BRIDGE ALTERNATIVE REPORT

Snider Bridge and Roadway Improvements from Susan Circle to Shady Lane

City of Lucas

Prepared for:
City of Lucas

Prepared by:

Lakes Engineering, Inc.

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APPENDICES

EXHIBITS

1. EXECUTIVE SUMMARY

Lakes Engineering, Inc. has prepared this Bridge Alternative Report (BAR) for the proposed Snider Bridge and Roadway Improvements from Susan Circle to Shady Lane. The intent of this report is to give the City of Lucas a comprehensive analysis of the different options and costs to replace Snider Road crossing over White Rock 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. Snider Lane Culvert over White Rock Creek is located approximately 0.3 miles east of Winningkoff Road. Snider Lane crosses the creek with triple 8-ft by 8-ft concrete box culverts within the floodplain and the roadway is below the flood elevation. White Rock Creek has historically overtopped Snider Lane frequently from the culvert crossing to Shady Lane. The aging culvert opening is not adequate for larger storm events, gets clogged easily with large debris, and has caused closure of the roadway many times. The debris build up contributes to the flooding requires the City to provide regular recurring maintenance. Flooding and overtopping of Snider Lane is a safety hazard for the residents and road users of the vicinity area. Replacing the culvert with a bridge above the flood elevation will provide an adequate opening, which will resolve the clogging and overtopping issues and may lower the water surface elevation locally. Replacing the existing crossing with a new culvert does not solve the clogging issue and would need to be sized much larger than any available precast culvert available to raise the roadway above the flood elevation. A new culvert would need to be cast in place, cost similar to a bridge, and not provide the sustainability of a bridge structure. For these reasons, a culvert replacement option was not evaluated. We have evaluated many bridge types and materials, provide a comparison, and recommend solutions, within this report.

This report identifies the project in terms of needs, purpose, and recommended solution. This report 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. Intersection Impact
E. Bridge Superstructure Options
F. Method of Construction

The major elements discussed above are summarized below:

A. The proposed Horizontal Alignment of, Snider Lane bridge over White Rock Creek will be shifted slightly to the south of the existing Snider Lane alignment smoothing the curves and to provide better visibility.
B. Most of the right-of-way within the project limits has been dedicated. However, there is a parcel at the south side of the bridge crossing owned by the United States Army Corps of Engineers that will require a temporary construction easement permit to build the proposed improvements.

   Snider Lane has existing 20ft utility easements on both sides of the roadway from Winningkoff Road to White Rock Creek.

C. There is one (1) utility service driveway and one (1) equestrian trail access within the project limits on Snider Lane that will be impacted. It is recommended that both the utility driveway and trail access be relocated near Natha Court. An in-depth evaluation for the utility driveway and trail access locations will be performed in the final design phase. Access must be provided for all property owners during the duration of construction.

D. The intersection of Snider Lane and Shady Lane will be impacted by the recommended vertical alignment. The recommended vertical alignment will raise the intersection of Snider Lane and Shady Lane approximately 5 feet from the existing top of pavement to the proposed top of pavement with retaining walls along both sides of Snider Lane and Shady Lane. This intersection will be evaluated in detail during the Preliminary or Final Design.

E. Seven (7) bridge superstructure alternatives are presented, and option 3 is the most cost-effective superstructure option considered. Option 3 offers overall cost-savings, despite having the largest vertical profile raise compared to the other options. Therefore, option 3 is the most feasible and is the recommended bridge superstructure alternative. This recommended alternative has the following characteristics:
    - 100ft single-span bridge with 30-degree skew
    - Four (4) TxDOT Prestressed Concrete I-Girders (TX46)
    - 8.5in thick cast-in-place reinforced concrete deck and 4in thick prestressed concrete deck panels
    - Aesthetics similar to the Blondy Jhune bridges
    - The recommended vertical alignment associated with option 3 will raise the pavement elevation at the crossing approximately 12 feet from the existing top of pavement and will have retaining walls at all four corners of the bridge.

F. The recommended method of construction is complete roadway closure and detour. The intersection of Shady Lane may be constructed in phases to avoid a complete closure.

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 with a recommendation. Issues addressed herein include geometric constraints, horizontal and vertical clearance requirements, utility conflicts, drainage issues, evaluation of span arrangements, evaluation of superstructure and substructure alternatives, aesthetics, traffic control, 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

Snider Lane crosses White Rock Creek approximately 0.6 miles east Winningkoff Road and approximately 1 mile west of Lavon Lake within the City of Lucas, located in Collin County, Texas. The existing culvert crossing is comprised of three concrete boxes with 8 feet by 8 feet openings and is approximately 31 feet long with the roadway directly on top of the boxes. It is estimated that the culvert was constructed around 1990 and does not appear to have been rehabilitated since construction other than slope protection addition. The crossing has a roadway width of approximately 29 feet and carries one lane of traffic in each direction with no shoulder width on either side.

Based on an inspection report performed by Lakes Engineering on July 11, 2019 (refer to Appendix B), the current condition of the culvert is functionally obsolete with a sufficiency rating of 93 (rated by NBIS procedure). It is important to note that functionally obsolete does not carry the meaning of functionally unsafe, at the time of this report. The field inspection found the following deficiencies:

1. Various diagonal cracks on approach slab 1 and 2
2. 6” settlement of approach slab 1 at the southwest corner
3. 2.5 settlement of approach slab 2 at the southeast corner
4. Lateral crack across the full width of the roadway on deck span 1
5. Light scaring on deck span 2
6. Concrete riprap settled 9” at abutment 4 southeast corner
7. Toe exposed, chipping and undermining of riprap at abutment 4 southeast corner
8. Exposed bottom slab toe with 18” scour and undermining at south channel south outfall
9. Exposed bottom slab toe with 5” scour at north channel northeast corner
10. Moderate bank erosion at north and south channels
11. 75% delaminated on southwest face of abutment 1
12. 7” x 24” x 3” spall at second railing post on span 1 south headwall
13. 15” x 3” spall at both railing post on span 2 south headwall
14. Full width hairline crack at the beginning of span 3 north headwall
15. Scaring and gouging from debris at northwest corner of abutment 1
16. Scaring and gouging from debris at northeast corner of abutment 4
17. 0.010” full height crack with efflorescence on abutment 1
18. 0.020” full diagonal crack on abutment 4
19. 0.025” full height crack on wall 2 and wall 3

20. Various spalls on north side of wall 3
21. Slope protection appears to have settle 8” southwest corner of abutment 1
22. No slope protection at northwest corner of abutment 1 and northeast corner of abutment 4

The waterway opening appears to be inadequate. It is reported that White Rock Creek overtops Snider Lane 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.

Snider Lane culvert over White Rock Creek has a weight limit of 10 tons with signage located near Shady lane.

Existing condition photos are shown below.

Approach- Looking East

Approach - Looking West

Upstream Headwall

Downstream Headwall

Upstream – During A Storm Event

Downstream – During A Storm Event

At Shady Lane – During A Storm Event

At Snider Lane Culvert – 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 Snider Lane over White Rock 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 Snider Lane over White Rock Creek located in the City of Lucas, Collin County, Texas. See **Figure 1 – Project Location Map.**

Figure 2 – Project Location Map

3. GEOMETRIC DESIGN

3.1. Geometric Criteria

Snider Lane is a low-speed, local road. It is classified as a low-speed, minor collector and is under the jurisdiction of the City of Lucas. Snider Lane has a posted speed limit of 35 mph. Snider Lane widens at the culvert over White Rock Creek.

Roadway Design Parameters

- Functional Classification: Rural/Minor Collector
- Design Speed: 35 mph
- Minimum Travel Lane Width: 12 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

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. 515.00. Based on TxDOT Hydraulic Design Manual a minimum 2'-0" freeboard, additional clearance above the flood elevation, is required. In order to prevent Snider Lane 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 be equal or exceed an elevation of 517.00. However, by replacing the culvert with a bridge, the current flood elevation may be lower. An in-depth Hydrology and Hydraulic study shall be performed in Preliminary or Final Design.

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 Snider Lane, within the limits of the culvert over the White Rock Creek, is on a tangent segment separated by two curves that do not meet current design standards. Only one alternative is presented for the proposed alignment.

Proposed Horizontal Alignment, Snider Lane bridge over White Rock Creek will be shifted slightly to the south of the existing Snider Lane alignment in order to correct the substandard curves. Additionally, this alignment will improve sight distance and visibility at Shady Lane.

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

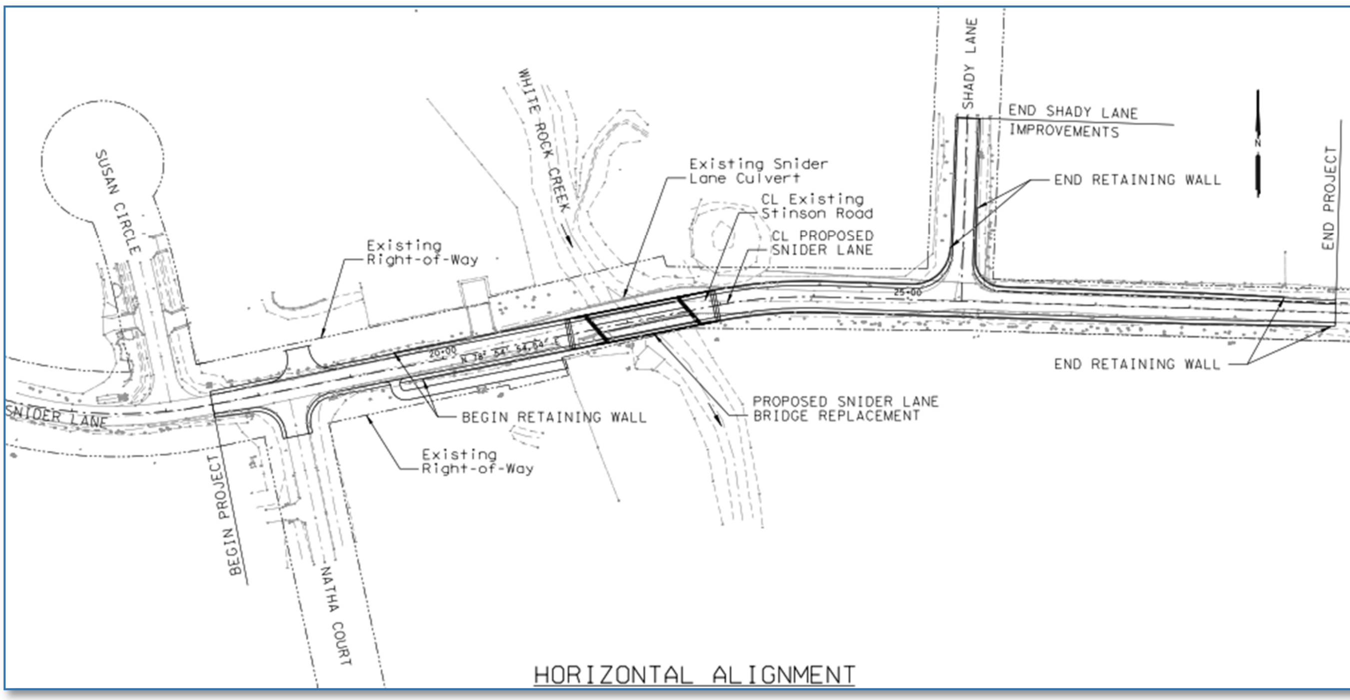

Figure 2 – Proposed Horizontal Alignment

Vertical Alignment/Profile

White Rock has historically frequently overtopped Snider Lane. Raising the top of the roadway to be above the designated flood elevation is recommended throughout the corridor. It is also recommended that the low member elevation of the bridge be a minimum of 2'-0" above the current 100-year flood elevation. 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 roads. There is a 90 feet dedicated right-of-way along Snider Lane from Winningkoff Road to the west end of the proposed bridge. At White Rock Creek crossing there is one (1) parcel north of Snider Lane that has a 50 feet dedicated right-of-way from the centerline and one (1) parcel on the south of Snider Lane that have a prescriptive right-of-way from the centerline of Snider Lane. East of the proposed bridge, there is one (1) parcel on the north of Snider Lane that has a 35 feet dedicated right-of-way from the centerline of Snider Lane. The proposed Horizontal Alignment at the bridge will require a temporary construction easement from one (1) parcel. Therefore, to build the bridge improvements a permit is required from the United States Army Corps of Engineers property to obtain a total of 44,365 square feet of temporary construction easement. See Exhibit A for reference.

3.4. Easement

The City of Lucas has 20 feet of water/utility easement offset from the existing right-of-way on both sides of Snider Lane from Winningkoff Road to White Rock Creek crossing. There are two (2) parcels on the north of Snider Lane and west of Shady Lane that do not have a water/utility easement on record. Also, there is (1) parcel on the north of Snider Lane and East of Shady Lane that does not have a water/utility easement on record. We recommend the acquisition of a 20-ft utility/drainage easement from the above three (3) parcels along Snider Lane. This project will require the relocation of several franchise utilities and those could be accommodated within the proposed easement area, separated from the roadway improvements.

3.5. Access Impact

There is one (1) utility service driveway and one (1) equestrian trail access within the project limits on Snider Lane that will be impacted. It is recommended both the utility driveway and trail access be relocated near Natha Court. An in-depth evaluation for the utility driveway and trail access locations will be performed in the final design phase. Access must be provided for all property owners during the duration of construction. Temporary driveways may be required.

3.6. Intersection Impact

Shady Lane at Snider Lane intersection will be impacted due to the proposed vertical alignment raise. The recommended vertical alignment will raise the intersection of approximately 5 feet from the existing top of pavement to the proposed top of pavement. Retaining walls are recommended to limit right of way acquisition. An in-depth retaining wall and intersection sight distance evaluation will be performed in the final design phase.

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), 8^{th} 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 Details 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)
- United State Army Corp of Engineers (USACE)

4.6. Aesthetics

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

4.7. Utilities

Based on field surveying performed by Surveying and Mapping, LLC (SAM) in April 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 – 8" water line located along the south side of Snider Lane and 3" water lines tapped at Susan Circle, Natha Court and Shady Lane.
- Grayson Collin Electric – Underground facilities on the south side of Snider lane.
- AT&T Fiber - Underground facilities located along the south side of Snider lane
- AT&T Telephone - Underground facilities located along the North side of Snider lane
- Frontier Telephone – Underground facilities located along the south side of Snider lane.
- Suddenlink CATV – Underground facilities along the east side of Susan Circle and west side of Natha Court.

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/Email	Relocation Potential
1	City of Lucas	Water	Jeremy Bogle	469-628-8586	Y
2	Grayson Collin	Electric	Michael Lauer	mlauer@gcec.net	Y
3	AT&T	Fiber	Joanie Baker	972-649-8759	Y
4	AT&T	Telephone	Joanie Baker	972-649-8759	Y
5	Frontier	Telephone	David Lemons	972-578-3212	Y
6	Suddenlink	CATV	N/A	N/A	N

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 proposed bridge, carrying electrical, and telephone/cable. These electric/telephone overhead utilities will need to be adjusted to meet the vertical clearance requirements. This will need to be discussed with the Franchise Utility owners and they will adjust or relocate according to their standards.

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 100’-0” is required to span over White Rock Creek. This would locate the begin and end bridge outside of the existing banks of White Rock Creek and would provide a 2H:1V slope embankment at each abutment. The proposed abutments would be placed approximately at the edge of White Rock Creek top of bank 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 3 – Plan View** below.

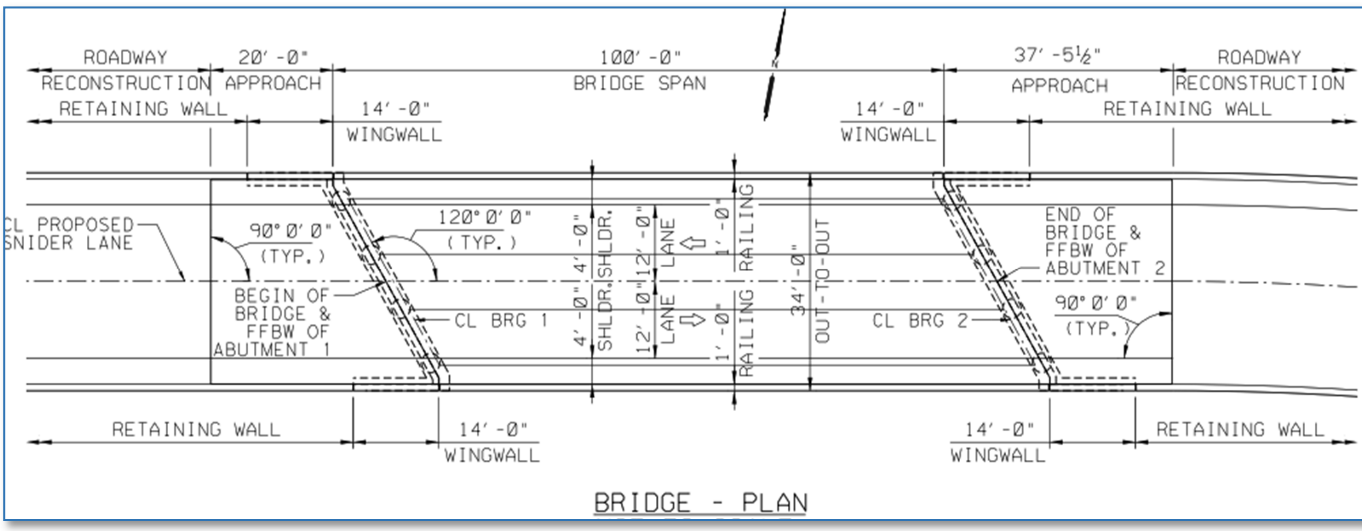

Figure 3 - Bridge Plan

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

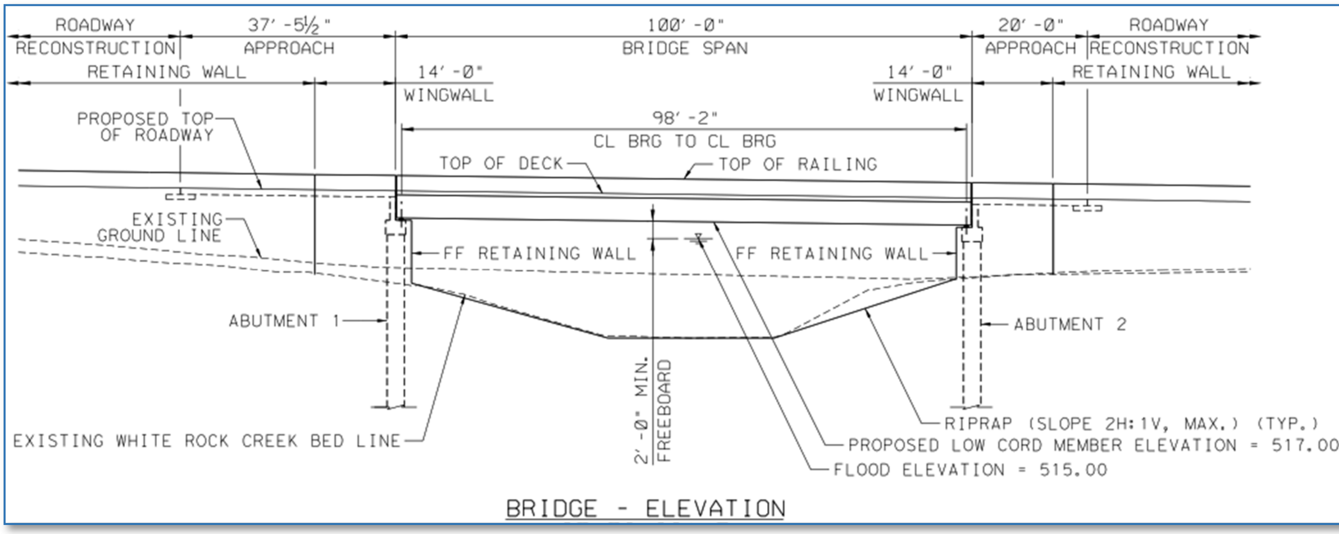

Figure 4 - Bridge Elevation

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 White Rock 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 White Rock 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

White Rock Creek is on an approximate 30-degree skew to Snider Lane; therefore, the bridge abutments will have a 30-degree skew.

5.3. Typical Section

The existing roadway approach typical sections have two (2) approximately 10 feet paved asphalt travel lanes and no shoulders on either side. The roadway widens over the White Rock Creek culvert crossing. The existing typical section of Snider Lane at the White Rock Creek culvert has two (2) approximately 14'-6" concrete paved travel lanes, no shoulders on either side, and a substandard guard rail. Flood gates are located before and after the culvert.

The existing typical section of Snider Lane over White Rock Creek is shown in **Figure 5 – Existing Typical Section** below.

