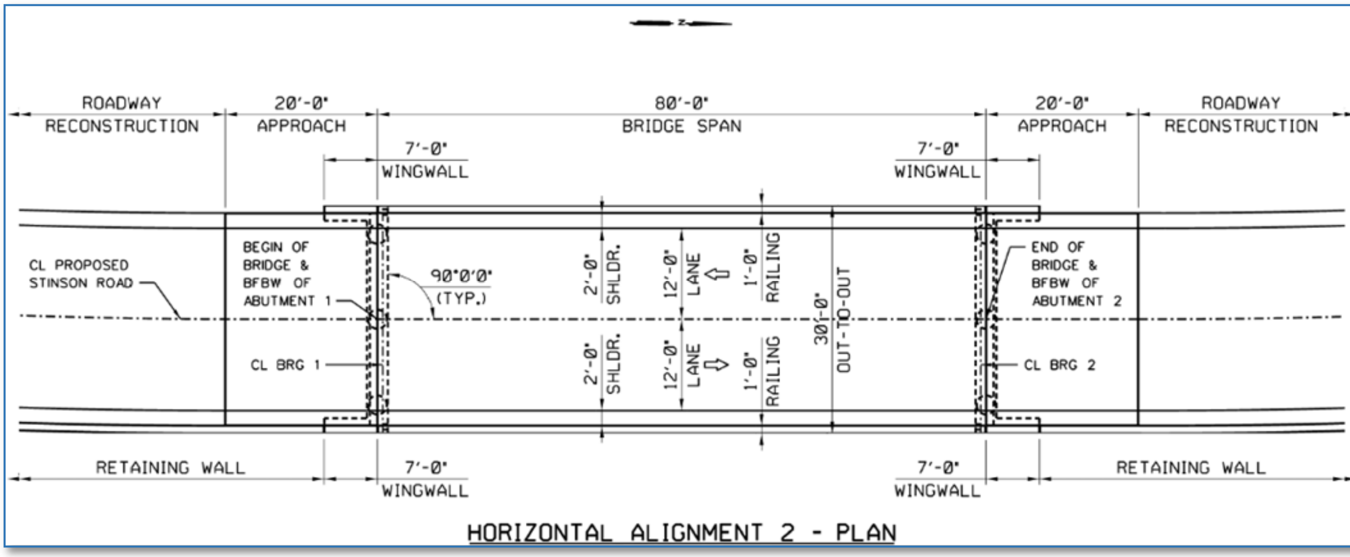


Figure 6 - Bridge Plan (Alignment 2)

The proposed Elevation for Horizontal Alignment 2 is shown in **Figure 7 – Elevation View** below.

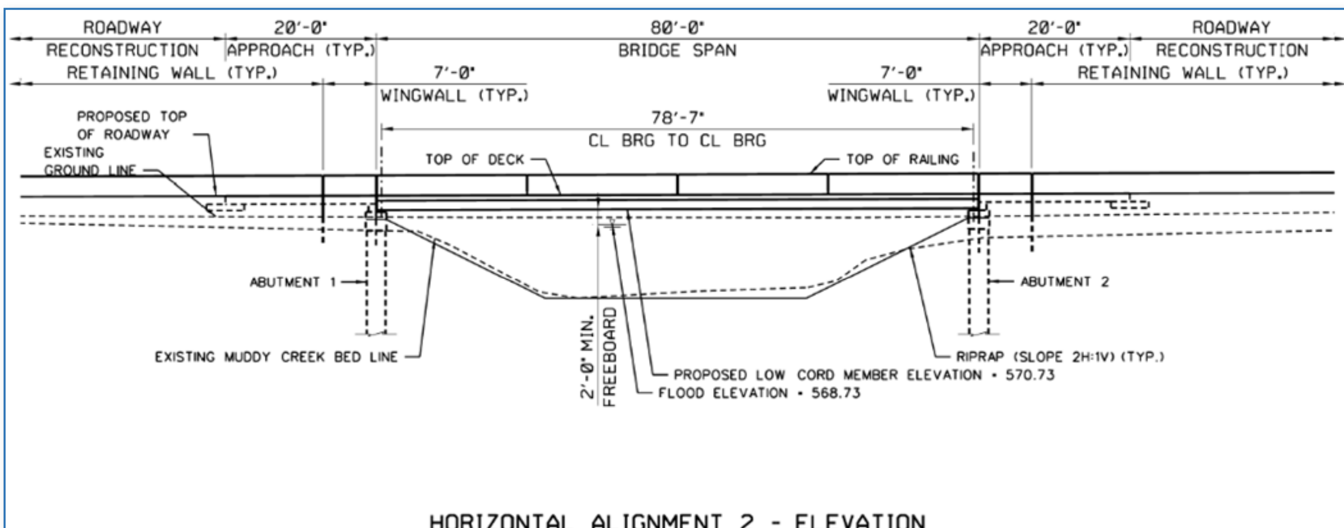


Figure 7 - Bridge Elevation (Alignment 2)

Two-Span Bridge Option

A two-span bridge is another option to minimize vertical profile raise; however, this option is less feasible as it would locate an intermediate bent in the middle of the Muddy Creek's, which would require additional future maintenance, introduces high scour potential, and impedes the hydraulic opening. Having an intermediate bent increases the overall construction cost above a similar length single-span bridge in this particular situation and is not considered economical. As such, a two-span bridge was not further evaluated.

Three-Span Bridge Option
A three-span bridge is another option to minimize vertical profile raise; however, this option is not feasible as it would locate two intermediate bents near the edge of the Muddy Creek's embankments, which increase the negative impacts mentioned above in the two-span option. As such, a three-span bridge was not further evaluated.

Recommendation
A single-span bridge configuration is recommended for the replacement structure.

5.2. Bridge Skew

Muddy Creek is perpendicular to Stinson Road; therefore, the bridge will have a 0-degree skew.

5.3. Typical Section

The existing roadway approach typical sections have two (2) approximately 11 ft paved asphalt travel lanes and no shoulders on either side. The roadway narrows over the Muddy Creek culvert crossing. The existing typical section of Stinson Road at the Muddy Creek culvert has two (2) approximately 10'-6" asphalt paved travel lanes, various unpaved shoulders on either side and a substandard black iron fence railing with a flood gate attached.

The existing typical section of Stinson Road at Muddy Creek is shown in **Figure 8 – Existing Typical Section** below.

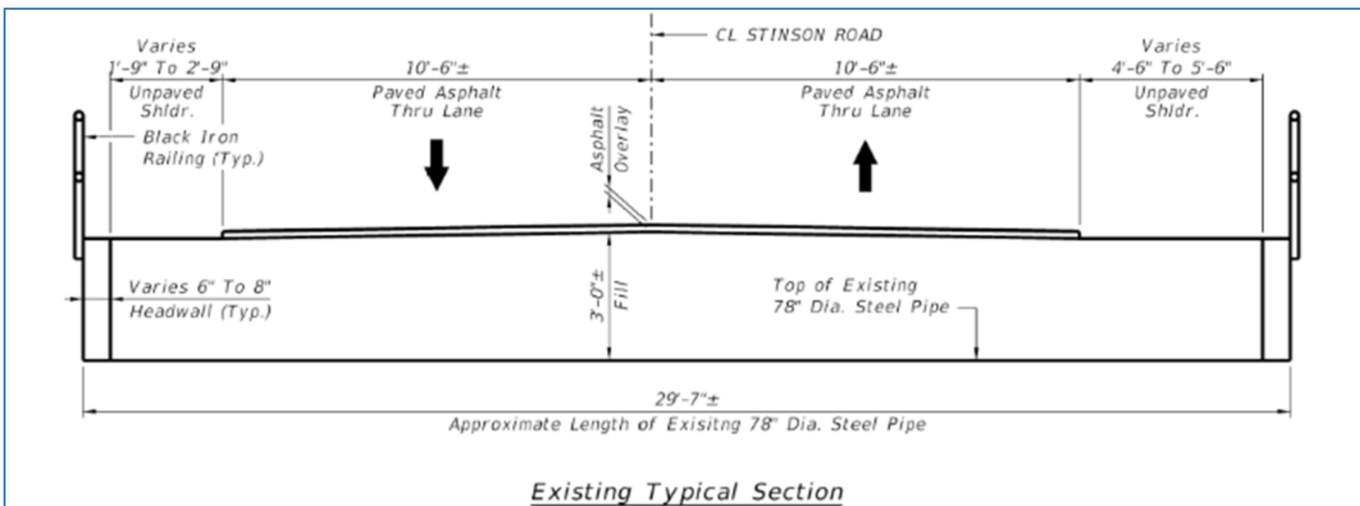


Figure 8 - Stinson Rd Typical Section at Muddy Creek

Stinson Road was recently reconstructed south of this project's limits. To provide a consistent corridor, it is recommended to match the roadway typical section for Stinson Road Bridge over Muddy Creek. The proposed roadway typical section provides two (2) 12'-0" travel lanes and a 2'-0" unpaved shoulder in each direction. Travel lanes and shoulders provide a cross-slope of 0.02 ft/ft and 0.06 ft/ft, respectively. The proposed bridge typical section provides two (2) 12'-0" travel lanes and a 2'-0" shoulder in each direction. Travel lanes and shoulders provide a constant cross-slope of 0.02 ft/ft. Based on TxDOT Bridge Railing Manual (September 2019), 45 mph or less is considered as low speed and a bridge railing that is a minimum Test Level 2 (TL-2) is required. There are three (3) types of bridge railings that have a minimum TL-2 rating, such as T631LS, T411, and C411. There are no sidewalks present on Stinson Road, therefore, type C411 is not suitable. Type T631LS is a w-beam supported on steel posts and needs to be replaced after an impact. Type T411 is a continuous concrete railing that has 6" wide windows spaced every 18", center to center, with a nominal 2'-8" height and 1'-0' width. The recommended bridge railing is type T411. Type T411 is less likely to require replacement after impact and offers better aesthetics, Texas Classic, over type T631LS. The proposed bridge typical section will have an out-to-out bridge width of 30'-0".

The proposed bridge typical section is shown in **Figure 9 – Proposed Bridge Typical Section** below.

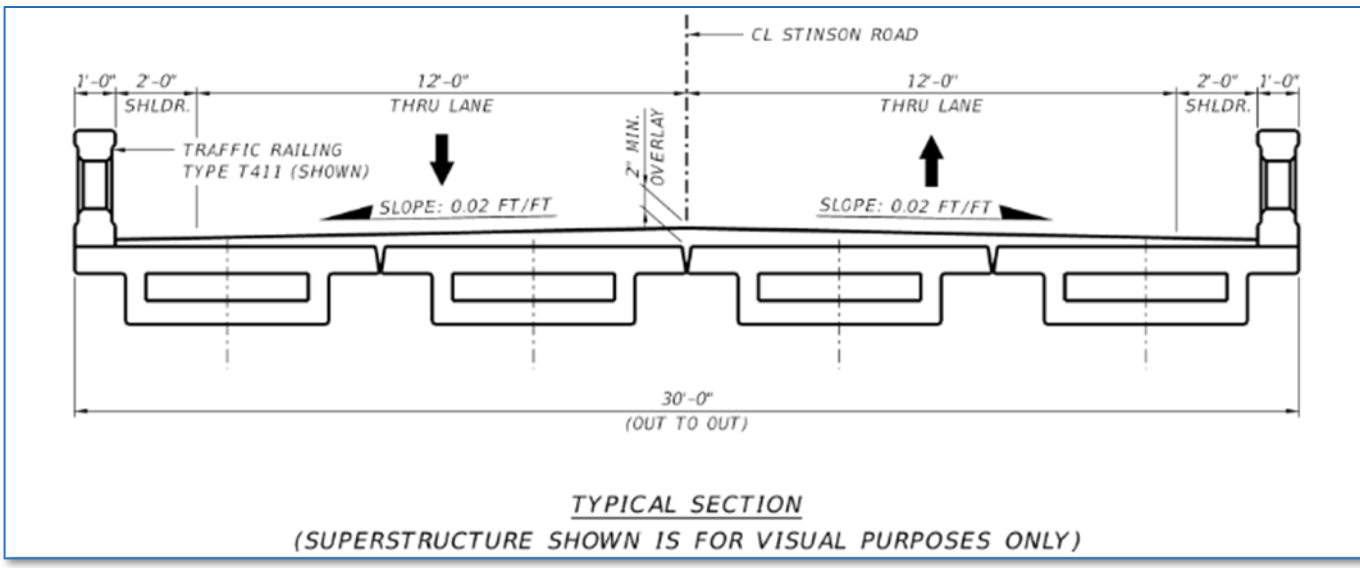


Figure 9 - Proposed Bridge Typical Section

5.4. Superstructure Alternatives

The superstructure alternatives have been selected to satisfy the minimum horizontal and vertical clearance, hydraulic requirements, and constructability. Different superstructure alternatives were considered and elevated based on two Horizontal Alignments as discussed in section 3.2 above

Horizontal Alignment 1:
Seven superstructure alternatives were considered and evaluated for Stinson Road Bridge over Muddy Creek. The overall bridge length is 60'-0" for Horizontal Alignment 1. TxDOT Prestressed Concrete Slab Beam was evaluated and eliminated due to capacity limitations for Horizontal Alignment 1. A steel through-

truss superstructure was considered to minimize superstructure depth. The advantages to a through-truss superstructure are generally realized in long spans where prestressed concrete does not perform well or the members become very large. Since the span is relatively short, the structure depth for a through-truss is not less than other alternatives considered. Therefore, the steel through-truss was eliminated. The remaining five superstructure alternatives are described below, options 1 through 5.

Each superstructure alternative presented below for Horizontal Alignment 1 is presented with the recommended typical section as discussed in Section 4.1 above.

Option 1: TxDOT Prestressed Concrete Decked Slab Beams (7DS23)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete Decked Slab Beams (7DS23) with a minimum of 2” thick concrete or asphalt overlay. The proposed superstructure depth is 25 inches. This shallow superstructure depth in conjunction with a modified vertical profile results in the lowest vertical profile raise over Muddy Creek and places the bottom of the bridge bearings elevation to be above the 100-year flood storm. Option 1 proposes a 3.64’ vertical profile raise and is the most cost-effective superstructure alternative.

Option 1 is considered the most economical and offers the lowest vertical profile raise compared to the other options. Therefore, this option appears the most feasible.

The proposed TxDOT Prestressed Concrete Decked Slab Beams (7DS23) typical section is shown in **Figure 10 – TxDOT Prestressed Concrete Decked Slab Beams (7SB23) Typical Section** below.

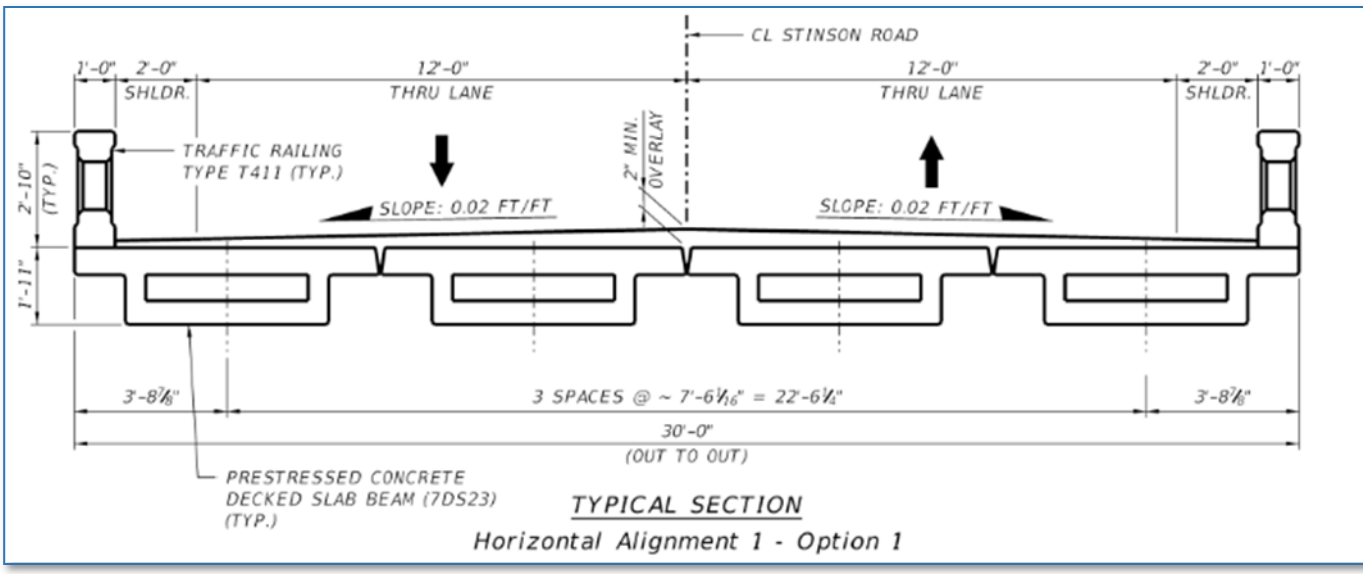


Figure 10 - TxDOT Prestressed Concrete Decked Slab Beams (7SB23) Typical Section

Option 2: TxDOT Prestressed Concrete Box Beams (5B20)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing six (6) TxDOT Prestressed Concrete Box Beams (5B20) with a minimum of 5" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 25". This shallow superstructure depth in conjunction with a modified vertical profile results in matching option 1 with the lowest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 2 proposes a 3.64' vertical profile raise and is the second most cost-effective superstructure alternative.

Although there is no reduction in the vertical profile raise compared to Option 1, utilizing six (6) TxDOT Prestressed Concrete Box Beams (5B20) with a 5" thick reinforced concrete deck increases the construction cost by 12%, see Appendix A for reference, compared to Option 1. Option 2 is not considered the most economical and does not offer any cost-saving or a lower vertical profile raise compared to Option 1. Therefore, this option was not further evaluated.

The proposed TxDOT Prestressed Concrete Box Beams (5B20) typical section is shown in **Figure 11 – TxDOT Prestressed Concrete Box Beams (5B20) Typical Section** below.

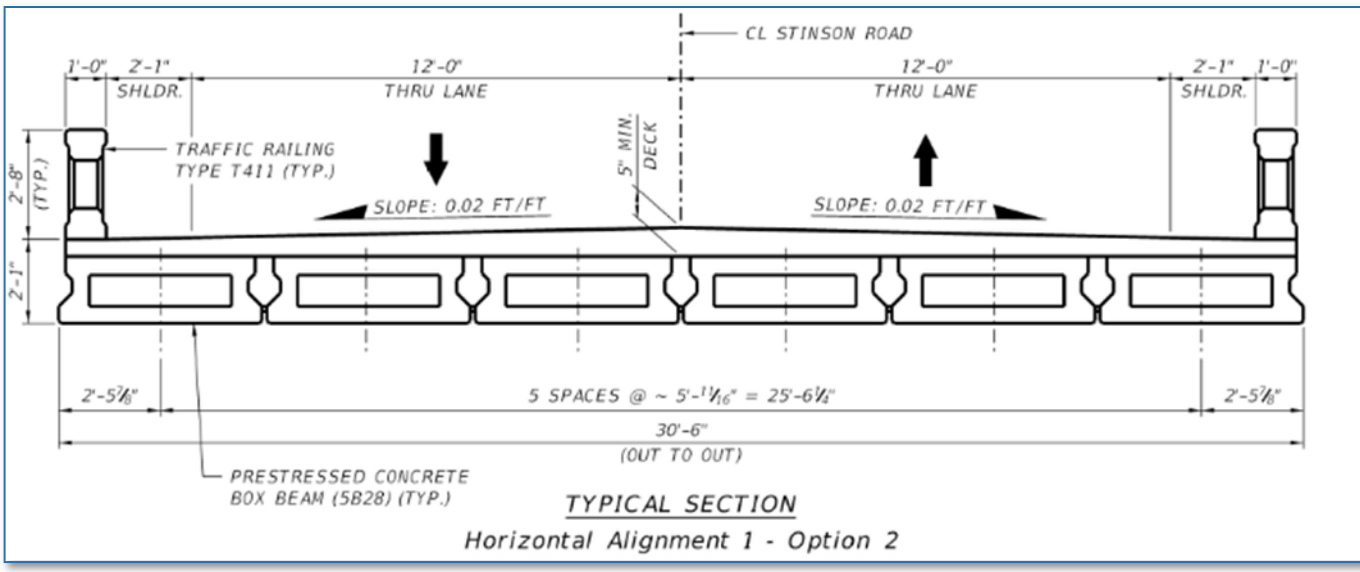


Figure 11 - TxDOT Prestressed Concrete Box Beams (5B20) Typical Section

Option 3: TxDOT Prestressed Concrete XBeams (5XB20)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete XBeams (5XB20) with an 8" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 30". This shallow superstructure depth in conjunction with a modified vertical profile results in the second lowest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 3 proposes a 4.06' vertical profile raise and is the fourth most cost-effective superstructure alternative.

There is a 5" increase in the vertical profile raise compared to Option 1. Also, utilizing four (4) TxDOT Prestressed Concrete XBeams (5XB20) with an 8" thick reinforced concrete deck increases the construction cost by 25%, see Appendix A for reference, compared to Option 1. Option 3 is not considered the most economical and does not offer any cost-saving or a lower vertical profile raise compared to Option 1. Therefore, this option was not further evaluated.

The proposed TxDOT Prestressed Concrete XBeams (5XB20) typical section is shown in **Figure 12 – TxDOT Prestressed Concrete XBeams (5XB20) Typical Section** below.

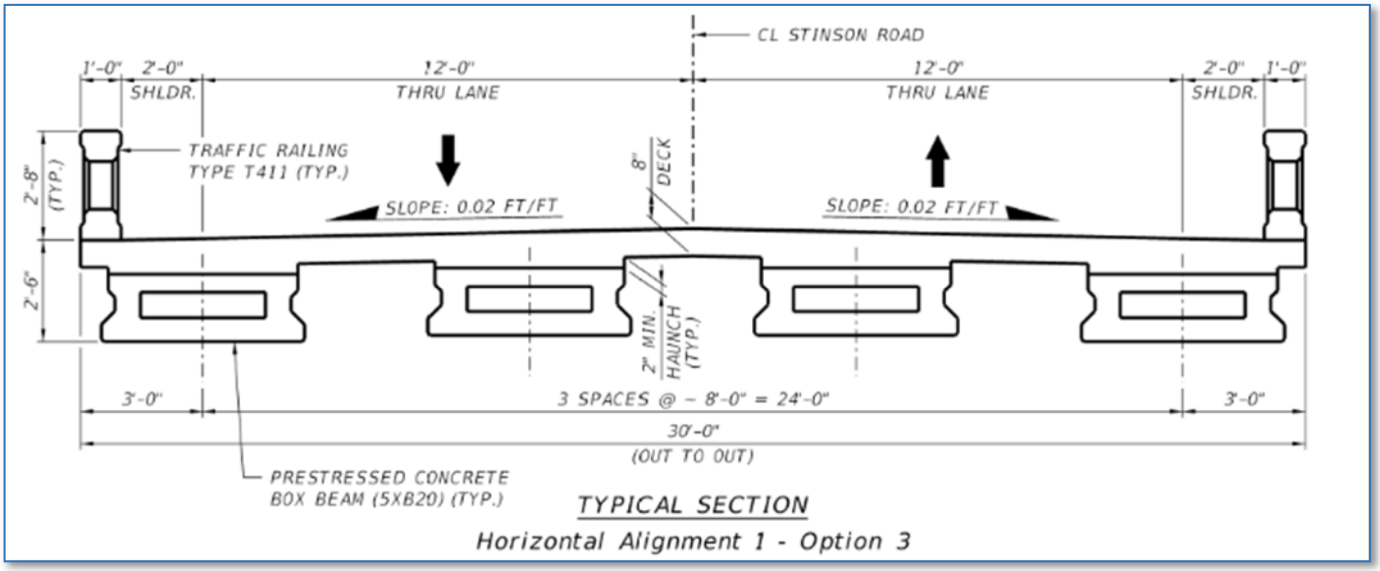


Figure 12 - TxDOT Prestressed Concrete XBeams (5XB20) Typical Section

Option 4: TxDOT Prestressed Concrete I-Girders (TX28)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete I-Girders (TX28) with an 8.5" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 38.5". This superstructure depth in conjunction with a modified vertical profile results in the highest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 4 proposes a 4.77' vertical profile raise and is the third most cost-effective superstructure alternative.

There is a 13.5" increase in the vertical profile raise compared to Option 1. Also, utilizing four (4) TxDOT Prestressed Concrete I-Girders (TX28) with an 8.5" thick reinforced concrete deck increases the construction cost by 15%, see Appendix A for reference, compared to Option 1. Option 4 is not considered the most economical and does not offer any cost-saving or a lower vertical profile raise compared to Option 1. Therefore, this option was not further evaluated.

The proposed TxDOT Prestressed Concrete I-Girders (TX28) typical shown in **Figure 13 – TxDOT Prestressed Concrete I-Girders (TX28) Typical Section** below.

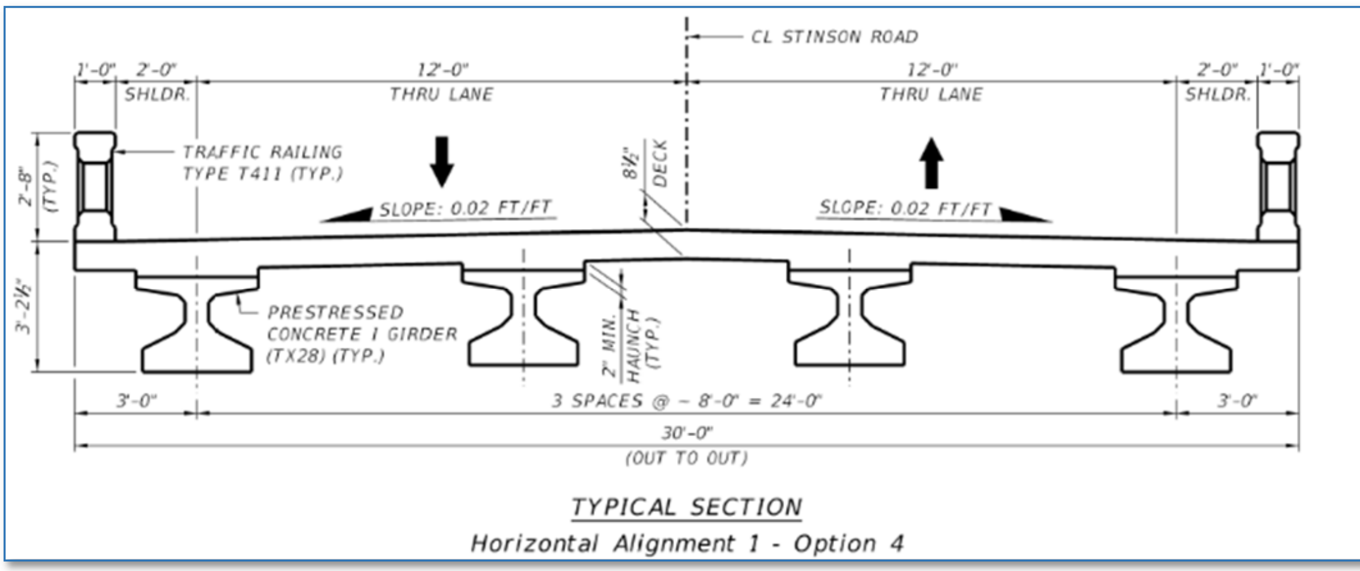


Figure 13 - TxDOT Prestressed Concrete I-Girders (TX28) Typical Section

Option 5: Steel Rolled Beams (W21X166)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) Steel Rolled Beams (W21X166) with an 8.5" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 33". This superstructure depth in conjunction with a modified vertical profile results in the third lowest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 5 proposes a 4.31' vertical profile raise and is the least cost-effective superstructure alternative.

There is an 8" increase in the vertical profile raise compared to Option 1. Also, utilizing four (4) Steel Rolled Beams (W21X166) with an 8.5" thick reinforced concrete deck increases the construction cost by 145%, see Appendix A for reference, compared to Option 1. The steel beams increase maintenance requirements as well. Option 5 is not considered the most economical and does not offer any cost-saving or a lower vertical profile raise compared to Option 1. Therefore, this option was not further evaluated.

The proposed Steel Rolled Beams (W21X166) typical section is shown in **Figure 14 – Steel Rolled Beams (W21X166) Typical Section** below.

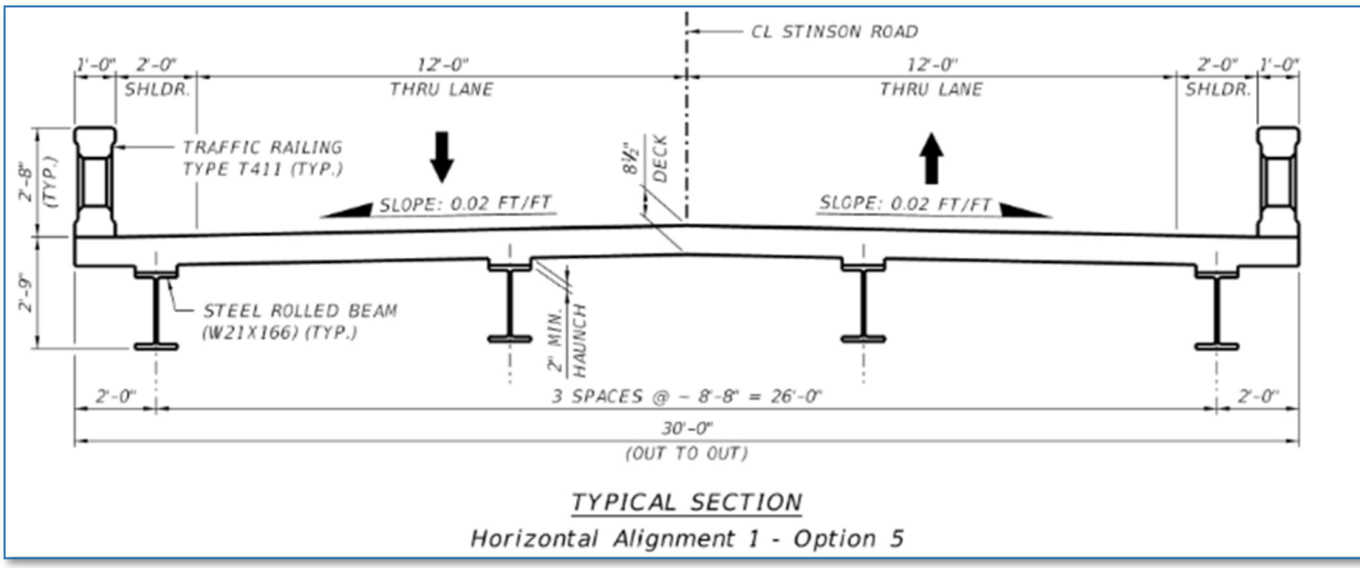


Figure 14 - Steel Rolled Beams (W21X166) Typical Section

Recommendation for Horizontal Alignment 1

Of the five options discussed above for Horizontal Alignment 1, Option 1 is recommended: a single-span bridge utilizing four (4) TxDOT Prestressed Concrete Decked Slab Beams (7DS23) with a 2" thick concrete or asphalt overlay. Option 1 is the most cost-effective superstructure alternative. This option provides the shallowest superstructure depth, minimizing the vertical profile raise, and provides the most overall cost savings.

Horizontal Alignment 2:

Four of the five superstructure alternatives considered for Horizontal Alignment 1 were considered and evaluated for Horizontal Alignment 2 of Stinson Road Bridge over Muddy Creek. The overall bridge length is 80'-0" for Horizontal Alignment 2. Option 1 considered the TxDOT Prestressed Concrete Decked Slab beam was evaluated and eliminated due to capacity limitations for Horizontal Alignment 2.

Each superstructure alternative for Horizontal Alignment 2 presented below is presented with the recommended typical section as discussed in Section 5.1 above.

Option 1: TxDOT Prestressed Concrete Decked Slab Beams (7DS23)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete Decked Slab Beams (7DS23) with a minimum of 2" thick concrete or asphalt overlay. However, TxDOT Prestressed Concrete Decked Slab Beams (7DS23) can only span up to 60'-0", Option 1 was not further evaluated.

Option 2: TxDOT Prestressed Concrete Box Beams (5B28)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing six (6) TxDOT Prestressed Concrete Box Beams (5B28) with a minimum of 5” thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 25”. This shallow superstructure depth in conjunction with a modified vertical profile results in the lowest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 2 proposes a 4.31’ vertical profile raise and is the second most cost-effective superstructure alternative.

Option 2 is the most cost-effective superstructure option considered for Alignment 2. This option offers overall cost-saving and the lowest vertical profile raise compared to the other options. Therefore, this option is the most feasible.

The proposed TxDOT Prestressed Concrete Box Beams (5B28) typical section is shown in **Figure 15 – TxDOT Prestressed Concrete Box Beams (5B28) Typical Section** below.

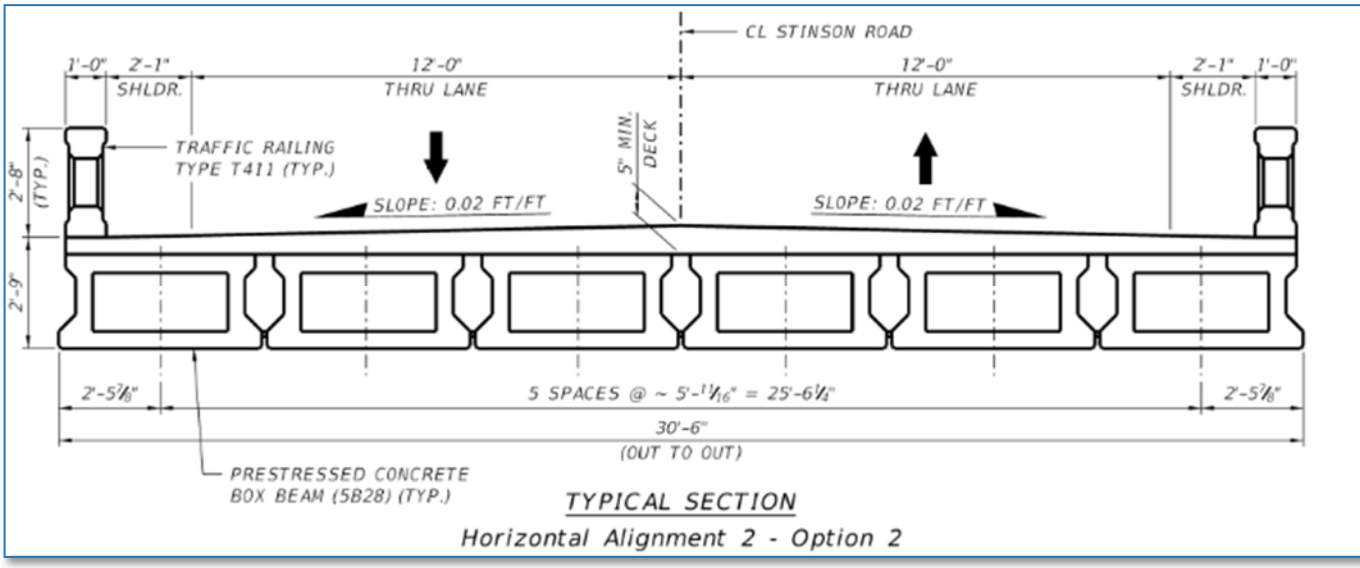


Figure 15 - TxDOT Prestressed Concrete Box Beams (5B28) Typical Section

Option 3: TxDOT Prestressed Concrete XBeams (5XB28)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete XBeams (5XB28) with an 8" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 30". This shallow superstructure depth in conjunction with a modified vertical profile results in the second lowest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 3 proposes a 4.73' vertical profile raise and is the third most cost-effective superstructure alternative.

There is a 5" increase in the vertical profile raise compared to Option 2. Also, utilizing four (4) TxDOT Prestressed Concrete XBeams (5XB28) with an 8" thick reinforced concrete deck increases the construction cost by 10%, see Appendix A for reference, compared to Option 2. Option 3 is not considered the most economical and does not offer any cost-saving or a lower vertical profile raise compared to Option 2. Therefore, this option was not further evaluated.