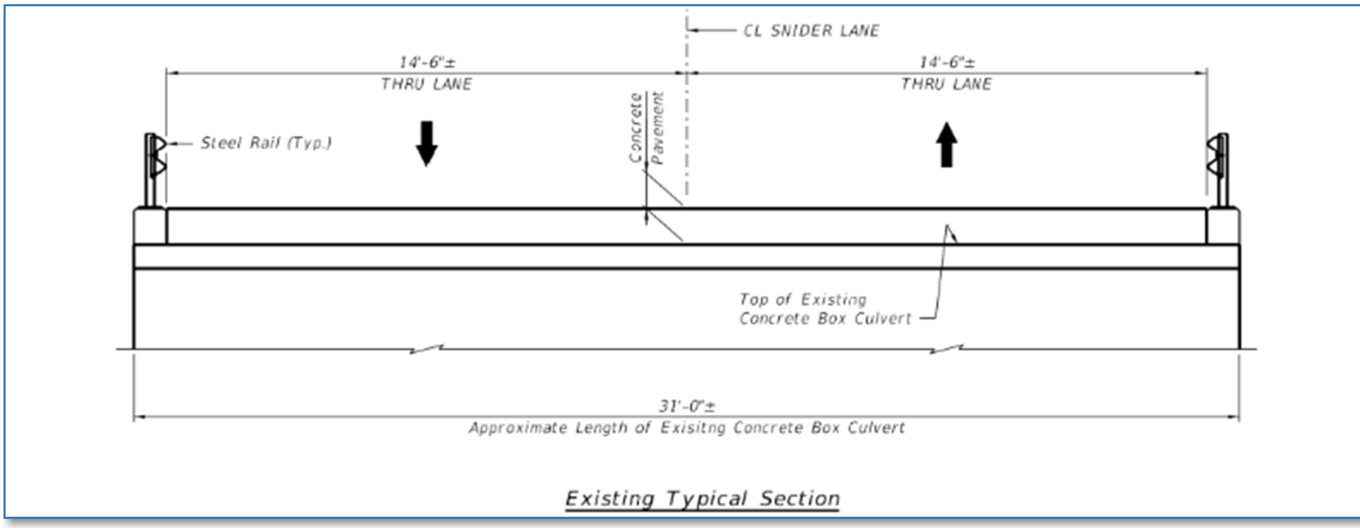

Figure 5 – Snider Lane Typical Section at White Rock Creek

Proposed Typical Section 1:

Based on TxDOT Statewide Planning Map, Snider Lane has an annual average daily traffic (AADT) count of 211 in 2018 and an estimated AADT count of 342 in 2038. Based on the TxDOT Roadway Design Manual (April 2018), the proposed Snider Lane's typical section is to follow a Rural Two-Way Highway design. The proposed roadway typical section provides two (2) 12'-0" travel lanes and a 4'-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 4'-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 Snider Lane, 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 34'-0".

The proposed bridge typical section is shown in **Figure 6 – Proposed Bridge Typical Section 1** below.

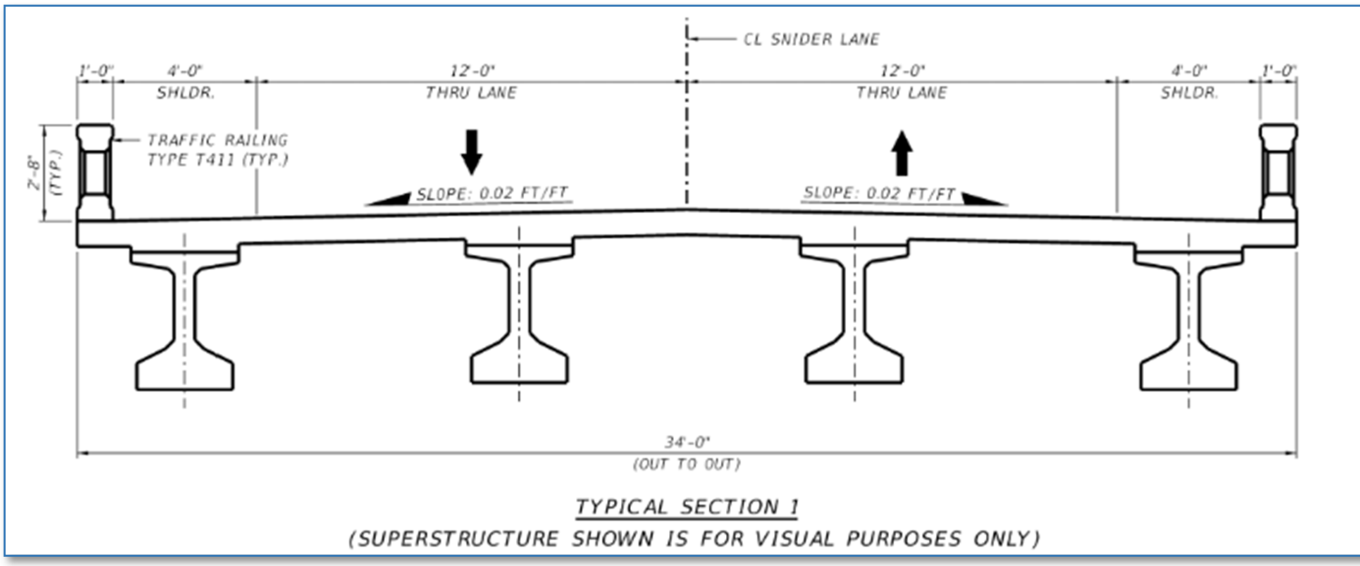

Figure 6 - Proposed Bridge Typical Section 1

Proposed Typical Section 2:

The City of Lucas has requested an ADT design of 20,000 be considered for Snider Lane to accommodate potential future traffic increases. Based on the TxDOT Roadway Design Manual (April 2018), the proposed Snider Lane's typical section is to follow a Rural Two-Way Highway design. The proposed roadway typical section provides two (2) 12'-0" travel lanes and an 8'-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 an 8'-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 Snider Lane, 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 42'-0".

The proposed bridge typical section is shown in **Figure 7 – Proposed Bridge Typical Section 2** below.

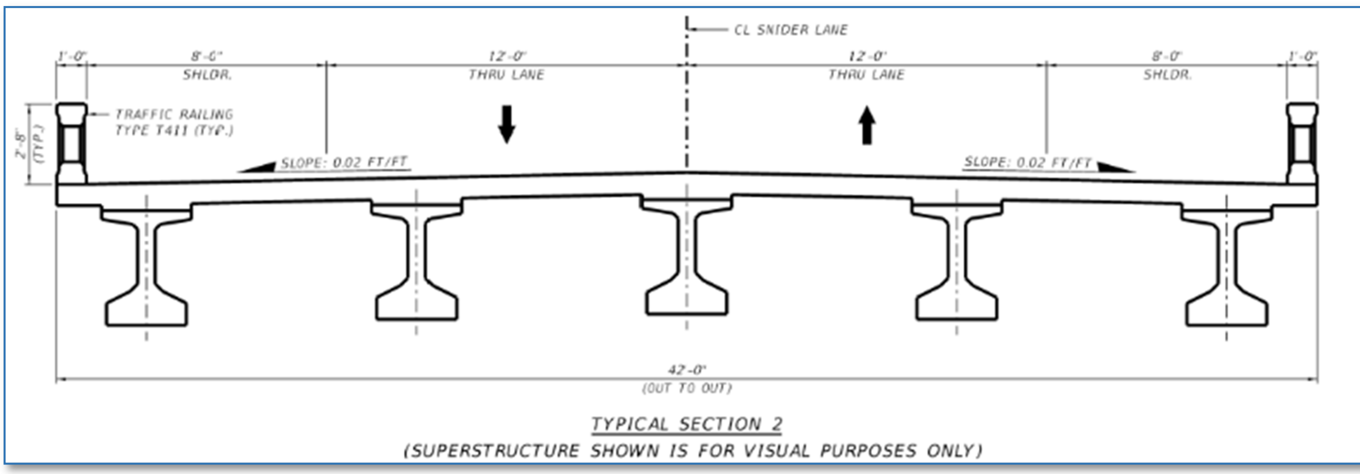

Figure 7 - Proposed Bridge Typical Section 2

Recommendation

The advantages of Bridge Typical Section 1 over Bridge Typical Section 2 are listed below.

- Lower overall construction cost
- Does not require Right-of-Way or easement acquisition from USACE on the south side of Snider Lane
- Less impact to driveways, turnouts and intersections

The disadvantages of Bridge Typical Section 1 over Bridge Typical Section 2 are listed below.

- Does not allows construction in phases or at least one lane open to traffic
- Less shoulder width
- Does not meet design standards for 20,000 ADT (Average Daily Traffic)

Proposed Bridge Typical Section 2 would require right-of-way acquisition and increased overall construction cost. A significant key disadvantage of Bridge Typical Section 1 over Bridge Typical Section 2 is that it does not meet the design standards for an ADT of 20,000. According to TxDOT Roadway Design Manual for a collector two-lane rural highway with an ADT more than 2,000 it is recommended to have a minimum of 8 feet shoulder. Snider Lane serves a small community with property size of 1 acre or more. It is not expected that this area will be developed with high density lots as most properties along Snider Lane are developed. Because of the large increase in bridge width required to meet design criteria for an ADT of 20,000, the cost increase for the Bridge Typical Section 2 is large. Bridge Typical Section 1 is functional and meets the needs of the community and the wider bridge typical section does not appear to provide a significant advantage to offset the overall cost increase; therefore, Bridge Typical Section 1 is recommended.

5.4. Superstructure Alternatives

The superstructure alternatives have been selected to satisfy the minimum horizontal and vertical clearance, hydraulic requirements, and constructability. Many superstructure alternatives were considered and evaluated based on the recommended Horizontal Alignment as discussed in section 3.2 above.

Seven superstructure alternatives were considered and evaluated for Snider Lane Bridge over White Rock Creek. The overall bridge length is 100'-0". TxDOT Prestressed Concrete Slab Beam and Decked Slab Beams were evaluated and eliminated due to capacity limitations at this span length. 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. Further, the structure depth is not a limiting factor since the roadway must be raised significantly to remain above the 100-year flood elevation. Therefore, the steel through-truss was eliminated. The remaining four superstructure alternatives are described below, options 1 through 4.

Each superstructure alternative presented below considers the recommended proposed Bridge Typical Section 1 as discussed in Section 5.3 above.

Option 1: TxDOT Prestressed Concrete Box Beams (5B34 &4B34)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing six (6) TxDOT Prestressed Concrete Box Beams (5B34) and one (1) TxDOT Prestressed Concrete Box Beam (4B34) with a minimum of 5" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 39". This shallow superstructure depth in conjunction with a modified vertical profile results in the lowest vertical profile raise over White Rock Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 1 proposes a 10.88' vertical profile raise and is the second most cost-effective superstructure alternative. Refer to Appendix A for the options cost comparison.

The proposed TxDOT Prestressed Concrete Box Beams (5B34 & 4B34) typical section is shown in **Figure 8 – TxDOT Prestressed Concrete Box Beams (5B34 & 4B34) Typical Section** below.

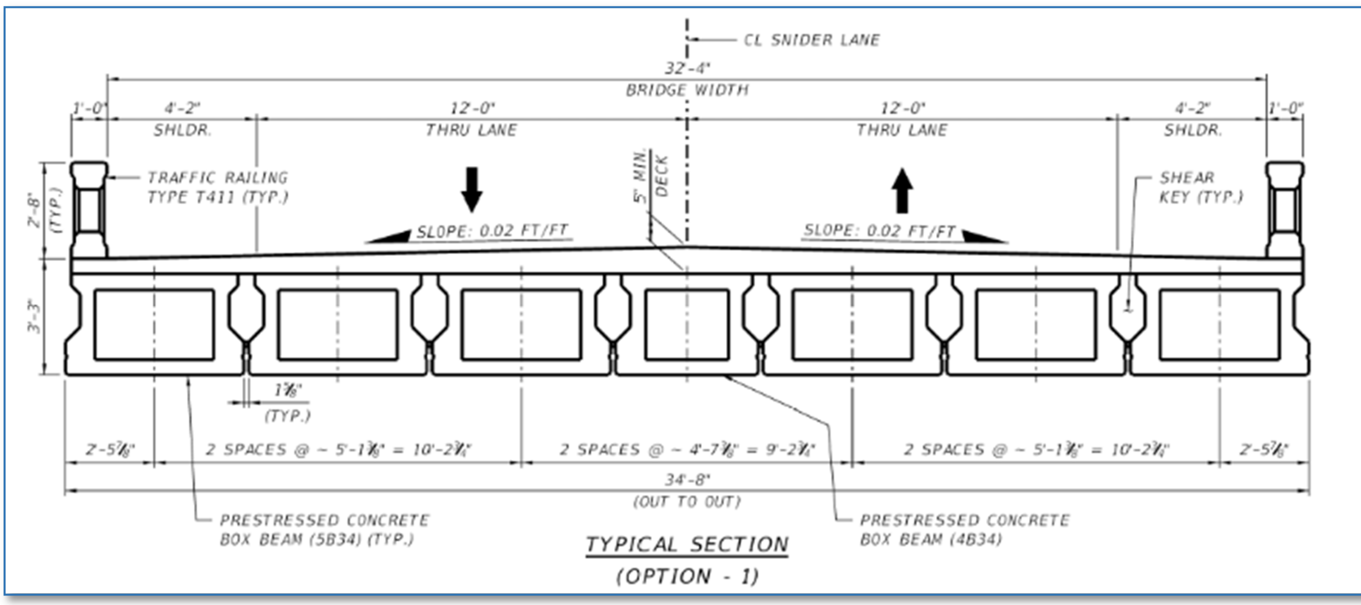

Figure 8 - TxDOT Prestressed Concrete Box Beams (5B34 & 4B34) Typical Section

Option 2: TxDOT Prestressed Concrete XBeams (5XB40)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete XBeams (5XB40) with an 8” thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 50”. This shallow superstructure depth in conjunction with a modified vertical profile results in the second lowest vertical profile raise over White Rock Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 2 proposes an 11.80’ vertical profile raise and is the third most cost-effective superstructure alternative. Refer to Appendix A for the options cost comparison.

The proposed TxDOT Prestressed Concrete XBeams (5XB40) typical section is shown in **Figure 9 – TxDOT Prestressed Concrete XBeams (5XB40) Typical Section** below.

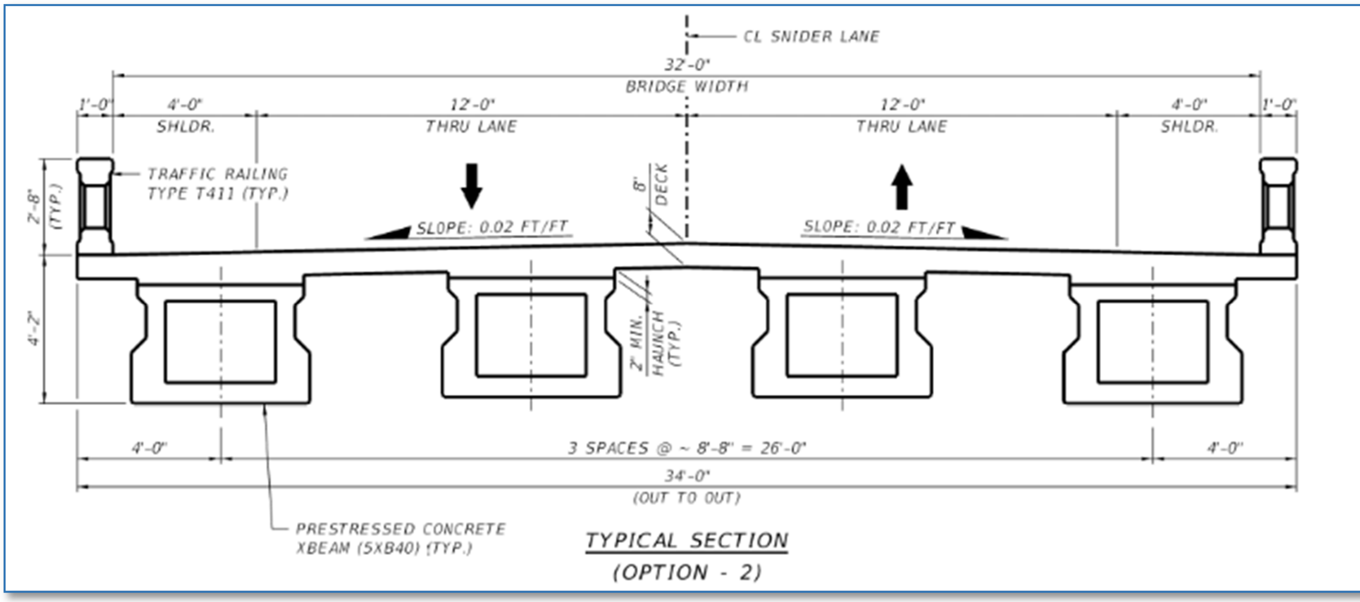

Figure 9 - TxDOT Prestressed Concrete XBeams (5XB40) Typical Section

Option 3: TxDOT Prestressed Concrete I-Girders (TX46)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing four (4) TxDOT Prestressed Concrete I-Girders (TX46) with an 8.5" thick Cast-in-Place (CIP) reinforced concrete deck and 4" thick prestressed concrete deck panels. The proposed superstructure depth is 56.5". This superstructure depth in conjunction with a modified vertical profile results in the highest vertical profile raise over White Rock Creek and places the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 3 proposes a 12.34' vertical profile raise and is the most cost-effective superstructure alternative. Refer to Appendix A for the options cost comparison.

The proposed TxDOT Prestressed Concrete I-Girders (TX46) typical shown in **Figure 10 – TxDOT Prestressed Concrete I-Girders (TX46) Typical Section** below.

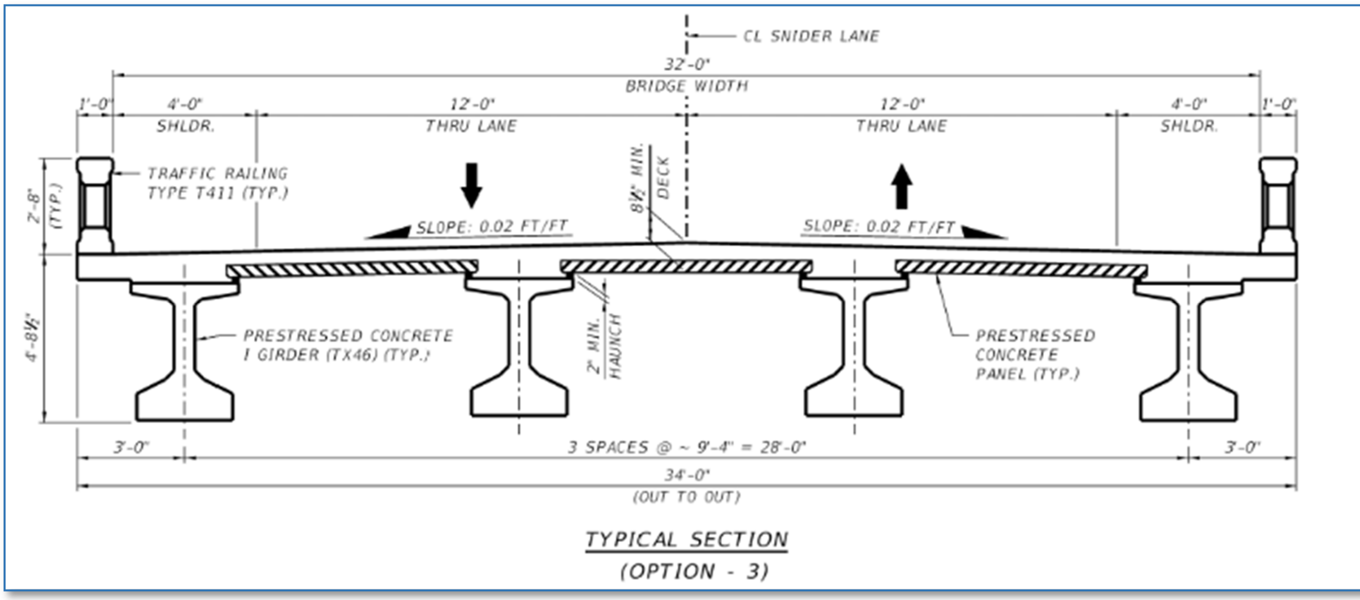

Figure 10 - TxDOT Prestressed Concrete I-Girders (TX46) Typical Section

Option 4A: Steel Plate Girders (40"X1/2" Web) or Option 4B: Steel Rolled Beams (W40X211)

This superstructure alternative consists of replacing the existing culvert structure with a single-span bridge utilizing five (5) Steel Plate Girders (40"X1/2" Web) or five (5) Steel Rolled Beams (W40X211), both with an 8.5" thick Cast-in-Place (CIP) reinforced concrete deck. The proposed superstructure depth is 53" for plate girders and 50" for rolled beams. These superstructure depths in conjunction with a modified vertical profile result in the third lowest vertical profile raise for plate girders and second lowest vertical profile raise for rolled beams over White Rock Creek and place the bottom of the bridge bearing elevation to be above the 100-year flood storm. Option 4A & 4B propose a 12.03' vertical profile raise for plate girders and 11.79' vertical profile raise for rolled beams and are both the least cost-effective superstructure alternatives. Refer to Appendix A for the options cost comparison.

The proposed Steel Plate Girders (40"X1/2" Web) or Steel Rolled Beams (W40X211) typical section is shown in **Figure 11 – Steel Plate Girders (40"X1/2" Web) or Steel Rolled Beams (W40X211) Typical Section** below.