The proposed TxDOT Prestressed Concrete XBeams (5XB28) typical section is shown in **Figure 16 – TxDOT Prestressed Concrete XBeams (5XB28) Typical Section** below.

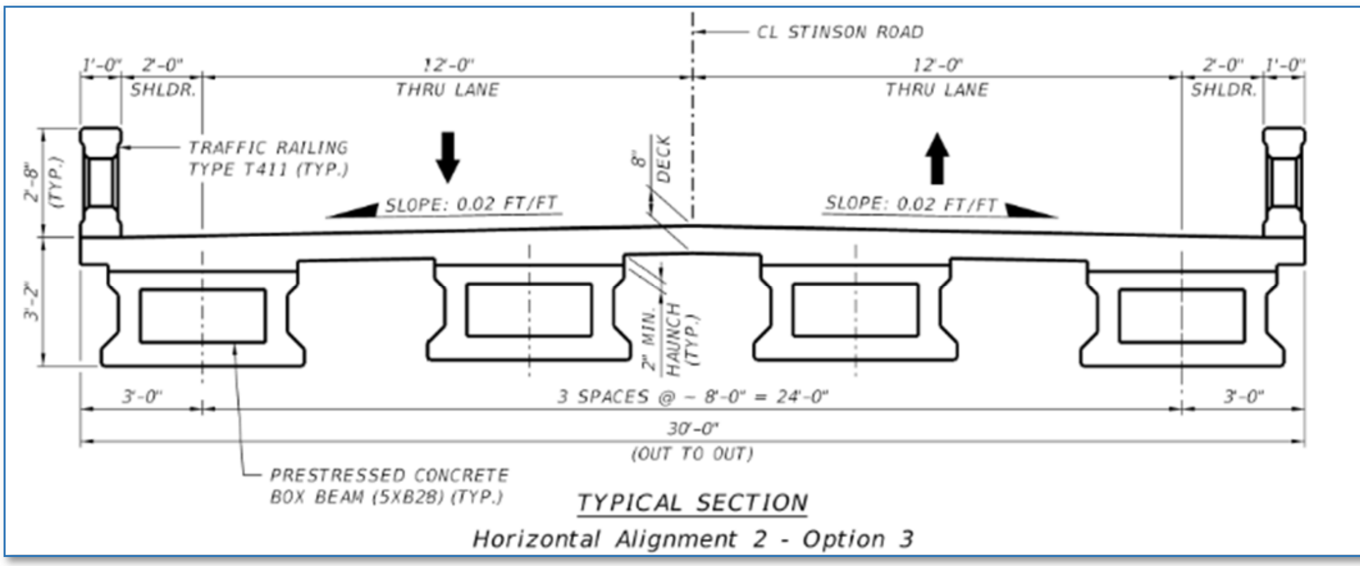


Figure 16 - TxDOT Prestressed Concrete XBeams (5XB28) Typical Section

Option 4: TxDOT Prestressed Concrete I-Girders (TX34)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete I-Girders (TX34) with an 8.5" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 38.5". This superstructure depth in conjunction with a modified vertical profile results in the highest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 4 proposes a 5.27' vertical profile raise and is the most cost-effective superstructure alternative.

There is a 13.5" increase in the vertical profile raise compared to Option 2. Utilizing four (4) TxDOT Prestressed Concrete I-Girders (TX34) with an 8.5" thick reinforced concrete deck decreases the construction cost by -12%, see Appendix A for reference, compared to Option 2. Option 4 is the most cost-effective superstructure alternative, but this option does not offer any overall cost-saving from the higher vertical profile raise compared to Option 2. Therefore, this option was not further evaluated.

The proposed TxDOT Prestressed Concrete I-Girders (TX34) typical shown in **Figure 17 – TxDOT Prestressed Concrete I-Girders (TX34) Typical Section** below.

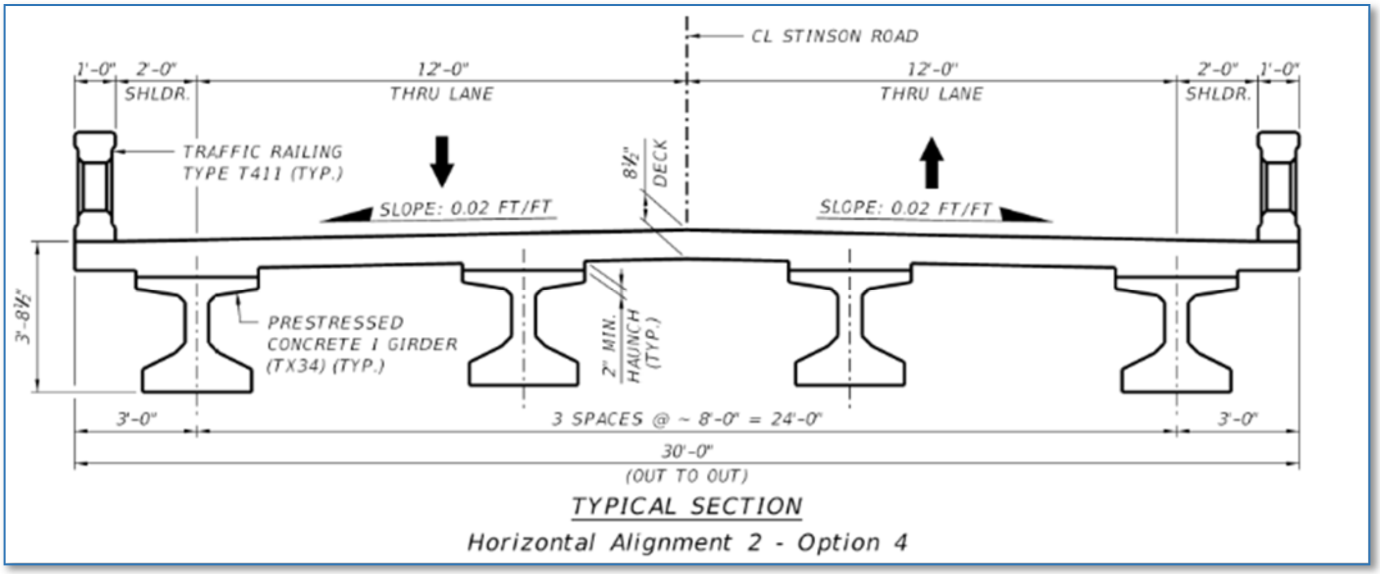


Figure 17 - TxDOT Prestressed Concrete I-Girders (TX34) Typical Section

Option 5: Steel Rolled Beams (W27X235)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) Steel Rolled Beams (W27X235) with an 8.5” thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 33”. This superstructure depth in conjunction with a modified vertical profile results in the third lowest vertical profile raise over Muddy Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 5 proposes a 4.82’ vertical profile raise and is the least cost-effective superstructure alternative.

There is an 8" increase in the vertical profile raise compared to Option 2. Also, utilizing four (4) Steel Rolled Beams (W27X235) with an 8.5” thick reinforced concrete deck increases the construction cost by 172%, see Appendix A for reference, compared to Option 2. Option 5 is not considered the most economical and does not offer any cost-saving or a lower vertical profile raise compared to Option 2. Therefore, this option was not further evaluated.

The proposed Steel Rolled Beams (W27X235) typical section is shown in **Figure 18 – Steel Rolled Beams (W27X235) Typical Section** below.

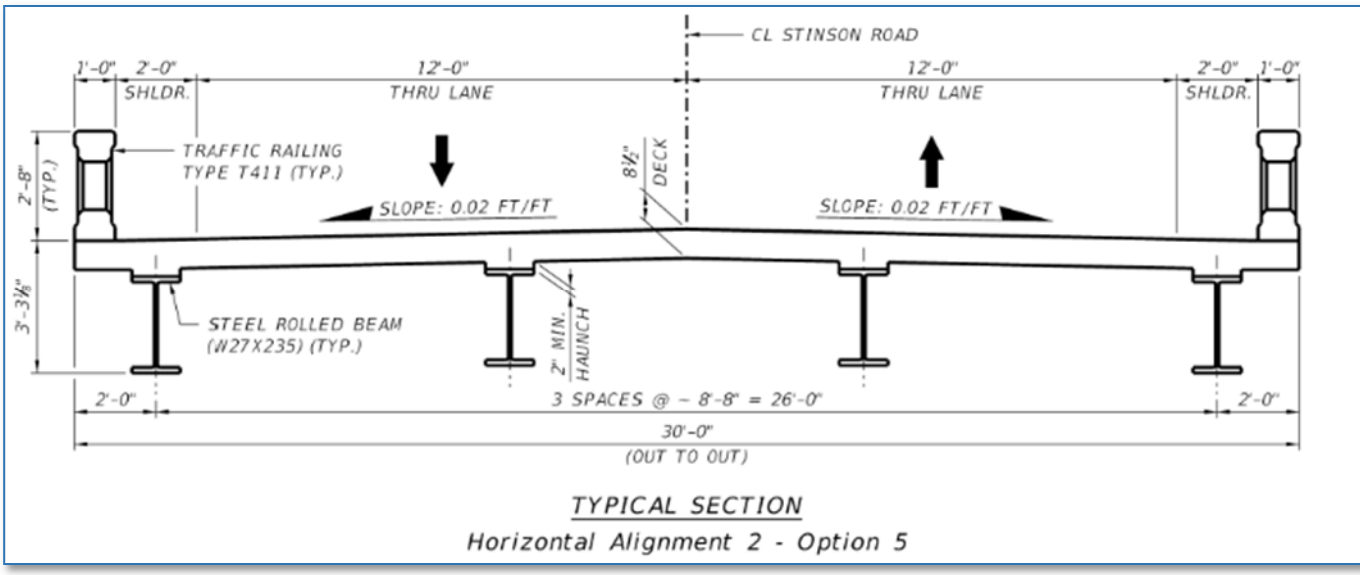


Figure 18 - Steel Rolled Beams (W27X235) Typical Section

Recommendation for Horizontal Alignment 2

Of the five options discussed above for Horizontal Alignment 2, Option 2 is recommended: a single-span bridge utilizing six (6) TxDOT Prestressed Concrete Box Beams (5B28) with 5” thick reinforced concrete deck. Option 2 is the most feasible superstructure alternative. This option provides the shallowest superstructure depth, minimizing the vertical profile raise, and provides the most overall cost savings.

5.5. Substructure / Foundation Alternatives

A full geotechnical evaluation of the bridge site will be investigated during the final design phase to determine the suitability and capacity needed for the proposed bridge replacement. TxDOT standards for prestressed concrete decked slab beams and box beams allow two foundation alternatives with a cast-in-place concrete abutment cap. A specialty design may also be considered should the geotechnical evaluation recommend a non-standard substructure.

Driven Concrete Piles
TxDOT Standard allows for five (5) 18"x18" driven concrete piles per an abutment for prestressed concrete decked slab beams and six (6) 18"x18" driven concrete piles per an abutment for prestressed concrete box beams. An in-depth foundation design will be performed to verify the capacity in the final design phase.

Drilled Shafts
TxDOT Standard allows for three (3) 30" diameter drilled shafts per an abutment for prestressed concrete decked slab beams and box beams. An in-depth foundation design will be performed to verify the capacity in the final design phase.

Recommendation
No recommendation is provided at this time for the substructure foundation alternatives.

5.6. Retaining Walls

Retaining walls will be used on this project to minimize the encroachment of the roadway embankment and to contain the typical section footprint within the limits of the existing right-of-way. Two types of walls are considered feasible, conventional Cast-In-Place (CIP) walls and proprietary walls. The required wall area is determined by superstructure type as well as the foundation soil conditions to determine what type of wall will be best suited for this application. An in-depth retaining wall evaluation will be performed in the final design phase.

5.7. Bridge Drainage

Bridge drainage will be evaluated in preliminary and final design phases.

5.8. Bridge Lighting

There is no street light system existing along Stinson Road, and there are no light poles on the existing culvert. Therefore, no lighting will be proposed for the bridge.

5.9. Construction Sequencing

Safety to motorists and pedestrians is the highest priority for the Traffic Control Plan and the plan must minimize disruption to traffic flow during the construction of these improvements. To achieve these goals several keys issues will be addressed in the development of the selected alternative:

- Maintain access to the residential community during all phases of construction.
- Communicate with all project stakeholders, including local HOAs.
- Avoid or minimize utility facility relocations.
- Minimize impacts to traffic during the construction phase.

The following two construction options have been evaluated:

Phased Construction Option

To maintain traffic along Stinson Road, phased construction was considered and evaluated. At the culvert, Stinson Road has a paved roadway width of approximately 21’. There are unpaved shoulder widths of approximately 1’-9” on the southbound and 4’-6” on the northbound. Also, the existing railing is substandard and should not be used as a safe bridge railing during construction. Therefore, a pre-stage to pave the shoulder and to install an appropriate traffic railing will be needed. TxDOT requires a 1’-0” offset from the barriers and a minimum 10’-0” lane. Given the required widths and width of temporary barriers, providing two lanes of traffic will be impossible, however leaving only one southbound lane open was considered. This option was utilized for the Stinson Road reconstruction immediately south of this project. Initial investigations find staged construction will require either widening the bridge significantly or shifting the horizontal alignment. Widening the bridge to accommodate a phased construction would significantly increase the cost without realizing the added benefit of shifting the alignment as discussed in section 2.2. If Horizontal Alignment 2 is ultimately chosen, then the additional cost of phased construction will be much smaller since the bridge will be offset from the existing roadway. The additional costs would be noticed in traffic control items and schedule.

Complete Closure with Detour Option

Replacement of the Stinson Road Culvert of Muddy Creek can be completed in a shorter duration and with a reduced construction cost (when compared to the phased option) by implementing complete closure from Bristol Park to Bentwater Drive during construction and implementing a Detour. An initial detour plan will utilize East Parker Road or West Lucas Road for west to east detours and Lewis Lane or Southview Drive for south to north detours. A minimum of one (1) driveway access would be required for each property within the closure, which may require temporary driveways and temporary construction easements through adjacent properties. An in-depth detour route and access plan will be evaluated in preliminary design.

Recommendation

The Complete Closure with Detour Option is recommended as this would allow for a shorter construction duration, resulting in overall construction savings.

6. ALTERNATIVE COST COMPARISON

Horizontal Alignment 1

A comparison of the estimated % difference in cost based on selective variable components of each alternatives to Option 1 of Horizontal Alignment 1 has been prepared for the bridge, roadway options, and retaining wall evaluated (refer to Appendix A - Alternatives Cost Comparison for more details).

The table below summarizes the bridge alternatives by percentage differences of cost for each alternative compared with Option 1 based only on superstructure types.

Bridge Alternatives	% Difference Compared to Option 1
Option 1: Single-Span with four-7DS23 Beams	
Option 2: Single-Span with six-5B20 Beams	5% increase
Option 3: Single-Span with four-5XB20 Beams	4% increase
Option 4: Single-Span with four-TX28 Beams	29% increase
Option 5: Single-Span with four-W21x166 Beams	102% increase

Based on a bridge superstructure cost estimated comparison, Option 1 is the most economical.

The table below summarizes the associated roadway profile raise of each bridge alternatives by percentage differences of cost compared with Option 1 based only on roadway fill. Profile raise is measured from the top of the existing pavement at the culvert to the top of the proposed concrete bridge deck at the center of the proposed bridge span. The top of the existing pavement at the culvert and at the center of the proposed bridge span is estimated to be at EL. 569.70.

Roadway Profile Raise	% Difference Compared to Option 1
Option 1: 3.64 feet Profile Raise	
Option 2: 3.64 feet Profile Raise	0% increase
Option 3: 4.06 feet Profile Raise	14% increase
Option 4: 4.77 feet Profile Raise	45% increase
Option 5: 4.31 feet Profile Raise	24% increase

Based on the roadway profile raise cost estimated comparison, Option 1 and Option 2 are the most economical.

The table below summarizes the associated retaining wall area of each bridge alternatives and roadway profile raise by percentage differences of cost compared with Option 1 based only on estimated exposed retaining wall area.

Retaining Wall Area	% Difference Compared to Option 1
Option 1: 1336 SF	
Option 2: 1336 SF	0% increase
Option 3: 1576 SF	18% increase
Option 4: 2118 SF	59% increase
Option 5: 1754 SF	31% increase

Based on retaining wall cost estimated comparison, Option 1 and Option 2 are the most economical. The table below summarizes the overall alternatives by percentage differences of cost for each alternative compared with Option 1.

Overall Alternatives	% Difference Compared to Option 1
Option 1: Single-Span with four-7DS23 Beams	
Option 2: Single-Span with six-5B20 Beams	2% increase
Option 3: Single-Span with four-5XB20 Beams	8% increase
Option 4: Single-Span with four-TX28 Beams	31% increase
Option 5: Single-Span with four-W21x166 Beams	46% increase

This comparison provides a summary of the overall cost for each option. Based on the above overall alternative cost estimated comparison, Option 1 is the most economical and provides an overall cost-saving.

Horizontal Alignment 2

A comparison of the estimated % difference in cost based on selective variable components of each alternatives to Option 2 of Horizontal Alignment 2 has been prepared for the bridge, roadway options, and retaining wall evaluated (refer to Appendix A for more details).

The table below summarizes the bridge alternatives by percentage differences of cost for each alternative compared with Option 2 based only on superstructure types.

Bridge Alternatives	% Difference Compared to Option 2
Option 2: Single-Span with six-5B28 Beams	
Option 3: Single-Span with four-5XB28 Beams	14% increase
Option 4: Single-Span with four-TX34 Beams	7% decrease
Option 5: Single-Span with four-W27x235 Beams	176% increase

Based on a bridge superstructure cost estimated comparison, Option 4 is the most economical. However, Option 4 roadway profile raise and retaining wall costs do not offset the cost enough from Option 2 roadway profile and retaining wall cost. Option 2 would be a more suitable alternative in this case.

The table below summarizes the associated roadway profile raise of each bridge alternatives by percentage differences of cost compared with Option 1 based only on roadway fill. Profile raise is measured from the top of the existing pavement at the culvert to the top of the proposed concrete bridge deck at the center of the proposed bridge span. The top of the existing pavement at the culvert and at the center of the proposed bridge span is estimated to be at EL. 569.70.

Roadway Profile Raise	% Difference Compared to Option 2
Option 2: 4.31 feet Profile Raise	
Option 3: 4.75 feet Profile Raise	8% increase
Option 4: 5.27 feet Profile Raise	21% increase
Option 5: 4.82 feet Profile Raise	10% increase

Based on the roadway profile raise cost estimated comparison, Option 2 is the most economical.
The table below summarizes the associated retaining wall area of each bridge alternatives and roadway profile raise by percentage differences of cost compared with Option 2, based only on estimated exposed retaining wall area.

Retaining Wall Area	% Difference Compared to Option 2
Option 2: 1345 SF	
Option 3: 1469 SF	9% increase
Option 4: 1684 SF	25% increase
Option 5: 1500 SF	12% increase

Based on retaining wall cost estimated comparison, Option 2 is the most economical.

The table below summarizes the overall alternatives by percentage differences of cost for each alternative compared with Option 2.

Overall Alternatives	% Difference Compared to Option 2
Option 2: Single-Span with six-5B28 Beams	
Option 3: Single-Span with four-5XB28 Beams	8% increase
Option 4: Single-Span with four-TX34 Beams	6% increase
Option 5: Single-Span with four-W27x235 Beams	68% increase

This comparison provides a summary of the overall cost for each option. Based on the above overall alternative cost estimated comparison, Option 2 is the most economical and provides an overall cost-saving.

Horizontal Alignment 1 vs Horizontal Alignment 2

The table below summarizes the overall horizontal alignment alternatives by percentage differences of cost for each alternative compared with Horizontal Alignment 2.

Overall Horizontal Alignment Alternatives	% Difference Compared to Horizontal Alignment 2
Horizontal Alignment 1 **Option 1: Single-Span with four-7DS23 Beams**	15% decrease
Horizontal Alignment 2 **Option 2: Single-Span with six-5B28 Beams**	

This comparison provides a summary of the overall cost for each horizontal alignment alternative. Based on the above overall horizontal alignment alternative cost estimated comparison, Horizontal Alignment 1 is the most economical. However, the advantages Horizontal Alignment 2 offers are worth the fraction increase.

Recommendation

The proposed bridge typical section provides one (1) 12'-0" traveling lanes in each direction and a 2'-0" wide shoulder on each side with a 0.02 ft/ft crown, and a bridge railing type T411. The proposed roadway typical section provides one concrete paved (1) 12'-0" traveling lanes in each direction and an unpaved 2'-0" wide shoulder on each side with a cross-slope of 0.02 ft/ft and 0.06 ft/ft, respectively.

Given the information here in presented, it is recommended that Stinson Road Culvert be replace with an 80'-0" single-span bridge on Horizontal Alignment 2 with a 4.31 ft vertical profile raise, utilizing Option 2: six (6) TxDOT Prestressed Concrete Box Beams (5B28) with a minimum 5" thick cast-in-place reinforced concrete deck, supported on twelve (12) 18"x18" driven concrete piles foundation or six (6) 30" diameter drilled shafts with a cast-in-place reinforced concrete abutment foundation. Retaining walls are recommended on the northeast and southeast of the bridge. It is also recommended that construction be completed by implementing a Complete Closure and Detour with southbound remaining open to local traffic only.

Horizontal Alignment 2 has a higher estimated cost by only 15%, see Appendix A for the Alternatives Cost Comparison. The increase is due to right-of-way acquisition and increased span length. A significant key advantage of the Horizontal Alignment 2 is that it offers added safety to the traveling to the public and residents along Stinson Road by encouraging reduced speed. It also makes phased construction feasible if the City should desire. Many advantages are realized by Horizontal Alignment 2 for a fractional increase in cost. Therefore, the recommended proposed alignment is Horizontal Alignment 2.

If Horizontal Alignment 2 is not feasible due to right-of-way acquisitions, then it is recommended that Stinson Road Culvert be replace with a 60'-0" single-span bridge on Horizontal Alignment 1 with a 3.64 ft vertical profile raise, utilizing Option 1: four (4) TxDOT Prestressed Concrete Decked Slab Beams (7DS23) with a minimum 2" thick concrete or asphalt overlay, which supports on ten (10) 18"x18" driven concrete piles foundation or six (6) 30" diameter drilled shafts with a cast-in-place reinforced concrete abutment foundation. Retaining walls are recommended on all four corners of the bridge.

APPENDIX A:
Alternative Cost Comparison Estimate / Calculations

Horizontal Alignment 1 - Alternative Cost Comparison

Stinson Bridge Roadway Improvements from Bristol Park to Bentwater Drive

City of Lucas

Horizontal Alignment 1					
Bridge Superstructure	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
Beam Type	**7DS23**	**5B20**	**5XB20**	**TX28**	**W21X166**
BEAMS					
beam length	59.83 lf	59.83 lf	59.83 lf	59.83 lf	59.83 lf
no. beam	4	6	4	4	4
beam unit weight (steel option only)					166 lb/lf
total beam length	239.33 lf	359.00 lf	239.33 lf	239.33 lf	39729.33 lb
unit cost ($/lf)	*$430.00*	*$235.00*	*$270.00*	*$400.00*	*$5.00 /lb*
total cost	$102,913.33	$84,365.00	$64,620.00	$95,733.33	$198,646.67
DECK					
deck/overlay width	30.00 lf	30.17 lf	30.00 lf	30.00 lf	30.00 lf
deck/overlay length	59.83 lf	59.83 lf	59.83 lf	59.83 lf	59.83 lf
deck thickness		5.0 in	8.0 in	8.5 in	8.5 in
total deck volume	199.44 sy	27.85 cy	44.32 cy	47.09 cy	47.09 cy
unit cost ($/cy)	*$125.00 / sy*	*$1,550.00*	*$1,550.00*	*$1,550.00*	*$1,550.00*
total cost	$24,930.56	$43,174.49	$68,697.53	$72,991.13	$72,991.13
BEARING PADS					
total no. bearing pads	8 ea	12 ea	8 ea	8 ea	8 ea
unit cost ($/each)	*$1,700.00*	*$1,700.00*	*$1,700.00*	*$1,700.00*	*$1,700.00*
total cost	$13,600.00	$20,400.00	$13,600.00	$13,600.00	$13,600.00
Overall bridge alternative cost *	**$141,443.89**	**$147,939.49**	**$146,917.53**	**$182,324.46**	**$285,237.79**
% difference Compared to Option 1	**0%**	**5%**	**4%**	**29%**	**102%**
Roadway Profile Fill	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
roadway profile fill area (elevation view)	925 sf	925 sf	1050 sf	1341 sf	1145 sf
roadway profile fill width	28 ft	28 ft	28 ft	28 ft	28 ft
roadway profile fill volume	959.26 cy	959.26 cy	1088.89 cy	1390.67 cy	1187.41 cy
unit cost ($/cy)	*$25.00*	*$25.00*	*$25.00*	*$25.00*	*$25.00*
total cost	$23,981.48	$23,981.48	$27,222.22	$34,766.67	$29,685.19
Overall roadway alternative cost *	**$23,981.48**	**$23,981.48**	**$27,222.22**	**$34,766.67**	**$29,685.19**
% difference Compared to Option 1	**0%**	**0%**	**14%**	**45%**	**24%**
Retaining Wall	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
retaining wall area	668 sf	668 sf	788 sf	1059 sf	877 sf
no. retaining walls	2	2	2	2	2
total retaining wall area	1336 sf	1336 sf	1576 sf	2118 sf	1754 sf
unit cost ($/sf)	*$95.00*	*$95.00*	*$95.00*	*$95.00*	*$95.00*
total cost	$126,920.00	$126,920.00	$149,720.00	$201,210.00	$166,630.00
Overall retaining wall cost *	**$126,920.00**	**$126,920.00**	**$149,720.00**	**$201,210.00**	**$166,630.00**
% difference Compared to Option 1	**0%**	**0%**	**18%**	**59%**	**31%**
Right-Of-Way Cost	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
Total Property Area	47518 sf	47518 sf	47518 sf	47518 sf	47518 sf
unit cost ($/sf)	*$2.30*	*$2.30*	*$2.30*	*$2.30*	*$2.30*
total cost	$109,086.32	$109,086.32	$109,086.32	$109,086.32	$109,086.32
Overall additional right-of-way cost *	**$109,086.32**	**$109,086.32**	**$109,086.32**	**$109,086.32**	**$109,086.32**

Easement Cost	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
Total Property Area	25645 sf	25645 sf	25645 sf	25645 sf	25645 sf
unit cost ($/sf)	*$0.23*	*$0.23*	*$0.23*	*$0.23*	*$0.23*
total cost	$5,887.28	$5,887.28	$5,887.28	$5,887.28	$5,887.28
Overall additional easement cost *	**$5,887.28**	**$5,887.28**	**$5,887.28**	**$5,887.28**	**$5,887.28**

	Horizontal Alignment 1				
	Option 1	Option 2	Option 3	Option 4	Option 5
OVERALL ALTERNATIVE COST **	**$407,318.97**	**$413,814.57**	**$438,833.35**	**$533,274.73**	**$596,526.58**
% difference Compared to Option 1	**0%**	**2%**	**8%**	**31%**	**46%**
	Recommendation				

* Does not reflect all components, and only selective variable components were used for aiding alternative selection.

** Overall Alternative Cost does not reflect fully estimated construction cost, and is only used for aiding alternative selection.

LAKES ENGINEERING

A BCC Engineering Company

Date: June 3, 2020

Horizontal Alignment 2 - Alternative Cost Comparison

Stinson Bridge Roadway Improvements from Bristol Park to Bentwater Drive

City of Lucas

Horizontal Alignment 2

Bridge Superstructure	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
Beam Type	**7DS23**	**5B28**	**5XB28**	**TX34**	**W27X235**
BEAMS					
beam length	N/A	79.83 lf	79.83 lf	79.83 lf	79.83 lf
no. beam		6	4	4	4
beam unit weight (steel option only)					235 lb/lf
total beam length		479.00 lf	319.33 lf	319.33 lf	75043.33 lb
unit cost ($/lf)		*$205.00*	*$300.00*	*$165.00*	*$5.00 /lb*
total cost	N/A	$98,195.00	$95,800.00	$52,690.00	$375,216.67
DECK					
deck/overlay width	N/A	30.17 lf	30.00 lf	30.00 lf	30.00 lf
deck/overlay length		79.83 lf	79.83 lf	79.83 lf	79.83 lf
deck thickness		5.0 in	8.0 in	8.5 in	8.5 in
total deck volume		37.17 cy	59.14 cy	62.83 cy	62.83 cy
unit cost ($/cy)		*$1,550.00*	*$1,550.00*	*$1,550.00*	*$1,550.00*
total cost	N/A	$57,606.07	$91,660.49	$97,389.27	$97,389.27
BEARING PADS					
total no. bearing pads	N/A	12 ea	8 ea	8 ea	8 ea
unit cost ($/each)		*$1,700.00*	*$1,700.00*	*$1,700.00*	*$1,700.00*
total cost	N/A	$20,400.00	$13,600.00	$13,600.00	$13,600.00
Overall bridge alternative cost *	**N/A**	**$176,201.07**	**$201,060.49**	**$163,679.27**	**$486,205.94**
% difference Compared to Option 4		**0%**	**14%**	**-7%**	**176%**
Roadway Profile Fill	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
roadway profile fill area (elevation view)	N/A	1713 sf	1844 sf	2070 sf	1876 sf
roadway profile fill width		28 ft	28 ft	28 ft	28 ft
roadway profile fill volume		1776.44 cy	1912.30 cy	2146.67 cy	1945.48 cy
unit cost ($/cy)		*$25.00*	*$25.00*	*$25.00*	*$25.00*
total cost	N/A	$44,411.11	$47,807.41	$53,666.67	$48,637.04
Overall roadway alternative cost *	**N/A**	**$44,411.11**	**$47,807.41**	**$53,666.67**	**$48,637.04**
% difference Compared to Option 4		**0%**	**8%**	**21%**	**10%**
Retaining Wall	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
retaining wall area	N/A	1345 sf	1469 sf	1684 sf	1500 sf
no. retaining walls		1	1	1	1
total retaining wall area		1345 sf	1469 sf	1684 sf	1500 sf
unit cost ($/sf)		*$95.00*	*$95.00*	*$95.00*	*$95.00*
total cost	N/A	$127,775.00	$139,555.00	$159,980.00	$142,500.00
Overall retaining wall cost *	**N/A**	**$127,775.00**	**$139,555.00**	**$159,980.00**	**$142,500.00**
% difference Compared to Option 4		**0%**	**9%**	**25%**	**12%**
Right-Of-Way Cost	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
Total Property Area		55240 sf	55240 sf	55240 sf	55240 sf
unit cost ($/sf)		*$2.30*	*$2.30*	*$2.30*	*$2.30*
total cost	N/A	$126,813.59	$126,813.59	$126,813.59	$126,813.59
Overall additional right-of-way cost *	**N/A**	**$126,813.59**	**$126,813.59**	**$126,813.59**	**$126,813.59**
Easement Cost	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 5**
Total Property Area		28440 sf	28440 sf	28440 sf	28440 sf
unit cost ($/sf)		*$0.23*	*$0.23*	*$0.23*	*$0.23*
total cost	N/A	$6,528.93	$6,528.93	$6,528.93	$6,528.93
Overall additional easement cost *	**N/A**	**$6,528.93**	**$6,528.93**	**$6,528.93**	**$6,528.93**

	Horizontal Alignment 2				
	Option 1	Option 2	Option 3	Option 4	Option 5
OVERALL ALTERNATIVE COST **	**N/A**	**$481,729.70**	**$521,765.42**	**$510,668.46**	**$810,685.49**
% difference Compared to Option 4		**0%**	**8%**	**6%**	**68%**
		Recommendation			

* Does not reflect all components, and only selective variable components were used for aiding alternative selection.

** Overall Alternative Cost does not reflect fully estimated construction cost, and is only used for aiding alternative selection.

LAKES ENGINEERING

A BCC Engineering Company

Date: June 3, 2020

Horizontal Alignment 1 VS Horizontal Alignment 2
Alternative Cost Comparison
Stinson Bridge Roadway Improvements from Bristol Park to Bentwater Drive
City of Lucas

	Horizontal Alignment 1	Horizontal Alignment 2
Bridge Superstructure	**Option 1**	**Option 2**
Beam Type	7DS23	5B28
BEAMS		
beam length	59.83 lf	79.83 lf
no. beam	4	6
beam unit weight (steel option only)		
total beam length	239.33 lf	479.00 lf
unit cost ($/lf)	*$430.00*	*$205.00*
total cost	$102,913.33	$98,195.00
DECK		
deck/overlay width	30.00 lf	30.17 lf
deck/overlay length	59.83 lf	79.83 lf
deck thickness		5.0 in
total deck volume	199.44 sy	37.17 cy
unit cost ($/cy)	*$125.00 / sy*	*$1,550.00*
total cost	$24,930.56	$57,606.07
BEARING PADS		
total no. bearing pads	8 ea	12 ea
unit cost ($/each)	*$1,700.00*	*$1,700.00*
total cost	$13,600.00	$20,400.00
Overall bridge alternative cost *	**$141,443.89**	**$176,201.07**
% difference Compared to Horizontal Alignment 2 - Option 2	**-20%**	**0%**
Roadway Profile Fill	**Option 1**	**Option 2**
roadway profile fill area (elevation view)	925 sf	1713 sf
roadway profile fill width	28 ft	28 ft
roadway profile fill volume	959.26 cy	1776.44 cy
unit cost ($/cy)	*$25.00*	*$25.00*
total cost	$23,981.48	$44,411.11
Overall roadway alternative cost *	**$23,981.48**	**$44,411.11**
% difference Compared to Horizontal Alignment 2 - Option 2	**-46%**	**0%**
Retaining Wall	**Option 1**	**Option 2**
retaining wall area	668 sf	1345 sf
no. retaining walls	2 sf	1 sf
total retaining wall area	1336 sf	1345 sf
unit cost ($/sf)	*$95.00*	*$95.00*
total cost	$126,920.00	$127,775.00
Overall retaining wall cost *	**$126,920.00**	**$127,775.00**
% difference Compared to Horizontal Alignment 2 - Option 2	**-1%**	**0%**
Right-Of-Way Cost	**Option 1**	**Option 2**
Total Property Area	47518 sf	55240 sf
unit cost ($/sf)	*$2.30*	*$2.30*
total cost	$109,086.32	$126,813.59
Overall additional right-of-way cost *	**$109,086.32**	**$126,813.59**
% difference Compared to Horizontal Alignment 2 - Option 2	**-14%**	**0%**
Easement Cost	**Option 1**	**Option 2**
Total Property Area	25645 sf	28440 sf
unit cost ($/sf)	*$0.23*	*$0.23*
total cost	$5,887.28	$6,528.93
Overall additional easement cost *	**$5,887.28**	**$6,528.93**
% difference Compared to Horizontal Alignment 2 - Option 2	**-10%**	**0%**

	Horizontal Alignment 1 Option 1	Horizontal Alignment 2 Option 2
OVERALL ALTERNATIVE COST **	**$407,318.97**	**$481,729.70**
% difference Compared to Horizontal Alignment 2 - Option 2	**-15%**	**0%**
		Recommendation

* Does not reflect all components, and only selective variable components were used for aiding alternative selection.

** Overall Alternative Cost does not reflect fully estimated construction cost, and is only used for aiding alternative selection.