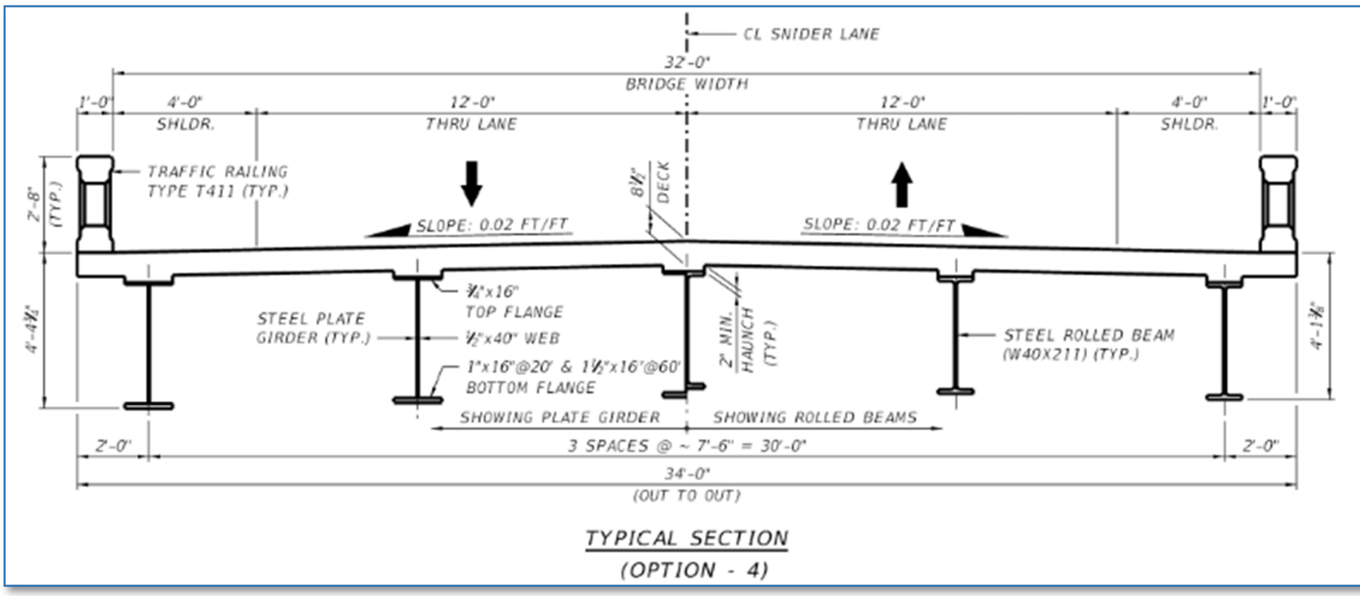

Figure 11 - Steel Plate Girders (40"X1/2" Web) or Steel Rolled Beams (W40X211) Typical Section

Recommendation

Of the four options discussed above for the proposed Horizontal Alignment, Option 3 is recommended: a single-span bridge utilizing four (4) TxDOT Prestressed Concrete I-Girders (TX46) with 8.5" thick reinforced concrete deck. Option 3 does not provide the shallowest superstructure depth, nor does it minimize the vertical profile raise, but this option is the most feasible superstructure in terms of 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 standard for prestressed concrete I-girders allows 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 six (6) 18"x18" driven concrete piles per an abutment for prestressed concrete I-girders. An in-depth foundation design will be performed to verify the capacity in the final design phase.

Drilled Shafts

TxDOT Standard allows for four (4) 30" diameter drilled shafts per an abutment for prestressed concrete I-girders. 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 Mechanically Stabilized Earth (MSE) retaining 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 streetlight system existing along Snider Lane, 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 Snider Lane, phased construction was considered and evaluated. At the culvert, Snider Lane has a paved roadway width of approximately 21 ft. TxDOT requires a 1’-0” offset from the temporary barriers and a minimum 12'-0” lane. Given the required widths and width of temporary barriers, providing two lanes of traffic will be impossible, however, leaving only one westbound or eastbound lane open was considered. Also, temporary shoring will be needed due to the significant profile raise, which increases the project limit even farther due to lane shifting requirements. Initial investigations find staged construction will require either widening the bridge or shifting the horizontal alignment. Either widening the bridge or shifting the horizontal alignment will require right-of-way or easement acquisition from USACE property. Widening the bridge or shifting the horizontal alignment to accommodate a phased construction would significantly increase the cost due to temporary shoring, traffic control items and schedule.

Complete Closure with Detour Option

Replacement of the Snider Lane Culvert of White Rock 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 Susan Circle to Shady Lane during construction and implementing a Detour. An initial detour plan will utilize East Lucas Road for west to east detours and Winningkoff Road for south to north detours. Shady Lane can be used for west to east detours only during the construction of the bridge and a portion of the roadway improvement up to Shady Lane. However, due to a change of profile at the intersection of Snider Lane and Shady Lane, Shady Lane will be closed for the construction of the remaining roadway improvement and access maintained from the north. 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

A comparison of the estimated difference in cost of each alternative to Option 3 has been prepared. The comparison is based on certain major components of cost, such as the bridge, roadway, and retaining walls 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 3 based only on superstructure types.

Bridge Alternatives	% Difference Compared to Option 3
Option 1: Single-Span with six-5B34 & one-4B34 Beams	38% increase
Option 2: Single-Span with four-5XB40 Beams	58% increase
Option 3: Single-Span with four-TX46 Beams	
Option 4A: Single-Span with five-Plate Girder Beams	66% increase
Option 4B: Single-Span with five-W40x211 Beams	222% increase

Based on a bridge superstructure cost estimated comparison, Option 3 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 3 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 beginning of the proposed bridge span. The top of the existing pavement at the culvert and at the beginning of the proposed bridge span is estimated to be at EL. 509.94.

Roadway Profile Raise	% Difference Compared to Option 3
Option 1: 10.88 feet Profile Raise	3% decrease
Option 2: 11.80 feet Profile Raise	3% decrease
Option 3: 12.34 feet Profile Raise	
Option 4A: 12.03 feet Profile Raise	2% decrease
Option 4B: 11.79 feet Profile Raise	3% decrease

Based on the roadway profile raise cost estimated comparison, Option 1 is the most economical. However, Option 3 bridge superstructure cost offsets the cost enough from Option 1 roadway profile cost. Option 3 would be a more suitable alternative in this case.

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 3 based only on estimated exposed retaining wall area.

Retaining Wall Area	% Difference Compared to Option 3
Option 1: 8709 SF	10% decrease
Option 2: 9292 SF	4% decrease
Option 3: 9637 SF	
Option 4A: 9438 SF	2% decrease
Option 4B: 9292 SF	4% decrease

Based on retaining wall cost estimated comparison, Option 1 is the most economical. However, Option 3 bridge superstructure cost offsets the cost enough from Option 1 retaining wall cost. Option 3 would be a more suitable alternative in this case.

The table below summarizes the overall alternatives by percentage differences of cost for each alternative compared with Option 3.

Overall Alternatives		% Difference Compared to Option 3
Option 1:	**Single-Span with six-5B34 & one-4B34 Beams**	3% increase
Option 2:	**Single-Span with four-5XB40 Beams**	12% increase
Option 3:	**Single-Span with four-TX46 Beams**	
Option 4A:	**Single-Span with five-Plate Girder Beams**	15% increase
Option 4B:	**Single-Span with five-W40x211 Beams**	52% increase

This comparison provides a summary of the overall cost for each option. Based on the above overall alternative cost estimated comparison, Option 3 is the most economical and provides an overall cost-savings.

Recommendation

The proposed bridge typical section provides one (1) 12'-0" traveling lanes in each direction and a 4'-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 (1) paved 12'-0" traveling lanes in each direction and a 4'-0" wide shoulder on each side with a cross-slope of 0.02 ft/ft.

Given the information herein presented, it is recommended that Snider Lane Culvert be replaced with a 100'-0" single-span bridge on the proposed Horizontal Alignment with a 12.34 ft vertical profile raise, utilizing Option 3: four (4) TxDOT Prestressed Concrete I-Girders (TX46) with an 8.5" thick cast-in-place reinforced concrete deck and 4” thick prestressed concrete deck panels, supported on twelve (12) 18”x18” driven concrete piles foundation or eight (8) 36” diameter drilled shafts with a cast-in-place reinforced concrete abutment foundation. Retaining walls are recommended on all four corners of the bridge. It is recommended that construction be completed by implementing a complete roadway closure and detour.

APPENDIX A:
Alternative Cost Comparison Estimate / Calculations

Bridge Typical Section 1 - Alternative Cost Comparison

Snider Bridge Roadway Improvements from Susan Circle to Shady Lane

City of Lucas

Bridge Typical Section 1					
Bridge Superstructure	**Option 1**	**Option 2**	**Option 3**	**Option 4A**	**Option 4B**
Beam Type	**5B34/4B34**	**5XB40**	**TX46**	**Plate Girder**	**W40X211**
BEAMS					
beam length	99.67 lf	99.67 lf	99.67 lf	99.67 lf	99.67 lf
no. beam	7	4	4	5	5
beam unit weight (steel option only)				196 lb/lf	211 lb/lf
total beam length	697.67 lf	398.67 lf	398.67 lf	97673.33 lb	105148.33 lb
unit cost ($/lf)	*$265.00*	*$475.00*	*$150.00*	*$2.00 /lb*	*$5.00 /lb*
total cost	$184,881.67	$189,366.67	$59,800.00	$195,346.67	$525,741.67
DECK					
deck/overlay width	34.67 lf	34.00 lf	34.00 lf	34.00 lf	34.00 lf
deck/overlay length	99.67 lf	99.67 lf	99.67 lf	99.67 lf	99.67 lf
deck thickness	5.0 in	8.0 in	8.5 in	8.5 in	8.5 in
total deck volume	53.32 cy	83.67 cy	88.90 cy	88.90 cy	88.90 cy
unit cost ($/cy)	*$1,550.00*	*$1,550.00*	*$1,550.00*	*$1,550.00*	*$1,550.00*
total cost	$82,645.40	$129,689.71	$137,795.32	$137,795.32	$137,795.32
BEARING PADS					
total no. bearing pads	14 ea	8 ea	8 ea	10 ea	10 ea
unit cost ($/each)	*$1,700.00*	*$1,700.00*	*$1,700.00*	*$1,700.00*	*$1,700.00*
total cost	$23,800.00	$13,600.00	$13,600.00	$17,000.00	$17,000.00
Overall bridge alternative cost *	**$291,327.07**	**$332,656.38**	**$211,195.32**	**$350,141.99**	**$680,536.99**
% difference Compared to Option 3	**38%**	**58%**	**0%**	**66%**	**222%**
Roadway Profile Fill	**Option 1**	**Option 2**	**Option 3**	**Option 4A**	**Option 4B**
roadway profile fill area (elevation view)	4860 sf	5171 sf	5355 sf	5249 sf	5171 sf
roadway profile fill width	34.33 ft	32 ft	32 ft	32 ft	32 ft
roadway profile fill volume	6180.25 cy	6128.55 cy	6346.19 cy	6220.63 cy	6128.55 cy
unit cost ($/cy)	*$25.00*	*$25.00*	*$25.00*	*$25.00*	*$25.00*
total cost	$154,506.36	$153,213.80	$158,654.81	$155,515.77	$153,213.80
Overall roadway alternative cost *	**$154,506.36**	**$153,213.80**	**$158,654.81**	**$155,515.77**	**$153,213.80**
% difference Compared to Option 3	**-3%**	**-3%**	**0%**	**-2%**	**-3%**
Retaining Wall	**Option 1**	**Option 2**	**Option 3**	**Option 4A**	**Option 4B**
retaining wall area	4354 sf	4646 sf	4818 sf	4719 sf	4646 sf
no. retaining walls	2	2	2	2	2
total retaining wall area	8709 sf	9292 sf	9637 sf	9438 sf	9292 sf
unit cost ($/sf)	*$50.00*	*$50.00*	*$50.00*	*$50.00*	*$50.00*
total cost	$435,440.00	$464,599.43	$481,830.00	$471,889.29	$464,599.43
Overall retaining wall cost *	**$435,440.00**	**$464,599.43**	**$481,830.00**	**$471,889.29**	**$464,599.43**
% difference Compared to Option 3	**-10%**	**-4%**	**0%**	**-2%**	**-4%**

	Bridge Typical Section 1				
	Option 1	Option 2	Option 3	Option 4A	Option 4B
OVERALL ALTERNATIVE COST **	**$881,273.43**	**$950,469.61**	**$851,680.13**	**$977,547.04**	**$1,298,350.21**
% difference Compared to Option 3	**3%**	**12%**	**0%**	**15%**	**52%**
			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.

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Date: July 10, 2020

Bridge Typical Section 2 - Alternative Cost Comparison

Snider Bridge Roadway Improvements from Susan Circle to Shady Lane

City of Lucas

Bridge Typical Section 2

Bridge Superstructure	Option 1	Option 2	Option 3	Option 4A	Option 4B
Beam Type	5B34/4B34	5XB40	TX46	Plate Girder	W44X262
BEAMS					
beam length	99.67 lf	99.67 lf	99.67 lf	99.67 lf	99.67 lf
no. beam	9	5	5	5	5
beam unit weight (steel option only)				245 lb/lf	262 lb/lf
total beam length	897.00 lf	498.33 lf	498.33 lf	122091.67 lb	130563.33 lb
unit cost ($/lf)	*$265.00*	*$475.00*	*$150.00*	*$2.00 /lb*	*$5.00 /lb*
total cost	$237,705.00	$236,708.33	$74,750.00	$244,183.33	$652,816.67
DECK					
deck/overlay width	42.89 lf	42.00 lf	42.00 lf	42.00 lf	42.00 lf
deck/overlay length	99.67 lf	99.67 lf	99.67 lf	99.67 lf	99.67 lf
deck thickness	5.0 in	8.0 in	8.5 in	8.5 in	8.5 in
total deck volume	65.96 cy	103.36 cy	109.82 cy	109.82 cy	109.82 cy
unit cost ($/cy)	*$1,550.00*	*$1,550.00*	*$1,550.00*	*$1,550.00*	*$1,550.00*
total cost	$102,238.92	$160,204.94	$170,217.75	$170,217.75	$170,217.75
BEARING PADS					
total no. bearing pads	18 ea	10 ea	10 ea	10 ea	10 ea
unit cost ($/each)	*$1,700.00*	*$1,700.00*	*$1,700.00*	*$1,700.00*	*$1,700.00*
total cost	$30,600.00	$17,000.00	$17,000.00	$17,000.00	$17,000.00
Overall bridge alternative cost *	**$370,543.92**	**$413,913.27**	**$261,967.75**	**$431,401.08**	**$840,034.41**
% difference Compared to Option 3	**41%**	**58%**	**0%**	**65%**	**221%**

Roadway Profile Fill	Option 1	Option 2	Option 3	Option 4A	Option 4B
roadway profile fill area (elevation view)	4860 sf	5171 sf	5355 sf	5249 sf	5171 sf
roadway profile fill width	42.56 ft	40 ft	40 ft	40 ft	40 ft
roadway profile fill volume	7661.57 cy	7660.69 cy	7932.74 cy	7775.79 cy	7660.69 cy
unit cost ($/cy)	*$25.00*	*$25.00*	*$25.00*	*$25.00*	*$25.00*
total cost	$191,539.13	$191,517.25	$198,318.52	$194,394.71	$191,517.25
Overall roadway alternative cost *	**$191,539.13**	**$191,517.25**	**$198,318.52**	**$194,394.71**	**$191,517.25**
% difference Compared to Option 3	**-3%**	**-3%**	**0%**	**-2%**	**-3%**

Retaining Wall	Option 1	Option 2	Option 3	Option 4A	Option 4B
retaining wall area	4354 sf	4646 sf	4818 sf	4719 sf	4646 sf
no. retaining walls	2	2	2	2	2
total retaining wall area	8709 sf	9292 sf	9637 sf	9438 sf	9292 sf
unit cost ($/sf)	*$50.00*	*$50.00*	*$50.00*	*$50.00*	*$50.00*
total cost	$435,440.00	$464,599.43	$481,830.00	$471,889.29	$464,599.43
Overall retaining wall cost *	**$435,440.00**	**$464,599.43**	**$481,830.00**	**$471,889.29**	**$464,599.43**
% difference Compared to Option 3	**-10%**	**-4%**	**0%**	**-2%**	**-4%**

	Bridge Typical Section 2				
	Option 1	Option 2	Option 3	Option 4A	Option 4B
OVERALL ALTERNATIVE COST **	**$997,523.05**	**$1,070,029.95**	**$942,116.27**	**$1,097,685.07**	**$1,496,151.09**
% difference Compared to Option 3	**6%**	**14%**	**0%**	**17%**	**59%**
			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.

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Date: July 10, 2020

Bridge Typical Section 1 VS Bridge Typical Section 2
Alternative Cost Comparison
Snider Bridge Roadway Improvements from Susan Circle to Shady Lane
City of Lucas

	Bridge Typical Section 1	Bridge Typical Section 2
Bridge Superstructure	**Option 3**	**Option 3**
Beam Type	**TX46**	**TX46**
BEAMS		
beam length	99.67 lf	99.67 lf
no. beam	4	5
beam unit weight (steel option only)		
total beam length	398.67 lf	498.33 lf
unit cost ($/lf)	*$150.00*	*$150.00*
total cost	$59,800.00	$74,750.00
DECK		
deck/overlay width	34.00 lf	42.00 lf
deck/overlay length	99.67 lf	99.67 lf
deck thickness	8.5 in	8.5 in
total deck volume	88.90 sy	109.82 cy
unit cost ($/cy)	*$1,550.00 / sy*	*$1,550.00*
total cost	$137,795.32	$170,217.75
BEARING PADS		
total no. bearing pads	8 ea	10 ea
unit cost ($/each)	*$1,700.00*	*$1,700.00*
total cost	$13,600.00	$17,000.00
Overall bridge alternative cost *	**$211,195.32**	**$261,967.75**
% difference Compared to Horizontal Alignment 2 - Option 2	**0%**	**24%**
Roadway Profile Fill	**Option 3**	**Option 3**
roadway profile fill area (elevation view)	5355 sf	5355 sf
roadway profile fill width	32 ft	40 ft
roadway profile fill volume	6346.19 cy	7932.74 cy
unit cost ($/cy)	*$25.00*	*$25.00*
total cost	$158,654.81	$198,318.52
Overall roadway alternative cost *	**$158,654.81**	**$198,318.52**
% difference Compared to Horizontal Alignment 2 - Option 2	**0%**	**25%**
Retaining Wall	**Option 3**	**Option 3**
retaining wall area	4818 sf	4818 sf
no. retaining walls	2	2
total retaining wall area	9637 sf	9637 sf
unit cost ($/sf)	*$50.00*	*$50.00*
total cost	$481,830.00	$481,830.00
Overall retaining wall cost *	**$481,830.00**	**$481,830.00**
% difference Compared to Horizontal Alignment 2 - Option 2	**0%**	**0%**

	Bridge Typical Section 1 Option 3	Bridge Typical Section 2 Option 3
OVERALL ALTERNATIVE COST **	**$851,680.13**	**$942,116.27**
% difference Compared to Horizontal Alignment 2 - Option 2	**0%**	**11%**
	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.

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Date: July 10, 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
04236001	RETAINING WALL (MSE)	SF	2	50,652.00	$65.56	30	1,481,765.79	$49.61	$50.00
04236008	RETAINING WALL (CAST - IN - PLACE)	SF	2	723.00	$51.67	16	40,607.00	$94.99	$95.00
04256005	PRESTR CONC BOX BEAM (4B34)	LF	2	656.00	$250.37	5	17,193.50	$195.13	$265.00
04256006	PRESTR CONC BOX BEAM (5B34)	LF	2	328.00	$250.37	5	18,850.00	$192.55	$265.00
04256024	PRESTR CONC BOX BEAM (5XB34)	LF				1	1,074.00	$371.50	$475.00
04256038	PRESTR CONC GIRDER (TX46)	LF	1	8,145.00	$150.00	23	167,490.40	$124.46	$150.00
04346024	ELASTOMERIC BEARING (E5)	EA	1	8.00	$1,650.00	3	15.00	$1,474.01	$1,700.00
04426001	STR STEEL (PLATE GIRDER)	LB	2	3,241,667.00	$1.57	9	19,872,961.00	$1.57	$2.00
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 BOX BEAM (5XB34)" was used as "5XB40" with a mark up.

Item "ELASTOMERIC BEARING (E5)" was "assumed" use for superstructure types.

APPENDIX B:
Existing Culvert Inspection Report

BRIDGE SUMMARY SHEET

City: Lucas County: Collin Name: ____ Structure #: ____ Route: Snider Lane

Description: 3-Barrel Concrete Box Culvert

Feature Crossed: White Rock Creek Inspector's Signature: ____ Date: 7/11/19

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

Selected Component Description and Rating:

	Inspection Rating (1085)	Inventory Rating H	Inventory Rating HS	Operating Rating H	Operating Rating HS
Concrete Multiple Box Culvert	6	-	20.0	-	27.0

Comments and/or Upgrade Recommendations (if applicable):

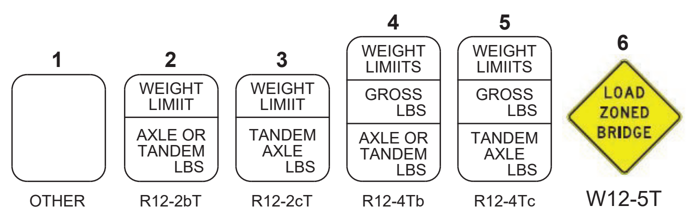
Backfill and protect undermined areas up and downstream.

MBGF (no blockouts) and terminals (turndowns) at approaches do not meet current standards.