LAKES ENGINEERING
A BCC Engineering Company

Date: June 3, 2020

Average Low Bid Unit Prices Based on Apr-2020 Link

ITEM CODE	ITEM DESCRIPTION	ITEM UNIT	STATEWIDE 3M COUNT	STATEWIDE 3M QUANTITY	STATEWIDE 3M AVG	STATEWIDE 12M COUNT	STATEWIDE 12M QUANTITY	STATEWIDE 12M AVG	USE
01326001	EMBANKMENT (FINAL)(ORD COMP)(TY A)	CY	3	984.00	$21.80	24	52,683.00	$16.08	$25.00
04206014	CL C CONC (ABUT)(HPC)	CY	4	489.37	$1,852.55	19	2,384.67	$1,540.16	$1,550.00
04236008	RETAINING WALL (CAST - IN - PLACE)	SF	2	723.00	$51.67	16	40,607.00	$94.99	$95.00
04256016	PRESTR CONC DECK SLAB BEAM (6DS23)	LF				1	220.00	$330.00	$430.00
04256002	PRESTR CONC BOX BEAM (5B20)	LF	1	69.50	$233.47	14	6,872.70	$187.57	$235.00
04256004	PRESTR CONC BOX BEAM (5B28)	LF				2	2,086.32	$201.79	$205.00
04256020	PRESTR CONC BOX BEAM (5XB20)	LF				1	387.00	$265.00	$270.00
04256062	PRESTR CONC BOX BM(5XB28)(MOD1)	LF				1	796.24	$270.00	$300.00
04256024	PRESTR CONC BOX BEAM (5XB34)	LF				1	1,074.00	$371.50	$375.00
04256035	PRESTR CONC GIRDER (TX28)	LF	5	12,676.99	$435.44	35	69,698.12	$195.30	$400.00
04256036	PRESTR CONC GIRDER (TX34)	LF	2	793.90	$162.24	19	38,538.46	$139.98	$165.00
04346024	ELASTOMERIC BEARING (E5)	EA	1	8.00	$1,650.00	3	15.00	$1,474.01	$1,700.00
04396002	CONCRETE OVERLAY (2 IN)	SY	1	14,051.00	$102.00	3	19,666.50	$99.18	$125.00
04426004	STR STEEL (ROLLED BEAM)	LB				1	54,042.00	$10.00	$5.00

Notes:

Item "EMBANKMENT (FINAL)(ORD COMP)(TY A)" was used as "fill" for Roadway profile raise, similar to recently reconstructed project south of project limits.
Item "CL C CONC (ABUT)(HPC)" was used as "deck" - Class S, similar to a nearby project on Blondy Jhune.
Item "PRESTR CONC DECK SLAB BEAM (6DS23)" was from Nov-2019 average low bid unit prices and was used as "7DS23" with a mark up.
Item "PRESTR CONC BOX BEAM (5B20)" average low bid unit prices was from Feb and Mar 2020 with a mark up.
Item "PRESTR CONC BOX BM(5XB28)(MOD1") was used as "5XB28" with a mark up.
Item "ELASTOMERIC BEARING (E5)" was "assumed" use for superstructure types.
Item "CONCRETE OVERLAY (2 IN)" was used as "overlay" for deck slab beams.

Horizontal Alighment 1 - ROW Take

Property I.D.	Property Address	Owner(s)	Estimated Land Value /SF	Estimated ROW Take	ROW Take Cost
1	805 Bristol Pk	Christopher & Heather Blair	$2.30 / SF	213 SF	$488.98
2	Stinson Rd	Lee G. & Betty A. Bauer	$2.30 / SF	7,635 SF	$17,527.55
3	1190 Stinson Rd	Jennie Ball	$2.30 / SF	823 SF	$1,889.35
4	1180 Stinson Rd	Francisco & Angel Lopez	$2.30 / SF	0 SF	$0.00
5	901 Parchman Pl	Manoj & Beena Pappen	$2.30 / SF	0 SF	$0.00
6	891 Parchman Pl	Laer Trams Co., LLC	$2.30 / SF	0 SF	$0.00
7	871 Parchman Pl	Laer Trams Co., LLC	$2.30 / SF	0 SF	$0.00
8	851 Parchman Pl	Brad J. & Marybeth G. Wilkerson	$2.30 / SF	0 SF	$0.00
9	821 Parchman Pl	Our Country Homes, INC.	$2.30 / SF	0 SF	$0.00
10	800 Bentwater Dr	Our Country Homes, INC.	$2.30 / SF	0 SF	$0.00
11	1015 Stinson Rd	HDT Homes, LLC	$2.30 / SF	0 SF	$0.00
12	1045 Stinson Rd	Shawn N. & Laura K. Warren	$2.30 / SF	0 SF	$0.00
13	1095 Stinson Rd	Joe S. & Peggy S. Athey	$2.30 / SF	0 SF	$0.00
14	1111 Stinson Rd	James & Ann Ellis	$2.30 / SF	7,940 SF	$18,227.73
15	1155 Stinson Rd	Venita Ellis	$2.30 / SF	8,236 SF	$18,907.25
16	1177 Stinson Rd	Roger A. & Janis H. Steven	$2.30 / SF	10,187 SF	$23,386.13
17	1325 Stinson Rd	Richard G. & Renee M. Phillips	$2.30 / SF	9,865 SF	$22,646.92
18	1415 Stinson Rd	Stinson 1415, LLC	$2.30 / SF	2,619 SF	$6,012.40
				47,518 SF	
				Total Cost	**$109,086.32**

Note:
Right-of-way acquistion area was estimated based on commonly used prescriptive 25 ft right-of-way offset from the centerline.
Cost of land in Lucas was provided by City of Lucas to be $100,000.00 per an acre or $2.30 per a square foot.

LAKES ENGINEERING
A BCC Engineering Company

Date: June 3, 2020

Horizontal Alighment 1 - Easement Take

Property I.D.	Property Address	Owner(s)	Estimated Land Value /SF	Estimated ESMT Take	ESMT Take Cost
1	805 Bristol Pk	Christopher & Heather Blair	$0.23 / SF	304 SF	$69.79
2	Stinson Rd	Lee G. & Betty A. Bauer	$0.23 / SF	0 SF	$0.00
3	1190 Stinson Rd	Jennie Ball	$0.23 / SF	0 SF	$0.00
4	1180 Stinson Rd	Francisco & Angel Lopez	$0.23 / SF	0 SF	$0.00
5	901 Parchman Pl	Manoj & Beena Pappen	$0.23 / SF	0 SF	$0.00
6	891 Parchman Pl	Laer Trams Co., LLC	$0.23 / SF	0 SF	$0.00
7	871 Parchman Pl	Laer Trams Co., LLC	$0.23 / SF	0 SF	$0.00
8	851 Parchman Pl	Brad J. & Marybeth G. Wilkerson	$0.23 / SF	0 SF	$0.00
9	821 Parchman Pl	Our Country Homes, INC.	$0.23 / SF	0 SF	$0.00
10	800 Bentwater Dr	Our Country Homes, INC.	$0.23 / SF	0 SF	$0.00
11	1015 Stinson Rd	HDT Homes, LLC	$0.23 / SF	1,123 SF	$257.81
12	1045 Stinson Rd	Shawn N. & Laura K. Warren	$0.23 / SF	1,000 SF	$229.57
13	1095 Stinson Rd	Joe S. & Peggy S. Athey	$0.23 / SF	2,362 SF	$542.24
14	1111 Stinson Rd	James & Ann Ellis	$0.23 / SF	6,378 SF	$1,464.19
15	1155 Stinson Rd	Venita Ellis	$0.23 / SF	6,560 SF	$1,505.97
16	1177 Stinson Rd	Roger A. & Janis H. Steven	$0.23 / SF	7,504 SF	$1,722.68
17	1325 Stinson Rd	Richard G. & Renee M. Phillips	$0.23 / SF	305 SF	$70.02
18	1415 Stinson Rd	Stinson 1415, LLC	$0.23 / SF	109 SF	$25.02
				25,645 SF	
				Total Cost	**$5,887.28**

Note:

Easement acquistion area was estimated based on matching existing 20 ft water/utility easement in vecinity properties.
Cost of Easement in Lucas was provided by City of Lucas to be $10,000.00 per an acre = or $0.23 per a square foot.

LAKES ENGINEERING
A BCC Engineering Company

Date: June 3, 2020

Horizontal Alighment 2 - ROW Take

Property I.D.	Property Address	Owner(s)	Estimated Land Value /SF	Estimated ROW Take	ROW Take Cost
1	805 Bristol Pk	Christopher & Heather Blair	$2.30 / SF	213 SF	$488.98
2	Stinson Rd	Lee G. & Betty A. Bauer	$2.30 / SF	3,631 SF	$8,335.63
3	1190 Stinson Rd	Jennie Ball	$2.30 / SF	0 SF	$0.00
4	1180 Stinson Rd	Francisco & Angel Lopez	$2.30 / SF	0 SF	$0.00
5	901 Parchman Pl	Manoj & Beena Pappen	$2.30 / SF	0 SF	$0.00
6	891 Parchman Pl	Laer Trams Co., LLC	$2.30 / SF	0 SF	$0.00
7	871 Parchman Pl	Laer Trams Co., LLC	$2.30 / SF	0 SF	$0.00
8	851 Parchman Pl	Brad J. & Marybeth G. Wilkerson	$2.30 / SF	0 SF	$0.00
9	821 Parchman Pl	Our Country Homes, INC.	$2.30 / SF	0 SF	$0.00
10	800 Bentwater Dr	Our Country Homes, INC.	$2.30 / SF	0 SF	$0.00
11	1015 Stinson Rd	HDT Homes, LLC	$2.30 / SF	0 SF	$0.00
12	1045 Stinson Rd	Shawn N. & Laura K. Warren	$2.30 / SF	0 SF	$0.00
13	1095 Stinson Rd	Joe S. & Peggy S. Athey	$2.30 / SF	0 SF	$0.00
14	1111 Stinson Rd	James & Ann Ellis	$2.30 / SF	7,940 SF	$18,227.73
15	1155 Stinson Rd	Venita Ellis	$2.30 / SF	8,739 SF	$20,061.98
16	1177 Stinson Rd	Roger A. & Janis H. Steven	$2.30 / SF	19,315 SF	$44,341.14
17	1325 Stinson Rd	Richard G. & Renee M. Phillips	$2.30 / SF	12,783 SF	$29,345.73
18	1415 Stinson Rd	Stinson 1415, LLC	$2.30 / SF	2,619 SF	$6,012.40
				55,240 SF	
				Total Cost	**$126,813.59**

Note:

Right-of-way acquistion area was estimated based on commonly used prescriptive 25 ft right-of-way offset from the centerline. Cost of land in Lucas was provided by City of Lucas to be $100,000.00 per an acre or $2.30 per a square foot.

LAKES ENGINEERING
A BCC Engineering Company

Date: June 3, 2020

Horizontal Alighment 2 - Easement Take

Property I.D.	Property Address	Owner(s)	Estimated Land Value /SF	Estimated ESMT Take	ESMT Take Cost
1	805 Bristol Pk	Christopher & Heather Blair	$0.23 / SF	304 SF	$69.79
2	Stinson Rd	Lee G. & Betty A. Bauer	$0.23 / SF	0 SF	$0.00
3	1190 Stinson Rd	Jennie Ball	$0.23 / SF	0 SF	$0.00
4	1180 Stinson Rd	Francisco & Angel Lopez	$0.23 / SF	0 SF	$0.00
5	901 Parchman Pl	Manoj & Beena Pappen	$0.23 / SF	0 SF	$0.00
6	891 Parchman Pl	Laer Trams Co., LLC	$0.23 / SF	0 SF	$0.00
7	871 Parchman Pl	Laer Trams Co., LLC	$0.23 / SF	0 SF	$0.00
8	851 Parchman Pl	Brad J. & Marybeth G. Wilkerson	$0.23 / SF	0 SF	$0.00
9	821 Parchman Pl	Our Country Homes, INC.	$0.23 / SF	0 SF	$0.00
10	800 Bentwater Dr	Our Country Homes, INC.	$0.23 / SF	0 SF	$0.00
11	1015 Stinson Rd	HDT Homes, LLC	$0.23 / SF	1,123 SF	$257.81
12	1045 Stinson Rd	Shawn N. & Laura K. Warren	$0.23 / SF	1,000 SF	$229.57
13	1095 Stinson Rd	Joe S. & Peggy S. Athey	$0.23 / SF	2,362 SF	$542.24
14	1111 Stinson Rd	James & Ann Ellis	$0.23 / SF	6,378 SF	$1,464.19
15	1155 Stinson Rd	Venita Ellis	$0.23 / SF	6,581 SF	$1,510.79
16	1177 Stinson Rd	Roger A. & Janis H. Steven	$0.23 / SF	7,512 SF	$1,724.52
17	1325 Stinson Rd	Richard G. & Renee M. Phillips	$0.23 / SF	3,071 SF	$705.00
18	1415 Stinson Rd	Stinson 1415, LLC	$0.23 / SF	109 SF	$25.02
				28,440 SF	
				Total Cost	**$6,528.93**

Note:

Easement acquistion area was estimated based on matching existing 20 ft water/utility easement in vecinity properties.

Cost of Easement in Lucas was provided by City of Lucas to be $10,000.00 per an acre = or $0.23 per a square foot.

LAKES ENGINEERING
A BCC Engineering Company

Date: June 3, 2020

APPENDIX B:
Existing Culvert Inspection Report
(Lakes Engineering, Inc. F-15243)

BRIDGE SUMMARY SHEET

City: Lucas County: Collin Name: ______ Structure #: ______ Route: Stinson Road

Description: Double Barrel Pipe Culvert

Feature Crossed: Muddy Creek Inspector's Signature: ______ Date: 6/26/19

Company Name and Company Number: Lakes Engineering, Inc. F-15243

Selected Component Description and Rating:

	Inspection Rating (1085)	Inventory Rating		Operating Rating	
		H	HS	H	HS
Double Barrel Steel Pipe Culvert	5				

Comments and/or Upgrade Recommendations (if applicable):

Loss of backfill at culvert pipe 2 should be investigated and repairs scheduled.

Structurally deficient. Functionally obsolete

Sufficiency Rating = 63

Load Posting Limits for Present Condition (if applicable):

Inventory

______ lbs Gross

______ lbs Tandem Axle

______ lbs Axle or Tandem

______ Sign Code

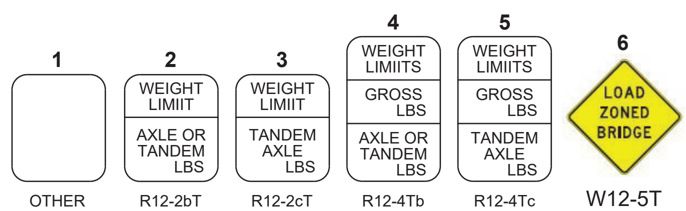
Operating

______ lbs Gross

______ lbs Tandem Axle

______ lbs Axle or Tandem

______ Sign Code



Posting Recommendation: ______

Previous Load Posting Recommendations:

______ R12-2bT X None

______ R12-2cT ______ lbs Gross

______ R12-4Tb ______ lbs Tandem Axle

______ R12-4Tc ______ lbs Axle or Tandem

Observed Load Posting at Bridge:

______ R12-2bT X None

______ R12-2cT ______ lbs Gross

______ R12-4Tb ______ lbs Tandem Axle

______ R12-4Tc ______ lbs Axle or Tandem

______ Other (desc): ______

Material Needed

______ - R12-2bT

______ - R12-2cT

______ - R12-4Tb

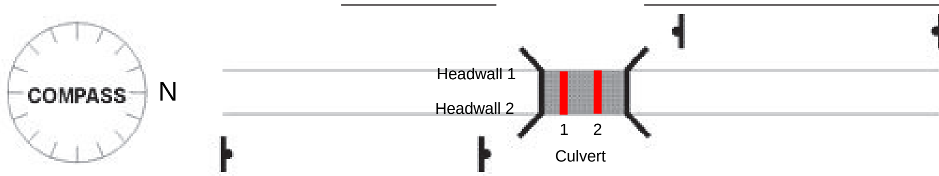
______ - R12-4Tc

______ - W12-5

______ - Posts

______ - Hardware Sets

______ - Decals



	Advanced Warning (optional)		Bridge Approach	Bridge Approach	Advanced Warning (optional)	
Sign Code						
Condition Code						
Maintenance Need						

A. Visible & Legible
B. Obscured by Vegetation
C. Sign Needs Cleaning
D. Improper Position
E. Damaged Beyond Repair
F. Sign Down
G. Sign Missing
H. Sign & Post Missing
J. Clear Vegetation
K. Clean Sign
L. Reposition Sign
M. Reposition Sign & Post
N. None
P. Replace Sign
S. Replace Sign & Post

BRIDGE INSPECTION RECORD

City: Lucas County: Collin Name: ______ Structure #: ______ Route: Stinson Road

Description: Double Barrel Steel Pipe Culvert

Feature Crossed: Muddy Creek Inspector's Signature: ______ Date: 6/26/2019

Company Name and Company Number: Lakes Engineering, Inc. F-15243 Inspector: Christopher Meszler, P.E.

Ratings Defined:

0 = Failed condition - bridge closed and beyond repair
1 = Failing condition - bridge closed but repairable
2 = Critical condition - bridge should be closed until repaired
3 = Serious condition - deterioration seriously affects structural capacity
4 = Poor condition - deterioration significantly affects structural capacity
5 = Fair condition - minor deterioration of structural elements (extensive)
6 = Satisfactory condition - minor deterioration of structural elements (limited)
7 = Good condition - some minor problems
8 = Very good condition - no problems noted
9 = Excellent condition
- = Not applicable

STATE OF TEXAS
CHRISTOPHER P. MESZLER
112052
LICENSED
PROFESSIONAL ENGINEER

08-01-2019

Enter a rating for each element of each component. Component ratings should equal the lowest rating of any element of the component, except for Deck. The Deck component is independent of its' associated element ratings. Fully supportive comments are to be made hereon or on attachments for all ratings of 7 or below.

General Comment:

Sufficiency Rating = 63
Structurally deficient: waterway adequacy rating (2). Functionally obsolete: waterway adequacy (2) & deck Geometry (3)

DECK (Item 58)

Minimum	Description	Rating	Comments
1	Deck - Rating	N	Elements are referred to and numbered:
6	Wearing Surface	6	south (begin) to north (end) and west to east.
6	Joints, Expansion, Open	-	
6	Joints, Expansion, Sealed	-	Photo 4: Lt lane, marginal longitudinal cracking (Typ.)
6	Joints, Other	-	
6	Drainage System	-	Photo 5: Rt lane, substantial longitudinal cracking (Typ.)
6	Curbs, Sidewalks & Parapets	-	
6	Median Barrier	-	Photo 6: Asphalt pavement edge failure all 4 corners (Typ.)
6	Railings	-	
7	Railing Protective Coating	-	Photo 7: Substantial failure northwest pavement edge (12")
7	Delineation (curve Markers)	-	
	Other	-	See additional comments.

SUPERSTRUCTURE (Item 59)

Minimum	Description	Rating	Comments
0	Main Members - Steel		
0	Main Members - Concrete		
0	Main Members - Timber		
0	Main Members - Connections		
1	Floor System Members		
1	Floor System Connections		
5	Secondary Members		
5	Secondary Members Connections		
6	Expansion Bearings		
6	Fixed Bearings		
6	Steel Protective Coating		
	Other		
	Component Rating	N	

BRIDGE INSPECTION RECORD

City: Lucas County: Collin Name: Structure #: Route: Stinson Road

SUBSTRUCTURE (Item 60)

Minimum	Description	Rating	Comments
0	Abutment Caps		
0	Above Ground		
0	Below Ground or Foundation		
0	Backwalls and Wingwalls		
0	Intermediate Supports		
	Caps - Concrete		
	Caps - Steel		
	Caps - Timber		
	Above Ground - Concrete		
	Above Ground - Steel		
	Above Ground - Timber		
	Above Ground - Masonry		
	Below Ground or Foundation		
5	Collision Protection System		
6	Steel Protective Coating		
	Component Rating	N	

CHANNEL (Item 61)

Minimum	Description	Rating	Comments
0	Channel Banks	6	
0	Channel Bed	6	
5	Rip Rap, Toe Walls and Aprons	N	
5	Dikes	N	
5	Jetties	N	
	Other		
	Component Rating	6	

CULVERTS (Item 62)

Minimum	Description	Rating	Comments
0	Top Slabs	-	Photo 9: Thickness along Headwall 1 Varies (6-8")
0	Bottom Slab or Footing	7	
0	Abutments & Intermediate Supports	-	Photo 10: 10" x 4" x 1" Spall Midspan Headwall 1
5	Headwalls and Wingwalls	6	
	Other	5	Photo 11: 0.025" crack midspan headwall 1, full depth. crack continues approx. 7.5' down headwall
	Component Rating	5	See additional comments.

BRIDGE INSPECTION RECORD

City: Lucas County: Collin Name: ______ Structure #: ______ Route: Stinson Road

APPROACHES

Minimum	Description	Rating	Comments
0	Embankments	6	Photo 29: 6' drop off within 1' of EOP (currently under construction)
4	Embankment Retaining Walls	N	
5	Slope Protection	N	
5	Roadway	5	
6	Relief Joints	N	
6	Drainage	N	
6	Guardfence	N	
7	Delineation	N	
7	Sight Distance	8	
	Other		
	Component Rating	5	

MISCELLANEOUS

Minimum	Description	Rating	Comments
7	Signs		
7	Illumination		
7	Warning Devices		
7	Utility Lines		
	Other - Gates	8	

TRAFFIC SAFETY (Item 36)

	Description	Rating	Comments
	Bridge Railing (036.1)	0	Guardrail and Bridge railing not present
	Transitions (036.2)	0	
	Approach Guardrail (036.3)	0	
	Approach Guardrail Ends (036.4)	0	

APPRAISAL RATINGS

	Description	Rating	Comments
	Waterway Adequacy (071)	2	Frequent overtopping with significant traffic delays (major collector)
	Approach Roadway Alignment (072)	8	

BRIDGE INSPECTION RECORD
ADDITIONAL COMMENTS

City: Lucas County: Collin Name: Stinson Rd Bridge Structure #: Route: Stinson Road

Description: Double Barrel Steel Pipe Culvert

Feature Crossed: Muddy Creek Inspector's Signature: Date: 6/26/2019

Company Name and Company Number: Lakes Engineering, Inc. F-15243 Inspector: Christopher Meszler, P.E.

DECK (Item 58)

Photo Num.	Comments
16	Railing connection at headwall 2 in good condition
29	6’ drop off 1’ off the road (currently under construction)

CULVERTS (Item 62)

Photo Num.	Comments
12	Honey combing of culvert 1 at headwall 1 (Typ.)
13	16” x 5” x 1.5” spall and 36” x 0.05” crack near culvert 1
14	Spall and 6’ x .030" crack north of culvert 2, headwall 1
15	Headwall 2 out of plumb
17	Crack and 8” x 5” x 2.5” Spall at headwall 2, top, midspan
18	Evidence of flooding at headwall 2
19	3” x 0.50” crack at first railing support connection to headwall 2
21	Spall at headwall 2, culvert 1 (Likely resulting from construction)
22	5’ horizontal crack at headwall 2, culvert 1
23	19” x 1/8” crack at wingwall 1
24	Approximately 1 ft of scour at outfall and exposed incased utility
25	Scour/erosion at outlet headwall above pipe. Loss of backfill
26	Culvert 1 pipe good condition
27	Moderate corrosion and sediment buildup inside culvert 2
28	Undermining of headwall 1 at midspan

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

01: Elevation – West View

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

02: Approach – Southbound

BRIDGE INSPECTION RECORD
Photos

City: Lucas   County: Collin   Name: Stinson Road Bridge   Structure #: 004   Route: Stinson Road

03: Approach – Northbound

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

04: Top of Deck – North View

Left lane with Marginal longitudinal cracking (Typ.).

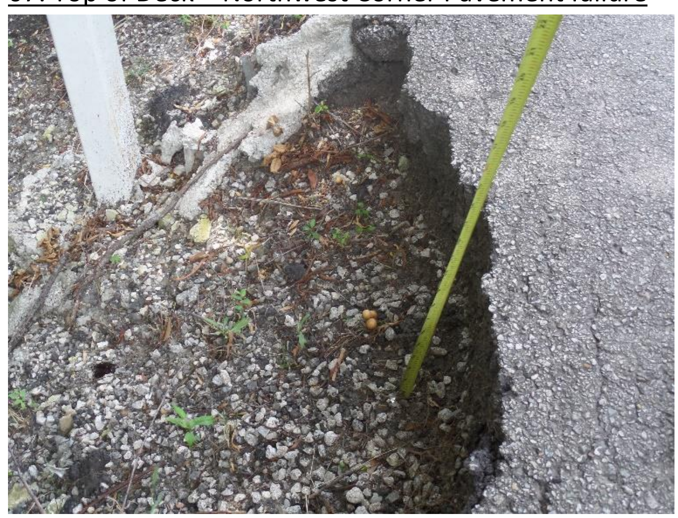
05: Top of Deck – North View

Right Lane substantial longitudinal cracking.

06: Top of Deck – Southwest Corner Pavement failure

Asphalt Pavement edge failure in all four corners (Typ.)

07: Top of Deck – Northwest Corner Pavement failure



Substantial pavement failure (12”)

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

08: Headwall 1 – North View

Typical - no deficiencies noted.

9: Headwall 1 – Top View

Headwall thickness varies from 6” to 8”

10: Headwall 1 – Top View

10” x 4” x 1” Spall midspan

11: Headwall 1

0.025” crack midspan headwall 1, full depth. crack continues approx. 7.5' down headwall

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

12: Headwall 1, Culvert 1

Honeycombing (typ.)

13: Headwall 1, Culvert 1

16” x 5” x 1.5” spall and 36” x 0.05” crack near culvert 1

14: Headwall 1, Culvert 2

Spall and 6’ x .030" crack north of culvert 2, headwall 1

15: Headwall 2 – North View

Headwall 2 out of plumb

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

16: Railing Connection – Headwall 2

Railing/gate connection in good condition

17: Headwall 2 – Midspan

Crack and 8” x 5” x 2.5” spall at headwall 2, top, midspan

18: Headwall 2 – Midspan

Evidence of flooding

19: Headwall 2

3” x .05” crack at first railing support connection to headwall 2

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

20: Headwall 2, Culvert 1

21: Headwall 2, Culvert 1

Spall at headwall 2, culvert 1 (Likely resulting from construction)

22: Headwall 2, Culvert 1

5’ Horizontal crack near culvert 1

23: Wingwall 1 – Southwest Corner

19” x 1/8” crack at wingwall 1

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

24: Headwall 2, Culvert 2 - Encased Utility & Waterway

Approximately 1 ft scour at outfall and exposed encased utility

25: Headwall 2, Culvert 2

Scour/erosion at outlet headwall above pipe. Loss of backfill

26: Inside of Culvert 1, East View

Typical – no deficiencies noted

27: Inside of Culvert 2, East View

Moderate corrosion and sediment build up along bottom

BRIDGE INSPECTION RECORD
Photos

City: Lucas County: Collin Name: Stinson Road Bridge Structure #: 004 Route: Stinson Road

28: Channel – West Side

Undermining of headwall 1 at midspan

29: Southwest Corner Pavement Dropoff

6’ drop off 1’ off the road (currently under construction)

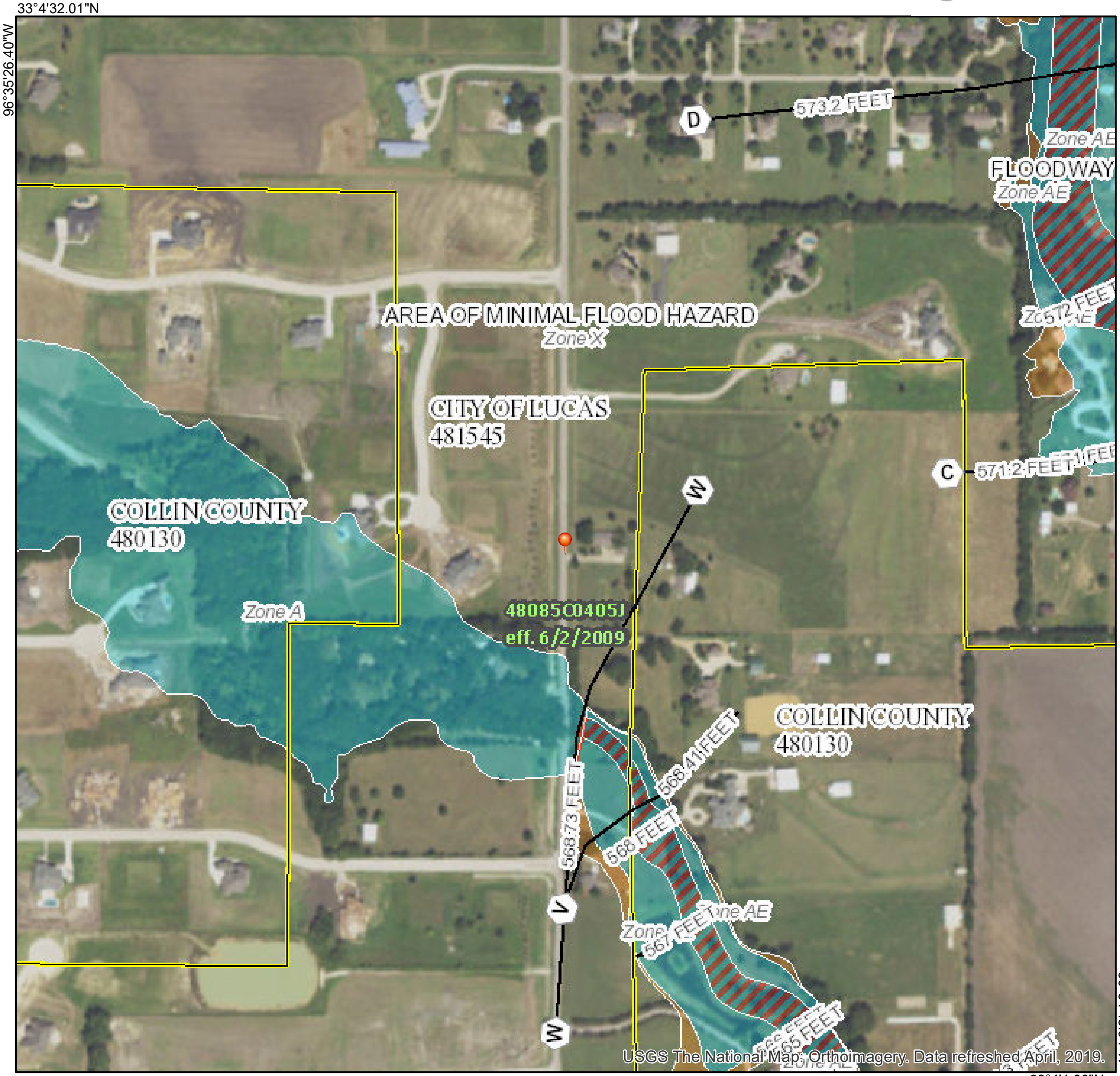
APPENDIX C:
References

National Flood Hazard Layer FIRMette

FEMA

33°4'32.01"N

96°35'26.40"W



96°34'48.94"W

33°4'1.86"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/31/2019 at 10:39:36 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

STRUCTURE	DESIGNED BEAMS (STRAIGHT STRANDS)			PRESTRESSING STRANDS							DEBONDED STRANDS PER ROW								CONCRETE		OPTIONAL DESIGN				
	SPAN LENGTH (ft)	BEAM NO.	BEAM TYPE	NON-STD STRAND PATTERN	TOTAL NO.	SIZE (in)	STRGTH fpu (ksi)	"e" ℄ (in)	"e" END (in)	TOT NO. DEB	DIST FROM BOTTOM (in)	NO. OF STRANDS TOTAL	NO. OF STRANDS DE-BONDED	NUMBER OF STRANDS DEBONDED TO (ft from end) 3	6	9	12	15	RELEASE STRGTH (1) f'ci (ksi)	MINIMUM 28 DAY COMP STRGTH f'c (ksi)	DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I) fct (ksi)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III) fcb (ksi)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I) (kip-ft)	LIVE LOAD DISTRIBUTION FACTOR (2) Moment	Shear
24' ROADWAY SB12 BEAM	25	ALL	5SB12		8	0.6	270	3.50	3.50	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.914	-1.217	448	0.450	0.450
	30	ALL	5SB12		10	0.6	270	3.50	3.50	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.292	-1.685	530	0.450	0.450
	35	ALL	5SB12		14	0.6	270	3.50	3.50	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.730	-2.219	675	0.450	0.450
	40	ALL	5SB12		18	0.6	270	3.50	3.50	0	2.50	18	0	0	0	0	0	0	4.000	5.000	2.218	-2.796	820	0.440	0.440
24' ROADWAY SB15 BEAM	25	ALL	5SB15		8	0.6	270	5.00	5.00	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.725	-0.897	551	0.450	0.450
	30	ALL	5SB15		8	0.6	270	5.00	5.00	0	2.50	8	0	0	0	0	0	0	4.000	5.000	1.020	-1.244	574	0.450	0.450
	35	ALL	5SB15		10	0.6	270	5.00	5.00	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.361	-1.640	708	0.450	0.450
	40	ALL	5SB15		14	0.6	270	5.00	5.00	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.739	-2.068	864	0.440	0.440
	45	ALL	5SB15		18	0.6	270	5.00	5.00	2	2.50	18	2	2	0	0	0	0	4.000	5.000	2.179	-2.574	1054	0.440	0.440
	50	ALL	5SB15		24	0.6	270	5.00	5.00	8	2.50	24	8	4	4	0	0	0	4.000	5.000	2.680	-3.153	1276	0.440	0.440
28' ROADWAY SB12 BEAM	25	ALL	5SB12		8	0.6	270	3.50	3.50	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.903	-1.184	444	0.430	0.430
	30	ALL	5SB12		10	0.6	270	3.50	3.50	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.276	-1.639	508	0.430	0.430
	35	ALL	5SB12		12	0.6	270	3.50	3.50	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.708	-2.159	647	0.430	0.430
	40	ALL	5SB12		18	0.6	270	3.50	3.50	0	2.50	18	0	0	0	0	0	0	4.000	5.000	2.200	-2.744	799	0.430	0.430
28' ROADWAY SB15 BEAM	25	ALL	5SB15		8	0.6	270	5.00	5.00	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.716	-0.874	529	0.430	0.430
	30	ALL	5SB15		8	0.6	270	5.00	5.00	0	2.50	8	0	0	0	0	0	0	4.000	5.000	1.007	-1.212	570	0.430	0.430
	35	ALL	5SB15		10	0.6	270	5.00	5.00	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.343	-1.598	680	0.430	0.430
	40	ALL	5SB15		14	0.6	270	5.00	5.00	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.725	-2.032	842	0.430	0.430
	45	ALL	5SB15		18	0.6	270	5.00	5.00	2	2.50	18	2	2	0	0	0	0	4.000	5.000	2.149	-2.508	1013	0.420	0.420
	50	ALL	5SB15		22	0.6	270	5.00	5.00	6	2.50	22	6	4	2	0	0	0	4.000	5.000	2.643	-3.073	1227	0.420	0.420
30' ROADWAY SB12 BEAM	25	ALL	4SB12		6	0.6	270	3.50	3.50	0	2.50	6	0	0	0	0	0	0	4.000	5.000	0.904	-1.187	341	0.340	0.340
	30	ALL	4SB12		8	0.6	270	3.50	3.50	0	2.50	8	0	0	0	0	0	0	4.000	5.000	1.277	-1.646	407	0.340	0.340
	35	ALL	4SB12		10	0.6	270	3.50	3.50	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.711	-2.169	518	0.340	0.340
	40	ALL	4SB12		14	0.6	270	3.50	3.50	0	2.50	14	0	0	0	0	0	0	4.000	5.000	2.205	-2.758	640	0.340	0.340
30' ROADWAY SB15 BEAM	25	ALL	4SB15		6	0.6	270	5.00	5.00	0	2.50	6	0	0	0	0	0	0	4.000	5.000	0.723	-0.888	431	0.350	0.350
	30	ALL	4SB15		6	0.6	270	5.00	5.00	0	2.50	6	0	0	0	0	0	0	4.000	5.000	1.017	-1.231	438	0.350	0.350
	35	ALL	4SB15		8	0.6	270	5.00	5.00	0	2.50	8	0	0	0	0	0	0	4.000	5.000	1.346	-1.605	545	0.340	0.340
	40	ALL	4SB15		12	0.6	270	5.00	5.00	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.729	-2.043	675	0.340	0.340
	45	ALL	4SB15		14	0.6	270	5.00	5.00	2	2.50	14	2	2	0	0	0	0	4.000	5.000	2.166	-2.542	823	0.340	0.340
	50	ALL	4SB15		18	0.6	270	5.00	5.00	4	2.50	18	4	2	2	0	0	0	4.000	5.000	2.665	-3.115	998	0.340	0.340

(1) Based on the following allowable stresses (ksi):

Compression = 0.65 f'ci

Tension = $0.24\sqrt{f'ci}$

Optional designs must likewise conform.

(2) Portion of full HL93.

DESIGN NOTES:

Designed according to AASHTO LRFD Bridge Design Specifications.

Prestress losses for the designed beams have been calculated for a relative humidity of 60 percent. Optional designs must likewise conform.

FABRICATION NOTES:

Provide Class H concrete.

Provide Grade 60 reinforcing steel.

Use low relaxation strands, each pretensioned to 75 percent of fpu.

Full-length debonded strands are not permitted in positions "A" and "B".

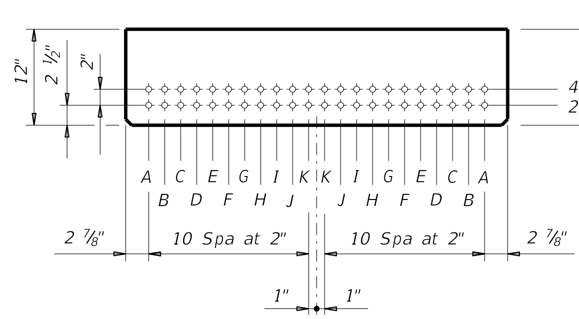
Strand debonding must comply with Item 424.4.2.2.2.4.

When shown on this sheet, the Fabricator has the option of furnishing either the designed beam or an approved optional beam design. All optional design submittals and shop drawings must be signed, sealed and dated by a Professional Engineer registered in the State of Texas.

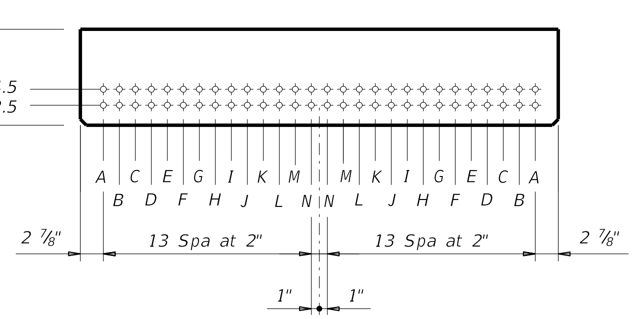
Locate strands for the designed beam as low as possible on the 2" grid system unless a non-standard strand pattern is indicated. Fill row "2.5", then row "4.5". Place strands within a row as follows:

1) Locate a strand in each "A" position.
2) Place strand symmetrically about vertical centerline of beam.
3) Space strands as equally as possible across the entire width.

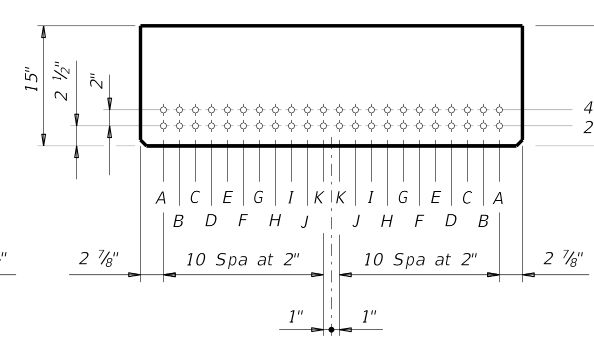
Do not debond strands in position "A". Distribute debonded strands symmetrically about the vertical centerline. Increase debonded lengths working outward, with debonding staggered in each row.



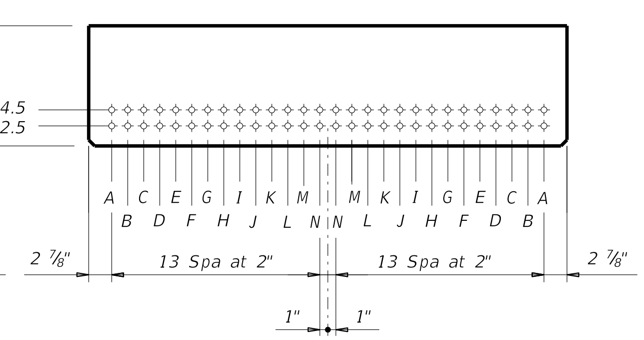
TxDOT 4SB12 SLAB BEAM



TxDOT 5SB12 SLAB BEAM



TxDOT 4SB15 SLAB BEAM



TxDOT 5SB15 SLAB BEAM

HL93 LOADING

Texas Department of Transportation | Bridge Division Standard

PRESTRESSED CONCRETE SLAB BEAM STD DESIGNS

(TY SB12 OR SB15)

24', 28' & 30' ROADWAY

PSBSD

FILE: psbsts08-17.dgn	DN: SRW	CK: BMP	DW: SFS	CK: SDB
©TxDOT January 2017	CONT	SECT	JOB	HIGHWAY
REVISIONS				
	DIST	COUNTY		SHEET NO.

DATE:
FILE:

DISCLAIMER:
The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

DESIGNED BEAMS (STRAIGHT STRANDS) / OPTIONAL DESIGN

STRUCTURE	SPAN LENGTH (ft)	BEAM NO.	BEAM TYPE	PRESTRESSING STRANDS: NON-STD STRAND PATTERN	TOTAL NO.	SIZE (in)	STRGTH fpu (ksi)	"e" ℄ (in)	"e" END (in)	TOT NO. DEB	DEBONDED STRAND PATTERN PER ROW: DIST FROM BOTTOM (in)	NO. OF STRANDS: TOTAL	NO. OF STRANDS: DE-BONDED	NUMBER OF STRANDS DEBONDED TO (ft from end): 3	6	9	12	15	CONCRETE: RELEASE STRGTH ① f'ci (ksi)	MINIMUM 28 DAY COMP STRGTH f'c (ksi)	OPTIONAL DESIGN: DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I) fct(ksi)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III) fcb(ksi)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I) (ft-kips)	LIVE LOAD DISTRIBUTION FACTOR ② Moment	Shear
28' ROADWAY 7DS20 BEAM	30	ALL	7DS20		10	0.6	270	8.73	8.73	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.128	-1.251	797	0.710	0.710
	35	ALL	7DS20		14	0.6	270	8.73	8.73	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.429	-1.594	1001	0.700	0.700
	40	ALL	7DS20		16	0.6	270	8.73	8.73	0	2.50	16	0	0	0	0	0	0	4.000	5.000	1.753	-1.968	1218	0.690	0.690
	45	ALL	7DS20		20	0.6	270	8.73	8.73	2	2.50	20	2	2	0	0	0	0	4.000	5.000	2.120	-2.392	1464	0.680	0.680
	50	ALL	7DS20		26	0.6	270	8.73	8.73	6	2.50	26	6	2	4	0	0	0	4.000	5.000	2.568	-2.905	1768	0.680	0.680
28' ROADWAY 7DS23 BEAM	30	ALL	7DS23		10	0.6	270	10.53	10.53	0	2.50	10	0	0	0	0	0	0	4.000	5.000	0.870	-0.986	900	0.710	0.710
	35	ALL	7DS23		12	0.6	270	10.53	10.53	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.102	-1.257	1007	0.700	0.700
	40	ALL	7DS23		14	0.6	270	10.53	10.53	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.353	-1.553	1227	0.690	0.690
	45	ALL	7DS23		16	0.6	270	10.53	10.53	0	2.50	16	0	0	0	0	0	0	4.000	5.000	1.638	-1.889	1475	0.680	0.680
	50	ALL	7DS23		20	0.6	270	10.53	10.53	0	2.50	20	0	0	0	0	0	0	4.000	5.000	1.984	-2.294	1782	0.680	0.680
	55	ALL	7DS23		24	0.6	270	10.53	10.53	2	2.50	24	2	2	0	0	0	0	4.000	5.000	2.334	-2.706	2086	0.670	0.670
	60	ALL	7DS23		30	0.6	270	10.40	10.37	6	2.50	28	6	2	2	2	0	0	4.000	5.000	2.722	-3.165	2425	0.670	0.670

DESIGN NOTES:
Designed in accordance with AASHTO LRFD Bridge Design Specifications.
Prestress losses for the designed beams have been calculated for a relative humidity of 60 percent. Optional designs must likewise conform.
Beam designs are applicable for 2" ACP overlay and 0 through 30 degree skews.

FABRICATION NOTES:
Provide Class H concrete.
Provide Grade 60 reinforcing steel bars.
Use low relaxation strands, each pretensioned to 75 percent of fpu.
When shown on this sheet, the Fabricator has the option of furnishing either the designed beam or an approved optional beam design. All optional design submittals and shop drawings must be signed, sealed and dated by a Professional Engineer registered in the State of Texas.
Locate strands for the designed beam as low as possible on the 2" grid system unless a non-standard stand pattern is indicated. Fill row "2.5", then row "4.5". Place strands within a row as follows:
1) Locate a strand in each "1" position.
2) Place strand symmetrically about vertical centerline of box.
3) Space strands as equally as possible across the entire width.
Strand debonding must comply with Item 424.4.2.2.2.4.
Do not debond strands in position "1". Distribute debonded strands equally about the vertical centerline. Decrease debonded lengths working inward, with debonding staggered in each row.
Full-length debonded strands are not permitted in positions "1" through "3".

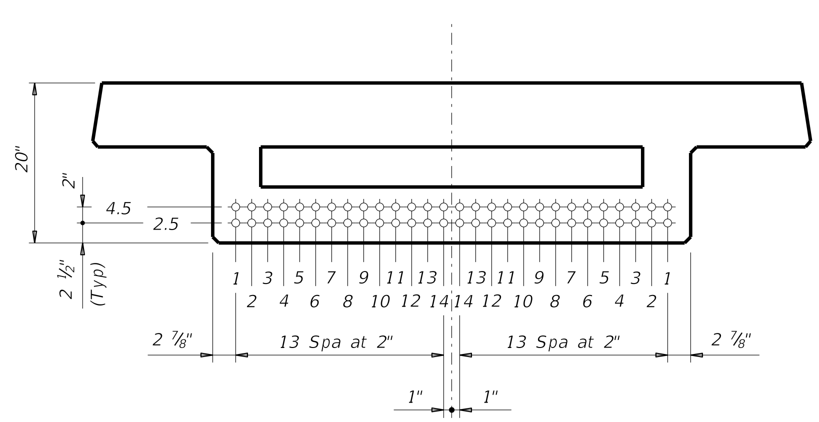
① Based on the following allowable stresses (ksi):

Compression = 0.65 f'ci

Tension = $0.24 \sqrt{f'ci}$

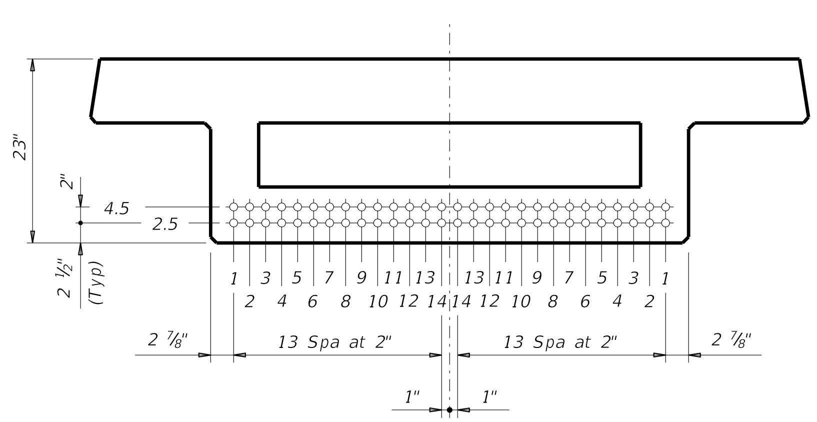
Optional designs must likewise conform.

② Portion of full HL93.



TxDOT 7DS20 DECKED SLAB BEAM

(Showing interior beam, exterior beam similar.)



TxDOT 7DS23 DECKED SLAB BEAM

(Showing interior beam, exterior beam similar.)

HL93 LOADING

Texas Department of Transportation | Bridge Division Standard

PRESTRESSED CONCRETE DECKED SLAB BEAM STANDARD DESIGNS

28' ROADWAY

DSBSD-28

FILE: dsbsts15.dgn	DN: GPT	CK: BMP	DW: SFS	CK: SDB
©TxDOT September 2010	CONT	SECT	JOB	HIGHWAY
REVISIONS				
04-11: f'ci and LLDF. 01-16: Notes, 0.6" strand designs.	DIST	COUNTY		SHEET NO.

DATE:
FILE:

DESIGNED BEAMS (STRAIGHT STRANDS) / OPTIONAL DESIGN

STANDARD SBBS-B20-28	SPAN LENGTH (ft)	BEAM NO.	BEAM TYPE	PRESTRESSING STRANDS: NON-STD STRAND PATTERN	TOTAL NO.	SIZE (in)	STRGTH fpu (ksi)	"e" ℄ (in)	"e" END (in)	DEBONDED STRAND PATTERN PER ROW: TOT NO. DEB	DIST FROM BOTTOM (in)	NO. OF STRANDS: TOTAL	NO. OF STRANDS: DE-BONDED	NUMBER OF STRANDS DEBONDED TO (ft from end): 3	6	9	12	15	CONCRETE: RELEASE STRGTH (1) f'ci (ksi)	CONCRETE: MINIMUM 28 DAY COMP STRGTH f'c (ksi)	OPTIONAL DESIGN: DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I) fct(ksi)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III) fcb(ksi)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I) (ft-kips)	LIVE LOAD DISTRIBUTION FACTOR (2): Moment	Shear
	30	ALL	5B20		8	0.6	270	7.38	7.38	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.654	-0.828	715	0.454	0.691
	35	ALL	5B20		8	0.6	270	7.38	7.38	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.861	-1.069	796	0.440	0.680
28' Roadway	40	ALL	5B20		10	0.6	270	7.38	7.38	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.092	-1.335	890	0.427	0.671
5" Slab	45	ALL	5B20		10	0.6	270	7.38	7.38	0	2.50	10	0	0	0	0	0	0	4.000	5.000	1.356	-1.638	980	0.417	0.663
	50	ALL	5B20		14	0.6	270	7.38	7.38	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.658	-1.988	1172	0.408	0.655
	55	ALL	5B20		16	0.6	270	7.38	7.38	0	2.50	16	0	0	0	0	0	0	4.000	5.000	1.985	-2.364	1374	0.400	0.649
	60	ALL	5B20		20	0.6	270	7.38	7.38	2	2.50	20	2	2	0	0	0	0	4.000	5.000	2.339	-2.766	1587	0.393	0.643
	65	ALL	5B20		24	0.6	270	7.38	7.38	6	2.50	24	6	2	2	0	2	0	4.000	5.000	2.720	-3.197	1811	0.387	0.638

DESIGN NOTES:

Designed in accordance with AASHTO LRFD Bridge Design Specifications.

Prestress losses for the designed beams have been calculated for a relative humidity of 60 percent. Optional designs must likewise conform.

Beam designs are applicable for 5" concrete slabs without overlay and 0 degree skew.

FABRICATION NOTES:

Provide Class H concrete.

Provide Grade 60 reinforcing steel bars.

Use low relaxation strands, each pretensioned to 75 percent of fpu.

When shown on this sheet, the Fabricator has the option of furnishing either the designed beam or an approved optional beam design. All optional design submittals and shop drawings must be signed, sealed and dated by a Professional Engineer registered in the State of Texas.

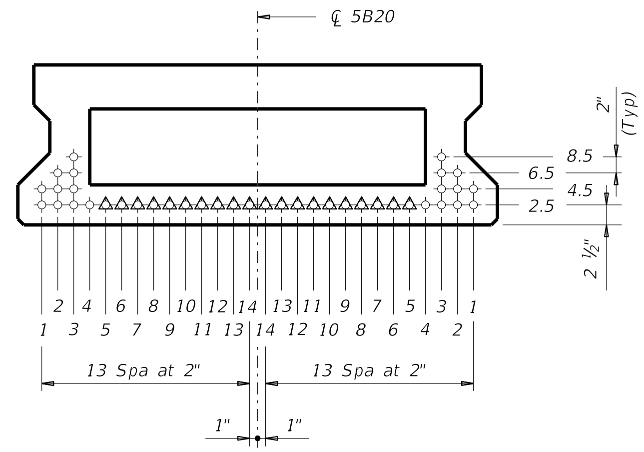
Locate strands for the designed beam as low as possible on the 2" grid system unless a non-standard stand pattern is indicated. Fill row "2.5", then row "4.5", then row "6.5", etc. Place strands within a row as follows:

1) Locate a strand in each "1" position.
2) Place strand symmetrically about vertical centerline of box.
3) Space strands as equally as possible across the entire width.

Strand debonding must comply with Item 424.4.2.2.2.4.

Do not debond strands in position "1". Distribute debonded strands equally about the vertical centerline. Decrease debonded lengths working inward, with debonding staggered in each row.

Full-length debonded strands are only permitted in positions marked △.



TxDOT 5B20 BOX BEAM

(1) Based on the following allowable stresses (ksi):

Compression = 0.65 f'ci

Tension = $0.24\sqrt{f'ci}$

Optional designs must likewise conform.

(2) Portion of full HL93.

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DATE:
FILE:

HL93 LOADING

Texas Department of Transportation — Bridge Division Standard

PRESTR CONC BOX BEAM STANDARD DESIGNS

TYPE B20 28' RDWY (WITH SLAB)

BBSDS-B20-28

FILE: bbstds25.dgn	DN: SRW	CK: BMP	DW: SFS	CK: SDB
©TxDOT December 2006	CONT	SECT	JOB	HIGHWAY
REVISIONS				
04-11: f'ci and LLDF. 01-16: Notes, 0.6" strand designs.	DIST	COUNTY		SHEET NO.

DISCLAIMER:
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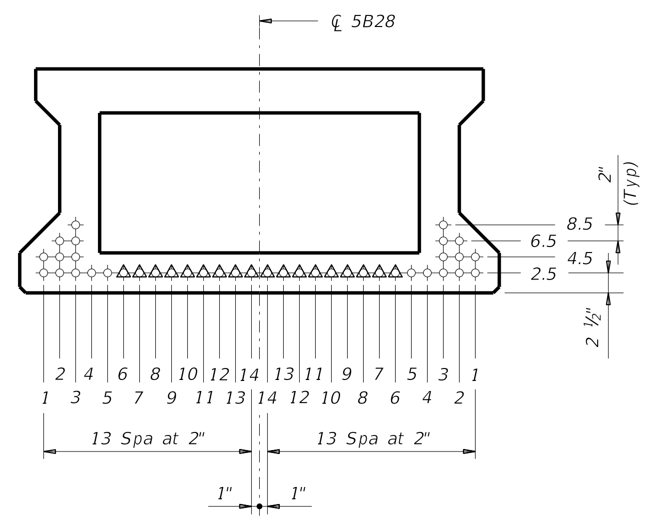
DESIGNED BEAMS (STRAIGHT STRANDS) / OPTIONAL DESIGN

STANDARD SBBS-B28-28	SPAN LENGTH (ft)	BEAM NO.	BEAM TYPE	PRESTRESSING STRANDS: NON-STD STRAND PATTERN	TOTAL NO.	SIZE (in)	STRGTH fpu (ksi)	"e" ℄ (in)	"e" END (in)	TOT NO. DEB	DEBONDED STRAND PATTERN PER ROW: DIST FROM BOTTOM (in)	NO. OF STRANDS: TOTAL	NO. OF STRANDS: DE-BONDED	NUMBER OF STRANDS DEBONDED TO (ft from end): 3	6	9	12	15	CONCRETE: RELEASE STRGTH (1) f'ci (ksi)	MINIMUM 28 DAY COMP STRGTH f'c (ksi)	OPTIONAL DESIGN: DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I) fct(ksi)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III) fcb(ksi)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I) (ft-kips)	LIVE LOAD DISTRIBUTION FACTOR (2): Moment	Shear
	30	ALL	5B28		8	0.6	270	11.24	11.24	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.457	-0.544	757	0.461	0.700
	35	ALL	5B28		8	0.6	270	11.24	11.24	0	2.50	8	0	0	0	0	0	0	4.000	5.000	0.599	-0.704	950	0.447	0.689
28' Roadway	40	ALL	5B28		10	0.6	270	11.24	11.24	0	2.50	10	0	0	0	0	0	0	4.000	5.000	0.759	-0.880	1157	0.434	0.679
5" Slab	45	ALL	5B28		10	0.6	270	11.24	11.24	0	2.50	10	0	0	0	0	0	0	4.000	5.000	0.942	-1.081	1342	0.424	0.671
	50	ALL	5B28		12	0.6	270	11.24	11.24	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.150	-1.313	1477	0.415	0.664
	55	ALL	5B28		12	0.6	270	11.24	11.24	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.377	-1.562	1477	0.407	0.657
	60	ALL	5B28		14	0.6	270	11.24	11.24	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.620	-1.828	1707	0.399	0.651
	65	ALL	5B28		16	0.6	270	11.24	11.24	0	2.50	16	0	0	0	0	0	0	4.000	5.000	1.883	-2.113	1952	0.393	0.646
	70	ALL	5B28		18	0.6	270	11.24	11.24	0	2.50	18	0	0	0	0	0	0	4.000	5.000	2.163	-2.416	2208	0.387	0.641
	75	ALL	5B28		22	0.6	270	11.24	11.24	2	2.50	22	2	2	0	0	0	0	4.000	5.000	2.461	-2.738	2477	0.382	0.636
	80	ALL	5B28		26	0.6	270	11.24	11.24	4	2.50	26	4	0	2	0	2	0	4.000	5.000	2.778	-3.078	2758	0.377	0.632

DESIGN NOTES:
Designed in accordance with AASHTO LRFD Bridge Design Specifications.
Prestress losses for the designed beams have been calculated for a relative humidity of 60 percent. Optional designs must likewise conform.
Beam designs are applicable for 5" concrete slabs without overlay and 0 degree skew.

FABRICATION NOTES:
Provide Class H concrete.
Provide Grade 60 reinforcing steel bars.
Use low relaxation strands, each pretensioned to 75 percent of fpu.
When shown on this sheet, the Fabricator has the option of furnishing either the designed beam or an approved optional beam design. All optional design submittals and shop drawings must be signed, sealed and dated by a Professional Engineer registered in the State of Texas.
Locate strands for the designed beam as low as possible on the 2" grid system unless a non-standard stand pattern is indicated. Fill row "2.5", then row "4.5", then row "6.5", etc. Place strands within a row as follows:
1) Locate a strand in each "1" position.
2) Place strand symmetrically about vertical centerline of box.
3) Space strands as equally as possible across the entire width.
Strand debonding must comply with Item 424.4.2.2.2.4.
Do not debond strands in position "1". Distribute debonded strands equally about the vertical centerline. Decrease debonded lengths working inward, with debonding staggered in each row.
Full-length debonded strands are only permitted in positions marked △.



TxDOT 5B28 BOX BEAM

(1) Based on the following allowable stresses (ksi):

Compression = 0.65 f'ci

Tension = $0.24\sqrt{f'ci}$

Optional designs must likewise conform.

(2) Portion of full HL93.

HL93 LOADING

Texas Department of Transportation — Bridge Division Standard

PRESTR CONC BOX BEAM STANDARD DESIGNS
TYPE B28 28' RDWY (WITH SLAB)

BBSDS-B28-28

FILE: bbstds27.dgn	DN: SRW	CK: BMP	DW: SFS	CK: SDB
©TxDOT December 2006	CONT	SECT	JOB	HIGHWAY
REVISIONS				
04-11: f'ci and LLDF. 01-16: Notes, 0.6" stand designs.	DIST	COUNTY		SHEET NO.

DATE:
FILE:

DESIGNED BEAMS (STRAIGHT STRANDS) / OPTIONAL DESIGN

STRUCTURE	SPAN LENGTH (ft)	BEAM NO.	BEAM TYPE	PRESTRESSING STRANDS: NON-STD STRAND PATTERN	PRESTRESSING STRANDS: TOTAL NO.	PRESTRESSING STRANDS: SIZE (in)	PRESTRESSING STRANDS: STRGTH fpu (ksi)	PRESTRESSING STRANDS: "e" ℄ (in)	PRESTRESSING STRANDS: "e" END (in)	DEBONDED STRAND PATTERN PER ROW: TOT NO. DEB	DEBONDED: DIST FROM BOTTOM (in)	DEBONDED: NO. OF STRANDS TOTAL	DEBONDED: NO. OF STRANDS DE-BONDED	NUMBER OF STRANDS DEBONDED TO (ft from end): 3	6	9	12	15	CONCRETE: RELEASE STRGTH (1) f'ci (ksi)	CONCRETE: MINIMUM 28 DAY COMP STRGTH f'c (ksi)	OPTIONAL DESIGN: DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I) fct(ksi)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III) fcb(ksi)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I) (ft-kips)	LIVE LOAD DISTRIBUTION FACTOR (2) Moment	LIVE LOAD DISTRIBUTION FACTOR (2) Shear
TYPE 5XB20	40	ALL	5XB20		12	0.6	270	7.03	7.03	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.231	-1.621	1255	0.688	0.903
X-BEAMS	45	ALL	5XB20		14	0.6	270	7.03	7.03	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.557	-1.997	1498	0.667	0.897
32' Roadway	50	ALL	5XB20		20	0.6	270	7.03	7.03	0	2.50	20	0	0	0	0	0	0	4.000	5.000	1.926	-2.432	1787	0.649	0.891
8" Slab	55	ALL	5XB20		24	0.6	270	7.03	7.03	4	2.50	24	4	2	2	0	0	0	4.000	5.000	2.333	-2.901	2090	0.633	0.887
	60	ALL	5XB20		30	0.6	270	6.90	6.87	6	2.50	28	6	2	2	2	0	0	4.400	5.000	2.777	-3.406	2407	0.619	0.883
	65	ALL	5XB20		36	0.6	270	6.59	6.46	8	2.50	28	8	2	2	2	2	0	4.900	5.200	3.259	-3.946	2739	0.606	0.879
TYPE 5XB28	40	ALL	5XB28		12	0.6	270	10.63	10.63	0	2.50	12	0	0	0	0	0	0	4.000	5.000	0.800	-1.023	1748	0.719	0.948
X-BEAMS	45	ALL	5XB28		12	0.6	270	10.63	10.63	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.006	-1.255	1793	0.697	0.942
32' Roadway	50	ALL	5XB28		12	0.6	270	10.63	10.63	0	2.50	12	0	0	0	0	0	0	4.000	5.000	1.240	-1.523	1870	0.678	0.937
8" Slab	55	ALL	5XB28		14	0.6	270	10.63	10.63	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.497	-1.812	2187	0.661	0.933
	60	ALL	5XB28		18	0.6	270	10.63	10.63	0	2.50	18	0	0	0	0	0	0	4.000	5.000	1.777	-2.124	2521	0.647	0.929
	65	ALL	5XB28		22	0.6	270	10.63	10.63	0	2.50	22	0	0	0	0	0	0	4.000	5.000	2.079	-2.454	2867	0.633	0.926
	70	ALL	5XB28		26	0.6	270	10.63	10.63	2	2.50	26	2	2	0	0	0	0	4.000	5.000	2.404	-2.807	3231	0.621	0.923
	75	ALL	5XB28		32	0.6	270	10.38	10.32	6	2.50	28	6	0	2	2	2	0	4.000	5.000	2.753	-3.182	3614	0.611	0.921
	80	ALL	5XB28		36	0.6	270	10.19	10.10	6	2.50	28	6	2	2	0	2	0	4.600	5.000	3.124	-3.578	4011	0.601	0.919
TYPE 5XB34	40	ALL	5XB34		10	0.6	270	13.11	13.11	0	2.50	10	0	0	0	0	0	0	4.000	5.000	0.657	-0.777	1818	0.736	0.976
X-BEAMS	45	ALL	5XB34		12	0.6	270	13.11	13.11	0	2.50	12	0	0	0	0	0	0	4.000	5.000	0.824	-0.953	2172	0.714	0.971
32' Roadway	50	ALL	5XB34		14	0.6	270	13.11	13.11	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.014	-1.158	2487	0.695	0.966
8" Slab	55	ALL	5XB34		14	0.6	270	13.11	13.11	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.222	-1.378	2432	0.678	0.962
	60	ALL	5XB34		16	0.6	270	13.11	13.11	0	2.50	16	0	0	0	0	0	0	4.000	5.000	1.449	-1.614	2632	0.663	0.958
	65	ALL	5XB34		18	0.6	270	13.11	13.11	0	2.50	18	0	0	0	0	0	0	4.000	5.000	1.693	-1.866	2997	0.649	0.956
	70	ALL	5XB34		22	0.6	270	13.11	13.11	0	2.50	22	0	0	0	0	0	0	4.000	5.000	1.955	-2.134	3381	0.637	0.953
	75	ALL	5XB34		24	0.6	270	13.11	13.11	0	2.50	24	0	0	0	0	0	0	4.000	5.000	2.236	-2.419	3781	0.626	0.951
	80	ALL	5XB34		28	0.6	270	13.11	13.11	4	2.50	28	4	2	2	0	0	0	4.000	5.000	2.535	-2.718	4197	0.615	0.949
	85	ALL	5XB34		34	0.6	270	12.75	12.65	8	2.50	28	8	4	2	2	0	0	4.000	5.000	2.853	-3.036	4634	0.606	0.947
	90	ALL	5XB34		40	0.6	270	12.51	12.31	10	2.50	28	10	2	2	2	2	2	4.200	5.000	3.188	-3.369	5086	0.597	0.946
	95	ALL	5XB34		44	0.6	270	12.38	12.17	10	2.50	28	10	2	2	2	2	2	4.600	5.200	3.542	-3.719	5558	0.589	0.945
TYPE 5XB40	40	ALL	5XB40		10	0.6	270	15.70	15.70	0	2.50	10	0	0	0	0	0	0	4.000	5.000	0.560	-0.629	1886	0.752	1.001
X-BEAMS	45	ALL	5XB40		12	0.6	270	15.70	15.70	0	2.50	12	0	0	0	0	0	0	4.000	5.000	0.701	-0.772	2255	0.729	0.996
32' Roadway	50	ALL	5XB40		14	0.6	270	15.70	15.70	0	2.50	14	0	0	0	0	0	0	4.000	5.000	0.861	-0.938	2694	0.709	0.991
8" Slab	55	ALL	5XB40		14	0.6	270	15.70	15.70	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.037	-1.117	3007	0.692	0.988
	60	ALL	5XB40		14	0.6	270	15.70	15.70	0	2.50	14	0	0	0	0	0	0	4.000	5.000	1.227	-1.308	2947	0.676	0.984
	65	ALL	5XB40		16	0.6	270	15.70	15.70	0	2.50	16	0	0	0	0	0	0	4.000	5.000	1.433	-1.513	3137	0.662	0.982
	70	ALL	5XB40		18	0.6	270	15.70	15.70	0	2.50	18	0	0	0	0	0	0	4.000	5.000	1.654	-1.731	3521	0.650	0.980
	75	ALL	5XB40		20	0.6	270	15.70	15.70	0	2.50	20	0	0	0	0	0	0	4.000	5.000	1.890	-1.962	3939	0.638	0.978
	80	ALL	5XB40		24	0.6	270	15.70	15.70	2	2.50	24	2	2	0	0	0	0	4.000	5.000	2.142	-2.207	4378	0.628	0.976
	85	ALL	5XB40		28	0.6	270	15.70	15.70	4	2.50	28	4	2	2	0	0	0	4.000	5.000	2.408	-2.464	4834	0.618	0.975
	90	ALL	5XB40		32	0.6	270	15.45	15.40	6	2.50	28	6	2	4	0	0	0	4.000	5.000	2.690	-2.735	5310	0.609	0.974
	95	ALL	5XB40		36	0.6	270	15.26	15.09	10	2.50	28	10	4	6	0	0	0	4.000	5.000	2.988	-3.020	5806	0.601	0.973
	100	ALL	5XB40		42	0.6	270	15.04	14.77	12	2.50	28	12	2	4	2	2	2	4.000	5.000	3.300	-3.318	6319	0.593	0.972
	105	ALL	5XB40		48	0.6	270	14.87	14.58	16	2.50	28	14	2	6	2	0	4	4.500	5.100	3.628	-3.630	6854	0.586	0.971
											4.50	20	2	2	0	0	0	0							

DESIGN NOTES:

Designed in accordance with AASHTO LRFD Bridge Design Specifications.

Prestress losses for the designed beams have been calculated for a relative humidity of 60 percent. Optional designs must likewise conform.

Beam designs are applicable for 8" concrete slabs without overlay and 0 through 30 degree skews.

FABRICATION NOTES:

Provide Class H concrete.

Provide Grade 60 reinforcing steel bars.

Use low relaxation strands, each pretensioned to 75 percent of fpu.

When shown on this sheet, the Fabricator has the option of furnishing either the designed beam or an approved optional beam design. All optional design submittals and shop drawings must be signed, sealed and dated by a Professional Engineer registered in the State of Texas.

Locate strands for the designed beam as low as possible on the 2" grid system unless a non-standard stand pattern is indicated. Fill row "2.5", then row "4.5", then row "6.5", etc. Place strands within a row as follows:

1) Locate a strand in each "1" position.
2) Place strand symmetrically about vertical centerline of box.
3) Space strands as equally as possible across the entire width.

Strand debonding must comply with Item 424.4.2.2.2.4.

Do not debond strands in position "1". Distribute debonded strands equally about the vertical centerline. Decrease debonded lengths working inward, with debonding staggered in each row.

Full-length debonded strands are only permitted in positions marked △.

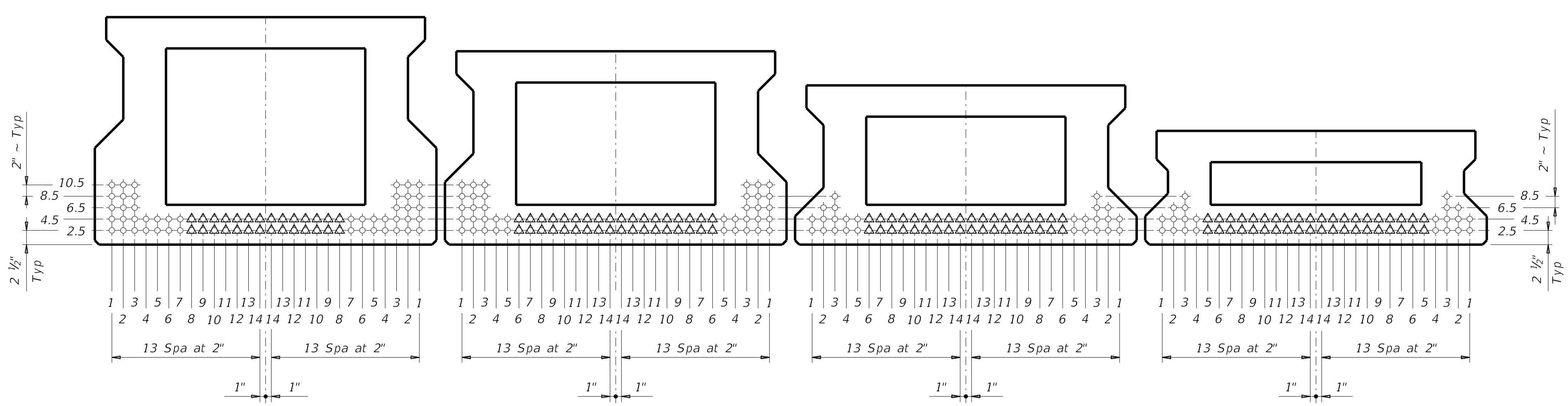
(1) Based on the following allowable stresses (ksi):

Compression = 0.65 f'ci

Tension = $0.24\sqrt{f'ci}$

Optional designs must likewise conform.

(2) Portion of full HL93.



TxDOT 5XB40 BEAMS

TxDOT 5XB34 BEAMS

TxDOT 5XB28 BEAMS

TxDOT 5XB20 BEAMS

HL93 LOADING

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE X-BEAM STANDARD DESIGNS

32' ROADWAY

XBSD-32

FILE: xbstds40.dgn	DN: SRW	CK: BMP	DW: SFS	CK: SDB
©TxDOT June 2011	CONT	SECT	JOB	HIGHWAY
REVISIONS				
01-16: Notes, 0.6" strand designs.	DIST	COUNTY		SHEET NO.