Functionally obsolete. Sufficiency Rating = 93

Load Posting Limits for Present Condition (if applicable):

Inventory		Operating	
____	lbs Gross	____	lbs Gross
____	lbs Tandem Axle	____	lbs Tandem Axle
____	lbs Axle or Tandem	____	lbs Axle or Tandem
____	Sign Code	____	Sign Code



Posting Recommendation: ____

Previous Load Posting Recommendations:

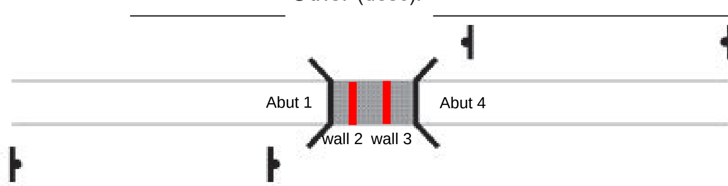
____	R12-2bT	X	None
____	R12-2cT	____	lbs Gross
____	R12-4Tb	____	lbs Tandem Axle
____	R12-4Tc	____	lbs Axle or Tandem

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

DO NOT DISCLOSE - INFORMATION CONFIDENTIAL UNDER THE TEXAS HOMELAND SECURITY ACT AND 23 USC SECTION 409, SAFETY SENSITIVE INFORMATION

BRIDGE INSPECTION RECORD

City: Lucas County: Collin Name: Snider Lane Bridge Structure #: ______ Route: Snider Lane

Description: 3-Barrel Concrete Box Culvert

Feature Crossed: White Rock Creek Inspector's Signature: ______________________ Date: 7/11/2019

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

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:

Elements are numbered and measured west to east and south to north. Functionally obsolete due to waterway adequacy rating (3)

DECK (Item 58)

Minimum	Description	Rating	Comments
1	Deck - Rating	N	Previously Noted:
6	Wearing Surface	7	Moderate impact damage to north railing: two posts are missing & flex beam is dented. - REPAIRED (Guardrail beam still dented)
6	Joints, Expansion, Open	-	
6	Joints, Expansion, Sealed	-	
6	Joints, Other	7	
6	Drainage System	-	Photo 2: Approach slab 1 southwest corner partially asphalt overlaid
6	Curbs, Sidewalks & Parapets	-	
6	Median Barrier	-	
6	Railings	6	Photo 4: Diagonal crack at southwest portion of approach slab 1
7	Railing Protective Coating	-	
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: Snider Lane Bridge Structure #: ______ Route: Snider Lane

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		

CHANNEL (Item 61)

Minimum	Description	Rating	Comments
0	Channel Banks		Previously Noted: (1) Minor bank erosion with exposed tree roots - NO CHG. (2) Moderate scour & channel degradations have exposed up to 3.5' of bottom slab toewall at upstream end & 3' of apron slab toewall (with slight undermining) at downstream end. Moderate amount of drift caught on culvert entrance - INCR. See additional comments
0	Channel Bed		
5	Rip Rap, Toe Walls and Aprons		
5	Dikes		
5	Jetties		
	Other		
	Component Rating		

CULVERTS (Item 62)

Minimum	Description	Rating	Comments
0	Top Slabs	7	Previously Noted: (1) Minor spalls on north end of interior walls - NO CHG. (2) Minor spalls on north headwall at post locations. Minor Vertical cracks with efflor. in headwalls - NO CHG. Photo 16: Abutment 1 75% delaminated on southwest face See additional comments
0	Bottom Slab or Footing	7	
0	Abutments & Intermediate Supports	6	
5	Headwalls and Wingwalls	6	
	Other		
	Component Rating	6	

BRIDGE INSPECTION RECORD

City: Lucas County: Collin Name: Snider Lane Bridge Structure #: Route: Snider Lane

APPROACHES (Item 65)

Minimum	Description	Rating	Comments
0	Embankments	6	Previously Noted: (2) Asphalt surface is worn & cracked at approaches - NO CHG. (3) Minor impact damage to approach guardfence - DECR. (Repaired) Northwest corner embankment moderate erosion See additional comments
4	Embankment Retaining Walls	-	
5	Slope Protection	5	
5	Roadway	6	
6	Relief Joints	-	
6	Drainage	-	
6	Guardfence	6	
7	Delineation	-	
7	Sight Distance	7	
	Other		
	Component Rating	5	

MISCELLANEOUS

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

TRAFFIC SAFETY (Item 36)

	Description	Rating	Comments
	Bridge Railing (036.1)	0	Previously Noted: (1) No blockouts. No Turndowns - NO CHG. General condition: substandard guardrail end treatments (both approaches)
	Transitions (036.2)	0	
	Approach Guardrail (036.3)	1	
	Approach Guardrail Ends (036.4)	0	

APPRAISAL RATINGS

	Description	Rating	Comments
	Waterway Adequacy (071)	3	Evidence of flooding outside of bridge limits Frequent overtopping with significant traffic delays. Minor collector
	Approach Roadway Alignment (072)	5	

BRIDGE INSPECTION RECORD
ADDITIONAL COMMENTS

City: Lucas County: Collin Name: Snider Lane Bridge Structure #: Route: Snider Lane

Description: 3-Barrel Concrete Box Culvert

Feature Crossed: White Rock Creek Inspector's Signature: Date: 7/11/2019

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

DECK (Item 58)

Photo Num.	Comments
5	6” settlement of approach slab 1 in southwest corner
-	Hairline longitudinal & lateral cracks northwest portion of approach 1
6	Approach slab 2 southeast corner 1/8” diagonal crack
7	Approach slab 2 2-1/2" settlement south east corner
8	Span 1 lateral crack along deck full width of roadway; light scaring (likely from heavy equipment)
9	Span 2 south side light scaring (likely from heavy equipment)
-	27” guardrail height (substandard)
-	Loose nuts on 10% of railing post anchors

CHANNEL (Item 61)

Photo Num.	Comments
10	Abutment 4 southeast corner concrete riprap settled 9"
11	Abutment 4 southeast corner moderate erosion and toe exposed; chipping & undermining of concrete riprap
12	Exposed bottom slab toe with 18” scour and undermining at south outfall
13	5” scour at bottom slab toe, northeast corner
14-15	Moderate bank erosion upstream and downstream

CULVERTS (Item 62)

Photo Num.	Comments
17	Span 1 south headwall 2” x 13” x 1” spall at second railing post
-	South headwall 6” x 2” x 1” spall at post 3
18	Span 2 7” x 24” x 3” spall at the second railing post of south headwall
19	Span 2 15” X 3” spall at both railing posts southside (Typ.)
20	Span 3 full width hairline crack north headwall
21	Scaring and gouging from debris at northwest corner of abutment 1 (Typ.)
22	Abutment 1 0.010” crack full height at 10’ with efflorescence
23	Wall 2 0.025” crack full height and depth through wall at 15’
-	Wall 2 0.016” crack full height and depth through wall at 21’
-	Wall 2 0.016" crack full height and depth through wall at 27'; associated 6' x .025" horizontal cracking at top of wall with efflorescence
24	Wall 3 0.025" crack full height and depth through wall at 12'
25	Wall 3 20” x 7” x 1” spall north side (varies) (likely from debris impact)
-	Wall 3 0.020" crack full height and depth through wall at 18'
-	Wall 3 0.016" crack full height and depth through wall at 24'
26	Abutment 4 0.020” full diagonal crack center of bridge
-	Abutment 4 0.016’ crack full height at 28’

Approach

Photo Num.	Comments
27	Abutment 1 Slope protection at southside (southwest corner) settled 8”
28	No slope protection at abutment 1 (northwest corner); 1/8” full height crack and spall
29	No slope protection at abutment 4 (northeast corner); Gouging from debris noted (Typ.)

01: Elevation – North View

02: Approach – Eastbound

03: Approach – Westbound

04: Approach Slab 1 – Eastbound

Diagonal crack at southwest portion of approach

05: Approach Slab 1 – Southwest Corner

6" settlement of approach slab in southwest corner

06: Approach Slab 2 – Southeast Corner

1/8" diagonal crack

07: Approach Slab 2 – Southeast Corner

2-1/2" settlement of approach slab 2

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08: Deck – Span 1

Lateral crack full width of roadway

09: Deck – South Side Span 2

Light scaring (likely from heavy equipment)

10: Abutment 4 – Southeast corner

Concrete riprap settled 9”

11: Abutment 4 – Southeast corner

Toe exposed; chipping and undermining of riprap

12: Bottom Slab Toe – South Channel

Exposed bottom slab toe with 18” scour and undermining at south outfall

13: Bottom Slab Toe – North Channel

5” scour at bottom slab toe, northeast corner

14: North Channel – Looking North

Moderate bank erosion looking upstream

15: South Channel – Looking South

Moderate bank erosion looking downstream

16: Abutment 1 – Southwest

75% delaminated on southwest face abutment 1

17: Span 1 – South Headwall

2” x 13” x 1” spall at second railing post of span 1

18: Span 2 – South Headwall

7” x 24” x 3” spall at the second post of span 2

19: Span 2 – South Headwall

15” X 3” spall at both posts on span 2 (Typ.)

20: Span 3 – North Headwall

Full width hairline crack at the beginning of span 3

21: Abutment 1

Scaring and gouging from debris at northwest corner (Typ.)

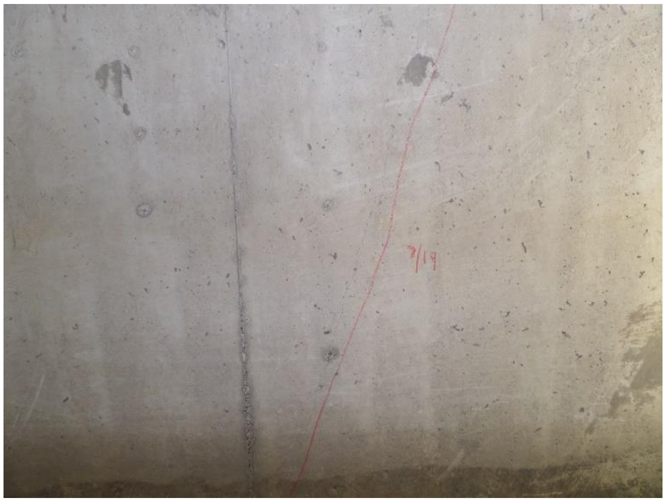
22: Abutment 1

0.010” crack full height at 10’ with efflorescence

23: Wall 2

0.025" crack full height and depth through wall at 15'

24: Wall 3

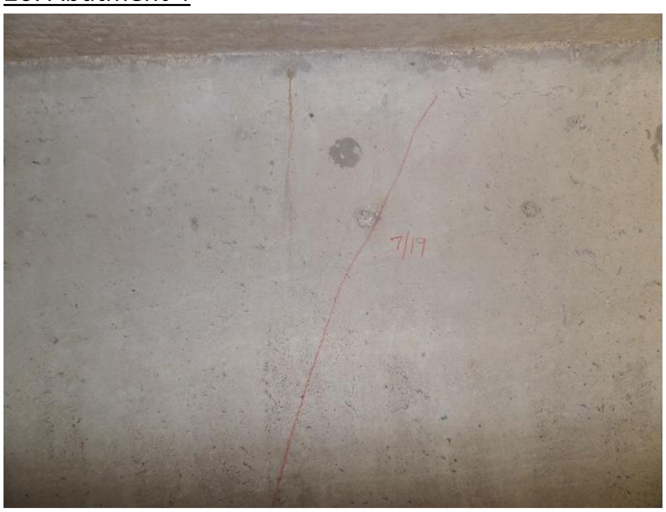


0.025" crack full height and depth through wall at 12'

25: Wall 3 – North Side

20” x 7” x 1” spall (varies) (likely from debris impact)

26: Abutment 4



0.020” full diagonal crack center of bridge

27: Abutment 1 – Southwest

Slope protection appears to have settled 8” at southwest corner

28: Abutment 1 – Northwest corner

No slope protection; 1/8” full height crack and spall; moderate bank erosion

29: Abutment 4 – Northeast corner

No slope protection; scoring and gouging from debris (Typ.)

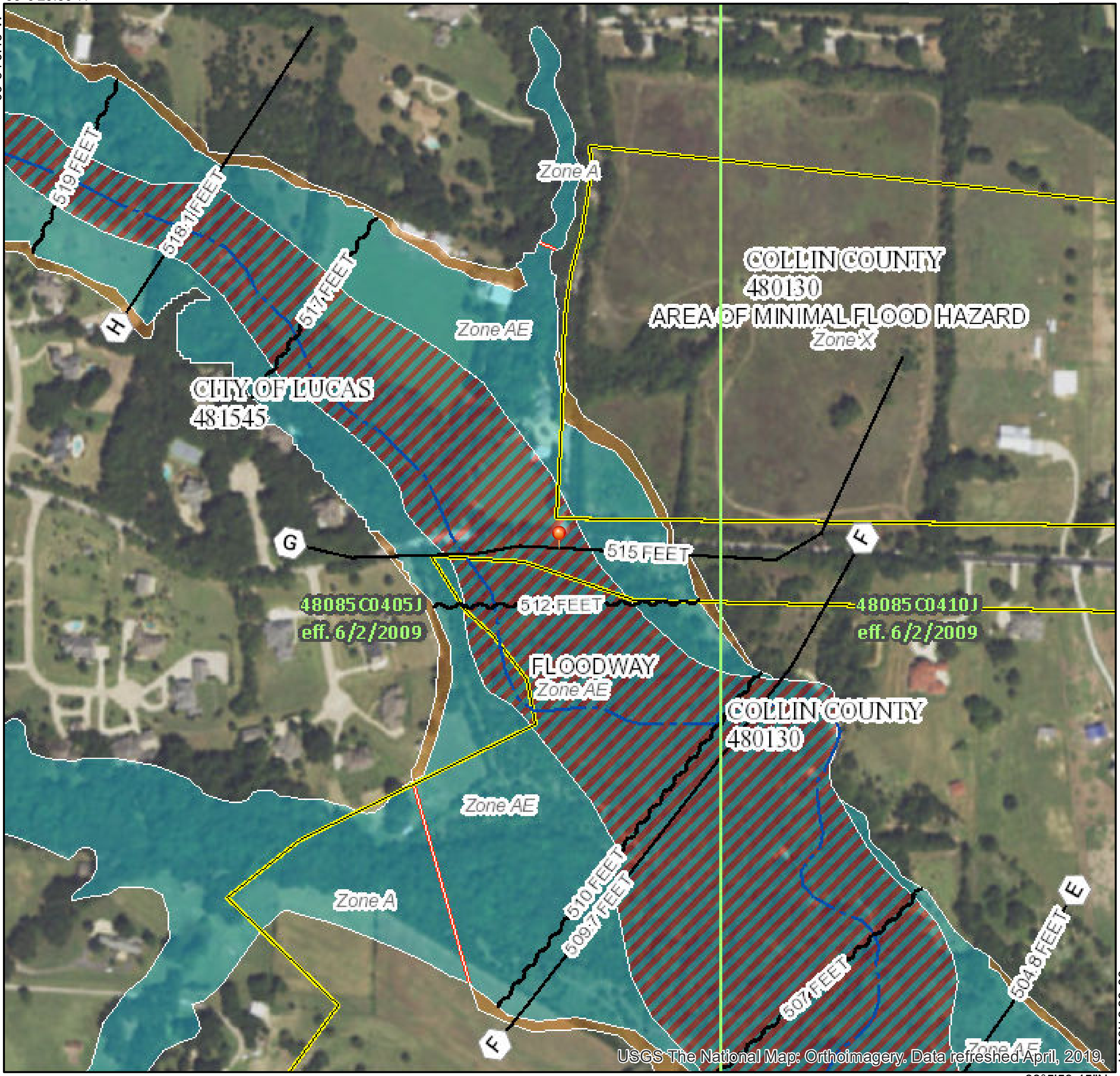
APPENDIX C:
References

National Flood Hazard Layer FIRMette

FEMA

33°6'29.59"N

96°34'9.13"W



96°33'31.68"W

33°5'59.45"N

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

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 1/20/2020 at 10:41:29 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	SPAN NO.	BEAM NO.	BEAM TYPE	DESIGNED BEAMS (STRAIGHT STRANDS): 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	LIVE LOAD DISTRIBUTION FACTOR (2): Shear

(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.

(3) Bottom corner chamfer required for 4B40 and 5B40 boxes when beam lengths are greater than 100 ft.

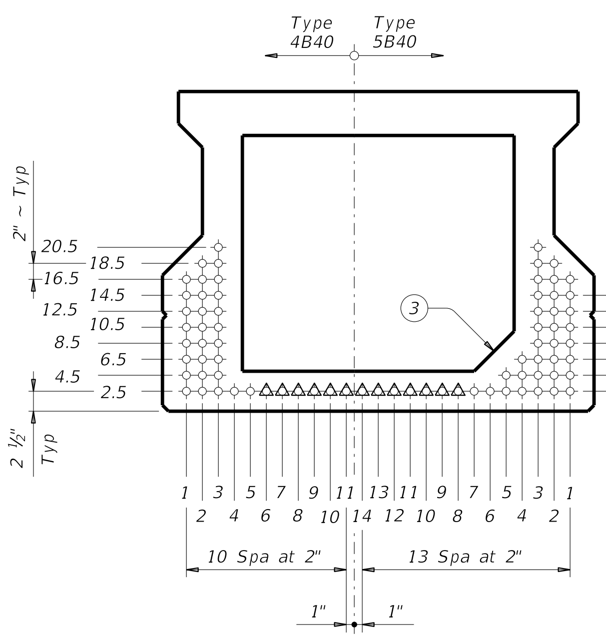
DISCLAIMER:
The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

DESIGN NOTES:

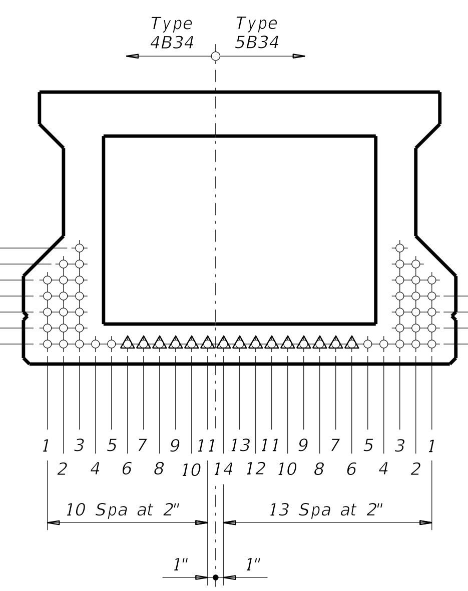
Designed in accordance with AASHTO LRFD Bridge Design Specifications.
Prestress losses for the designed beams have been calculated for a relative humidity of percent. Optional designs must likewise conform.

FABRICATION NOTES:

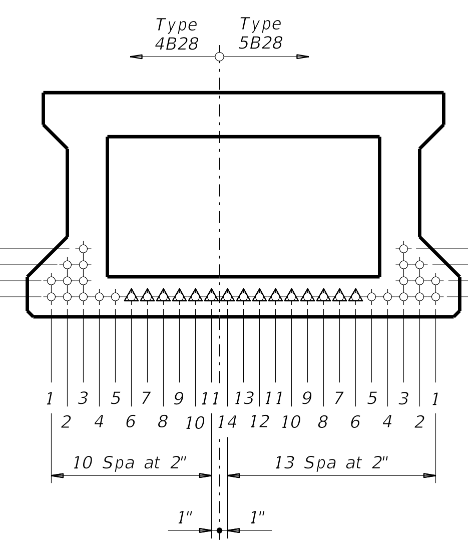
Provide Class H concrete.
Provide Grade 60 reinforcing steel bars.
Use low relaxation strands, each pretensioned to 75 percent of fpu.
When shown on this sheet, the Fabricator has the option of furnishing either the designed beam or an approved optional beam design. All optional design submittals and 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 △.



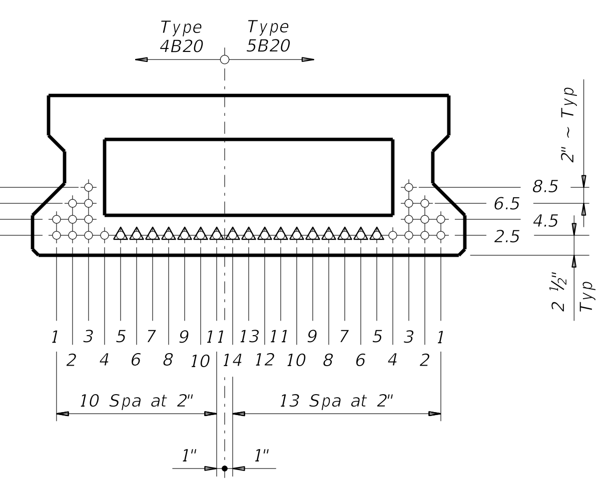
TxDOT B40 BOX BEAMS



TxDOT B34 BOX BEAMS



TxDOT B28 BOX BEAMS



TxDOT B20 BOX BEAMS

HL93 LOADING

Texas Department of Transportation

Bridge Division Standard

PRESTRESSED CONCRETE BOX BEAM DESIGNS (NON-STANDARD SPANS)

BBND

FILE: bbstds07.dgn	DN: TxDOT	CK: TxDOT	DW: SFS	CK: SDB
©TxDOT December 2006	CONT	SECT	JOB	HIGHWAY
REVISIONS				
04-11: f'ci and LLDF. 01-16: Notes.	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	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)	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
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 △.