DATE:
FILE:

STRUCTURE	SPAN NO.	GIRDER NO.	GIRDER TYPE	NON-STD STRAND PATTERN	TOTAL NO.	SIZE (in)	STRGTH fpu (ksi)	"e" ℄ (in)	"e" END (in)	DEPRESSED STRAND PATTERN NO.	TO END (in)	RELEASE STRGTH ① f'ci (ksi)	MINIMUM 28 DAY COMP STRGTH f'c (ksi)	DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I) fct(ksi)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III) fcb(ksi)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I) (kip-ft)	LIVE LOAD DISTRIBUTION FACTOR ② Moment	LIVE LOAD DISTRIBUTION FACTOR ② Shear
Type Tx28 Girders 28' Roadway 8.5" Slab	40	ALL	Tx28		12	0.6	270	10.48	10.48			4.700	5.000	1.152	-1.588	1581	0.760	0.960
	45	ALL	Tx28		12	0.6	270	10.48	10.48			4.800	5.800	1.458	-1.949	1578	0.740	0.970
	50	ALL	Tx28		14	0.6	270	10.48	9.62	2	8.5	4.000	5.200	1.787	-2.340	1855	0.710	0.970
	55	ALL	Tx28		18	0.6	270	10.04	7.81	4	14.5	4.000	6.000	2.167	-2.793	2180	0.700	0.980
	60	ALL	Tx28		22	0.6	270	9.75	6.48	4	22.5	4.400	6.500	2.557	-3.243	2487	0.680	0.980
	65	ALL	Tx28		24	0.6	270	9.65	7.65	4	16.5	5.200	6.600	2.999	-3.736	2808	0.660	0.980
	70	ALL	Tx28		28	0.6	270	9.48	6.91	4	22.5	5.700	7.400	3.448	-4.249	3154	0.650	0.990
Type Tx34 Girders 28' Roadway 8.5" Slab	40	ALL	Tx34		12	0.6	270	13.01	13.01			4.000	5.000	0.884	-1.199	1806	0.790	0.940
	45	ALL	Tx34		12	0.6	270	13.01	13.01			4.000	5.000	1.113	-1.460	1921	0.760	0.950
	50	ALL	Tx34		14	0.6	270	13.01	13.01			5.100	6.000	1.375	-1.769	2187	0.740	0.950
	55	ALL	Tx34		14	0.6	270	13.01	13.01			5.000	6.000	1.662	-2.098	2224	0.720	0.960
	60	ALL	Tx34		16	0.6	270	12.76	11.76	4	8.5	4.000	5.000	1.957	-2.432	2537	0.700	0.960
	65	ALL	Tx34		20	0.6	270	12.41	9.61	4	18.5	4.000	5.500	2.285	-2.804	2886	0.690	0.960
	70	ALL	Tx34		22	0.6	270	12.28	8.65	4	24.5	4.200	5.800	2.636	-3.195	3247	0.680	0.970
	75	ALL	Tx34		26	0.6	270	12.09	8.40	4	28.5	4.800	6.100	3.004	-3.588	3587	0.660	0.970
	80	ALL	Tx34		30	0.6	270	11.81	7.81	6	26.5	5.300	6.500	3.398	-4.016	3966	0.650	0.970
	85	ALL	Tx34		34	0.6	270	11.48	7.25	6	30.5	5.800	7.100	3.830	-4.476	4364	0.640	0.980
Type Tx40 Girders 28' Roadway 8.5" Slab	40	ALL	Tx40		10	0.6	270	15.60	15.60			4.000	5.000	0.735	-0.976	1872	0.820	0.930
	45	ALL	Tx40		12	0.6	270	15.60	15.60			4.000	5.000	0.917	-1.181	2207	0.790	0.930
	50	ALL	Tx40		14	0.6	270	15.60	15.60			4.500	5.500	1.130	-1.430	2590	0.770	0.940
	55	ALL	Tx40		14	0.6	270	15.60	15.60			4.300	5.300	1.364	-1.695	2518	0.750	0.940
	60	ALL	Tx40		16	0.6	270	15.35	14.35	4	8.5	4.000	5.000	1.604	-1.964	2637	0.730	0.950
	65	ALL	Tx40		16	0.6	270	15.35	14.35	4	8.5	4.000	5.000	1.876	-2.258	2970	0.710	0.950
	70	ALL	Tx40		18	0.6	270	15.16	14.27	4	8.5	4.000	5.000	2.170	-2.579	3347	0.700	0.950
	75	ALL	Tx40		22	0.6	270	14.87	11.24	4	24.5	4.000	5.300	2.461	-2.887	3694	0.680	0.950
	80	ALL	Tx40		24	0.6	270	14.77	10.77	4	28.5	4.300	5.500	2.793	-3.239	4093	0.670	0.960
	85	ALL	Tx40		28	0.6	270	14.60	10.03	4	36.5	4.800	5.700	3.120	-3.588	4489	0.660	0.960
	90	ALL	Tx40		32	0.6	270	14.23	8.98	6	34.5	5.200	5.800	3.489	-3.972	4911	0.650	0.960
	95	ALL	Tx40		36	0.6	270	13.93	8.93	6	36.5	5.800	6.500	3.863	-4.359	5336	0.640	0.970
Type Tx46 Girders 28' Roadway 8.5" Slab	40	ALL	Tx46		10	0.6	270	17.60	17.60			4.000	5.000	0.646	-0.778	1949	0.850	0.920
	45	ALL	Tx46		12	0.6	270	17.60	17.60			4.000	5.000	0.809	-0.947	2308	0.820	0.920
	50	ALL	Tx46		12	0.6	270	17.60	17.60			4.000	5.000	0.994	-1.141	2728	0.790	0.920
	55	ALL	Tx46		14	0.6	270	17.60	17.60			4.000	5.000	1.190	-1.346	3018	0.770	0.930
	60	ALL	Tx46		14	0.6	270	17.60	17.60			4.500	5.500	1.412	-1.577	3048	0.760	0.930
	65	ALL	Tx46		16	0.6	270	17.35	16.35	4	8.5	4.000	5.000	1.649	-1.814	3161	0.740	0.930
	70	ALL	Tx46		16	0.6	270	17.35	16.85	4	6.5	4.000	5.000	1.903	-2.063	3487	0.720	0.940
	75	ALL	Tx46		18	0.6	270	17.16	15.83	4	10.5	4.000	5.000	2.162	-2.322	3884	0.710	0.940
	80	ALL	Tx46		22	0.6	270	16.88	15.06	4	14.5	4.000	5.000	2.452	-2.607	4306	0.700	0.940
	85	ALL	Tx46		24	0.6	270	16.77	14.10	4	20.5	4.000	5.000	2.738	-2.889	4726	0.690	0.940
	90	ALL	Tx46		28	0.6	270	16.60	11.46	4	40.5	4.200	5.200	3.061	-3.199	5174	0.680	0.950
	95	ALL	Tx46		32	0.6	270	16.23	9.85	6	40.5	4.500	5.400	3.387	-3.512	5624	0.670	0.950
	100	ALL	Tx46		36	0.6	270	15.94	10.27	6	40.5	5.100	5.800	3.728	-3.837	6086	0.660	0.950
	105	ALL	Tx46		40	0.6	270	15.70	10.30	6	42.5	5.600	6.400	4.099	-4.186	6571	0.650	0.950

(Column groups: DESIGNED GIRDERS — PRESTRESSING STRANDS; DEPRESSED STRAND PATTERN; CONCRETE; OPTIONAL DESIGN)

NON-STANDARD STRAND PATTERNS

PATTERN	STRAND ARRANGEMENT AT ℄ OF GIRDER

① Based on the following allowable stresses (ksi):

Compression = 0.65 f'ci

Tension = $0.24\sqrt{f'ci}$

Optional designs must likewise conform.

② Portion of full HL93.

DESIGN NOTES:

Designed according to AASHTO LRFD Bridge Design Specifications.

Optional designs for girders 120 feet or longer must have a calculated residual camber equal to or greater than that of the designed girder.

Prestress losses for the designed girders have been calculated for a relative humidity of 60 percent. Optional designs must likewise conform.

FABRICATION NOTES:

Provide Class H concrete.

Provide Grade 60 reinforcing steel bars.

Use low relaxation strands, each pretensioned to 75 percent of fpu.

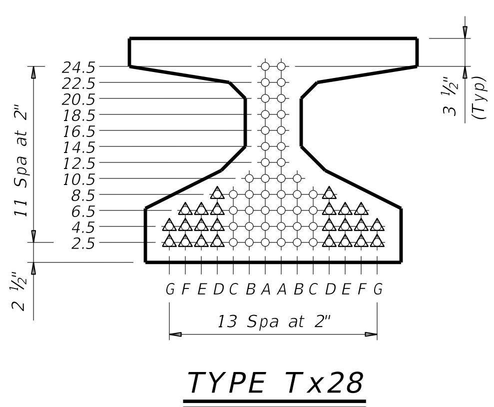
Strand debonding must comply with Item 424.4.2.2.2.4. Full-length debonded strands are only permitted in positions marked △. Double wrap full-length debonded strands in outer most position of each row.

When shown on this sheet, the Fabricator has the option of furnishing either the designed girder or an approved optional design. All optional design submittals must be signed, sealed and dated by a Professional Engineer registered in the State of Texas.

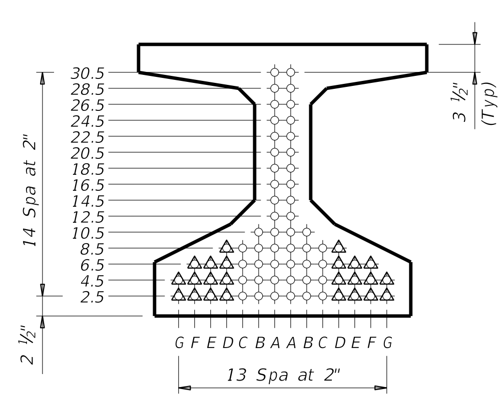
Seal cracks in girder ends exceeding 0.005" in width as directed by the Engineer. The fabricator is permitted to decrease the spacing of Bars R and S by providing additional bars to help limit crack width provided the decreased spacing results in no less than 1" clear between bars. The fabricator must take an approved corrective action if cracks greater than 0.005" form on a repetitive basis.

DEPRESSED STRAND DESIGNS:

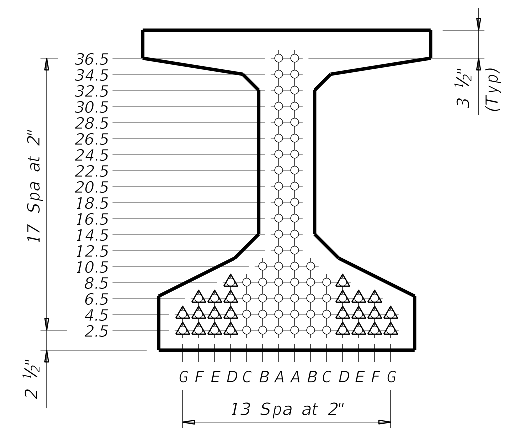
Locate strands for the designed girder as low as possible on the 2" grid system unless a non-standard strand pattern is indicated. Fill row "2.5", then row "4.5", then row "6.5", etc., beginning each row in the "A" position and working outward until the required number of strands is reached. All strands in the "A" position must be depressed, maintaining the 2" spacing so that, at the girder ends, the upper two strands are in the position shown in the table.



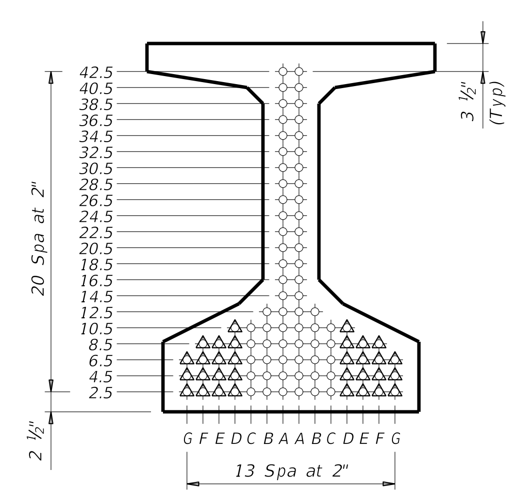
TYPE Tx28



TYPE Tx34



TYPE Tx40



TYPE Tx46

HL93 LOADING SHEET 1 OF 2

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE I-GIRDER STANDARD DESIGNS

28' ROADWAY

IGSD-28

FILE: ig02stds-19.dgn | DN: EFC | CK: AJF | DW: EFC | CK: TAR

 | CONT | SECT | JOB | HIGHWAY

REVISIONS
10-19: Redesigned girders.

DIST | COUNTY | SHEET NO.

DATE:
FILE:

STRUCTURE	DESIGNED GIRDERS									DEPRESSED STRAND PATTERN		CONCRETE		OPTIONAL DESIGN				
	SPAN NO.	GIRDER NO.	GIRDER TYPE	PRESTRESSING STRANDS: NON-STD STRAND PATTERN	TOTAL NO.	SIZE (in)	STRGTH fpu (ksi)	"e" ℄ (in)	"e" END (in)	NO.	TO END (in)	RELEASE STRGTH (1) f'ci (ksi)	MINIMUM 28 DAY COMP STRGTH f'c (ksi)	DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I) fct(ksi)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III) fcb(ksi)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I) (kip-ft)	LIVE LOAD DISTRIBUTION FACTOR (2) Moment	Shear
Type Tx54 Girders 28' Roadway 8.5" Slab	40	ALL	Tx54		10	0.6	270	21.01	21.01			4.000	5.000	0.536	-0.634	2015	0.880	0.910
	45	ALL	Tx54		12	0.6	270	21.01	21.01			4.000	5.000	0.670	-0.771	2387	0.850	0.910
	50	ALL	Tx54		12	0.6	270	21.01	21.01			4.000	5.000	0.822	-0.929	2824	0.820	0.910
	55	ALL	Tx54		14	0.6	270	21.01	21.01			4.000	5.000	0.983	-1.096	3285	0.800	0.920
	60	ALL	Tx54		14	0.6	270	21.01	21.01			4.000	5.000	1.163	-1.277	3619	0.780	0.920
	65	ALL	Tx54		16	0.6	270	20.76	20.26	4	6.5	4.000	5.000	1.356	-1.468	3862	0.760	0.920
	70	ALL	Tx54		16	0.6	270	20.76	20.26	4	6.5	4.000	5.000	1.567	-1.677	3811	0.750	0.920
	75	ALL	Tx54		18	0.6	270	20.56	19.67	4	8.5	4.000	5.000	1.782	-1.884	4043	0.730	0.930
	80	ALL	Tx54		18	0.6	270	20.56	19.67	4	8.5	4.000	5.000	2.026	-2.119	4448	0.720	0.930
	85	ALL	Tx54		20	0.6	270	20.41	18.81	4	12.5	4.000	5.000	2.263	-2.349	4883	0.710	0.930
	90	ALL	Tx54		22	0.6	270	20.28	18.46	4	14.5	4.000	5.000	2.528	-2.601	5348	0.700	0.930
	95	ALL	Tx54		26	0.6	270	20.08	16.39	4	28.5	4.000	5.000	2.786	-2.848	5805	0.690	0.930
	100	ALL	Tx54		30	0.6	270	19.81	12.21	6	44.5	4.000	5.000	3.077	-3.120	6296	0.680	0.940
	105	ALL	Tx54		32	0.6	270	19.63	12.51	6	44.5	4.300	5.000	3.381	-3.403	6800	0.670	0.940
	110	ALL	Tx54		36	0.6	270	19.34	12.01	6	50.5	4.700	5.400	3.686	-3.686	7303	0.660	0.940
	115	ALL	Tx54		40	0.6	270	19.11	12.51	6	50.5	5.300	6.100	4.016	-3.989	7832	0.650	0.940
	120	ALL	Tx54		44	0.6	270	18.83	11.55	8	48.5	5.600	6.500	4.352	-4.308	8420	0.650	0.940
	125	ALL	Tx54	*	48	0.6	270	18.42	10.09	10	50.5	5.800	7.200	4.709	-4.633	8977	0.640	0.940
Type Tx62 Girders 28' Roadway 8.5" Slab	60	ALL	Tx62		14	0.6	270	25.78	25.78			4.000	5.000	0.916	-1.069	3911	0.800	0.910
	65	ALL	Tx62		14	0.6	270	25.78	25.78			4.000	5.000	1.069	-1.235	4248	0.790	0.910
	70	ALL	Tx62		16	0.6	270	25.53	25.53			4.000	5.000	1.231	-1.403	4544	0.770	0.910
	75	ALL	Tx62		16	0.6	270	25.53	25.53			4.000	5.000	1.395	-1.579	4502	0.760	0.920
	80	ALL	Tx62		18	0.6	270	25.33	25.33			4.000	5.000	1.576	-1.763	4785	0.740	0.920
	85	ALL	Tx62		18	0.6	270	25.33	25.33			4.000	5.000	1.771	-1.964	5084	0.730	0.920
	90	ALL	Tx62		18	0.6	270	25.33	25.33			4.000	5.000	1.976	-2.174	5571	0.720	0.920
	95	ALL	Tx62		22	0.6	270	25.05	23.96	4	10.5	4.000	5.000	2.192	-2.393	6073	0.710	0.920
	100	ALL	Tx62		24	0.6	270	24.94	23.28	4	14.5	4.000	5.000	2.400	-2.605	6563	0.700	0.920
	105	ALL	Tx62		28	0.6	270	24.78	20.21	4	36.5	4.000	5.000	2.636	-2.841	7092	0.690	0.930
	110	ALL	Tx62		30	0.6	270	24.58	17.78	6	40.5	4.000	5.000	2.858	-3.067	7602	0.680	0.930
	115	ALL	Tx62		34	0.6	270	24.25	15.42	6	56.5	4.200	5.000	3.113	-3.319	8156	0.670	0.930
	120	ALL	Tx62		36	0.6	270	24.11	17.11	6	48.5	4.700	5.500	3.378	-3.579	8725	0.660	0.930
	125	ALL	Tx62		40	0.6	270	23.88	16.68	6	54.5	5.100	6.000	3.629	-3.839	9330	0.660	0.930
	130	ALL	Tx62		44	0.6	270	23.60	14.87	8	56.5	5.300	6.200	3.913	-4.116	9926	0.650	0.930
	135	ALL	Tx62		48	0.6	270	23.28	14.94	8	58.5	5.800	6.700	4.206	-4.402	10535	0.640	0.940

NON-STANDARD STRAND PATTERNS

PATTERN	STRAND ARRANGEMENT AT ℄ OF GIRDER
*	2.5(14),4.5(14),6.5(14),8.5(4),10.5(2)

(1) Based on the following allowable stresses (ksi):

Compression = 0.65 f'ci

Tension = $0.24\sqrt{f'ci}$

Optional designs must likewise conform.

(2) Portion of full HL93.

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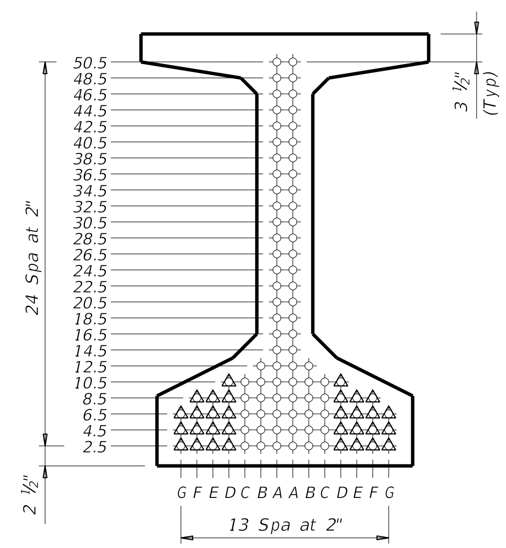
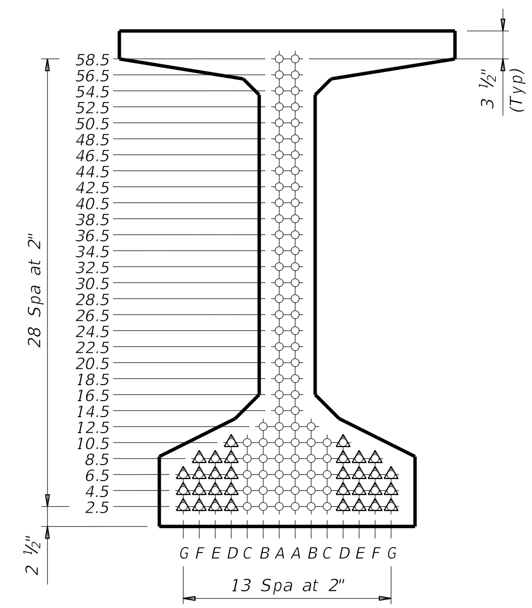


TYPE Tx54



TYPE Tx62

HL93 LOADING

SHEET 2 OF 2

Texas Department of Transportation

Bridge Division Standard

PRESTRESSED CONCRETE I-GIRDER STANDARD DESIGNS

28' ROADWAY

IGSD-28

FILE: ig02stds-19.dgn	DN: EFC	CK: AJF	DW: EFC	CK: TAR
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REVISIONS 10-19: Redesigned girders.				
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TABLE OF REQUIRED BEAM SIZES, DESIGN DATA AND STEEL QUANTITIES

SPAN (ft)	ROLLED BEAM Beam Member	ROLLED BEAM Dimension "Y" (in)	ROLLED BEAM Deflection "A" (feet) Slab DL	ROLLED BEAM Deflection "A" (feet) Total DL	OPTIONAL PLATE GIRDER Plate Sizes (inches) Top Flange	OPTIONAL PLATE GIRDER Plate Sizes (inches) Bott Flange	OPTIONAL PLATE GIRDER Plate Sizes (inches) Web	OPTIONAL PLATE GIRDER Dimension "Y" (in)	OPTIONAL PLATE GIRDER Deflection "A" (feet) Slab DL	OPTIONAL PLATE GIRDER Deflection "A" (feet) Total DL	Diaphragm Spaces "N" (ea)	Stud Spacing "X" (in)	Elastomeric Bearing Type	Estimated Quantities Structural Steel (lbs) Rolled Beam	Estimated Quantities Structural Steel (lbs) PL Girder (1)
30	W18 x 130	29.25	0.017	0.021	1 x 12	1 1/4 x 12	1/2 x 17	29.25	0.018	0.022	2	8	SB - 1	18,200	17,200
	W21 x 132	31.83	0.013	0.017	7/8 x 12	1 1/4 x 12	1/2 x 19.5	31.62	0.014	0.017	2	8	SB - 1	19,440	18,110
	W24 x 117	34.26	0.012	0.015	3/4 x 12	1 x 12	1/2 x 22.5	34.25	0.013	0.016	2	9	SB - 1	17,660	16,920
	W27 x 146	37.38	0.008	0.010	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.009	0.011	2	9	SB - 2	21,190	19,120
	W30 x 173	40.44	0.005	0.007	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.005	0.007	2	9	SB - 3	24,490	23,620
	W33 x 118	42.86	0.007	0.009	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.007	0.009	2	10.5	SB - 1	18,490	18,290
	W36 x 135	45.55	0.006	0.007	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.006	0.007	2	10.5	SB - 1	20,530	19,450
	W40 x 149	48.20	0.005	0.006	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.005	0.006	2	10.5	SB - 1	22,320	20,700
35	W18 x 130	29.25	0.032	0.039	1 x 12	1 1/4 x 12	1/2 x 17	29.25	0.033	0.040	2	8	SB - 1	20,850	19,670
	W21 x 132	31.83	0.025	0.031	7/8 x 12	1 1/4 x 12	1/2 x 19.5	31.62	0.026	0.032	2	8	SB - 1	22,140	20,560
	W24 x 117	34.26	0.022	0.027	3/4 x 12	1 x 12	1/2 x 22.5	34.25	0.024	0.029	2	9	SB - 1	20,040	19,160
	W27 x 146	37.38	0.014	0.018	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.016	0.020	2	9	SB - 2	24,160	21,690
	W30 x 173	40.44	0.010	0.013	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.010	0.013	2	9	SB - 3	28,000	26,930
	W33 x 118	42.86	0.014	0.017	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.013	0.016	2	10.5	SB - 1	20,890	20,640
	W36 x 135	45.55	0.010	0.013	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.011	0.013	2	10.5	SB - 1	23,280	21,980
	W40 x 149	48.20	0.008	0.011	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.009	0.011	2	10.5	SB - 1	25,350	23,410
40	W18 x 130	29.25	0.054	0.067	1 x 12	1 1/4 x 12	1/2 x 17	29.25	0.055	0.068	3	8	SB - 1	24,080	22,720
	W21 x 132	31.83	0.042	0.052	7/8 x 12	1 1/4 x 12	1/2 x 19.5	31.62	0.044	0.054	2	8	SB - 1	24,840	23,020
	W24 x 117	34.26	0.038	0.047	3/4 x 12	1 x 12	1/2 x 22.5	34.25	0.041	0.050	2	9	SB - 1	22,430	21,390
	W27 x 146	37.38	0.024	0.031	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.028	0.035	2	9	SB - 2	27,130	24,270
	W30 x 173	40.44	0.017	0.022	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.017	0.022	2	9	SB - 3	31,510	30,240
	W33 x 118	42.86	0.023	0.028	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.023	0.028	2	10.5	SB - 1	23,300	22,980
	W36 x 135	45.55	0.018	0.022	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.018	0.023	2	10.5	SB - 1	26,030	24,510
	W40 x 149	48.20	0.014	0.018	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.015	0.019	2	10.5	SB - 1	28,370	26,130
45	W18 x 130	29.25	0.087	0.108	1 x 12	1 1/4 x 12	1/2 x 17	29.25	0.089	0.109	3	8	SB - 1	26,740	25,190
	W21 x 132	31.83	0.067	0.084	7/8 x 12	1 1/4 x 12	1/2 x 19.5	31.62	0.070	0.086	2	8	SB - 1	27,540	25,470
	W24 x 117	34.26	0.061	0.075	3/4 x 12	1 x 12	1/2 x 22.5	34.25	0.065	0.079	2	9	SB - 1	24,830	23,650
	W27 x 146	37.38	0.039	0.050	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.045	0.056	2	9	SB - 2	30,110	26,860
	W30 x 173	40.44	0.027	0.035	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.027	0.035	2	9	SB - 3	35,020	33,560
	W33 x 118	42.86	0.037	0.046	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.036	0.045	2	10.5	SB - 1	25,700	25,310
	W36 x 135	45.55	0.028	0.036	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.029	0.037	2	10.5	SB - 1	28,760	27,030
	W40 x 149	48.20	0.023	0.029	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.024	0.030	2	10.5	SB - 1	31,390	28,830
50	W18 x 130	29.25	0.132	0.164	1 x 12	1 1/4 x 12	1/2 x 17	29.25	0.135	0.166	3	8	SB - 1	29,400	27,660
	W21 x 132	31.83	0.102	0.128	7/8 x 12	1 1/4 x 12	1/2 x 19.5	31.62	0.107	0.131	2	8	SB - 1	30,230	27,930
	W24 x 117	34.26	0.093	0.114	3/4 x 12	1 x 12	1/2 x 22.5	34.25	0.099	0.121	2	9	SB - 1	27,220	25,880
	W27 x 146	37.38	0.059	0.076	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.068	0.085	2	9	SB - 2	33,070	29,440
	W30 x 173	40.44	0.041	0.054	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.040	0.053	2	9	SB - 3	38,530	36,870
	W33 x 118	42.86	0.056	0.069	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.055	0.068	2	10.5	SB - 1	28,100	27,650
	W36 x 135	45.55	0.043	0.054	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.045	0.056	2	10.5	SB - 1	31,510	29,560
	W40 x 149	48.20	0.035	0.044	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.036	0.045	2	10.5	SB - 1	34,420	31,550
55	W21 x 132	31.83	0.149	0.187	7/8 x 12	1 1/4 x 12	1/2 x 19.5	31.62	0.156	0.192	3	8	SB - 2	33,900	31,350
	W24 x 117	34.26	0.136	0.167	3/4 x 12	1 x 12	1/2 x 22.5	34.25	0.146	0.177	3	9	SB - 2	30,580	29,100
	W27 x 146	37.38	0.087	0.111	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.100	0.124	3	9	SB - 2	36,970	32,950
	W30 x 173	40.44	0.060	0.079	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.059	0.077	3	9	SB - 3	42,980	41,120
	W33 x 118	42.86	0.082	0.102	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.081	0.100	3	10.5	SB - 2	31,740	31,210
	W36 x 135	45.55	0.063	0.080	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.065	0.081	3	10.5	SB - 2	35,490	33,320
	W40 x 149	48.20	0.051	0.065	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.053	0.066	3	10.5	SB - 2	38,720	35,540
60	W21 x 166	32.48	0.161	0.209	1 x 12	1 5/8 x 12	1/2 x 19.75	32.38	0.187	0.235	3	8	SB - 2	44,710	38,800
	W24 x 131	34.48	0.171	0.214	7/8 x 12	1 1/8 x 12	1/2 x 22.5	34.50	0.183	0.225	3	9	SB - 2	36,310	33,750
	W27 x 146	37.38	0.123	0.157	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.141	0.176	3	9	SB - 2	39,930	35,530
	W30 x 173	40.44	0.085	0.112	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.084	0.109	3	9	SB - 3	46,480	44,430
	W33 x 118	42.86	0.117	0.144	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.115	0.142	3	10.5	SB - 2	34,140	33,560
	W36 x 135	45.55	0.089	0.113	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.093	0.115	3	10.5	SB - 2	38,240	35,850
	W40 x 149	48.20	0.072	0.092	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.076	0.093	3	10.5	SB - 2	41,750	38,250

(1) For Contractor's information only. Structural Steel pay weight shall be based on Rolled Beams.

GENERAL NOTES:

Designed according to AASHTO LRFD Specifications.

See Steel Beam Span sheets for beam spacing, diaphragm locations, fabrication notes and references to values "A","N", "X" & "Y".

See standard SBEB for bearing details.

Indicated beam/girder designs are applicable for spans with 0, 15 and 30 degree skews.

See Bridge Layout for beam type. Change in beam type within a bridge, for example W18 to W24, is not supported by this standard.

The standard beam designs shown on these sheets are applicable for use only with the Steel Beam Spans shown on Standards SSB-28, SSB-28-15 and SSB-28-30.

HL93 LOADING

SHEET 1 OF 2

Texas Department of Transportation — Bridge Division Standard

STEEL BEAM STANDARD DESIGNS

28' ROADWAY

SBSD-28

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REVISIONS					
Rev. 02-06: W36 sections	DIST	COUNTY		SHEET NO.	

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TABLE OF REQUIRED BEAM SIZES, DESIGN DATA AND STEEL QUANTITIES

SPAN (ft)	ROLLED BEAM				OPTIONAL PLATE GIRDER							Diaphragm Spaces	Stud Spacing	Elastomeric Bearing	Estimated Quantities Structural Steel (lbs)	
	Beam Member	Dimension "Y" (in)	Deflection "A" (feet) Slab DL	Total DL	Plate Sizes (inches) Top Flange	Bott Flange	Web	Dimension "Y" (in)	Deflection "A" (feet) Slab DL	Total DL	"N" (ea)	"X" (in)	Type	Rolled Beam	PL Girder (1)
65	W24 x 162	35.00	0.185	0.239	1 1/4 x 12	1 1/2 x 12	1/2 x 22.5	35.25	0.196	0.248	3	9	SB - 2	47,010	44,160
	W27 x 146	37.38	0.170	0.216	3/4 x 14	1 x 14	1/2 x 25.5	37.25	0.195	0.242	3	9	SB - 2	42,910	38,120
	W30 x 173	40.44	0.117	0.154	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.116	0.150	3	9	SB - 3	50,000	47,760
	W33 x 130	43.09	0.142	0.178	3/4 x 12	3/4 x 12	1/2 x 31.5	43.00	0.141	0.176	3	10.5	SB - 2	39,640	35,960
	W36 x 135	45.55	0.123	0.155	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.128	0.159	3	10.5	SB - 2	40,980	38,370
	W40 x 149	48.20	0.099	0.127	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.104	0.129	3	10.5	SB - 2	44,760	40,960
70	W24 x 207	35.71	0.189	0.257	1 1/2 x 12	1 7/8 x 12	1/2 x 22.5	35.88	0.203	0.267	3	9	SB - 2	62,830	54,300
	W27 x 178	37.81	0.185	0.244	3/4 x 14	1 3/8 x 14	1/2 x 25.5	37.62	0.229	0.289	3	9	SB - 2	54,800	45,690
	W30 x 173	40.44	0.158	0.207	1 x 15	1 1/4 x 15	1/2 x 28.5	40.75	0.155	0.202	3	9	SB - 3	53,510	51,070
	W33 x 141	43.30	0.173	0.220	3/4 x 12	1 1/8 x 12	1/2 x 31.5	43.38	0.182	0.227	3	9	SB - 2	45,440	42,570
	W36 x 135	45.55	0.166	0.209	3/4 x 12	7/8 x 12	1/2 x 34	45.62	0.172	0.214	3	10.5	SB - 2	43,720	40,900
	W40 x 149	48.20	0.133	0.170	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.140	0.173	3	10.5	SB - 2	47,790	43,670
75	W27 x 217	38.43	0.193	0.265	1 1/4 x 14	1 3/4 x 14	1/2 x 25.5	38.50	0.209	0.277	3	9	SB - 2	70,050	61,050
	W30 x 191	40.68	0.213	0.286	1 x 15	1 3/8 x 15	1/2 x 28.5	40.88	0.198	0.259	3	9	SB - 3	62,390	56,290
	W33 x 169	43.82	0.184	0.241	1 x 12	1 1/4 x 12	1/2 x 31.5	43.75	0.203	0.259	3	10.5	SB - 2	56,580	49,710
	W36 x 160	46.01	0.176	0.228	7/8 x 12	1 1/4 x 12	1/2 x 34	46.12	0.183	0.233	3	10.5	SB - 2	53,940	49,520
	W40 x 149	48.20	0.175	0.224	3/4 x 12	1 x 12	1/2 x 36.5	48.25	0.184	0.228	3	10.5	SB - 2	50,820	46,390
80	W27 x 235	38.66	0.231	0.322	1 1/4 x 14	1 3/4 x 14	1/2 x 25.75	38.75	0.266	0.354	4	9	SB - 3	81,170	65,980
	W30 x 191	40.68	0.243	0.326	1 x 15	1 3/8 x 15	1/2 x 28.5	40.88	0.256	0.335	4	9	SB - 3	67,190	60,680
	W33 x 201	43.68	0.194	0.263	3/4 x 16	1 1/4 x 16	1/2 x 31.5	43.50	0.237	0.306	4	10.5	SB - 3	71,440	59,470
	W36 x 170	46.17	0.212	0.278	7/8 x 12	1 1/4 x 12	1/2 x 34	46.12	0.238	0.303	4	10.5	SB - 3	61,610	53,690
	W40 x 167	48.59	0.192	0.251	7/8 x 12	1 1/4 x 12	1/2 x 36.5	48.62	0.205	0.262	4	12	SB - 3	60,790	55,190
85	W30 x 235	41.30	0.244	0.341	1 x 15	1 3/4 x 15	1/2 x 28.5	41.25	0.294	0.390	4	10.5	SB - 3	85,870	70,480
	W33 x 221	43.93	0.223	0.308	1 1/4 x 16	1 3/8 x 16	1/2 x 31.5	44.12	0.226	0.306	4	10.5	SB - 3	82,270	74,260
	W36 x 194	46.49	0.236	0.317	1 1/8 x 12	1 1/2 x 12	1/2 x 34	46.62	0.250	0.327	4	10.5	SB - 3	73,170	63,530
	W40 x 183	48.98	0.214	0.285	1 x 12	1 3/8 x 12	1/2 x 36.5	48.88	0.237	0.307	4	12	SB - 3	69,580	61,650
90	W30 x 261	41.61	0.274	0.394	1 1/4 x 15	1 7/8 x 15	1/2 x 28.5	41.62	0.319	0.434	4	10.5	SB - 3	99,940	81,150
	W33 x 241	44.18	0.253	0.357	1 1/8 x 16	1 5/8 x 16	1/2 x 31.5	44.25	0.278	0.377	4	10.5	SB - 3	93,910	80,670
	W36 x 231	46.49	0.268	0.374	1 1/8 x 16	1 1/2 x 16	1/2 x 33.5	46.12	0.256	0.346	4	10.5	SB - 3	90,360	79,520
	W40 x 199	48.67	0.241	0.327	7/8 x 16	1 1/4 x 16	1/2 x 36.5	48.62	0.261	0.344	4	12	SB - 3	79,020	71,760
95	W33 x 291	44.84	0.253	0.374	1 1/2 x 16	2 x 16	1/2 x 31.5	45.00	0.270	0.382	4	12	SB - 3	117,630	100,150
	W36 x 231	46.49	0.299	0.417	1 1/8 x 16	1 1/2 x 16	1/2 x 33.5	46.12	0.317	0.429	4	12	SB - 3	94,950	83,480
	W40 x 215	48.98	0.268	0.370	1 x 16	1 3/8 x 16	1/2 x 36.5	48.88	0.292	0.392	4	12	SB - 3	89,110	80,510
100	W36 x 247	46.67	0.343	0.486	1 1/8 x 16	1 5/8 x 16	1/2 x 33.5	46.25	0.377	0.512	4	12	SB - 3	105,980	90,220
	W40 x 249	49.38	0.283	0.403	1 1/8 x 16	1 5/8 x 16	1/2 x 36.5	49.25	0.316	0.432	4	12	SB - 3	107,000	92,500
105	W36 x 282	47.11	0.356	0.521	1 3/8 x 16	1 7/8 x 16	1/2 x 33.5	46.75	0.388	0.542	5	12	SB - 4	126,780	106,940
	W40 x 277	49.69	0.338	0.494	1 1/4 x 16	1 7/8 x 16	1/2 x 36.5	49.62	0.343	0.479	5	12	SB - 4	124,950	106,520
110	W40 x 277	49.69	0.371	0.542	1 1/4 x 16	1 7/8 x 16	1/2 x 36.5	49.62	0.413	0.577	5	12	SB - 4	130,540	111,210
115	W40 x 297	49.84	0.419	0.624	1 3/8 x 16	2 x 16	1/2 x 36.5	49.88	0.460	0.649	5	12	SB - 4	145,290	122,120
120	W40 x 324	50.20	0.451	0.687	1 5/8 x 16	2 1/8 x 16	1/2 x 36.5	50.25	0.486	0.701	5	12	SB - 4	164,190	136,840

(1) For Contractor's information only. Structural Steel pay weight shall be based on Rolled Beams.