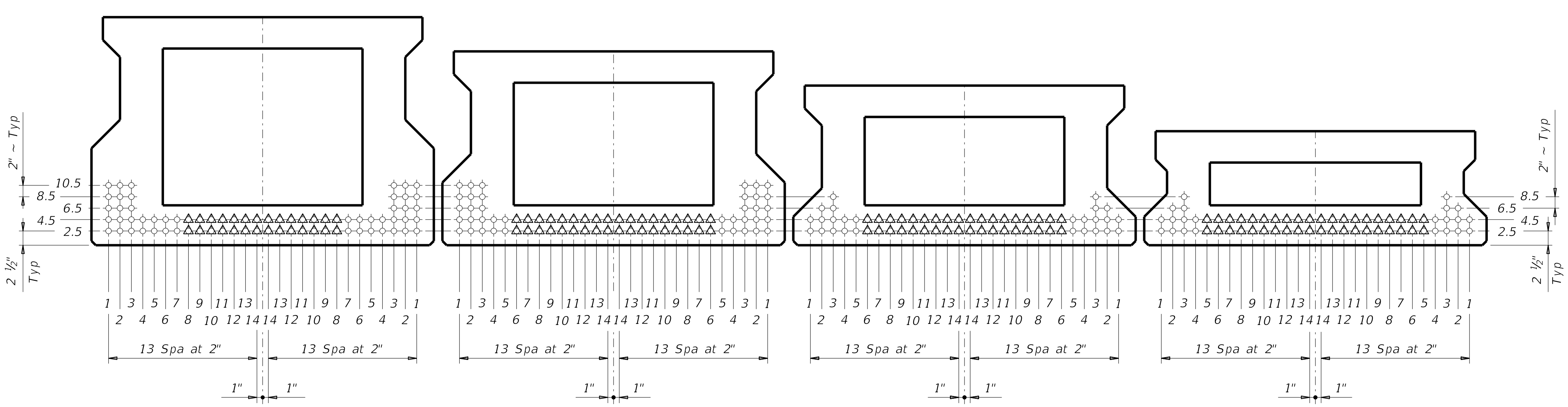
(1) Based on the following allowable stresses (ksi):

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

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DATE:
FILE:

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.

STRUCTURE	DESIGNED GIRDERS			PRESTRESSING STRANDS						DEPRESSED STRAND PATTERN		CONCRETE		OPTIONAL DESIGN				
	SPAN NO.	GIRDER NO.	GIRDER TYPE	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	LIVE LOAD DISTRIBUTION FACTOR (2) Shear
Type Tx28 Girders 32' Roadway 8.5" Slab	40	ALL	Tx28		14	0.6	270	10.48	9.34	2	10.5	4.000	5.000	1.189	-1.700	1731	0.850	1.070
	45	ALL	Tx28		14	0.6	270	10.48	9.34	2	10.5	4.000	5.400	1.507	-2.077	1717	0.820	1.080
	50	ALL	Tx28		16	0.6	270	10.23	9.23	4	8.5	4.000	5.800	1.853	-2.508	2040	0.800	1.080
	55	ALL	Tx28		18	0.6	270	10.04	8.26	4	12.5	4.100	6.400	2.247	-2.980	2377	0.780	1.090
	60	ALL	Tx28		22	0.6	270	9.75	7.57	4	16.5	4.800	6.900	2.655	-3.462	2715	0.760	1.090
	65	ALL	Tx28		26	0.6	270	9.56	7.71	4	16.5	5.600	7.300	3.104	-3.978	3064	0.740	1.100
Type Tx34 Girders 32' Roadway 8.5" Slab	40	ALL	Tx34		12	0.6	270	13.01	13.01			4.000	5.000	0.934	-1.303	1975	0.880	1.050
	45	ALL	Tx34		14	0.6	270	13.01	12.15	2	8.5	4.000	5.000	1.180	-1.588	2124	0.850	1.060
	50	ALL	Tx34		16	0.6	270	12.76	11.76	4	8.5	4.000	5.000	1.437	-1.907	2248	0.830	1.060
	55	ALL	Tx34		16	0.6	270	12.76	11.76	4	8.5	4.000	5.000	1.739	-2.263	2449	0.810	1.060
	60	ALL	Tx34		18	0.6	270	12.57	11.23	4	10.5	4.000	5.500	2.068	-2.640	2806	0.790	1.070
	65	ALL	Tx34		22	0.6	270	12.28	7.92	4	28.5	4.000	6.000	2.424	-3.039	3173	0.770	1.070
	70	ALL	Tx34		26	0.6	270	12.09	8.09	4	30.5	4.700	6.500	2.807	-3.458	3548	0.750	1.080
	75	ALL	Tx34		30	0.6	270	11.81	7.41	6	28.5	5.200	6.700	3.195	-3.894	3951	0.740	1.080
	80	ALL	Tx34		34	0.6	270	11.48	7.25	6	30.5	5.800	7.000	3.633	-4.373	4378	0.730	1.080
Type Tx40 Girders 32' Roadway 8.5" Slab	40	ALL	Tx40		12	0.6	270	15.60	15.60			4.000	5.000	0.768	-1.053	2052	0.910	1.030
	45	ALL	Tx40		14	0.6	270	15.60	15.60			4.700	5.000	0.967	-1.282	2430	0.880	1.040
	50	ALL	Tx40		14	0.6	270	15.60	15.60			4.500	5.000	1.195	-1.554	2558	0.860	1.040
	55	ALL	Tx40		16	0.6	270	15.35	14.35	4	8.5	4.000	5.000	1.442	-1.834	2685	0.830	1.050
	60	ALL	Tx40		18	0.6	270	15.16	13.82	4	10.5	4.000	5.000	1.687	-2.118	2875	0.810	1.050
	65	ALL	Tx40		18	0.6	270	15.16	13.82	4	10.5	4.000	5.000	1.978	-2.447	3277	0.800	1.060
	70	ALL	Tx40		20	0.6	270	15.00	13.40	4	12.5	4.000	5.200	2.288	-2.783	3666	0.780	1.060
	75	ALL	Tx40		24	0.6	270	14.77	9.77	4	34.5	4.100	5.700	2.619	-3.135	4064	0.760	1.060
	80	ALL	Tx40		28	0.6	270	14.60	10.60	4	32.5	4.900	6.000	2.964	-3.509	4498	0.750	1.070
	85	ALL	Tx40		32	0.6	270	14.23	8.60	6	36.5	5.100	6.200	3.328	-3.900	4944	0.740	1.070
	90	ALL	Tx40		36	0.6	270	13.93	9.27	6	34.5	5.900	6.600	3.695	-4.294	5394	0.730	1.070
Type Tx46 Girders 32' Roadway 8.5" Slab	40	ALL	Tx46		12	0.6	270	17.60	17.60			4.000	5.000	0.678	-0.844	2150	0.950	1.020
	45	ALL	Tx46		14	0.6	270	17.60	17.60			4.500	5.000	0.846	-1.024	2543	0.920	1.020
	50	ALL	Tx46		14	0.6	270	17.60	17.60			4.500	5.000	1.041	-1.235	3012	0.890	1.030
	55	ALL	Tx46		16	0.6	270	17.35	16.35	4	8.5	4.000	5.000	1.257	-1.465	3277	0.870	1.030
	60	ALL	Tx46		16	0.6	270	17.35	16.35	4	8.5	4.000	5.000	1.489	-1.701	3221	0.840	1.040
	65	ALL	Tx46		18	0.6	270	17.16	15.83	4	10.5	4.000	5.000	1.732	-1.957	3424	0.830	1.040
	70	ALL	Tx46		18	0.6	270	17.16	15.83	4	10.5	4.000	5.000	2.001	-2.227	3834	0.810	1.040
	75	ALL	Tx46		20	0.6	270	17.00	15.40	4	12.5	4.000	5.000	2.289	-2.510	4254	0.790	1.040
	80	ALL	Tx46		24	0.6	270	16.77	14.10	4	20.5	4.000	5.100	2.579	-2.804	4703	0.780	1.050
	85	ALL	Tx46		28	0.6	270	16.60	11.46	4	40.5	4.200	5.500	2.905	-3.125	5181	0.770	1.050
	90	ALL	Tx46		32	0.6	270	16.23	9.48	6	42.5	4.400	5.700	3.234	-3.438	5624	0.750	1.050
	95	ALL	Tx46		34	0.6	270	16.07	11.13	6	34.5	5.000	5.900	3.582	-3.777	6117	0.740	1.060
	100	ALL	Tx46		38	0.6	270	15.81	11.39	6	34.5	5.600	6.600	3.961	-4.139	6635	0.730	1.060

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.

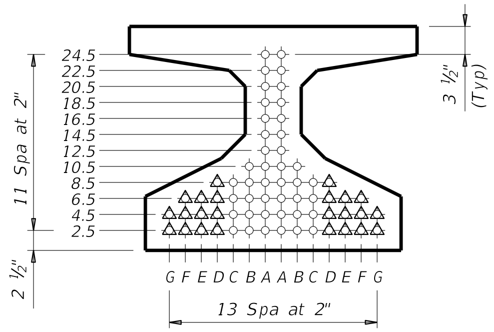
Strand debonding must comply with Item 424.4.2.2.2.4. Full-length debonded strands are only permitted in positions marked △. Double wrap full-length debonded strands in outer most position of each row.

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.

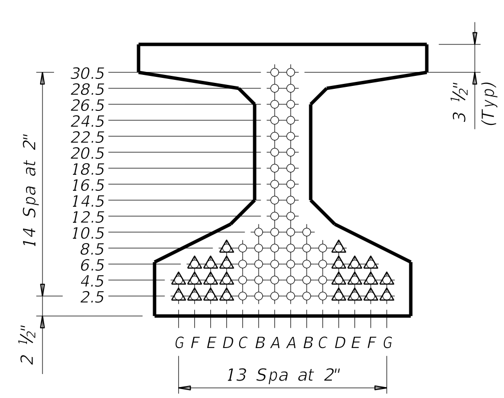
Seal cracks in girder ends exceeding 0.005" in width as directed by the Engineer. The fabricator is permitted to decrease the spacing of Bars R and S by providing additional bars to help limit crack width provided the decreased spacing results in no less than 1" clear between bars. The fabricator must 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



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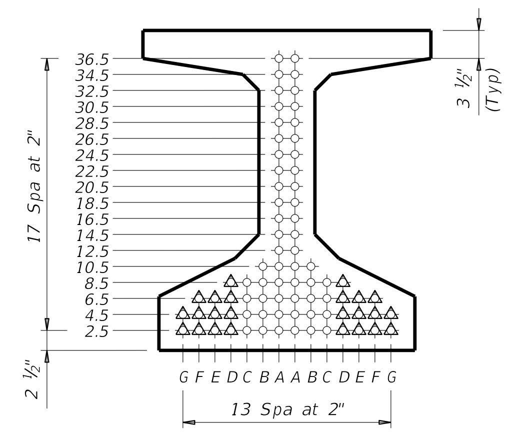

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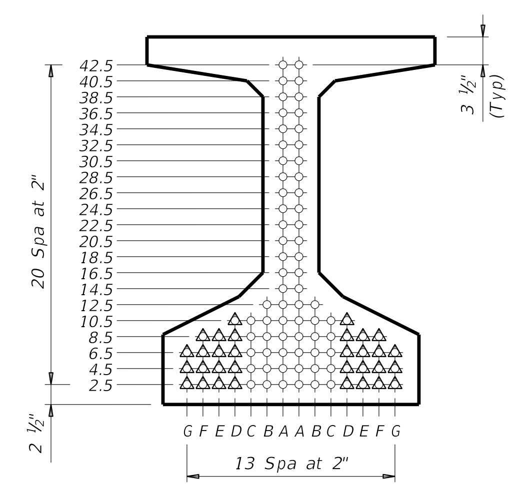

TYPE Tx46

HL93 LOADING

SHEET 1 OF 2

Texas Department of Transportation

Bridge Division Standard

PRESTRESSED CONCRETE I-GIRDER STANDARD DESIGNS

32' ROADWAY

IGSD-32

FILE: igd6stds-19.dgn	DN: EFC	CK: AJF	DW: EFC	CK: TAR
©TxDOT August 2017	CONT	SECT	JOB	HIGHWAY
REVISIONS 10-19: Redesigned girders.	DIST		COUNTY	SHEET NO.

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DATE:
FILE:

STRUCTURE	DESIGNED GIRDERS									DEPRESSED STRAND PATTERN		CONCRETE		OPTIONAL DESIGN				
	SPAN NO.	GIRDER NO.	GIRDER TYPE	PRESTRESSING STRANDS								RELEASE STRGTH (1)	MINIMUM 28 DAY COMP STRGTH	DESIGN LOAD COMP STRESS (TOP ℄) (SERVICE I)	DESIGN LOAD TENSILE STRESS (BOTT ℄) (SERVICE III)	REQUIRED MINIMUM ULTIMATE MOMENT CAPACITY (STRENGTH I)	LIVE LOAD DISTRIBUTION FACTOR (2)	
				NON-STD STRAND PATTERN	TOTAL NO.	SIZE (in)	STRGTH fpu (ksi)	"e" ℄ (in)	"e" END (in)	NO.	TO END (in)	f'ci (ksi)	f'c (ksi)	fct(ksi)	fcb(ksi)	(kip-ft)	Moment	Shear
Type Tx54 Girders 32' Roadway 8.5" Slab	40	ALL	Tx54		12	0.6	270	21.01	21.01			4.000	5.000	0.561	-0.686	2216	0.980	1.010
	45	ALL	Tx54		12	0.6	270	21.01	21.01			4.000	5.000	0.703	-0.835	2629	0.950	1.010
	50	ALL	Tx54		14	0.6	270	21.01	21.01			4.000	5.000	0.858	-1.003	3108	0.920	1.020
	55	ALL	Tx54		16	0.6	270	20.76	20.26	4	6.5	4.000	5.000	1.035	-1.189	3629	0.900	1.020
	60	ALL	Tx54		16	0.6	270	20.76	20.26	4	6.5	4.000	5.000	1.224	-1.381	3931	0.870	1.020
	65	ALL	Tx54		18	0.6	270	20.56	19.23	4	10.5	4.000	5.000	1.430	-1.588	4159	0.850	1.020
	70	ALL	Tx54		18	0.6	270	20.56	19.23	4	10.5	4.000	5.000	1.653	-1.815	4103	0.840	1.030
	75	ALL	Tx54		20	0.6	270	20.41	18.81	4	12.5	4.000	5.000	1.877	-2.035	4399	0.820	1.030
	80	ALL	Tx54		20	0.6	270	20.41	18.81	4	12.5	4.000	5.000	2.129	-2.284	4880	0.810	1.030
	85	ALL	Tx54		22	0.6	270	20.28	18.46	4	14.5	4.000	5.000	2.392	-2.534	5339	0.790	1.040
	90	ALL	Tx54		26	0.6	270	20.08	16.39	4	28.5	4.000	5.000	2.665	-2.800	5839	0.780	1.040
	95	ALL	Tx54		28	0.6	270	20.01	14.29	4	44.5	4.000	5.000	2.951	-3.075	6353	0.770	1.040
	100	ALL	Tx54		32	0.6	270	19.63	12.51	6	44.5	4.300	5.200	3.262	-3.370	6892	0.760	1.040
	105	ALL	Tx54		36	0.6	270	19.34	12.01	6	50.5	4.700	5.400	3.574	-3.667	7434	0.750	1.040
	110	ALL	Tx54		40	0.6	270	19.11	12.51	6	50.5	5.300	6.100	3.899	-3.973	7988	0.740	1.050
	115	ALL	Tx54		44	0.6	270	18.83	11.55	8	48.5	5.600	6.400	4.252	-4.301	8569	0.730	1.050
	120	ALL	Tx54	*	48	0.6	270	18.42	10.09	10	50.5	5.800	7.700	4.619	-4.640	9165	0.720	1.050
Type Tx62 Girders 32' Roadway 8.5" Slab	60	ALL	Tx62		16	0.6	270	25.53	25.53			4.000	5.000	0.961	-1.157	4309	0.900	1.010
	65	ALL	Tx62		16	0.6	270	25.53	25.53			4.000	5.000	1.121	-1.331	4614	0.880	1.010
	70	ALL	Tx62		18	0.6	270	25.33	25.33			4.000	5.000	1.292	-1.514	4894	0.860	1.020
	75	ALL	Tx62		18	0.6	270	25.33	25.33			4.000	5.000	1.475	-1.705	4844	0.840	1.020
	80	ALL	Tx62		20	0.6	270	25.18	24.38	4	8.5	4.000	5.000	1.659	-1.903	5116	0.830	1.020
	85	ALL	Tx62		20	0.6	270	25.18	24.38	4	8.5	4.000	5.000	1.866	-2.120	5578	0.820	1.020
	90	ALL	Tx62		20	0.6	270	25.18	24.38	4	8.5	4.500	5.500	2.080	-2.338	6072	0.800	1.030
	95	ALL	Tx62		24	0.6	270	24.94	22.94	4	16.5	4.000	5.000	2.310	-2.574	6621	0.790	1.030
	100	ALL	Tx62		26	0.6	270	24.85	22.39	4	20.5	4.000	5.000	2.531	-2.805	7159	0.780	1.030
	105	ALL	Tx62		30	0.6	270	24.58	14.18	6	58.5	4.800	5.800	2.771	-3.050	7723	0.770	1.030
	110	ALL	Tx62		34	0.6	270	24.25	15.42	6	56.5	4.200	5.000	3.020	-3.304	8301	0.760	1.030
	115	ALL	Tx62		36	0.6	270	24.11	17.44	6	46.5	4.700	5.600	3.291	-3.576	8909	0.750	1.030
	120	ALL	Tx62		40	0.6	270	23.88	16.68	6	54.5	5.100	6.000	3.545	-3.835	9493	0.740	1.040
	125	ALL	Tx62		44	0.6	270	23.60	14.87	8	56.5	5.300	6.100	3.836	-4.124	10128	0.730	1.040
	130	ALL	Tx62		48	0.6	270	23.28	15.28	8	56.5	5.800	6.700	4.144	-4.438	10849	0.730	1.040

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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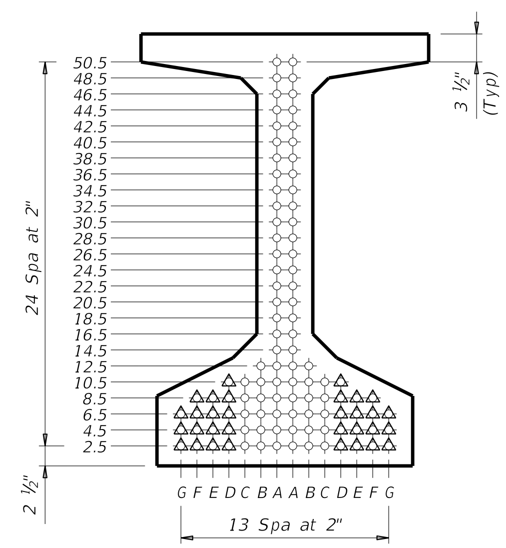
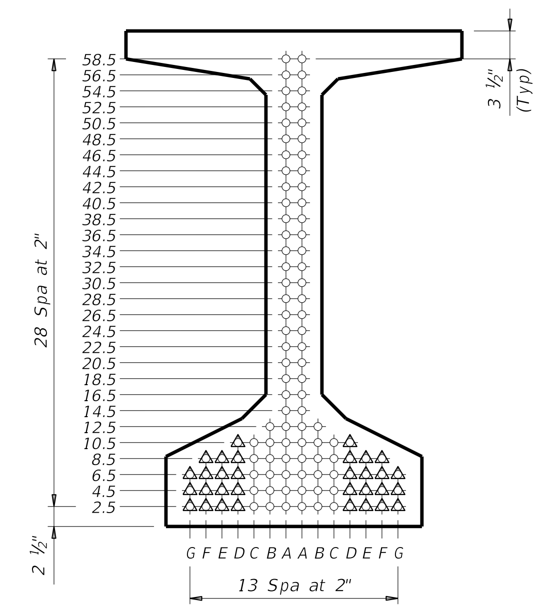


TYPE Tx54



TYPE Tx62

HL93 LOADING — SHEET 2 OF 2

Texas Department of Transportation — Bridge Division Standard

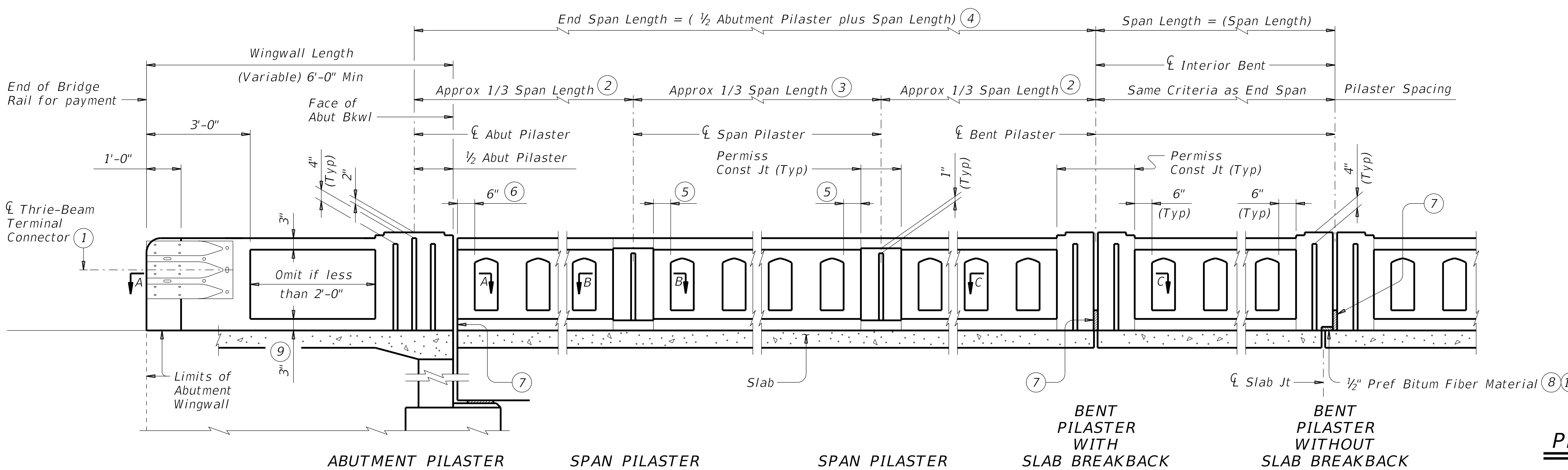
PRESTRESSED CONCRETE I-GIRDER STANDARD DESIGNS

32' ROADWAY

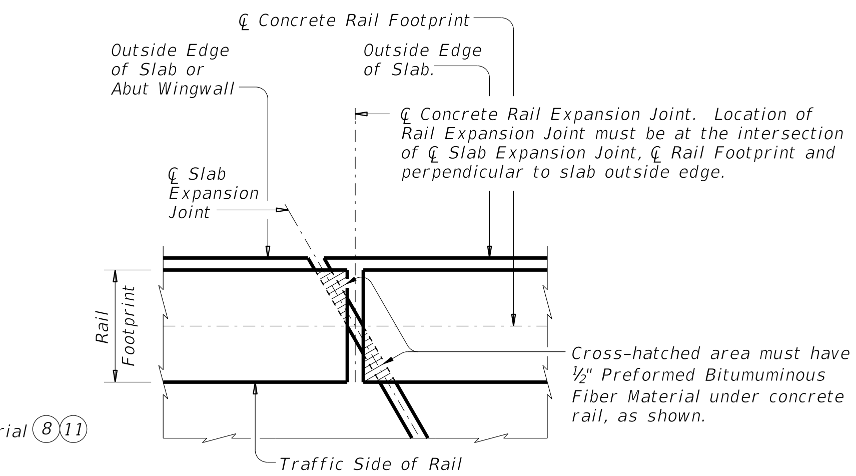
IGSD-32

FILE: ig06stds-19.dgn	DN: EFC	CK: AJF	DW: EFC	CK: TAR
©TxDOT August 2017	CONT	SECT	JOB	HIGHWAY
REVISIONS 10-19: Redesigned girders.	DIST	COUNTY		SHEET NO.