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HL93 LOADING

SHEET 2 OF 2

Texas Department of Transportation

Bridge Division Standard

STEEL BEAM
STANDARD DESIGNS
28' ROADWAY

SBSD-28

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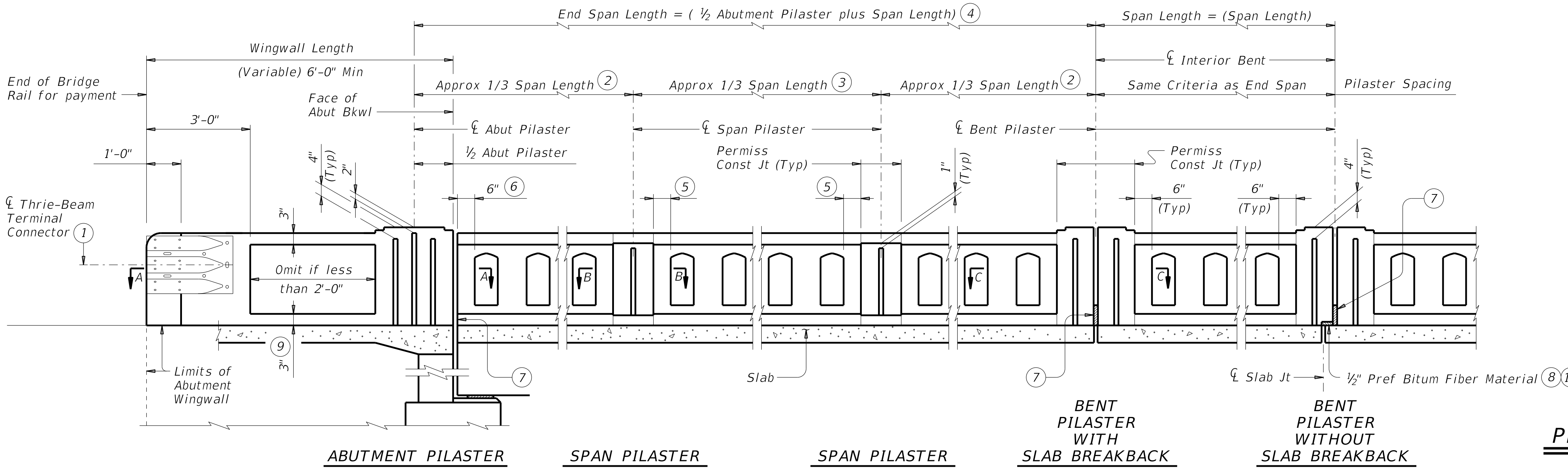
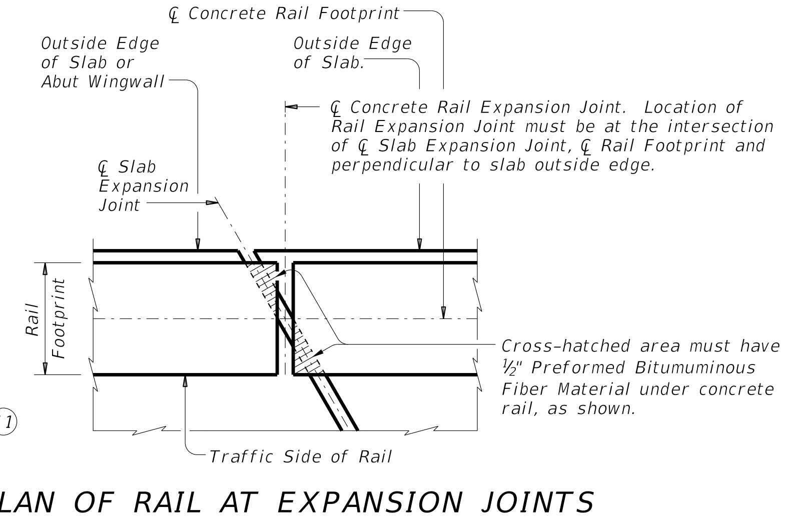
REVISIONS				
Rev. 02-06: W36 sections	DIST	COUNTY		SHEET NO.



ROADWAY ELEVATION OF RAIL



PLAN OF RAIL AT EXPANSION JOINTS

Example showing Slab Expansion Joints without breakbacks.

(1) Terminal Connectors and associated hardware are to be paid for under the Item "Metal Beam Guard Fence". Attach Metal Beam Guard Fence Transitions to the bridge unless otherwise shown in the plans.

(2) Number of windows in exterior bays are equal.

(3) Number of windows in interior bay(s) are not less than the amount in exterior bays (Note 2).

(4) Space Span Pilasters at 1/3 span length (Approx) when spans are 100 ft and less, as shown. Space Span Pilasters at 1/5 span length (Approx) for spans greater than 100 ft.

(5) Dimension is the same for all posts adjacent to Span Pilasters in a span. Dimension may vary from span to span, Min = 3", Max = 7 ½".

(6) Min = 6", Max = 1'-3".

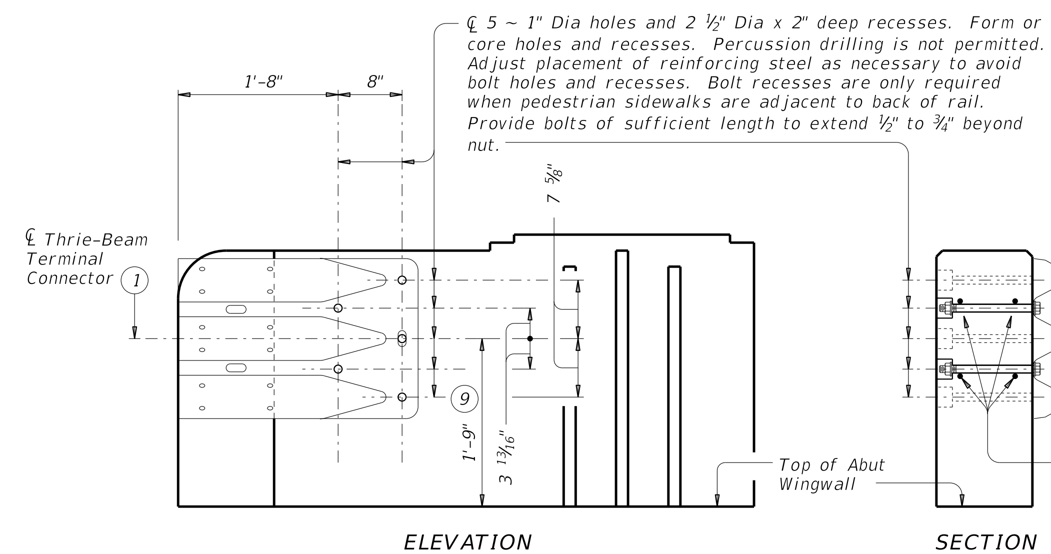
(7) Provide rail joints at ends of all spans the same width as Slab joint opening, except that Rail Joints over construction joints must be ¼" Min to ¾" Max in width. Joints must be open if slab joint opening is not sealed. Joints over construction joints and over sealed deck joints must be plugged. Forming material used in joints may be left in place if it is light in color and compressible, such as the following materials: polystyrene, molded cork granules, sponge rubber sheet, etc. If forming material is not left in place, plug the bottom 6" with slab joint sealing compound to prevent drainage and staining.

(8) Place Preformed Bituminous Fiber Material between slab and rail when rail extends over expansion joint. Shift Bars U as necessary.

(9) Increase 2" for structures with overlay.

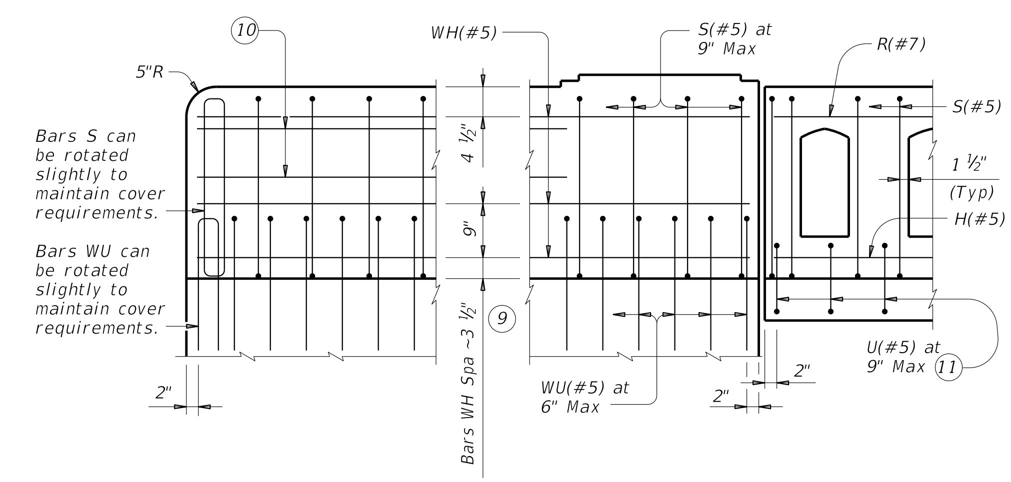
(10) Place 4 additional Bars WH(#5) 3'-8" in length inside Bars S(#5) and centered 2'-0" from end of rail when Terminal Connections are required. Field bend as needed.

(11) Shift U Bars from region below ½" Preformed Bituminous Fiber Material at joints.



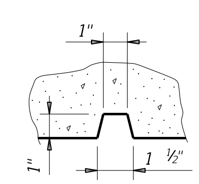
TERMINAL CONNECTION DETAILS

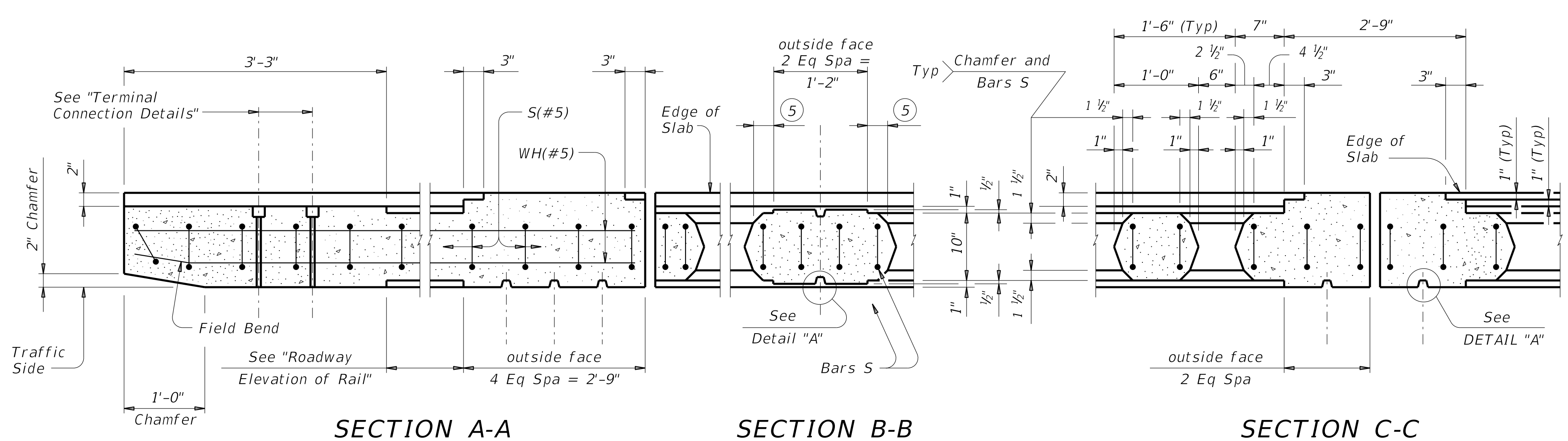
(Showing parapet with Pilaster on 6'-0" Wingwall)



ELEVATION SHOWING TYPICAL REINFORCING PLACEMENT

The use of this railing is restricted to speeds of 45 mph or less.





SHEET 1 OF 2

Texas Department of Transportation | Bridge Division Standard

TRAFFIC RAIL
TEXAS CLASSIC

TYPE T411

FILE: rlstd008-19.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
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REVISIONS	DIST	COUNTY		SHEET NO.

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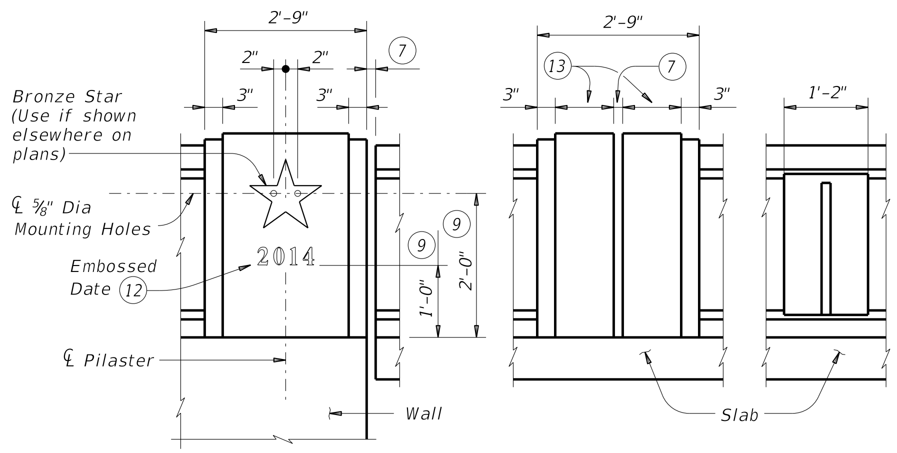
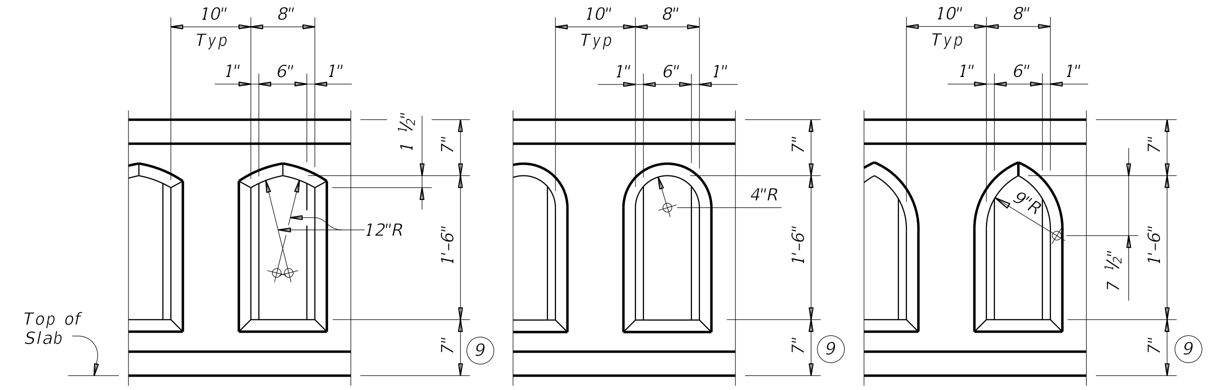


ABUTMENT

BENT

SPAN

EXTERIOR PILASTER ELEVATIONS

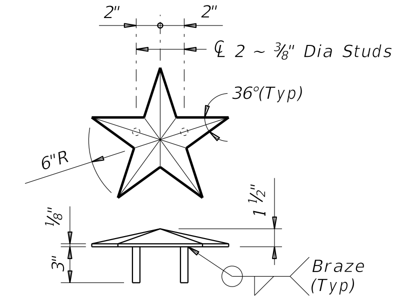


TYPE A

TYPE B

TYPE C

WINDOW TYPES



BRONZE STAR DETAIL 18

Two known manufacturers are:

1. Kassons Castings
 Austin, Texas

2. Southwell Company
 San Antonio, Texas

7 Provide rail joints at ends of all spans the same width as Slab joint opening, except that Rail Joints over construction joints must be 1/4" Min to 3/4" Max in width. Joints must be open if slab joint opening is not sealed. Joints over construction joints and over sealed deck joints must be plugged. Forming material used in joints may be left in place if it is light in color and compressible, such as the following materials: polystyrene, molded cork granules, sponge rubber sheet, etc. If forming material is not left in place, plug the bottom 6" with slab joint sealing compound to prevent drainage and staining.

9 Increase 2" for structures with overlay.

12 Construction year (use if shown elsewhere on plans) 3" High "Plantin Bold" Typeface with 1/4" recess. Placed at one Abutment only or as directed by the Engineer.

13 Dimensions must be the same on each side of joint.

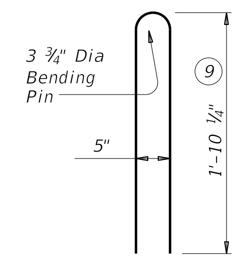
14 Reduce by 2" or field bend over Preformed Bituminous Fiber Material to gain cover.

15 5 1/4" when vertical reinforcing has closer clear cover over horizontal reinforcing in abutment wingwalls or retaining walls on traffic side of wall.

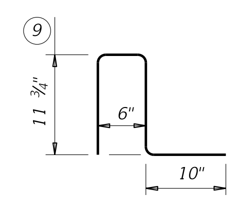
16 As an aid in supporting reinforcement, additional longitudinal bars may be used in the slab with the approval of the Engineer. Such bars must be furnished at the Contractor's expense.

17 Top longitudinal slab bar may be adjusted laterally 3" plus or minus to tie reinforcing.

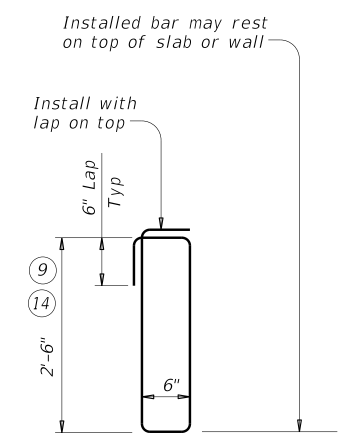
18 Bronze Star dimensions of the final product can be slightly smaller due to shrinkage after casting.



BARS WU (#5)



BARS U (#5)



BARS S (#5)

CONSTRUCTION NOTES:

Attach Bronze Star with a Type III Class C, D, E, or F epoxy adhesive. Clamp star until epoxy achieves set. Remove any visible epoxy "squeeze out" from under star.

Face of rail and pilasters, parapet must be plumb unless otherwise approved.

Apply a one rub finish to all railing surfaces unless otherwise shown elsewhere on the plans.

MATERIAL NOTES:

Provide Class "S" concrete for railing. Provide Class "S" (HPC) concrete if shown elsewhere in the plans.

Provide Grade 60 reinforcing steel.

Epoxy coat or galvanize all reinforcing steel if slab bars are epoxy coated or galvanized.

Bronze Star must be cast of architectural bronze having the following composition: Copper 85 %, Tin 5 %, Lead 5 %, Zinc 5 %.

Provide bar laps, where required, as follows:

Uncoated or galvanized ~ #5 = 2'-0"
Uncoated or galvanized ~ #7 = 2'-11"
Epoxy coated ~ #5 = 3'-0"
Epoxy coated ~ #7 = 4'-4"

GENERAL NOTES:

This rail has been evaluated and approved to be of equal strength to railing with like geometry, which have been crash tested to meet MASH TL-2 criteria. This rail can be used for speeds of 45 mph and less when a TL-2 or TL-3 rated guard fence transition is used. This rail is only approved for low speed use, speeds of 45 mph and less.

Do not use this railing on bridges with expansion joints providing more than 5" movement.

Rail anchorage details shown on this standard may require modification for select structure types. See appropriate details elsewhere in plans for these modifications.

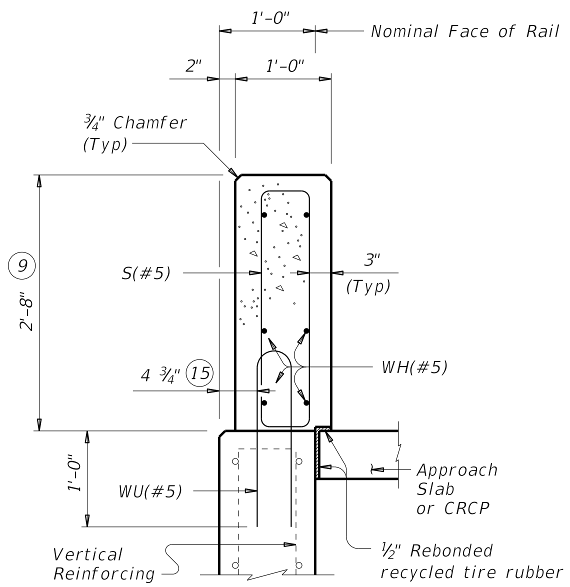
Shop drawings will not be required for this rail.

See Bridge Layout or other plan sheets for the following: dimensions with the number of span pilasters, dimensions with the number of windows, window type, inclusion of bronze stars, inclusion of construction year with abutment identity.

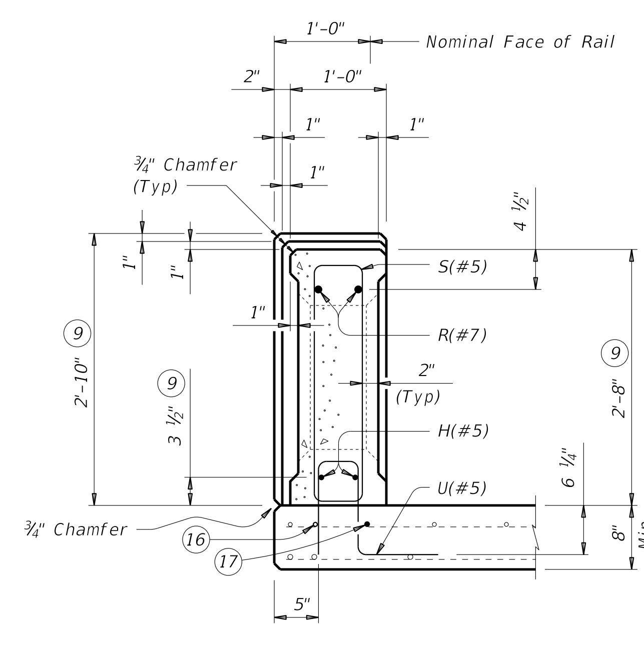
Submit erection drawings showing span number, span pilaster locations, number of windows between pilasters and spacing to first window (see Note 6) to the Engineer for approval.

Average weight of railing with no overlay increase and no pilasters is 270 plf.

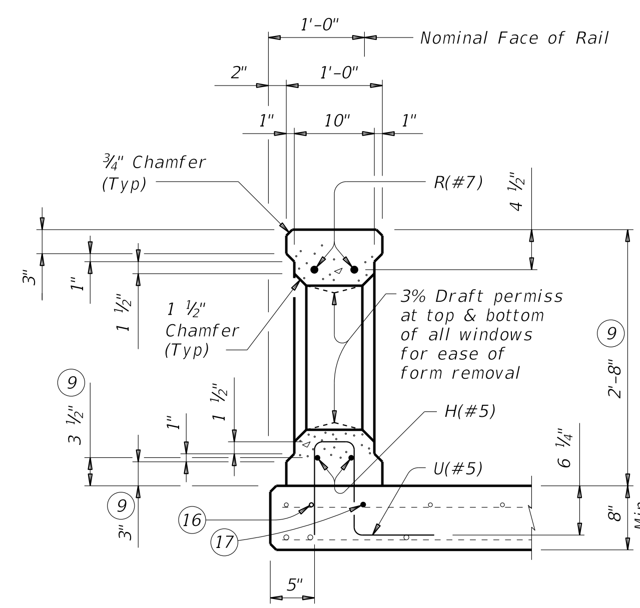
Cover dimensions are clear dimensions, unless noted otherwise.
Reinforcing bar dimensions shown are out-to-out of bar.



ON ABUTMENT WINGWALLS
OR CIP RETAINING WALLS



SECTION THRU
POST ON BRIDGE SLAB
(Showing Pilaster)



SECTION THRU
WINDOW ON BRIDGE SLAB

SECTIONS THRU RAIL

SHEET 2 OF 2

Texas Department of Transportation

Bridge Division Standard

TRAFFIC RAIL TEXAS CLASSIC

TYPE T411

FILE: rlstd008-19.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT September 2019	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST	COUNTY		SHEET NO.

DATE:
FILE:

BAR	SIZE
A	#8
B	#5
D	#5
E	#5
F	#5
G	#5
T	#5

BAR TABLE

APPROXIMATE QUANTITIES (4)

Reinf steel weight = 8.5 Lbs/SF of Approach Slab
= 18.4 Lbs/LF of Support Slab

Vol of Appr Slab Conc (CY) = $1.057W - 0.008W \times T + 0.02W^2 \tan S$
(Includes Support Slab)

W = Width of Approach Slab (ft)

T = Conc Pavement Thickness (in)

S = Skew Angle (deg)

(1) Flare Bars B and D in this region (1'-6" Max Spa, 3" Min Spa). Minimum flared bar length = 2'-6". Bend bars as necessary.

(2) Provide longitudinal construction joints that align with longitudinal construction joints in the bridge slab with bridges built in stages. Other longitudinal construction joints must receive approval of the Engineer.

(3) See details elsewhere in plans for shoulder drain location and details.

(4) For Contractor's information only. Quantities shown are for one approach slab only.

(5) On portion of support slab that supports the concrete pavement, adjust top surface elevation, if required, to accommodate concrete pavement thickness. Smooth trowel finish. Oil top of support slab with 60 grade oil and apply heavy coat of powdered graphite. Press down one layer of 30# roofing felt.

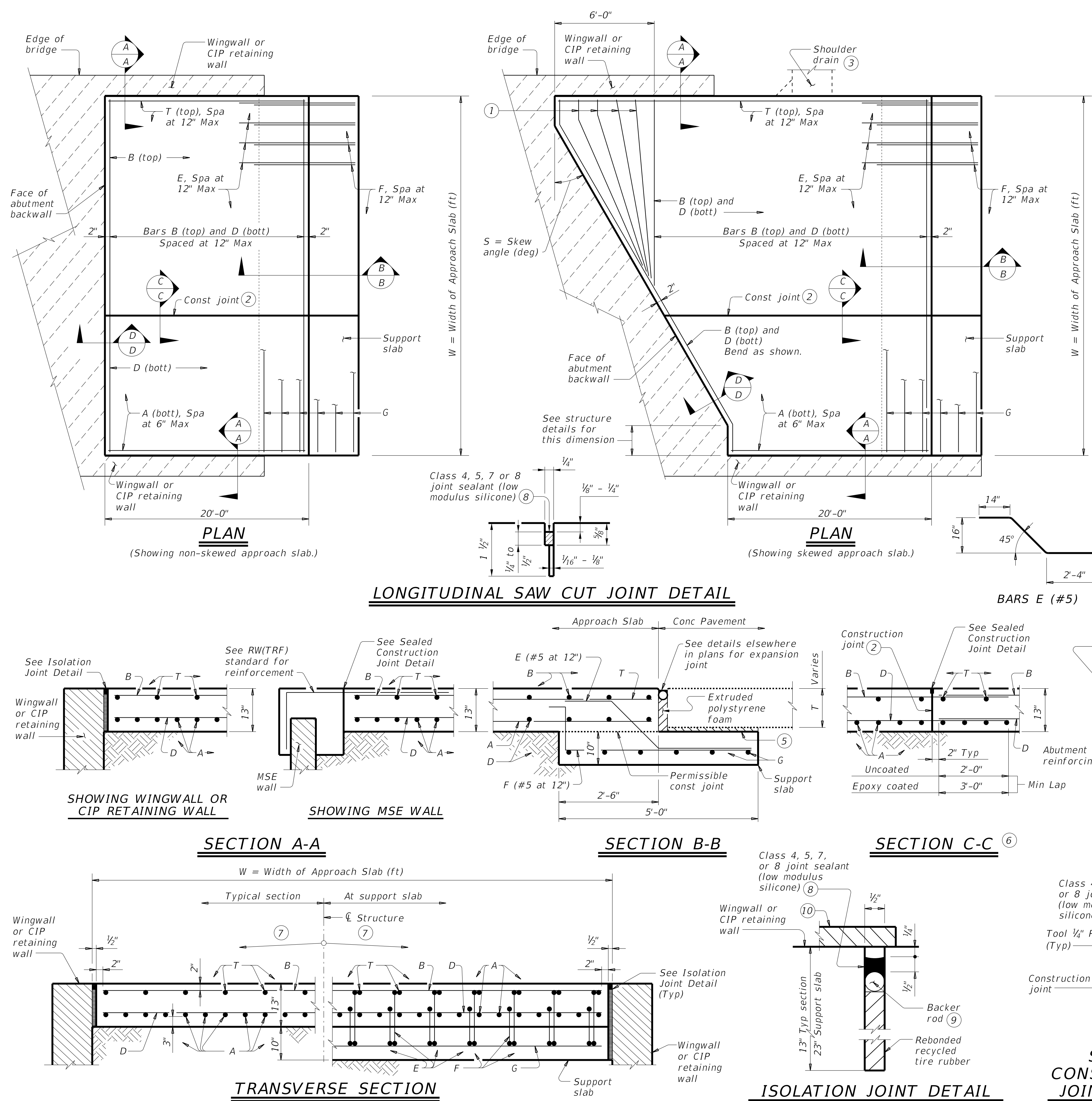
(6) Multiple piece tie bars are acceptable at longitudinal construction joints provided minimum laps shown are achieved.

(7) See details elsewhere in plans for required cross-slope.

(8) Place in accordance with Item 438.

(9) Provide backer rod that is 25% larger than joint opening and compatible with the sealant.

(10) If bridge rail is present at the wingwall or CIP retaining wall, place ½" rebonded recycled tire rubber between concrete railing and top of approach slab as shown when concrete railing projects over the approach slab.



PLAN
(Showing non-skewed approach slab.)

PLAN
(Showing skewed approach slab.)

LONGITUDINAL SAW CUT JOINT DETAIL

SHOWING WINGWALL OR CIP RETAINING WALL

SHOWING MSE WALL

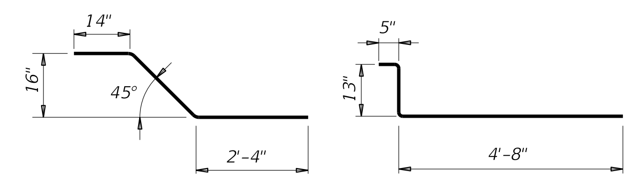
SECTION A-A

SECTION B-B

SECTION C-C (6)

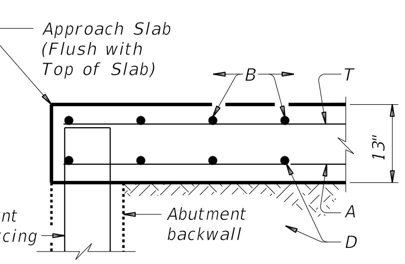
TRANSVERSE SECTION

ISOLATION JOINT DETAIL

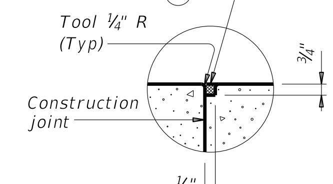


BARS E (#5)

BARS F (#5)



SECTION D-D



SEALED CONSTRUCTION JOINT DETAIL

GENERAL NOTES:

Construct approach slab in accordance with Item 422.

Provide Class "S" concrete with a minimum compressive strength of 4,000 psi.

Provide Grade 60 reinforcing steel.

Provide longitudinal joints as shown on the Longitudinal Saw Cut Joint Detail at lane lines and shoulders when width between longitudinal construction joints or edges of approach slab exceeds 16 feet. Saw cut joints within 24 hours of concrete placement to a depth of 1 ½" and seal in accordance with Item 438. Alternately, provide a controlled joint consisting of 1 ½" vinyl or plastic joint former (Stress Cap, Zip Strip, Stress Lock, or equal as approved by the Engineer.)

Provide rebonded recycled tire rubber joint filler that meets the requirements of DMS-6310. "Joint Sealants and Fillers."

Construct the subgrade or subbase away from the bridge for a minimum distance of 100 feet prior to the approach slab, unless otherwise indicated on the plans.

Compact and finish the subgrade or foundation for the approach slab to the typical cross-section and to the lines and grades shown on the plans.

Cure for 4 days using water or membrane curing per Item 422.

All details shown herein are subsidiary to bridge approach slab.

Cover dimensions are clear dimensions, unless noted otherwise. Reinforcing bar dimensions shown are out-to-out of bar.

DATE:
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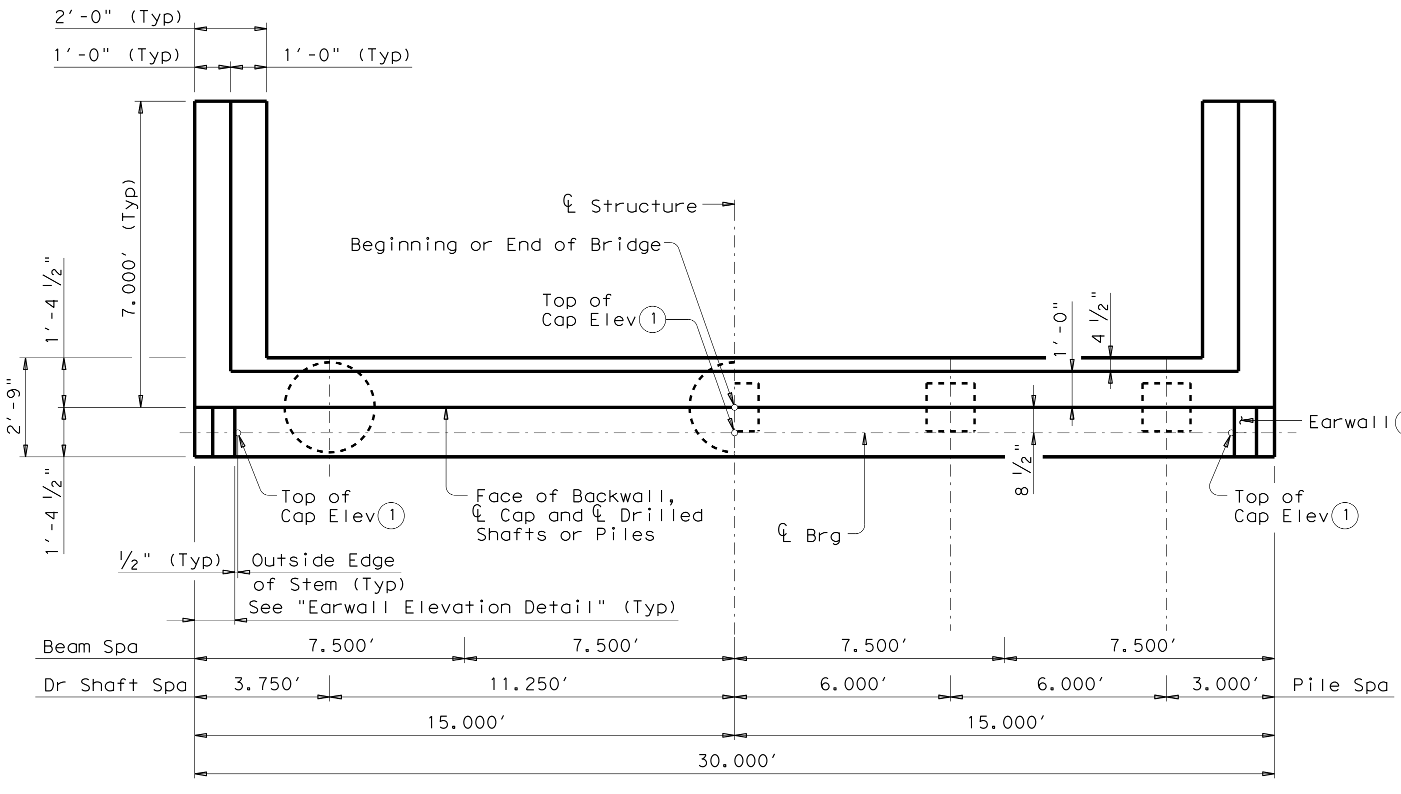
Texas Department of Transportation — Bridge Division Standard

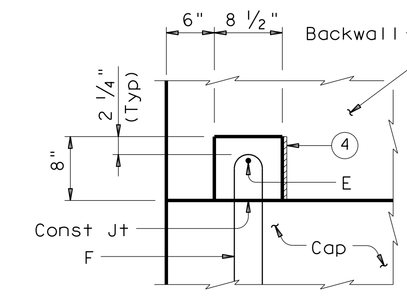
BRIDGE APPROACH SLAB
CONCRETE PAVEMENT

BAS-C

FILE: bascste1-20.dgn	DN: TxDOT	CK: TxDOT	DW: TxDOT	CK: TxDOT
©TxDOT April 2019	CONT	SECT	JOB	HIGHWAY
REVISIONS				
02-20: Removed stress relieving pad.	DIST		COUNTY	SHEET NO.



PLAN



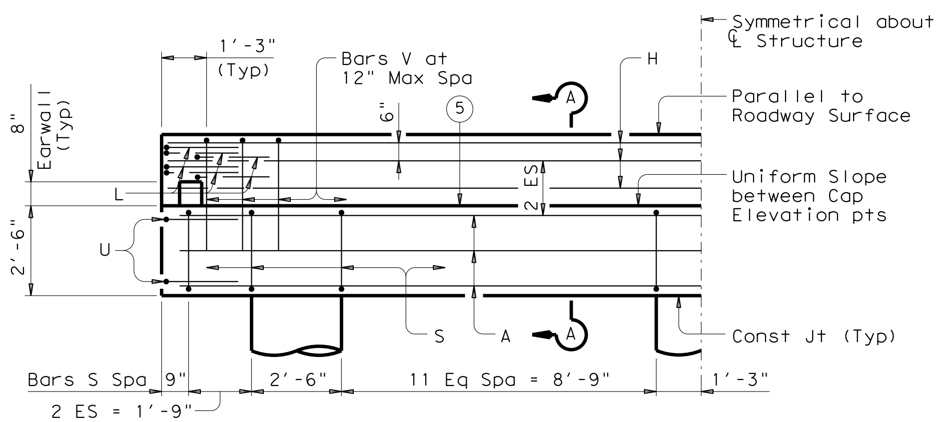
EARWALL ELEVATION DETAIL 6

(Slope top of earwall away from beams)

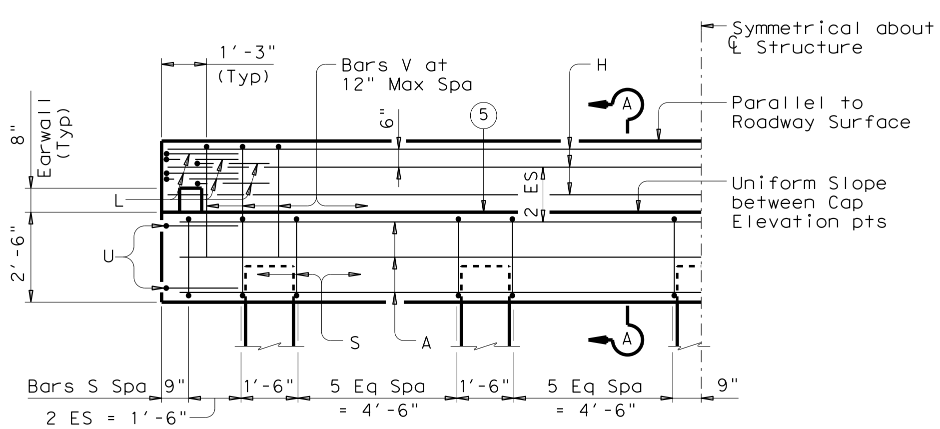
Span Length	Drilled Shaft Load	Pile Load
Ft	Tons/DS	Tons/Pile
30	46	27
35	50	30
40	54	33
45	58	35
50	62	37
55	65	39
60	69	41

TABLE OF FOUNDATION LOADS

1. Top of cap elevations are based on section depths shown on span details.
2. 1'-8" for 7DS20 beams, 1'-11" for 7DS23 beams.
3. With Pile foundations, replace Bar A, located at bottom centerline of cap with 4 ~ #11 x 4'-8" bars placed between piles. Deduct 55 Lbs from reinforcing steel total.
4. 1/2" Preformed Bituminous Fiber material between beam stem and earwall. Bond to beam with an approved adhesive. Inside face of earwall to be cast with face of beam stem.
5. Surface finish for the top of cap must be a wood float finish. The surface must be level in the direction of the centerline of beams. Bearing surface must be clean and free of all loose material before placing bearing pads.
6. Do not cast earwalls until beams are erected in their final position.
7. Top of backwall elevation is equal to top of beam elevation.

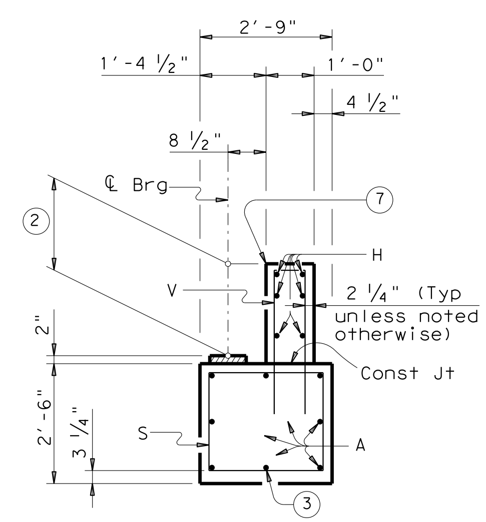


HALF ELEVATION ~ DRILLED SHAFT ABUTMENT



HALF ELEVATION ~ PILE ABUTMENT

(Showing 16" Piles ~ for Piles larger than 16", adjust Bars S spacing as required to avoid Piling)



SECTION A-A

GENERAL NOTES:

Designed according to AASHTO LRFD Specifications.
Concrete strength f'c = 3,600 psi.
All reinforcing must be Grade 60.
Designed for normal embankment header slope of 3:1 or 2:1.
See Bridge Layout for beam type and foundation type, size and length.
See standard FD for all foundation details and notes.
See applicable rail details for rail anchorage cast in wingwalls.
See standard CRR for riprap attachment details, if applicable.
These abutment details may only be used with the following standard: SDSB-28

HL93 LOADING — SHEET 1 OF 2

Texas Department of Transportation — Bridge Division Standard

ABUTMENTS

PRESTRESSED CONCRETE DECKED SLAB BEAMS 28' ROADWAY

ADSB-28

FILE: dsbste16.dgn	DN: JMH	CK: AM	DW: JTR	CK: JMH
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REVISIONS	DIST	COUNTY		SHEET NO.

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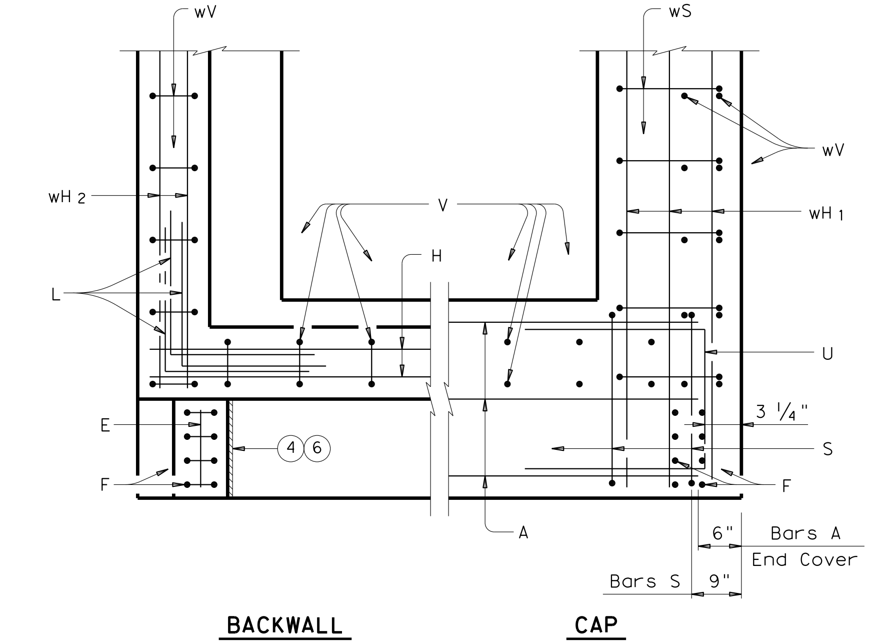


CORNER DETAILS

TABLE OF ESTIMATED QUANTITIES (TYPE 7DS20 BEAMS) (8)

Bar	No.	Size	Length	Weight
A (3)	8	#11	29'- 0"	1,233
E	2	# 5	1'- 1"	2
F	8	# 4	3'-10"	20
H	6	# 6	29'- 8"	267
L	12	# 6	4'- 0"	72
S	30	# 4	9'- 8"	194
U	4	# 6	7'- 3"	44
V	29	# 5	6'-11"	209
wH1	14	# 6	8'- 0"	168
wH2	12	# 6	6'- 8"	120
wS	16	# 4	7'- 9"	83
wV	16	# 5	6'-11"	115
Reinforcing Steel			Lb	2,527
Class "C" Concrete			CY	12.6

TABLE OF ESTIMATED QUANTITIES (TYPE 7DS23 BEAMS) (8)

Bar	No.	Size	Length	Weight
A (3)	8	#11	29'- 0"	1,233
E	2	# 5	1'- 1"	2
F	8	# 4	3'-10"	20
H	6	# 6	29'- 8"	267
L	12	# 6	4'- 0"	72
S	30	# 4	9'- 8"	194
U	4	# 6	7'- 3"	44
V	29	# 5	6'-11"	209
wH1	14	# 6	8'- 0"	168
wH2	12	# 6	6'- 8"	120
wS	16	# 4	7'- 9"	83
wV	16	# 5	6'-11"	115
Reinforcing Steel			Lb	2,527
Class "C" Concrete			CY	13.0

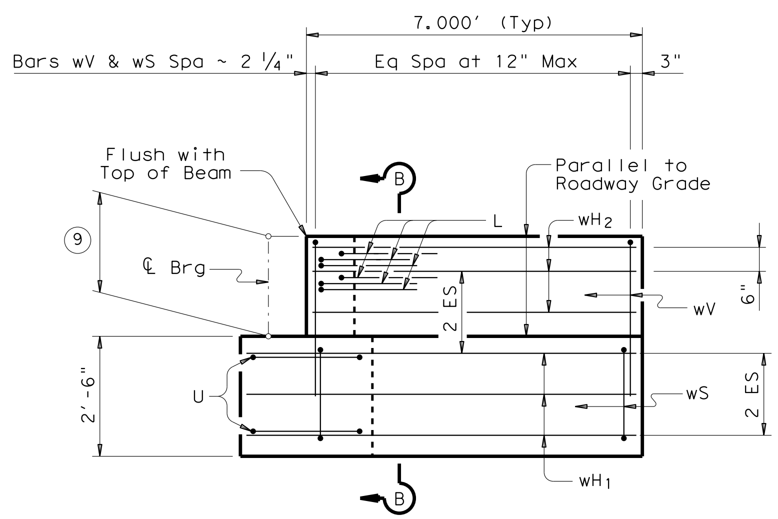
(3) With Pile foundations, replace Bar A, located at bottom centerline of cap with 4 ~ #11 x 4'-8" bars placed between piles. Deduct 55 Lbs from reinforcing steel total.

(4) ½" Preformed Bituminous Fiber material between beam stem and earwall. Bond to beam with an approved adhesive. Inside face of earwall to be cast with face of beam stem.

(6) Do not cast earwalls until beams are erected in their final position.

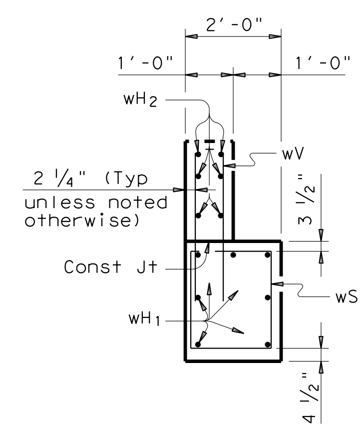
(8) Quantities shown are for one Abutment only.

(9) 1'-10" for 7DS20 beams, 2'-1" for 7DS23 beams.

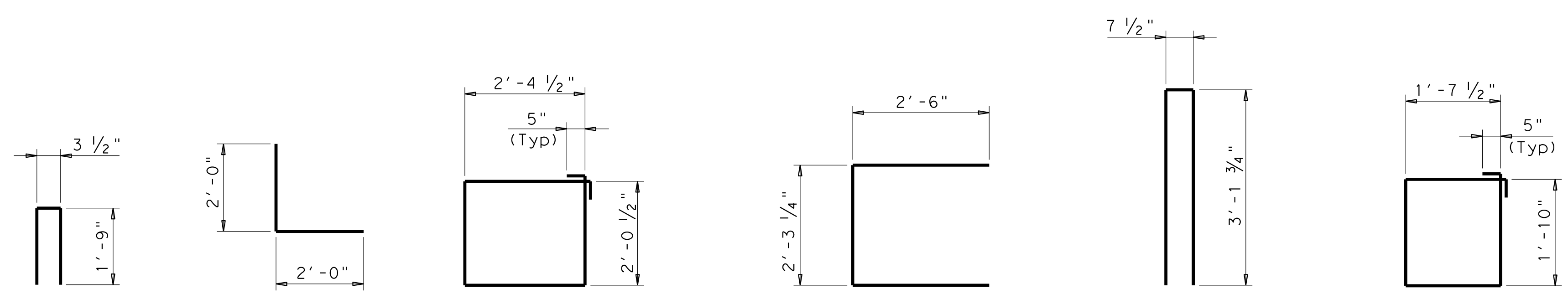


WINGWALL ELEVATION

(Earwall omitted for clarity)



SECTION B-B



HL93 LOADING SHEET 2 OF 2

Texas Department of Transportation — Bridge Division Standard

ABUTMENTS

PRESTRESSED CONCRETE DECKED SLAB BEAMS 28' ROADWAY

ADSB-28

FILE: dsbste16.dgn	DN: JMH	CK: AM	DW: JTR	CK: JMH
©TxDOT September 2010	CONT	SECT	JOB	HIGHWAY
REVISIONS	DIST	COUNTY		SHEET NO.

DATE:
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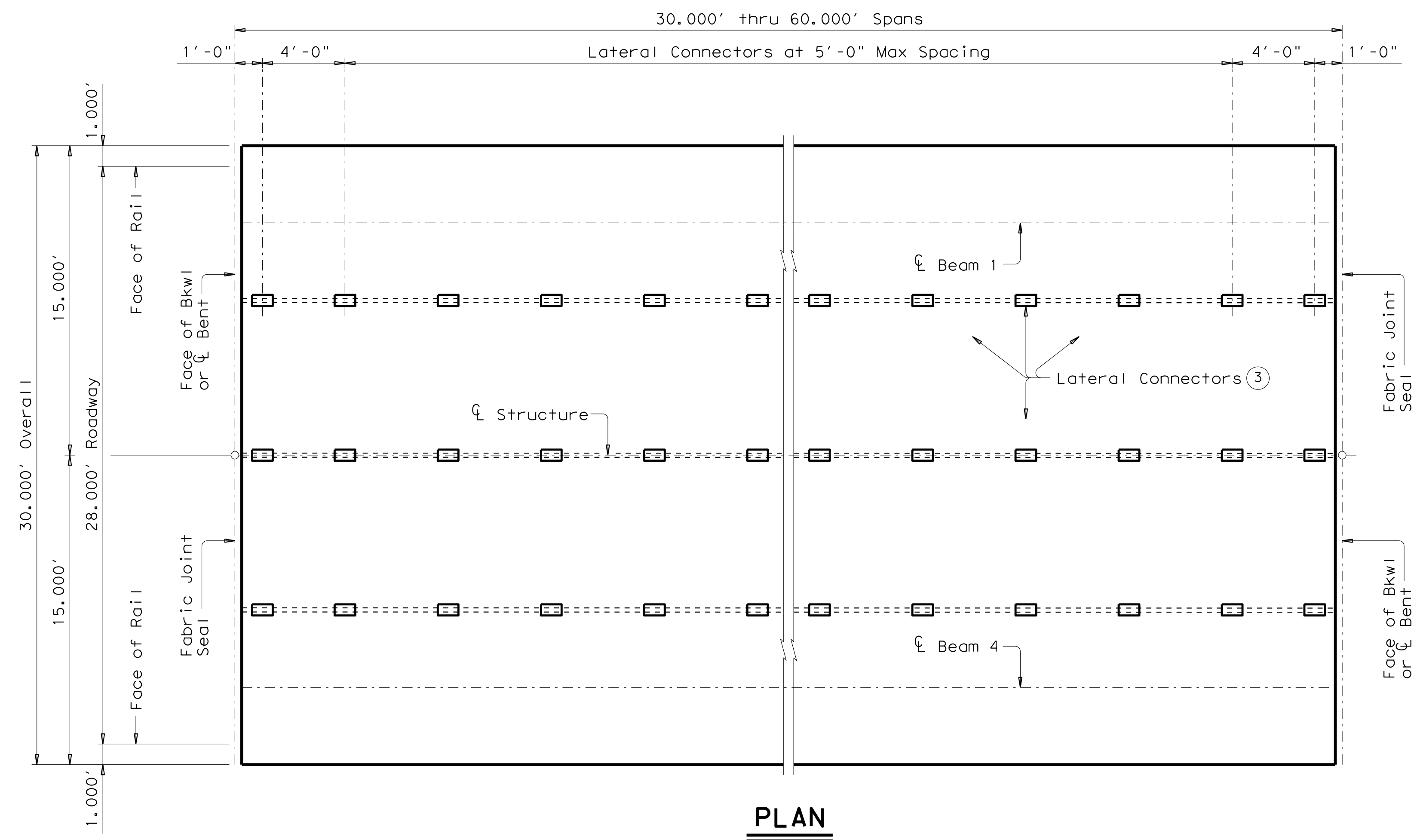
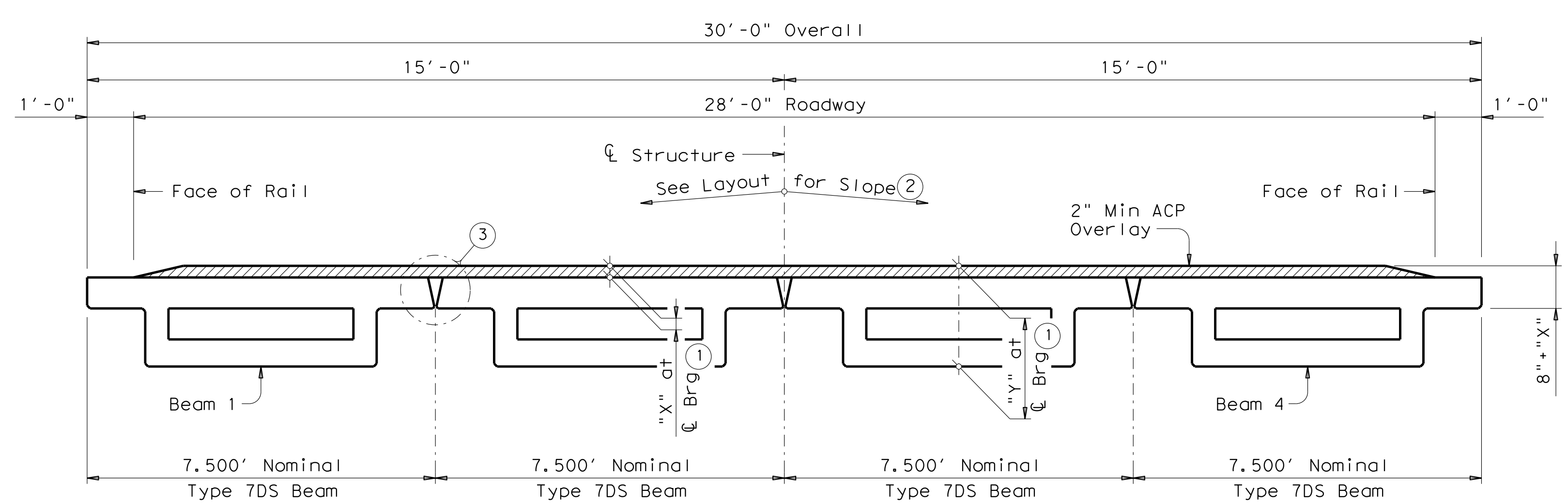


PLAN



TYPICAL TRANSVERSE SECTION

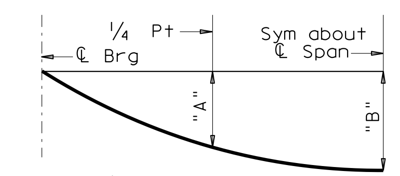
(1) Based on theoretical beam camber, dead load deflections of two-course surface treatment and 2" ACP Overlay, and a constant grade.

(2) This Standard does not provide for changes in roadway cross-slopes within the structure.

(3) See Lateral Connector Details.

TABLE OF VARIABLE VALUES

SPAN LENGTH	BEAM TYPE	DEAD LOAD DEFLECTIONS		SECTION DEPTHS (1)	
		"A"	"B"	"X" AT ℄ BRG	"Y" AT ℄ BRG
Ft		Ft	Ft	In	Ft/In
30	7DS20	0.001	0.001	2 ½"	1'-10 ½"
35	7DS20	0.001	0.002	2 ¾"	1'-10 ¾"
40	7DS20	0.002	0.003	3"	1'-11"
45	7DS20	0.004	0.005	3 ½"	1'-11 ½"
50	7DS20	0.006	0.008	4"	2'-0"
30	7DS23	0.001	0.001	2 ½"	2'-1 ½"
35	7DS23	0.001	0.001	2 ½"	2'-1 ½"
40	7DS23	0.002	0.002	2 ¾"	2'-1 ¾"
45	7DS23	0.002	0.003	3"	2'-2"
50	7DS23	0.004	0.005	3 ¼"	2'-2 ¼"
55	7DS23	0.006	0.008	3 ¾"	2'-2 ¾"
60	7DS23	0.008	0.011	4 ½"	2'-3 ½"



Deflections shown are due to two-course surface treatment and 2" ACP overlay only, (E_c = 5 x 10^3 ksi). Calculated deflections shown are theoretical and actual dimension may be less. Adjust deflections based on field observation.

DEAD LOAD DEFLECTION DIAGRAM

GENERAL NOTES:

Designed according to AASHTO LRFD Specifications.
Lateral Connector Rods (LCR) must be Grade 36 or 50.
See railing details and standard DSBRA for rail anchorage.
This standard does not support the use of transition bents.
It is recommended, with crown cross-slope, to erect beams adjacent to crown point first. For structures without a crown point, it is recommended to erect beams on the high side of cross-slope first and progress to the low side.
Payment for the following is considered subsidiary to the other bid items: packaged non-metallic, non-shrink cementitious grout; corrosion inhibiting bonding agent; fabric underseal; work performed; materials furnished; and curing time.
Payment for Fabric Joint Seal is considered subsidiary to other bid items.

HL93 LOADING *SHEET 1 OF 2*

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE DECKED SLAB BEAM SPANS (TYPE 7DS20 OR 7DS23)

28' ROADWAY

SDSB-28

FILE: dsbste22.dgn	DN: JMH	CK: AM	DW: JTR	CK: JMH
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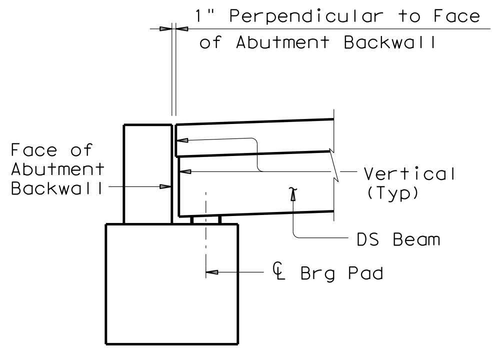
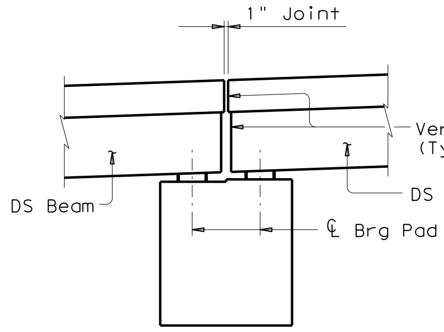


AT ABUTMENT



AT INTERIOR BENT

STANDARD BEAM END ELEVATIONS

(ACP Overlay not shown for clarity.)

(4) Fabricator must adjust beam lengths for beam slopes as required.

(5) Seat and center 1" diameter smooth Lateral Connector Rod (LCR) in the bottom of the flange connection "Vee" prior to welding to minimize grout leakage. Caulk where necessary between connectors.

(6) Coat steel surfaces in contact with grout with a 3-component, water-based, epoxy-modified cement bonding agent including a corrosion inhibitor (BASF Emaco P24, Euclid Corr-Bond, Sika Armatec 110 EpoCem or approved equal). Submit material data sheet to Engineer for approval, prior to use. Apply in accordance with manufacturer's specifications and not prior to 12 hours before grout placement.

(7) Fill shear keys with packaged non-metallic, non-shrink cementitious grout that is certified by the manufacturer to meet the requirements of ASTM C 1107, free of chlorides, and capable of a compressive strength of 4,000 psi after 3 days of curing at anticipated temperatures. Surface preparation, mixing and consistency of grout, placing, and curing grout must follow the manufacturer's recommendations. Curing compounds are not allowed. Cure 3 days, minimum, prior to placing surface treatment and overlay. Approximate grout quantity for three beam joints = 0.33 CF of grout per foot of span length.

(8) Use forming material between Lateral Connectors. Maintain a uniform grout depth along length of beams.

(9) Lateral Connector Rods are to be considered subsidiary to other pertinent bid items.

(10) After the specified cure times for the grout is reached, apply fabric underseal to the limits shown. Use fabric underseal meeting the requirements of Item 356, "Fabric Underseal".

(11) Provide joint for roadway width and/or between toe of rails on the superstructure.

(12) Place backer rod in joint opening prior to placing binder. Backer rods must be suitable for contact with hot asphalt.

(13) Use fabric underseal meeting the requirements of Item 356, "Fabric Underseal." When using the self-adhesive type fabric underseal, pressure roll fabric underseal to improve adhesion. Apply binder to fabric joint underseal as required by the manufacturer's installation instructions.

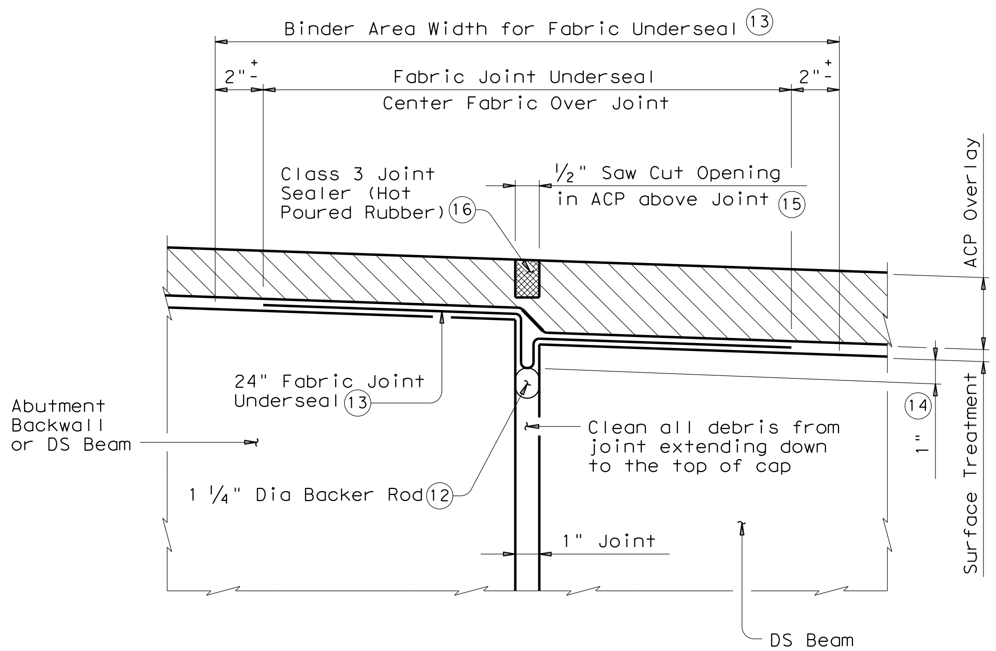
(14) Tuck fabric 1" into joint opening. Mark location of centerline of joint on curb or barrier as approved.

(15) After the asphaltic concrete pavement operations are complete, saw cut through the asphalt at centerline of joint. Make multiple saw cuts to create a ½" minimum joint opening. Depth of saw cut will be ½" less than total ACP Overlay over joint. Do not damage the underseal.

(16) Seal the joint opening with a Class 3, "Hot Poured Rubber" in accordance with DMS-6310, "Joint Sealants and Fillers." Seal flush with the top of the asphaltic concrete pavement.

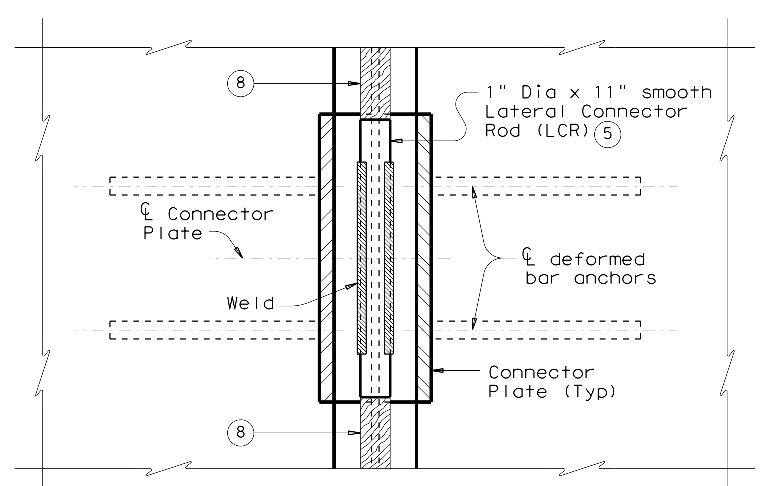
TABLE OF ESTIMATED QUANTITIES

SPAN LENGTH	BEAM TYPE	PRESTRESSED CONCRETE DECKED SLAB BEAMS (4)		
		ABUTMENT TO INTERIOR BENT	INT BENT TO INT BENT	ABUTMENT TO ABUTMENT
Ft		LF	LF	LF
30	7DS20	119.50	119.67	119.33
35	7DS20	139.50	139.67	139.33
40	7DS20	159.50	159.67	159.33
45	7DS20	179.50	179.67	179.33
50	7DS20	199.50	199.67	199.33
30	7DS23	119.50	119.67	119.33
35	7DS23	139.50	139.67	139.33
40	7DS23	159.50	159.67	159.33
45	7DS23	179.50	179.67	179.33
50	7DS23	199.50	199.67	199.33
55	7DS23	219.50	219.67	219.33
60	7DS23	239.50	239.67	239.33

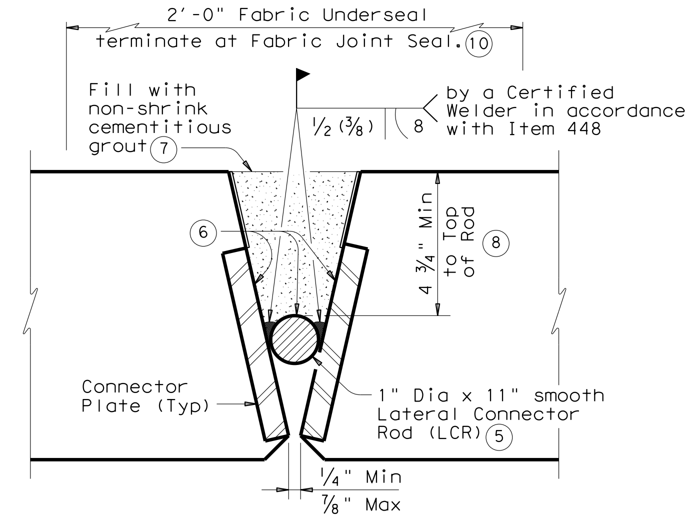


FABRIC JOINT SEAL (11)

(Showing Expansion Joint with ACP Overlay.)



PLAN



SECTION

(deformed bar anchors not shown for clarity)

LATERAL CONNECTOR DETAILS (9)

Do not apply load to beams while welding lateral connector rods.
No vehicles are allowed on the span until shear key grout has cured 72 hours.

HL93 LOADING — SHEET 2 OF 2

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE DECKED SLAB BEAM SPANS (TYPE 7DS20 OR 7DS23)

28' ROADWAY

SDSB-28

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REVISIONS				
	DIST	COUNTY		SHEET NO.