DATE:
FILE:



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".

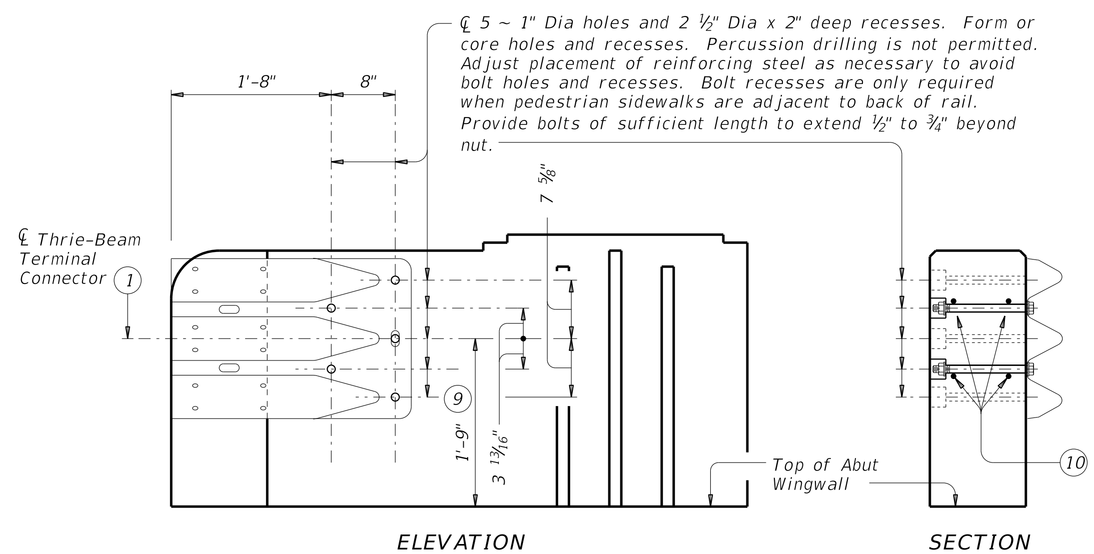
(7) Provide rail joints at ends of all spans the same width as Slab joint opening, except that Rail Joints over construction joints must be ¼" Min to ¾" Max in width. Joints must be open if slab joint opening is not sealed. Joints over construction joints and over sealed deck joints must be plugged. 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.

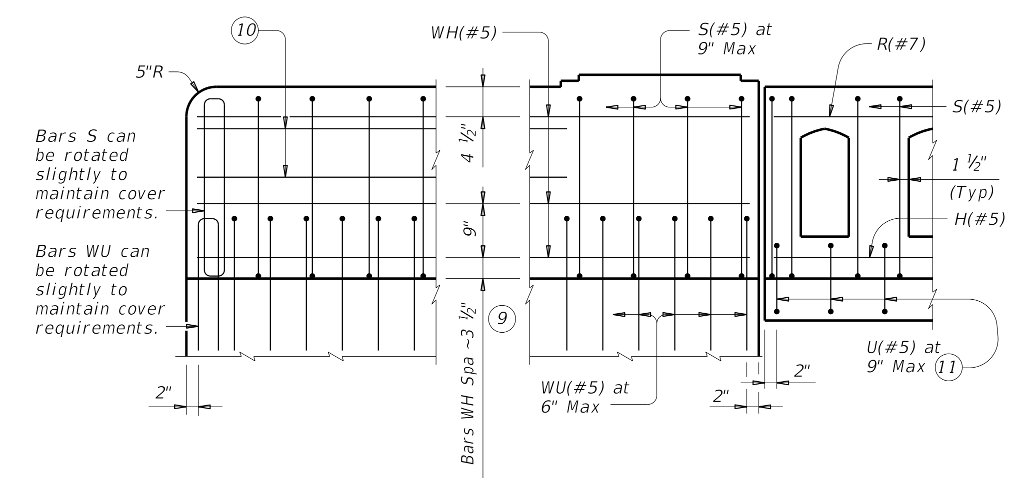
(10) Place 4 additional Bars WH(#5) 3'-8" in length inside Bars S(#5) and centered 2'-0" from end of rail when Terminal Connections are required. Field bend as needed.

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



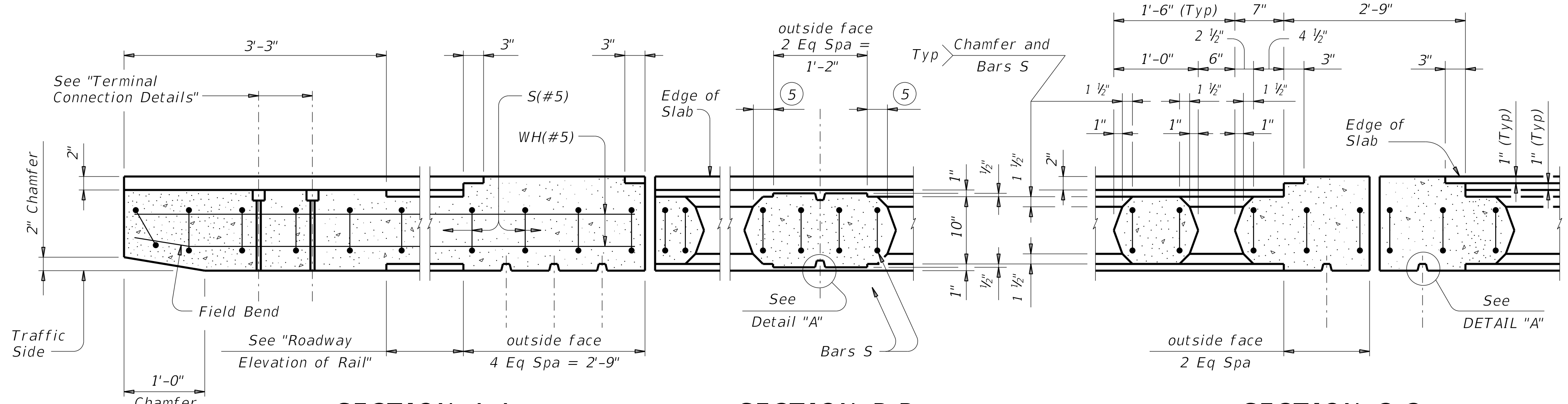
TERMINAL CONNECTION DETAILS

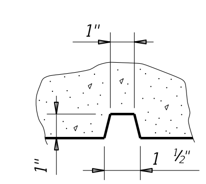
(Showing parapet with Pilaster on 6'-0" Wingwall)



ELEVATION SHOWING TYPICAL REINFORCING PLACEMENT

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





DETAIL "A"

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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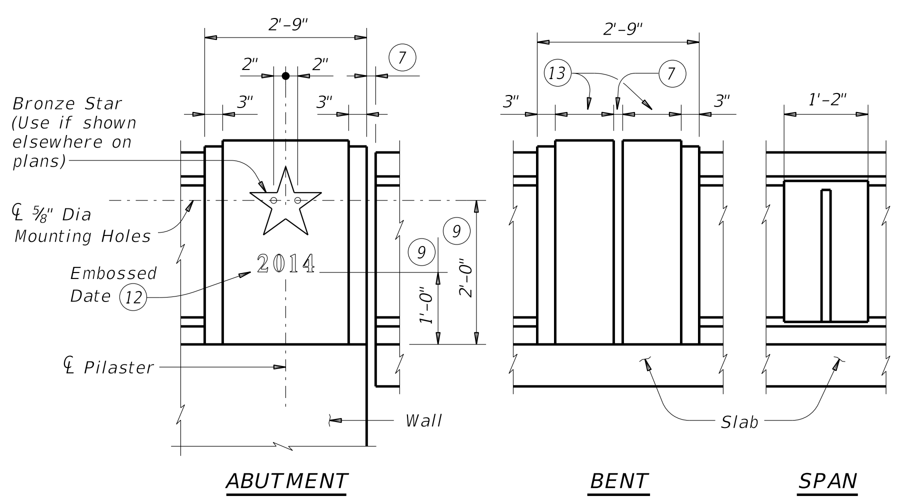
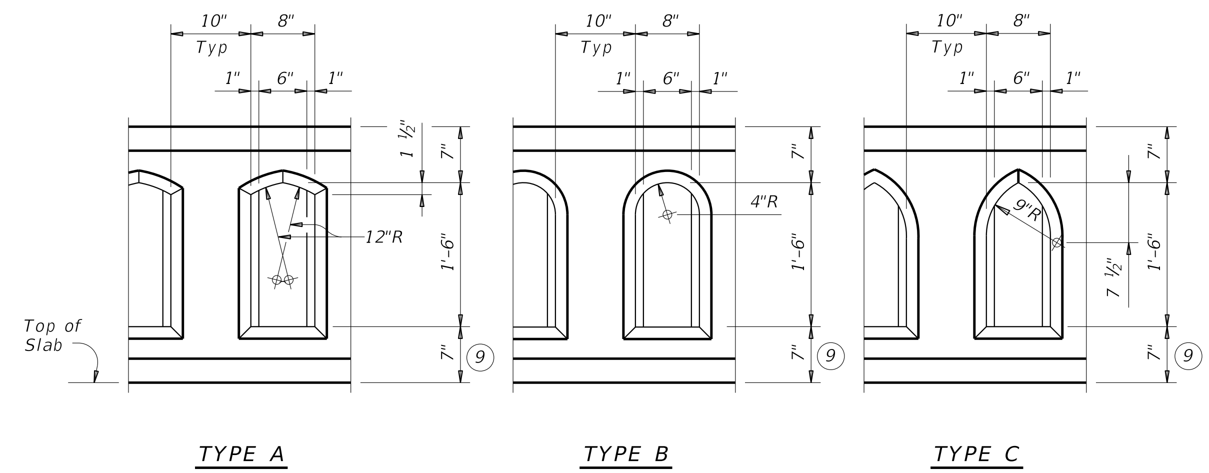
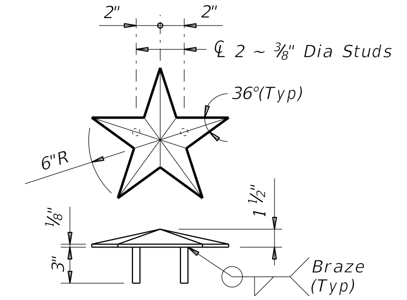


EXTERIOR PILASTER ELEVATIONS



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 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.

(9) Increase 2" for structures with overlay.

(12) Construction year (use if shown elsewhere on plans) 3" High "Plantin Bold" Typeface with ¼" recess. Placed at one Abutment only or as directed by the Engineer.

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

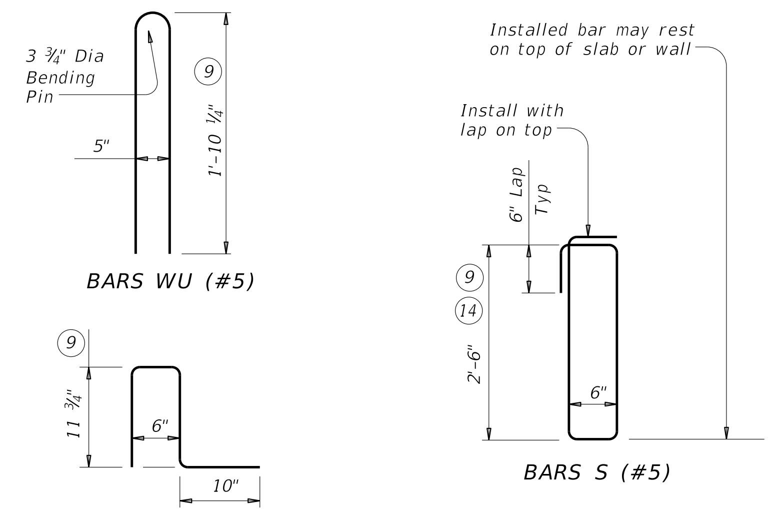
(14) Reduce by 2" or field bend over Preformed Bituminous Fiber Material to gain cover.

(15) 5 ¼" 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.



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.

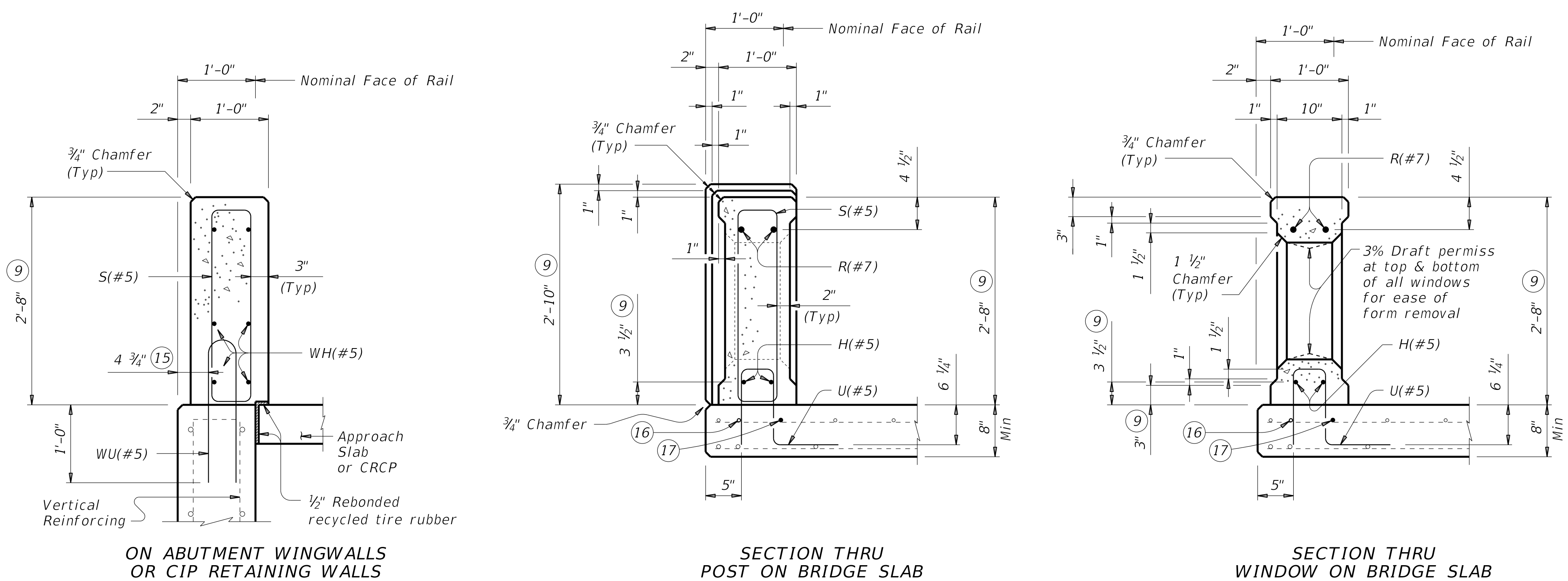
Shop drawings will not be required for this rail.

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.



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:
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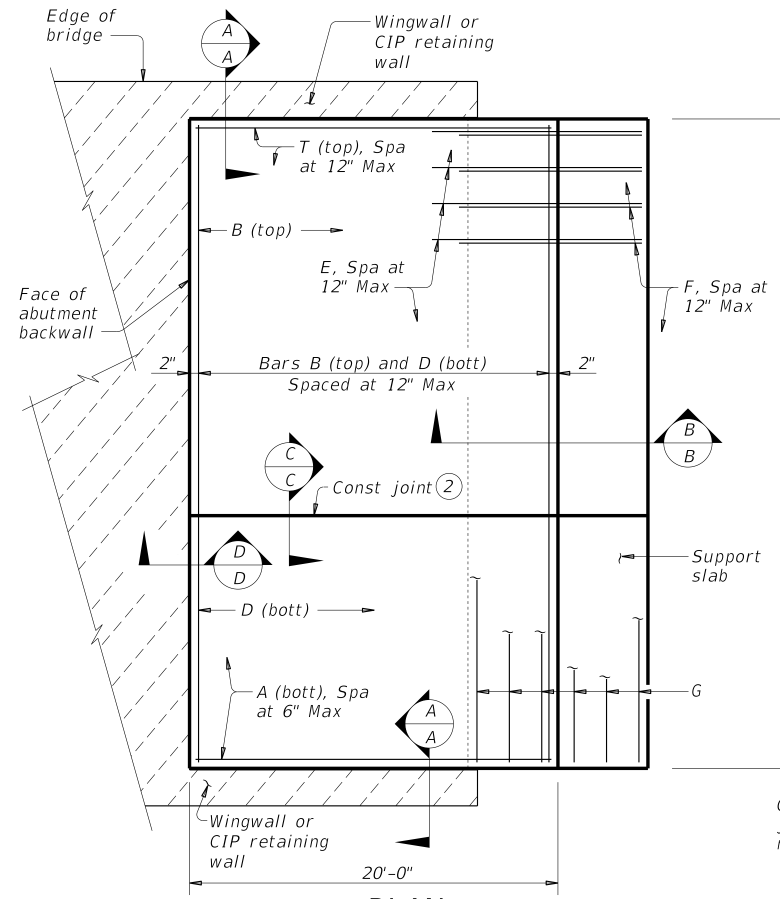
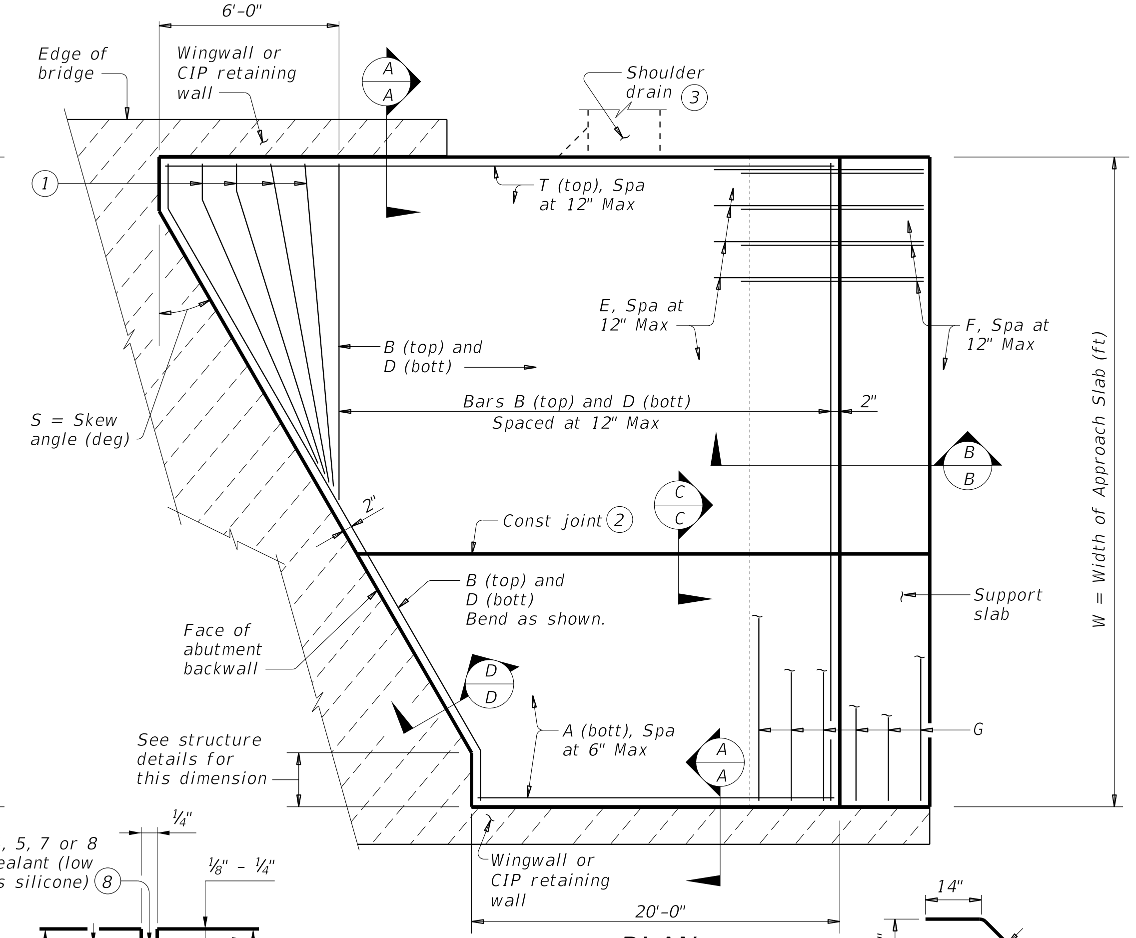
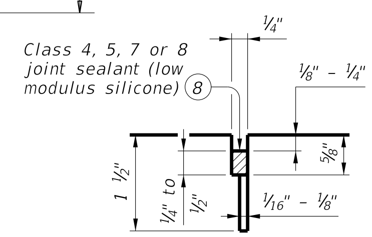


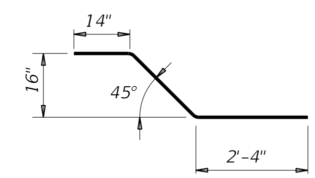
PLAN
(Showing non-skewed approach slab.)



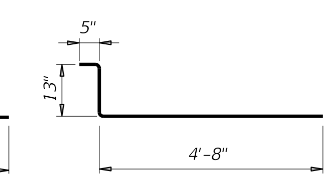
PLAN
(Showing skewed approach slab.)



LONGITUDINAL SAW CUT JOINT DETAIL



BARS E (#5)



BARS F (#5)

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.

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."

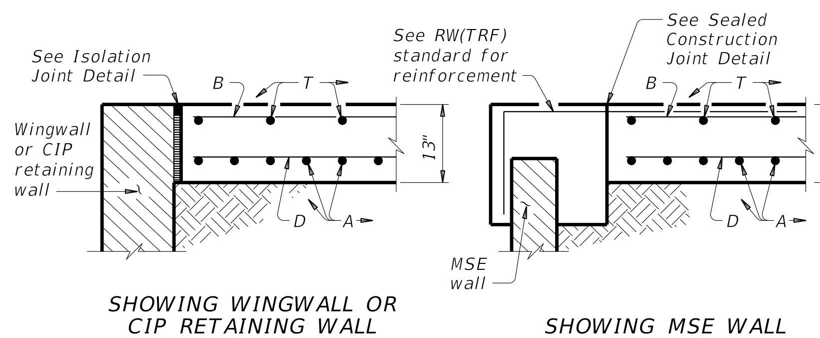
Construct the subgrade or subbase away from the bridge for a minimum distance of 100 feet prior to the approach slab, unless otherwise indicated on the plans.

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.

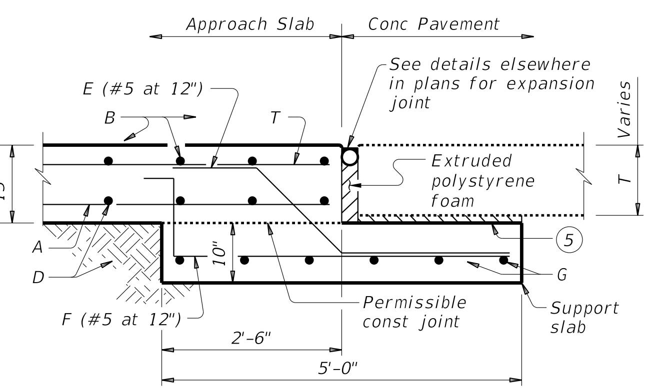
Cure for 4 days using water or membrane curing per Item 422.

All details shown herein are subsidiary to bridge approach slab.

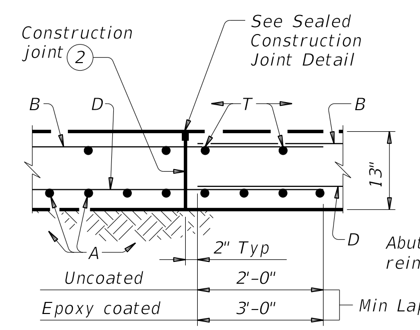
Cover dimensions are clear dimensions, unless noted otherwise.
Reinforcing bar dimensions shown are out-to-out of bar.



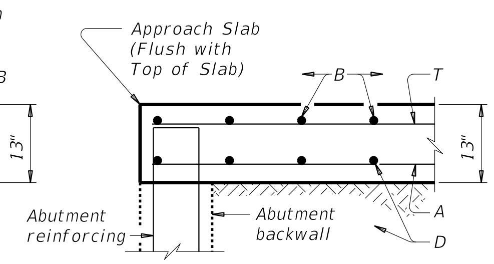
SECTION A-A



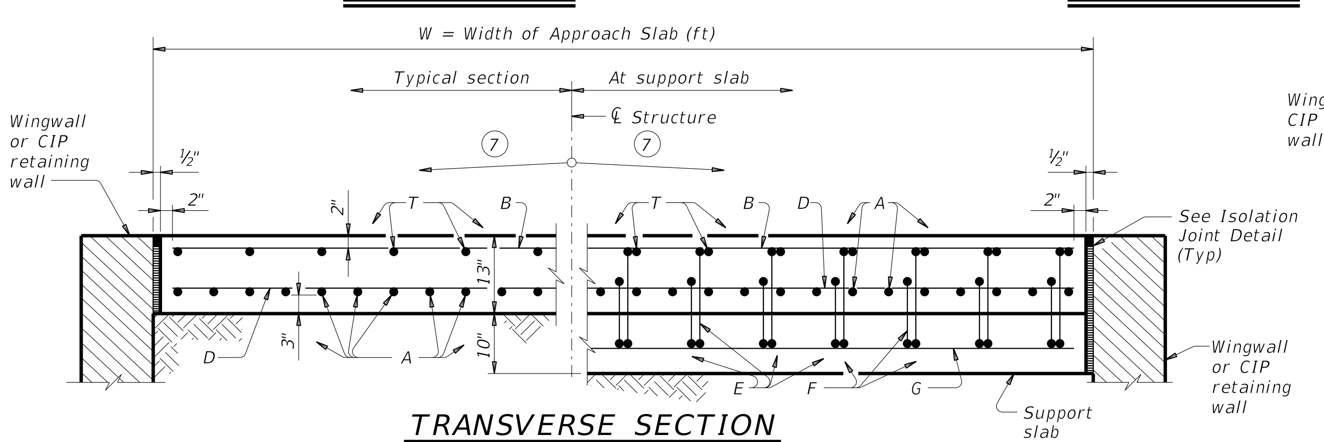
SECTION B-B



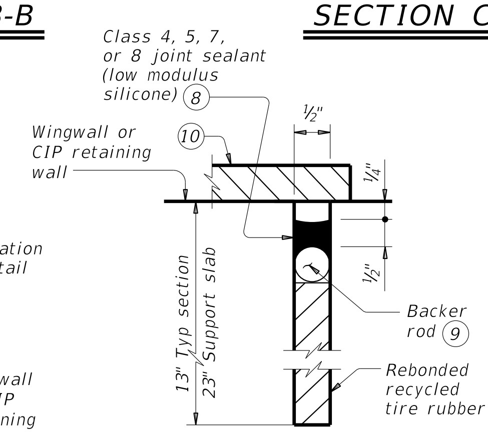
SECTION C-C 6



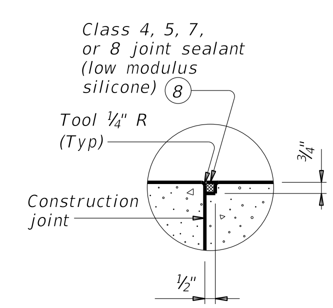
SECTION D-D



TRANSVERSE SECTION



ISOLATION JOINT DETAIL



SEALED CONSTRUCTION JOINT DETAIL

Texas Department of Transportation

Bridge Division Standard

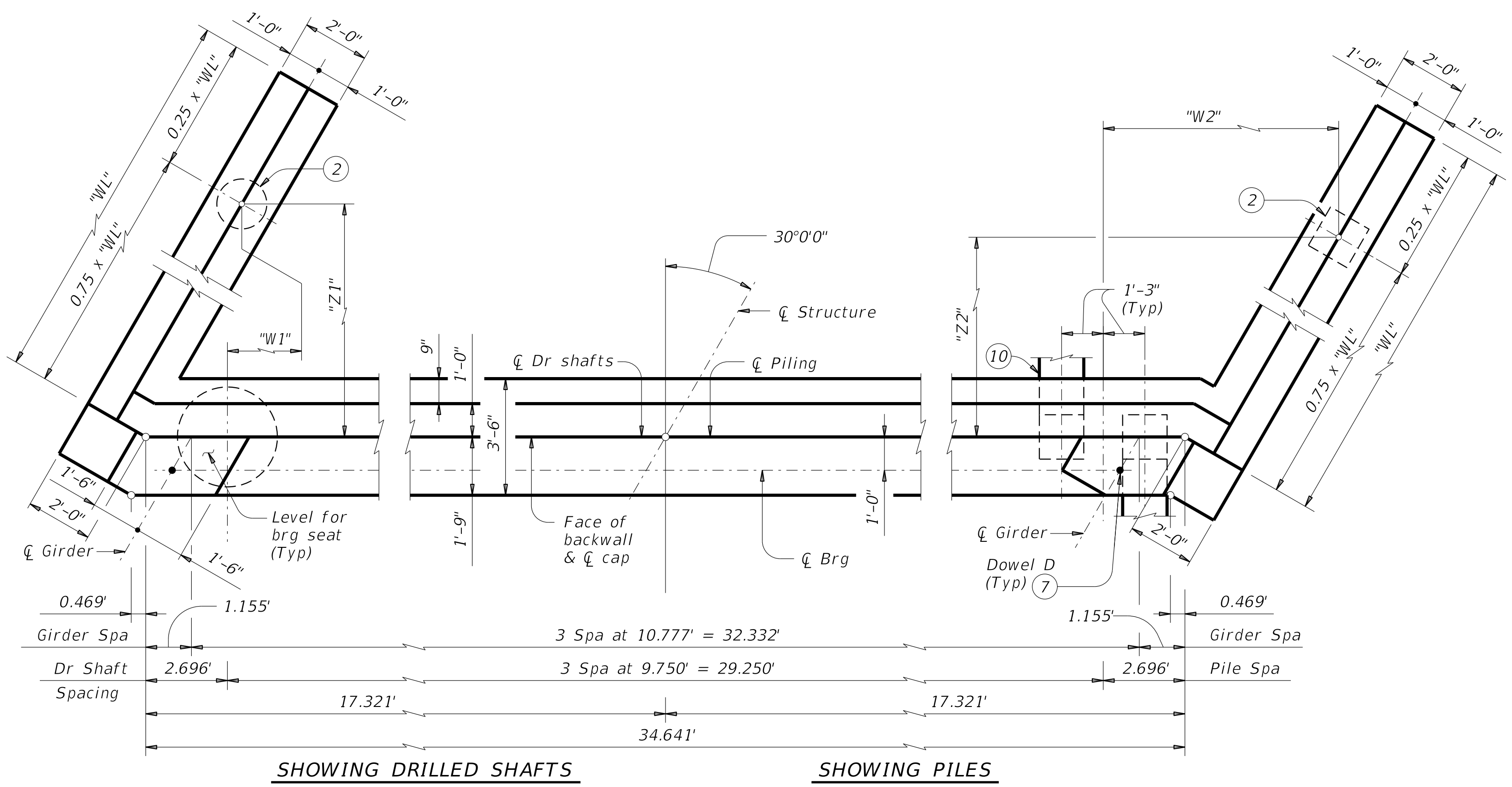
BRIDGE APPROACH SLAB

CONCRETE PAVEMENT

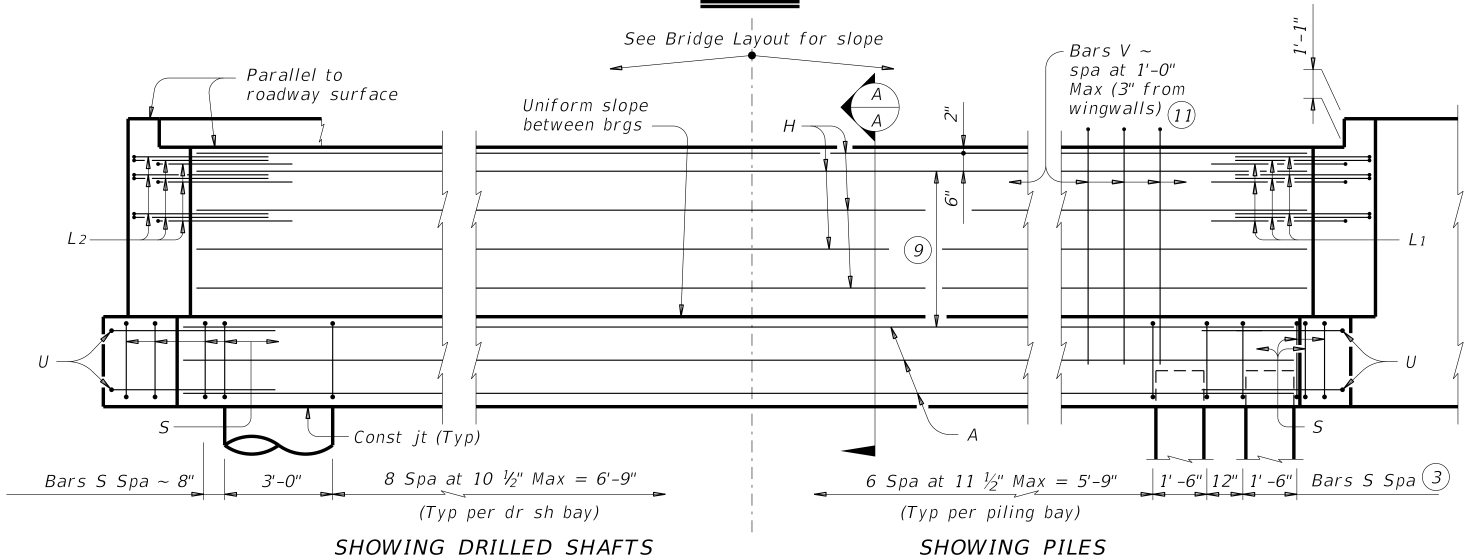
BAS-C

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.

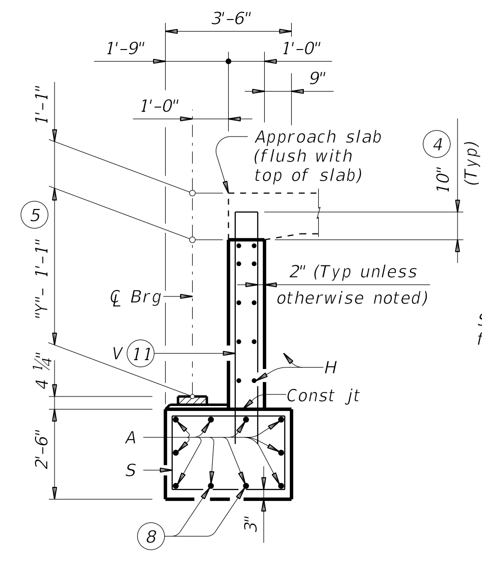
DATE:
FILE:



PLAN 1

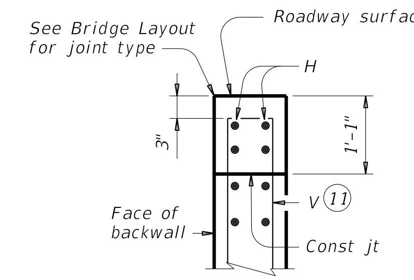


ELEVATION



SECTION A-A

(With approach slab) 6



BACKWALL DETAIL

(Without approach slab) 6

TABLE OF FOUNDATION LOADS

Span Length	All Girder Types	
Ft	Tons/Shaft	Tons/Pile
40	54	51
45	58	53
50	61	54
55	64	56
60	68	58
65	71	59
70	74	61
75	77	63
80	80	64
85	84	66
90	87	68
95	90	69
100	93	71
105	96	72
110	99	74
115	102	76
120	105	77

1. See Table A for variable dimensions based on header slope and girder type.
2. See Table A to determine if wingwall foundations are required.
3. For piling larger than 16" adjust Bars S spacing as required to avoid piling.
4. Increase as required to maintain 3" from finished grade.
5. See Span details for "Y" value.
6. See Bridge Layout to determine if approach slab is present.
7. Omit Dowels D at end of multi-span unit. Adjust reinforcing steel total accordingly.
8. With pile foundations, move Bars A shown to clear piles.
9. Spacing based on girder type:
   Tx28 ~ 3 spaces at 1'-0" Max
   Tx34 ~ 3 spaces at 1'-0" Max
   Tx40 ~ 4 spaces at 1'-0" Max
   Tx46 ~ 4 spaces at 1'-0" Max
   Tx54 ~ 5 spaces at 1'-0" Max
10. See Detail A on FD standard.
11. Field bend as needed to clear piles.

GENERAL NOTES:

Designed according to AASHTO LRFD Bridge Design Specifications.
See Bridge Layout for header slope and foundation type, size and length.
See Common Foundation Details (FD) standard sheet for all foundation details and notes.
See Concrete Riprap (CRR) standard sheet or Stone Riprap (SRR) standard sheet for riprap attachment details, if applicable.
See applicable rail details for rail anchorage in wingwalls.
Details are drawn showing right forward skew. See Bridge Layout for actual skew directions.
These abutment details may be used with standard SIG-32-30 only.

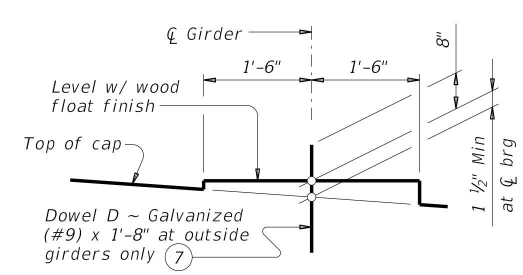
Cover dimensions are clear dimensions, unless noted otherwise.
Reinforcing bar dimensions shown are out-to-out of bar.

MATERIAL NOTES:

Provide Class C concrete (f'c = 3,600 psi).
Provide Class C (HPC) concrete if shown elsewhere in the plans.
Provide Grade 60 reinforcing steel.
Galvanize dowel bars D.

TABLE A

Header Slope	Girder Type	Wingwall Type	Wingwall Lgth "WL"	"W1"	"Z1"	"W2"	"Z2"
2:1	Tx28	Cantilevered	10.000'	Not Applicable			
	Tx34	Cantilevered	11.000'				
	Tx40	Cantilevered	12.000'				
	Tx46	Founded	14.000'	1.688'	9.593'	8.812'	8.593'
	Tx54	Founded	15.000'	2.063'	10.243'	9.187'	9.243'
3:1	Tx28	Founded	14.000'	1.688'	9.593'	8.812'	8.593'
	Tx34	Founded	16.000'	2.438'	10.892'	9.562'	9.892'
	Tx40	Founded	18.000'	3.188'	12.191'	10.312'	11.191'
	Tx46	Founded	20.000'	3.938'	13.490'	11.062'	12.490'
	Tx54	Founded	22.000'	4.688'	14.789'	11.812'	13.789'



BEARING SEAT DETAIL

(Bearing surface must be clean and free of all loose material before placing bearing pad.)