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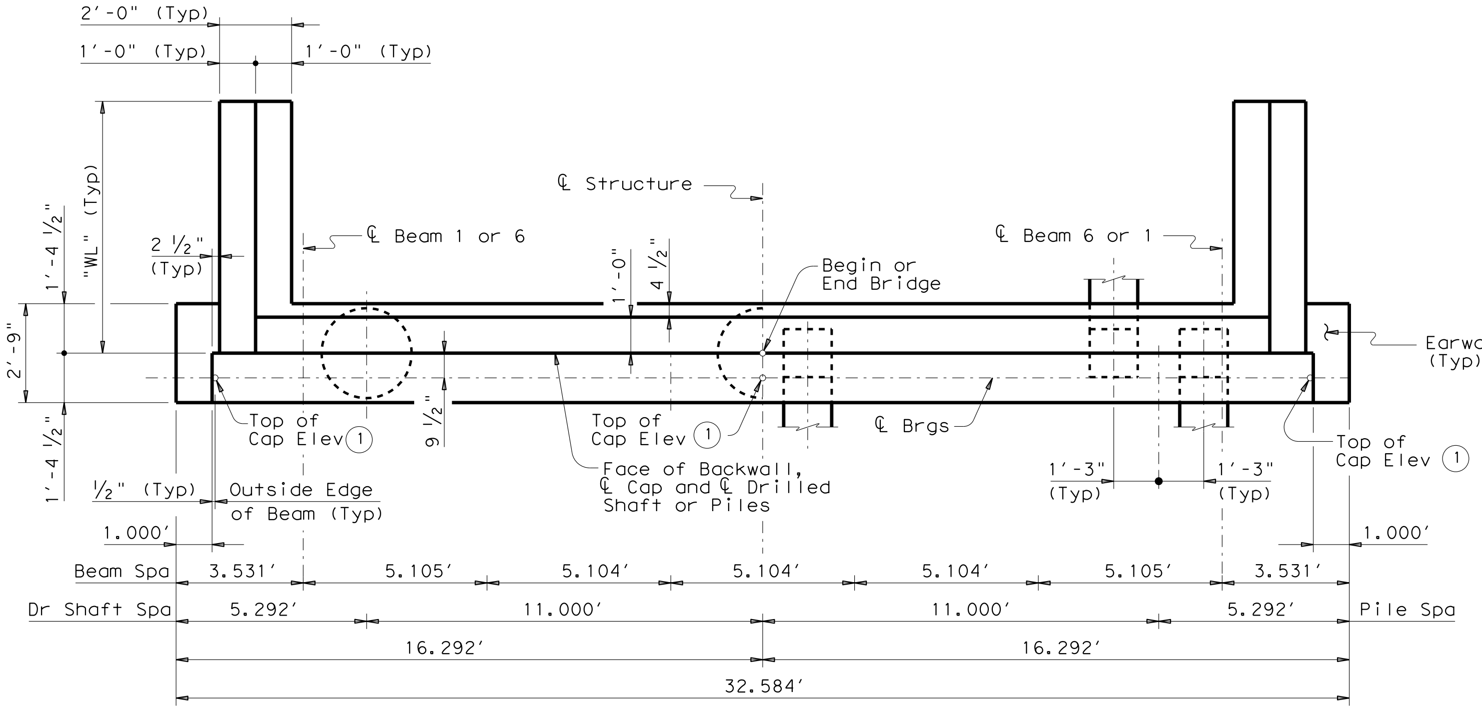

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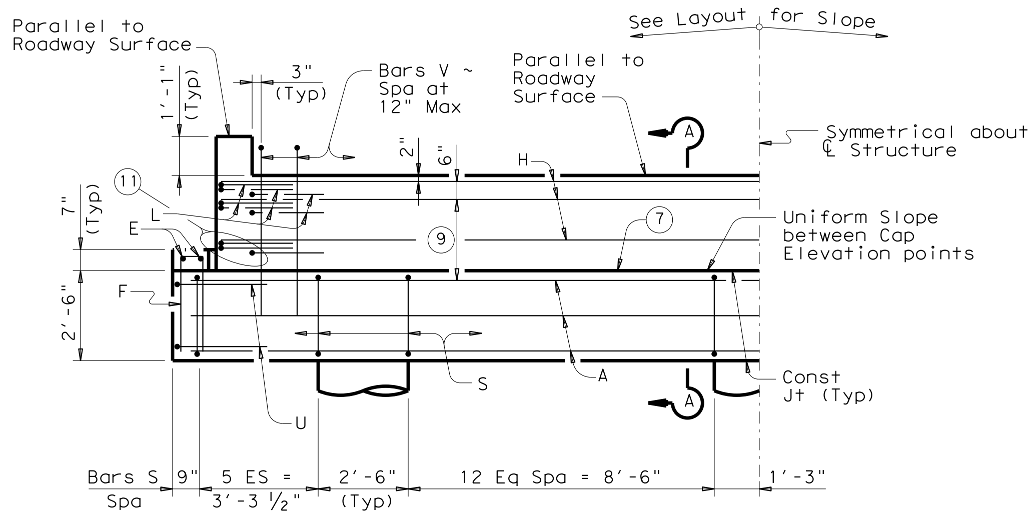
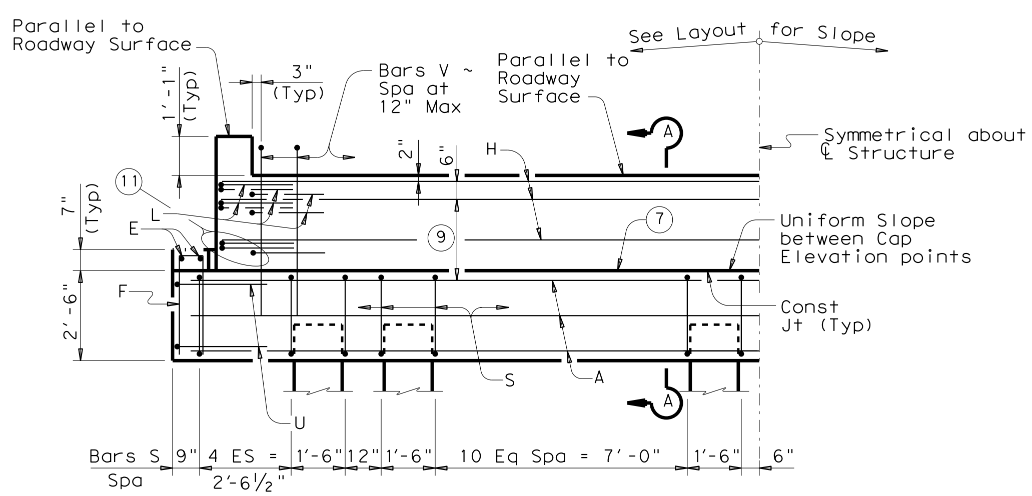
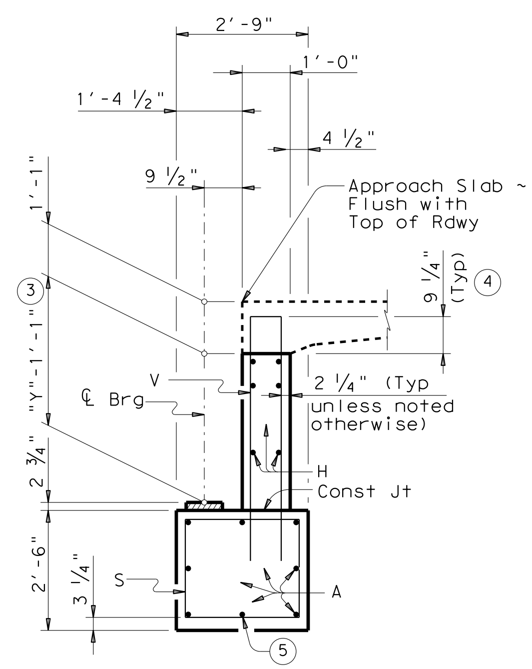


HALF ELEVATION ~ DRILLED SHAFT ABUTMENT



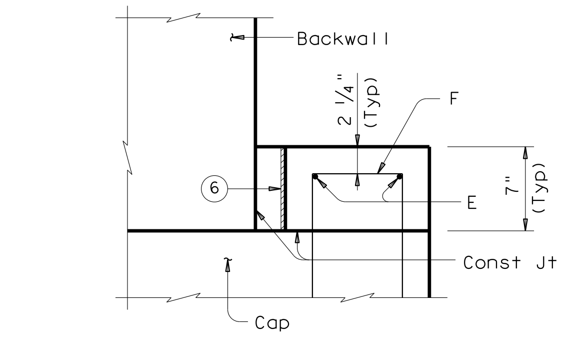
HALF ELEVATION ~ PILE ABUTMENT

(Showing 16" Piles ~ for Piles larger than 16", adjust Bars S spacing as required to avoid Piling)



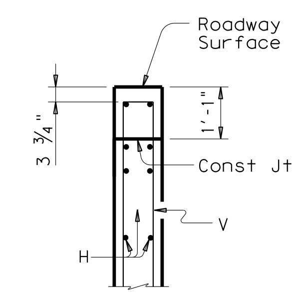
SECTION A-A

(Showing Approach Slab) 2



EARWALL ELEVATION DETAIL 10

(Slope top of earwall away from beams)



BACKWALL DETAIL

(Without Approach Slab) 2

TABLE OF WINGWALL LENGTHS "WL"

Beam Type	"WL"
B20	8.000'
B28	10.000'
B34	11.000'

TABLE OF FOUNDATION LOADS 8

Span Length	Drilled Shaft Load	Battered Pile Load
Ft	Tons/DS	Tons/Pile
30	53	41
35	58	44
40	63	46
45	68	49
50	72	51
55	77	54
60	81	56
65	86	58
70	90	60
75	94	63
80	99	65
85	103	67
90	107	69
95	112	71
100	116	74

1. Top of Cap Elevations are based on section depths shown on Span Details.
2. See Bridge Layout for Joint type and to determine if Approach Slab is present.
3. See Span details for "Y" value.
4. Increase as required to maintain 3 ¾" from Finished Grade.
5. With pile foundations, replace Bar A, located at bottom centerline of cap with 2 ~ #11 x 7'-0" bars placed between pile groups. Deduct 93 Lbs from reinforcing steel total.
6. ½" Preformed Bituminous Fiber material between beam and earwall. Bond to beam with an approved adhesive. Inside face of earwall to be cast with vertical side of beam.
7. Surface finish for the top of Cap will be a textured wood float finish. The surface must be level in the direction of the centerline of Beams.
8. Foundation loads are based on B34 beams.
9. Use 2 Eq Spa for B28 and B34 beams. Use 1 space for B20 beams.
10. Do not cast earwalls until beams are erected in their final position.
11. This set of Bars L only required for B28 and B34 beams.

GENERAL NOTES:

Designed according to AASHTO LRFD Specifications.
Concrete strength f'c = 3,600 psi.
All reinforcing must be Grade 60.
Designed for normal embankment header slope of 3:1 or 2:1.
See Bridge Layout for beam type and foundation type, size and length.
See standard FD for all foundation details and notes.
See applicable rail details for rail anchorage cast in wingwalls.
See standard CRR for riprap attachment details, if applicable.
These abutment details may be used only with the following standards:
SBBS-B20-28 or SBBO-B20-28
SBBS-B28-28 or SBBO-B28-28
SBBS-B34-28 or SBBO-B34-28

HL93 LOADING — SHEET 1 OF 2

Texas Department of Transportation — Bridge Division Standard

ABUTMENTS

PRESTR CONC BOX BEAMS 28' RDWY

ABB-28

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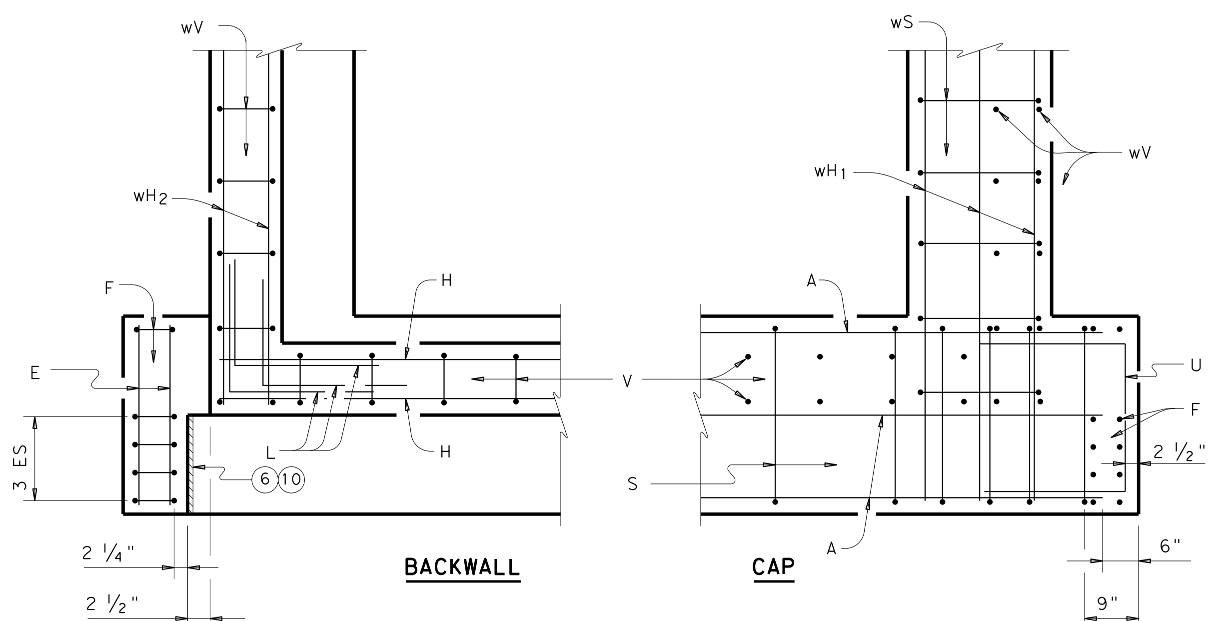


BACKWALL

CAP

CORNER DETAILS

TABLE OF ESTIMATED QUANTITIES (TYPE B20 BEAMS) (12)

BAR	NO.	SIZE	LENGTH	WEIGHT
A (5)	8	#11	31'- 7"	1,342
E	4	# 5	2'- 5"	10
F	10	# 5	6'- 1"	63
H	4	# 6	29'-10"	179
L	12	# 6	4'- 0"	72
S	38	# 4	9'- 8"	245
U	4	# 6	7'- 6"	227
V	29	# 5	7'- 6"	227
wH1	14	# 6	9'- 0"	189
wH2	12	# 6	7'- 8"	138
wS	18	# 4	7'- 9"	93
wV	18	# 5	7'- 9"	145
Reinforcing Steel			Lb	2,747
Class "C" Concrete (w/Slab)			CY	13.8
Class "C" Concrete (w/ACP)			CY	13.5

TABLE OF ESTIMATED QUANTITIES (TYPE B28 BEAMS) (12)

BAR	NO.	SIZE	LENGTH	WEIGHT
A (5)	8	#11	31'- 7"	1,342
E	4	# 5	2'- 5"	10
F	10	# 5	6'- 1"	63
H	6	# 6	29'-10"	269
L	18	# 6	4'- 0"	108
S	38	# 4	9'- 8"	245
U	4	# 6	7'- 3"	44
V	29	# 5	8'-10"	267
wH1	14	# 6	11'- 0"	231
wH2	16	# 6	9'- 8"	232
wS	22	# 4	7'- 9"	114
wV	22	# 5	9'- 1"	208
Reinforcing Steel			Lb	3,133
Class "C" Concrete (w/Slab)			CY	16.1
Class "C" Concrete (w/ACP)			CY	15.7

TABLE OF ESTIMATED QUANTITIES (TYPE B34 BEAMS) (12)

BAR	NO.	SIZE	LENGTH	WEIGHT
A (5)	8	#11	31'- 7"	1,342
E	4	# 5	2'- 5"	10
F	10	# 5	6'- 1"	63
H	6	# 6	29'-10"	269
L	18	# 6	4'- 0"	108
S	38	# 4	9'- 8"	245
U	4	# 6	7'- 3"	44
V	29	# 5	9'- 9"	295
wH1	14	# 6	12'- 0"	252
wH2	16	# 6	10'- 8"	256
wS	24	# 4	7'- 9"	124
wV	24	# 5	10'- 0"	250
Reinforcing Steel			Lb	3,258
Class "C" Concrete (w/Slab)			CY	17.6
Class "C" Concrete (w/ACP)			CY	17.2

(3) See Span details for "Y" value.

(5) With pile foundations, replace Bar A, located at bottom centerline of cap, with 2 ~ #11 x 7'-0" bars placed between pile groups. Deduct 93 Lbs from reinforcing steel total.

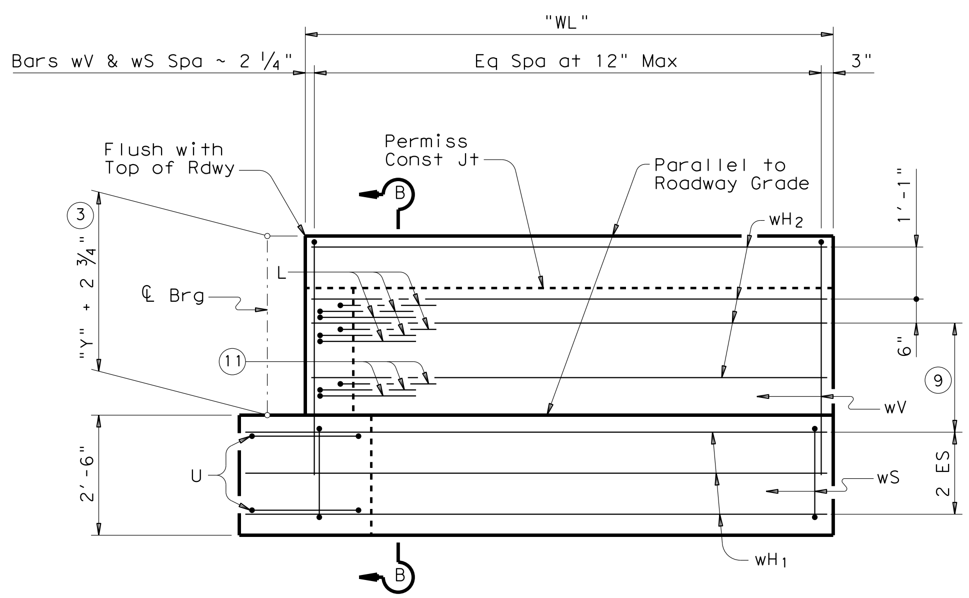
(6) 1/2" Preformed Bituminous Fiber material between beam and earwall. Bond to beam with an approved adhesive. Inside face of earwall to be cast with vertical side of beam.

(9) Use 2 Eq Spa for B28 and B34 beams and 1 space for B20 beams.

(10) Do not cast earwalls until beams are erected in their final position.

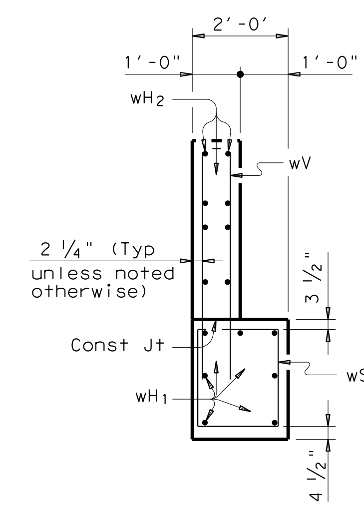
(11) This set of Bars L only required for B28 and B34 beams.

(12) Quantities shown are for one Abutment only (with Approach Slab). With no Approach Slab, add 1.1 CY Class "C" concrete and 90 Lb reinforcing steel for 2 additional Bars H.

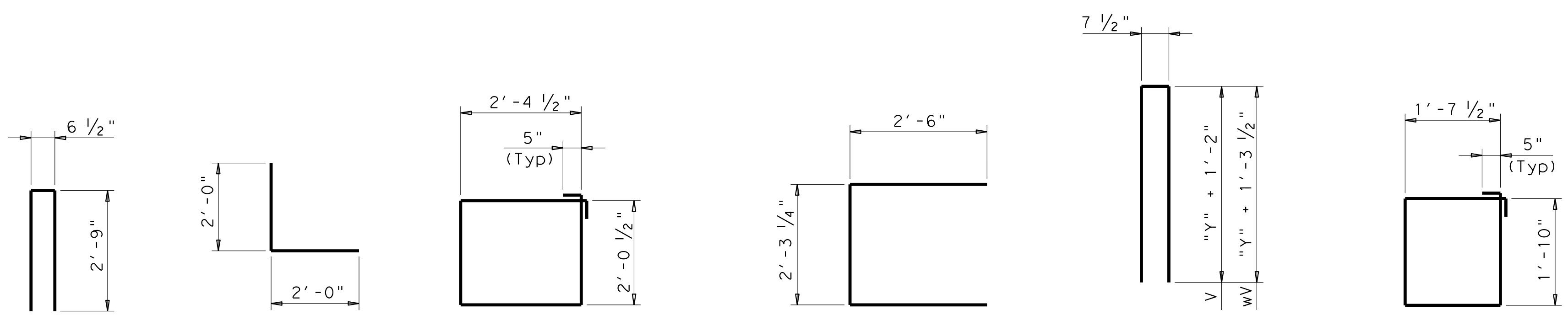


WINGWALL ELEVATION

(Earwall omitted for clarity)



SECTION B-B



BARS F   BARS L   BARS S   BARS U   BARS V & wV (3)   BARS wS

HL93 LOADING

SHEET 2 OF 2

Texas Department of Transportation

Bridge Division Standard

ABUTMENTS

PRESTR CONC BOX BEAMS 28' RDWY

ABB-28

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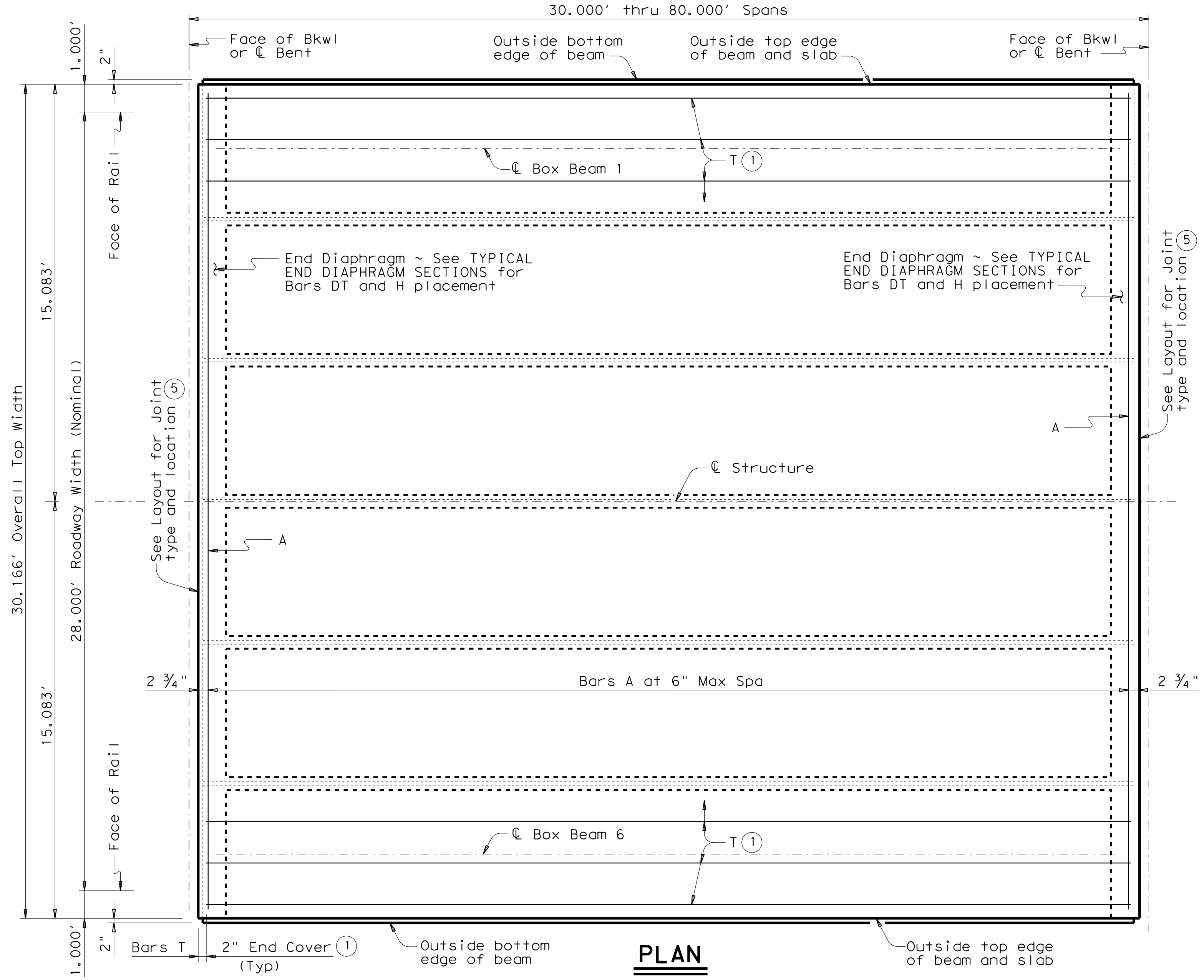
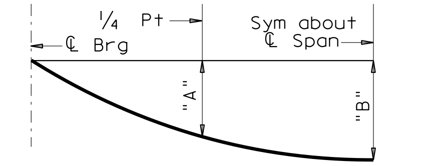


PLAN

DEAD LOAD DEFLECTION DIAGRAM



Note: Deflections shown are due to shear key and concrete slab only, (Ec = 5 x 10^3 ksi). Calculated deflections shown are theoretical and actual dimension may be less. Deflections may be adjusted based on field observation.

BAR TABLE

BAR	SIZE
A	#4
DT	#4
H	#5
T	#4

TABLE OF DEFLECTIONS AND SECTION DEPTHS

SPAN LENGTH (FT)	BEAM NO.	POINT	DEAD LOAD DEFLECTIONS (FT) SHEAR KEY	SLAB	TOTAL	SECTION DEPTHS "X" AT ℄ BRG (2)	"Y" AT ℄ BRG (2)
30	ALL	"A"	0.000	0.001	0.001	5"	2'-9"
		"B"	0.000	0.001	0.001		
35	ALL	"A"	0.001	0.001	0.002	5 ¼"	2'-9 ¼"
		"B"	0.001	0.002	0.003		
40	ALL	"A"	0.001	0.003	0.004	5 ¼"	2'-9 ¼"
		"B"	0.002	0.003	0.005		
45	ALL	"A"	0.002	0.003	0.005	5 ¼"	2'-9 ¼"
		"B"	0.003	0.005	0.008		
50	ALL	"A"	0.003	0.006	0.009	5 ¼"	2'-9 ¼"
		"B"	0.004	0.008	0.012		
55	ALL	"A"	0.004	0.008	0.012	5 ½"	2'-9 ½"
		"B"	0.006	0.012	0.018		
60	ALL	"A"	0.006	0.012	0.018	5 ½"	2'-9 ½"
		"B"	0.010	0.016	0.026		
65	ALL	"A"	0.009	0.016	0.025	5 ¾"	2'-9 ¾"
		"B"	0.012	0.023	0.035		
70	ALL	"A"	0.013	0.021	0.034	6"	2'-10"
		"B"	0.018	0.030	0.048		
75	ALL	"A"	0.017	0.028	0.045	6 ½"	2'-10 ½"
		"B"	0.024	0.040	0.064		
80	ALL	"A"	0.022	0.037	0.059	7"	2'-11"
		"B"	0.031	0.052	0.083		

(1) If multi-span units (with slab continuous over Interior Bents) are indicated on the Bridge Layout, Bars T must be continuous through joint. See Continuous Slab Detail.

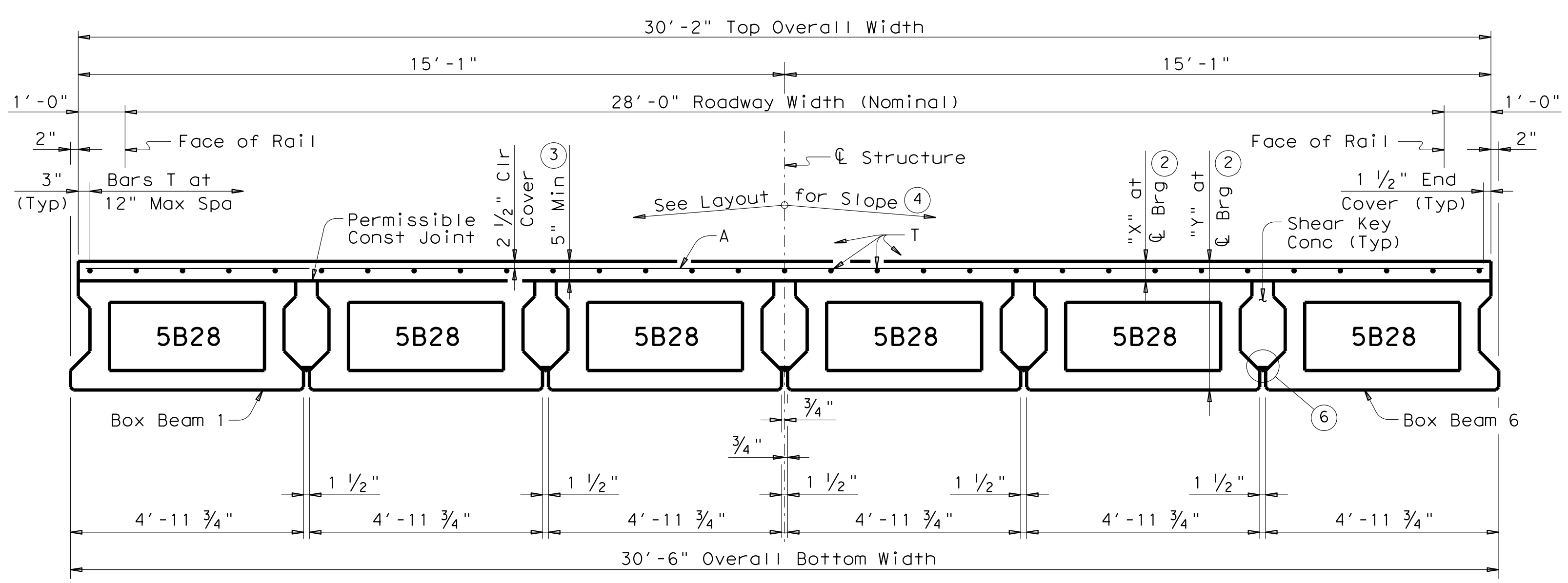
(2) Based on theoretical beam camber, dead load deflections of 5" Cast-in-place slab, shear key dead load and a constant grade. The contractor must adjust these values for any vertical curve.

(3) Slab thickness at midspan of Beams may not exceed 7 inches.

(4) This standard does not provide for changes in roadway cross slopes within the structure.

(5) If using Type A expansion joints, the maximum distance between joints is 100 feet.

(6) Form bottom of shear keys with foam backer rod or other material acceptable to the Engineer.



TYPICAL TRANSVERSE SECTION

GENERAL NOTES:

Designed according to AASHTO LRFD Specifications.

Provide Class S concrete (f'c = 4,000 psi) for slab and shear key. Provide Class S (HPC) concrete if shown elsewhere in the plans.

All reinforcing must be Grade 60.

Two-span or three-span units, with the slab continuous over Interior Bents, may be formed with the details on this standard. Unit Length cannot exceed 3.5 times length of the shortest end span.

Bar laps, where required, will be as follows:
- Uncoated ~ #4 = 1'-5"
- Epoxy coated ~ #4 = 2'-1"

It is recommended, with crown cross-slope, to erect beams adjacent to crown point first. For structures without a crown point, it is recommended to erect beams on the high side of cross-slope first and progress to the low side.

This sheet does not support the use of Transition Bents.

See railing details and standard BBRAS for rail anchorage.

HL93 LOADING | SHEET 1 OF 2

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE BOX BEAM SPANS

TYPE B28 28' RDWY (WITH SLAB)

SBBS-B28-28

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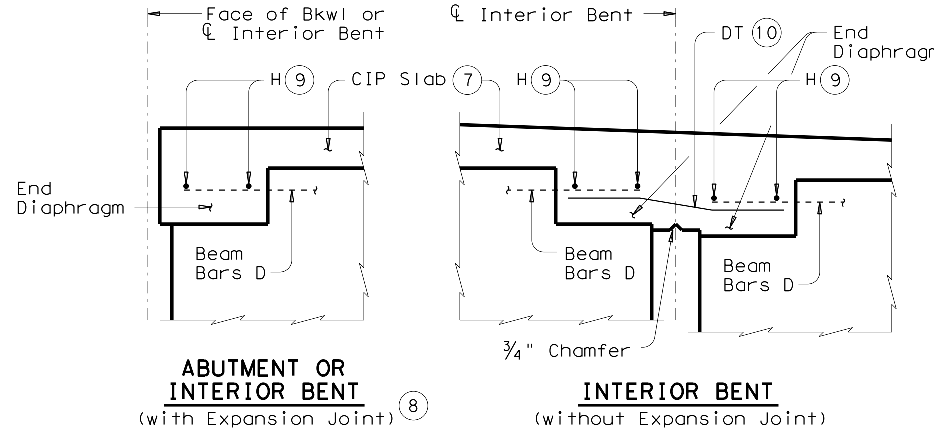
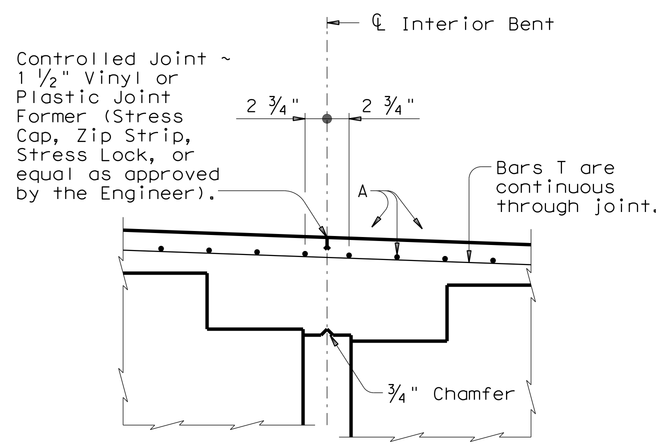


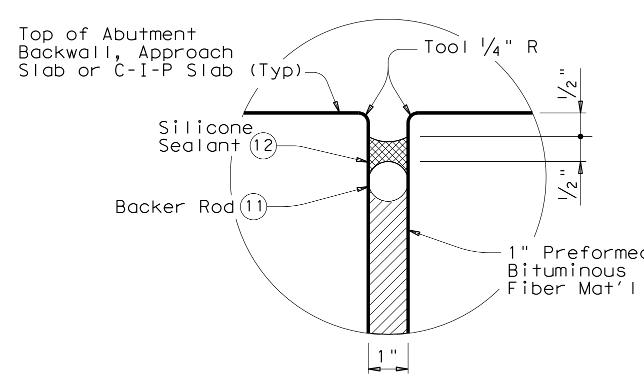
TYPICAL END DIAPHRAGM SECTIONS

(along centerline of Box Beam)



CONTINUOUS SLAB DETAIL

(Diaphragm reinforcing not shown for clarity)



TYPE A JOINT DETAIL (5)

TABLE OF ESTIMATED QUANTITIES

SPAN LENGTH	SHEAR KEY	REINF CONC SLAB (BOX BEAM)	PRESTR CONCRETE BOX BEAMS (TY 5B28) (13)	TOTAL REINF STEEL (14)
FT	CY	SF	LF	Lb
30	7.9	905	177.00	1,810
35	9.3	1,056	207.00	2,112
40	10.6	1,207	237.00	2,414
45	12.0	1,357	267.00	2,714
50	13.3	1,508	297.00	3,016
55	14.7	1,659	327.00	3,318
60	16.0	1,810	357.00	3,620
65	17.4	1,961	387.00	3,922
70	18.7	2,112	417.00	4,224
75	20.0	2,262	447.00	4,524
80	21.4	2,413	477.00	4,826

(5) If using Type A expansion joints, the maximum distance between joints is 100 ft.

(7) Slab reinforcing omitted for clarity.

(8) See Bridge Layout for Joint type.

(9) Provide 1 ½" end cover to Bars H. After all beams have been placed, weld one Bar H to two Bars D at each end of all beams.

(10) Lap Bars DT 9" Min with each Beam Bar D at Interior Bents without Expansion Joints. Bars DT shown bent for clarity only.

(11) Backer rod must be 25% larger than joint opening and must be compatible with the sealant.

(12) Use Class 7 silicone sealant. Prepare joint and seal in accordance with Item 438 "Cleaning and Sealing Joints".

(13) Fabricator must adjust beam lengths for beam slopes as required.

(14) Reinforcing steel weight is based on an approximate factor of 2.0 lbs per square foot of slab.

HL93 LOADING SHEET 2 OF 2

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE BOX BEAM SPANS

TYPE B28 28' RDWY
(WITH SLAB)

SBBS-B28-28

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