HL93 LOADING SHEET 1 OF 3

Texas Department of Transportation — Bridge Division Standard

ABUTMENTS
TYPE TX28 THRU TX54
PRESTR CONC I-GIRDERS
32' ROADWAY 30° SKEW

AIG-32-30

FILE: aig43sts-17.dgn | DN: TAR | CK: KCM | DW: JTR | CK: TAR

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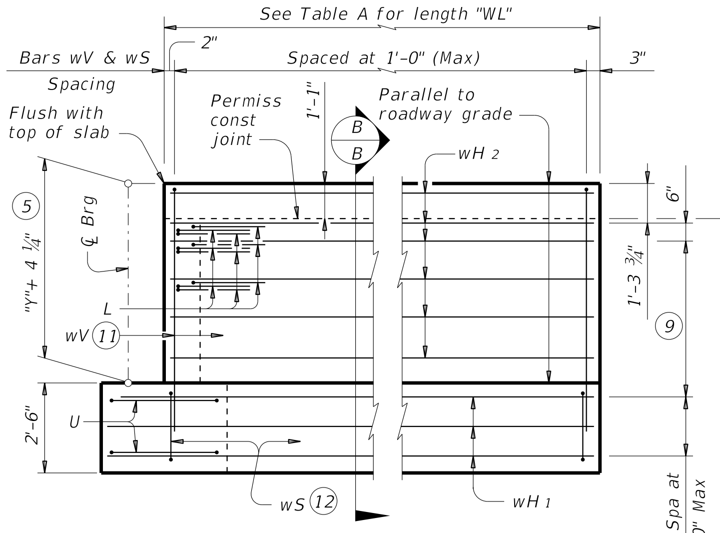
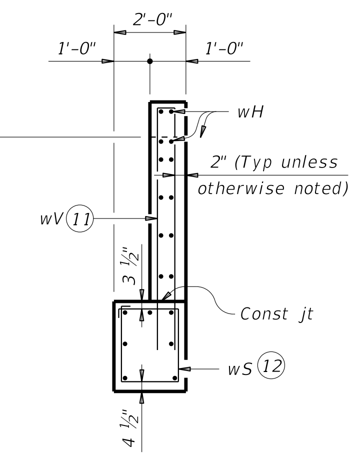
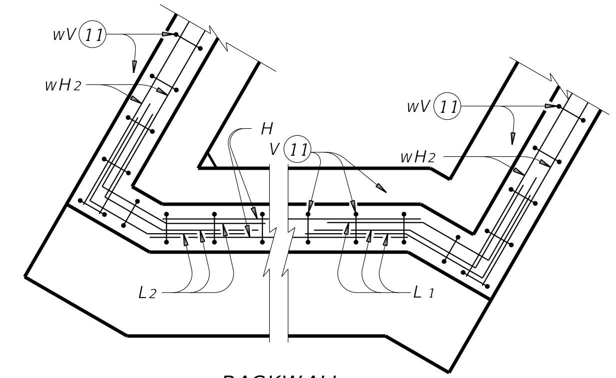


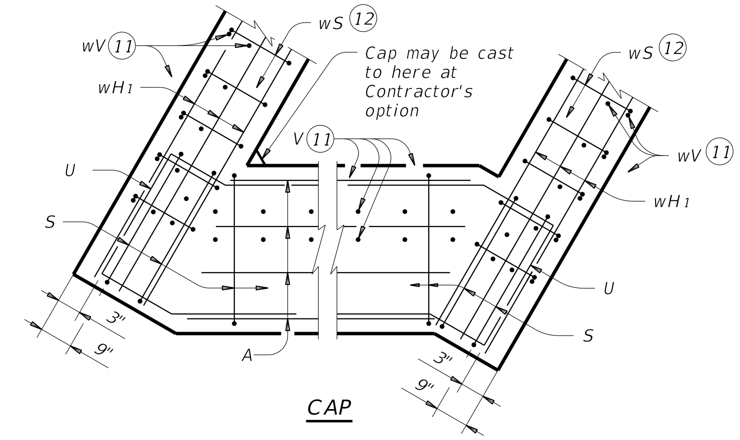
WINGWALL ELEVATION



SECTION B-B

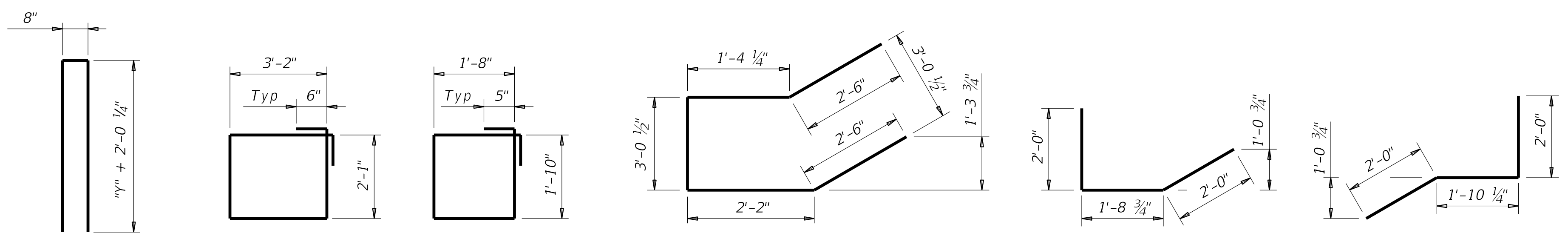


BACKWALL



CAP

CORNER DETAILS



BARS V & wV (5) BARS S BARS wS BARS U BARS L2 BARS L1

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

(9) Spacing based on girder type:
Tx28 ~ 3 spaces at 1'-0" Max
Tx34 ~ 3 spaces at 1'-0" Max
Tx40 ~ 4 spaces at 1'-0" Max
Tx46 ~ 4 spaces at 1'-0" Max
Tx54 ~ 5 spaces at 1'-0" Max

(11) Field bend as needed to clear piles.

(12) Adjust as required to avoid piling.

HL93 LOADING SHEET 2 OF 3

Texas Department of Transportation | Bridge Division Standard

ABUTMENTS
TYPE TX28 THRU TX54
PRESTR CONC I-GIRDERS
32' ROADWAY 30° SKEW

AIG-32-30

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TABLES OF ESTIMATED QUANTITIES WITH 2:1 HEADER SLOPE (13)

TYPE Tx28 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	8	#6	34'-8"	417
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	11'-4"	449
wH1	14	#6	11'-5"	240
wH2	20	#6	9'-8"	290
wS	22	#4	7'-10"	115
wV	22	#5	11'-4"	260
Reinforcing Steel			Lb	4,272
Class "C" Concrete			CY	21.8

TYPE Tx34 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	8	#6	34'-8"	417
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	12'-4"	489
wH1	14	#6	12'-5"	261
wH2	20	#6	10'-8"	320
wS	24	#4	7'-10"	126
wV	24	#5	12'-4"	309
Reinforcing Steel			Lb	4,423
Class "C" Concrete			CY	23.5

TYPE Tx40 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	10	#6	34'-8"	521
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	13'-4"	528
wH1	14	#6	13'-5"	282
wH2	24	#6	11'-8"	421
wS	26	#4	7'-10"	136
wV	26	#5	13'-4"	362
Reinforcing Steel			Lb	4,751
Class "C" Concrete			CY	25.3

TYPE Tx46 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	10	#6	34'-8"	521
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	14'-4"	568
wH1	14	#6	15'-5"	324
wH2	24	#6	13'-8"	493
wS	30	#4	7'-10"	157
wV	30	#5	14'-4"	448
Reinforcing Steel			Lb	5,012
Class "C" Concrete			CY	27.9

TYPE Tx54 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	12	#6	34'-8"	625
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	15'-8"	621
wH1	14	#6	16'-5"	345
wH2	28	#6	14'-8"	617
wS	32	#4	7'-10"	167
wV	32	#5	15'-8"	523
Reinforcing Steel			Lb	5,399
Class "C" Concrete			CY	30.3

TABLES OF ESTIMATED QUANTITIES WITH 3:1 HEADER SLOPE (13)

TYPE Tx28 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	8	#6	34'-8"	417
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	11'-4"	449
wH1	14	#6	15'-5"	324
wH2	20	#6	13'-8"	411
wS	30	#4	7'-10"	157
wV	30	#5	11'-4"	355
Reinforcing Steel			Lb	4,614
Class "C" Concrete			CY	24.4

TYPE Tx34 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	8	#6	34'-8"	417
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	12'-4"	489
wH1	14	#6	17'-5"	366
wH2	20	#6	15'-8"	471
wS	34	#4	7'-10"	178
wV	34	#5	12'-4"	437
Reinforcing Steel			Lb	4,859
Class "C" Concrete			CY	26.9

TYPE Tx40 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	10	#6	34'-8"	521
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	13'-4"	528
wH1	14	#6	19'-5"	408
wH2	24	#6	17'-8"	637
wS	38	#4	7'-10"	199
wV	38	#5	13'-4"	528
Reinforcing Steel			Lb	5,322
Class "C" Concrete			CY	29.6

TYPE Tx46 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	10	#6	34'-8"	521
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	14'-4"	568
wH1	14	#6	21'-5"	450
wH2	24	#6	19'-8"	709
wS	42	#4	7'-10"	220
wV	42	#5	14'-4"	628
Reinforcing Steel			Lb	5,597
Class "C" Concrete			CY	32.5

TYPE Tx54 Girders

Bar	No.	Size	Length	Weight
A	10	#11	34'-8"	1,842
D (7)	2	#9	1'-8"	11
H	12	#6	34'-8"	625
L1	9	#6	5'-11"	80
L2	9	#6	5'-9"	78
S	35	#5	11'-6"	420
U	4	#6	11'-7"	70
V	38	#5	15'-8"	621
wH1	14	#6	23'-5"	492
wH2	28	#6	21'-8"	911
wS	46	#4	7'-10"	241
wV	46	#5	15'-8"	752
Reinforcing Steel			Lb	6,143
Class "C" Concrete			CY	35.9

(7) Omit Dowels D at end of multi-span unit. Adjust reinforcing steel total accordingly.

(13) Quantities shown are for one abutment only (with approach slab). With no approach slab, add 1.5 CY Class "C" concrete and 208 lbs reinforcing steel for 4 additional Bars H.

HL93 LOADING — SHEET 3 OF 3

Texas Department of Transportation — Bridge Division Standard

ABUTMENTS
TYPE TX28 THRU TX54
PRESTR CONC I-GIRDERS
32' ROADWAY 30° SKEW

AIG-32-30

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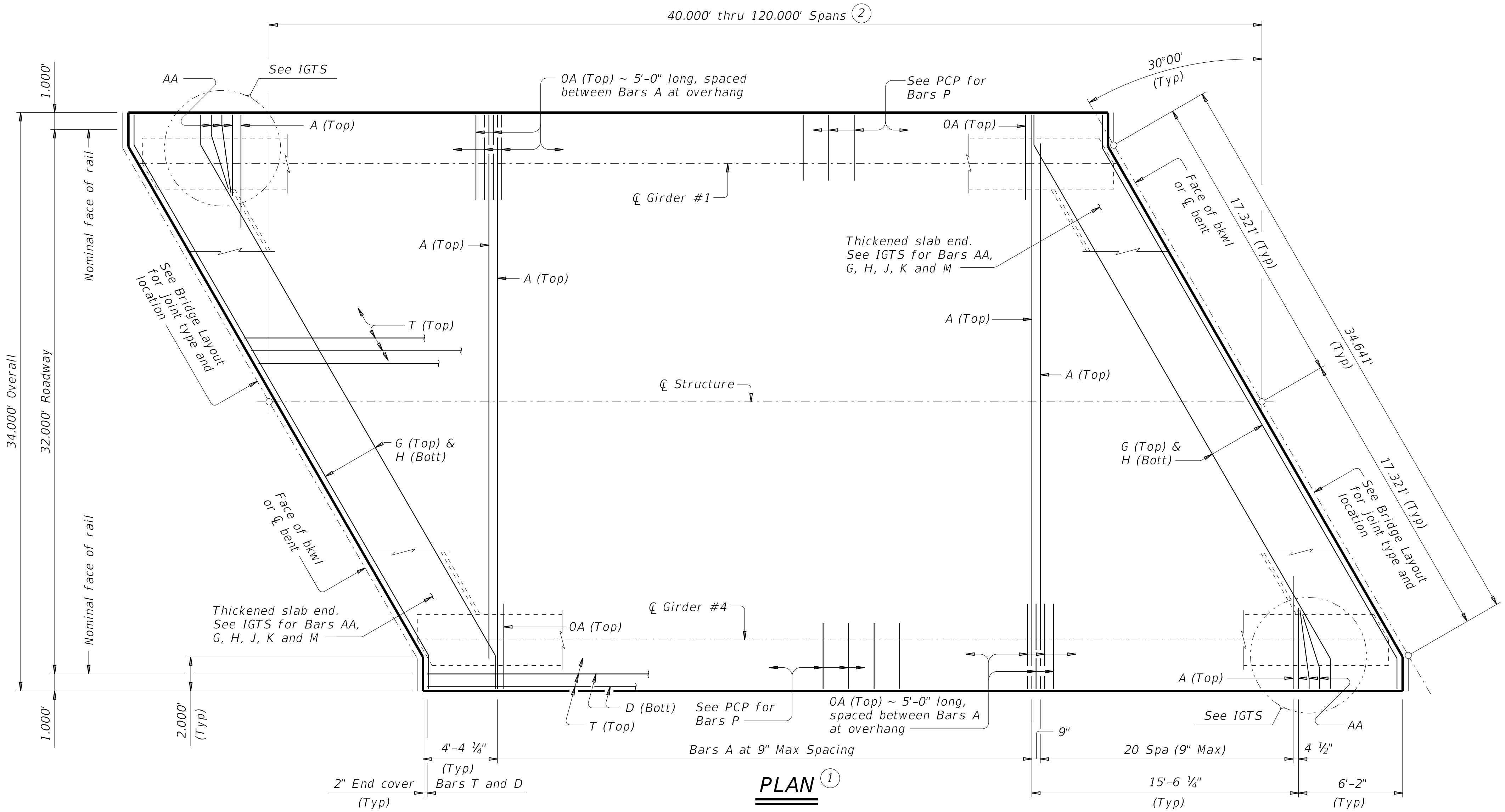


PLAN (1)

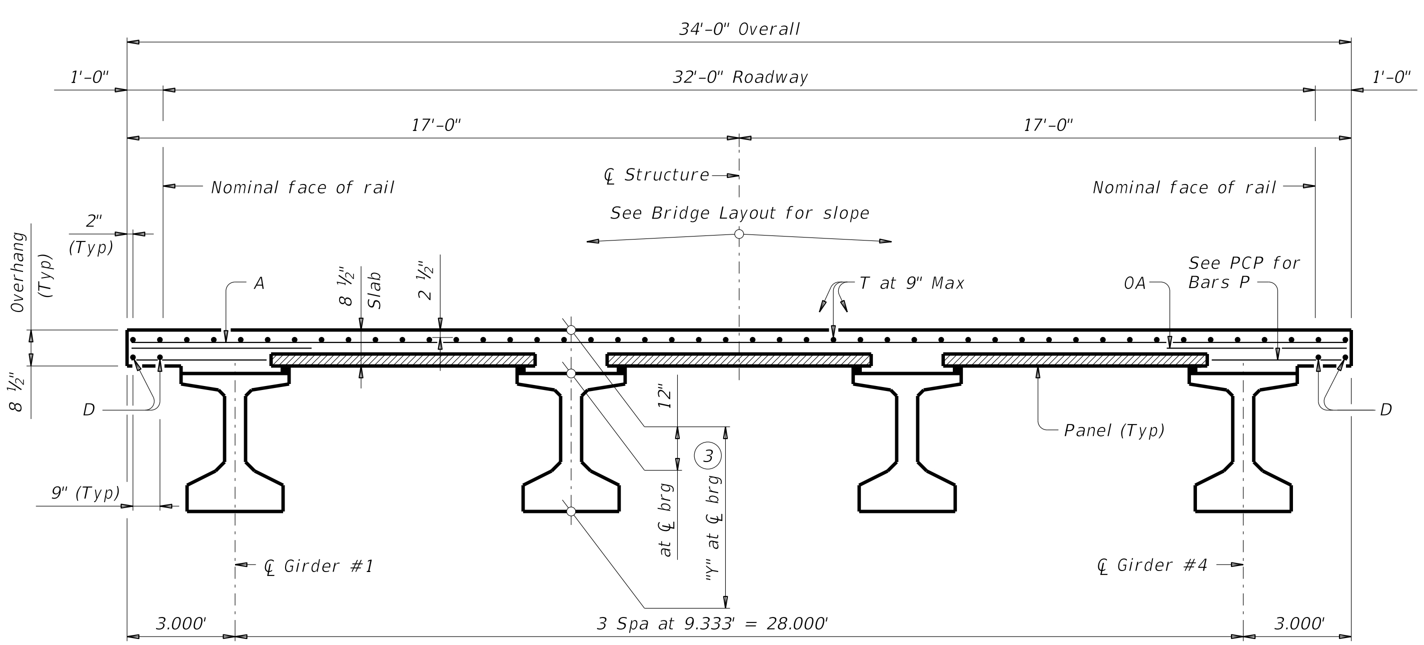
BAR TABLE

BAR	SIZE
A	#4
AA	#5
D	#4
G	#4
H	#4
J	#4
K	#4
M	#4
0A	#5
P	#4
T	#4

(1) If multi-span units (with slab continuous over interior bents) are indicated on the Bridge Layout, see standard IGCS for adjustment to slab reinforcement and quantities.

(2) Span lengths for prestressed concrete I-Girder type:
Type Tx28 for spans lengths 40.000' thru 65.000'.
Type Tx34 for spans lengths 40.000' thru 80.000'.
Type Tx40 for spans lengths 40.000' thru 90.000'.
Type Tx46 for spans lengths 40.000' thru 100.000'.
Type Tx54 for spans lengths 40.000' thru 120.000'.

(3) "Y" value shown is based on theoretical girder camber, dead load deflection from an 8 ½" concrete slab, a constant roadway grade, and using precast panels (PCP). The Contractor will adjust this value as necessary for any roadway vertical curve and/or if the precast overhang panel (PCP(0)) option is used.



TYPICAL TRANSVERSE SECTION

(Showing girder type Tx46)

TABLE OF SECTION DEPTHS

GIRDER TYPE	"Y" AT ℄ BRG (3) Ft/In
Tx28	3'-4"
Tx34	3'-10"
Tx40	4'-4"
Tx46	4'-10"
Tx54	5'-6"

HL93 LOADING SHEET 1 OF 2

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE I-GIRDER SPANS (TYPE Tx28 THRU Tx54)

32' ROADWAY 30° SKEW

SIG-32-30

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TABLE OF DEAD LOAD DEFLECTIONS

TYPE Tx28 GIRDERS

SPAN LENGTH	"A"	"B"
Ft	Ft	Ft
40	0.011	0.015
45	0.017	0.024
50	0.026	0.037
55	0.040	0.056
60	0.057	0.080
65	0.079	0.111

TYPE Tx34 GIRDERS

SPAN LENGTH	"A"	"B"
Ft	Ft	Ft
40	0.006	0.009
45	0.010	0.014
50	0.016	0.022
55	0.024	0.033
60	0.034	0.048
65	0.047	0.066
70	0.064	0.090
75	0.085	0.120
80	0.111	0.156

TYPE Tx40 GIRDERS

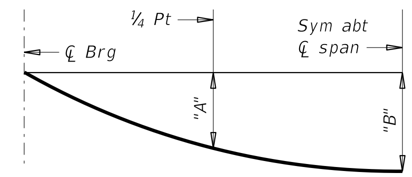
SPAN LENGTH	"A"	"B"
Ft	Ft	Ft
40	0.004	0.006
45	0.006	0.009
50	0.011	0.015
55	0.016	0.022
60	0.022	0.031
65	0.031	0.043
70	0.042	0.059
75	0.056	0.078
80	0.073	0.102
85	0.093	0.131
90	0.118	0.165

TYPE Tx46 GIRDERS

SPAN LENGTH	"A"	"B"
Ft	Ft	Ft
40	0.003	0.004
45	0.004	0.006
50	0.007	0.010
55	0.011	0.015
60	0.015	0.021
65	0.021	0.030
70	0.028	0.040
75	0.038	0.053
80	0.049	0.069
85	0.063	0.089
90	0.080	0.113
95	0.100	0.140
100	0.123	0.173

TYPE Tx54 GIRDERS

SPAN LENGTH	"A"	"B"
Ft	Ft	Ft
40	0.002	0.003
45	0.003	0.004
50	0.005	0.007
55	0.007	0.010
60	0.010	0.014
65	0.014	0.020
70	0.019	0.027
75	0.025	0.035
80	0.033	0.046
85	0.042	0.059
90	0.053	0.074
95	0.066	0.093
100	0.081	0.114
105	0.100	0.140
110	0.120	0.169
115	0.144	0.202
120	0.172	0.241



DEAD LOAD DEFLECTION DIAGRAM

Calculated deflections shown are due to the concrete slab on interior girders only (Ec = 5000 ksi). Adjust values as required for exterior girders and if optional slab forming is used. These values may require field verification.

TABLE OF ESTIMATED QUANTITIES

SPAN LENGTH	REINF CONCRETE SLAB	Prestressed Concrete Girders			TOTAL REINF STEEL (5)
		ABUT TO INT BT (4)	INT BT TO INT BT (4)	ABUT TO ABUT (4)	
Ft	SF	LF	LF	LF	Lb
40	1,360	157.85	158.00	157.69	3,128
45	1,530	177.85	178.00	177.69	3,519
50	1,700	197.85	198.00	197.69	3,910
55	1,870	217.85	218.00	217.69	4,301
60	2,040	237.85	238.00	237.69	4,692
65	2,210	257.85	258.00	257.69	5,083
70	2,380	277.85	278.00	277.69	5,474
75	2,550	297.85	298.00	297.69	5,865
80	2,720	317.85	318.00	317.69	6,256
85	2,890	337.85	338.00	337.69	6,647
90	3,060	357.85	358.00	357.69	7,038
95	3,230	377.85	378.00	377.69	7,429
100	3,400	397.85	398.00	397.69	7,820
105	3,570	417.85	418.00	417.69	8,211
110	3,740	437.85	438.00	437.69	8,602
115	3,910	457.85	458.00	457.69	8,993
120	4,080	477.85	478.00	477.69	9,384

(4) Fabricator will adjust lengths for girder slopes as required.

(5) Reinforcing steel weight is calculated using an approximate factor of 2.3 lbs/SF.

GENERAL NOTES:

Designed according to AASHTO LRFD Bridge Design Specifications.
Multi-span units, with slab continuous over interior bents, may be formed with the details shown on this sheet and standard IGCS.
See IGTS standard for Thickened Slab End details and quantity adjustments.
See PCP and PCP-FAB for panel details not shown.
See PCP(O) and PCP(O)-FAB for precast overhang panel details if this option is used.
See IGMS standard for miscellaneous details.
See applicable rail details for rail anchorage in slab.
See PMDF standard for details and quantity adjustments if this option is used.
This standard is drawn showing right forward skew. See Bridge Layout for actual skew direction.
This standard does not support the use of transition bents.

Cover dimensions are clear dimensions, unless noted otherwise.

MATERIAL NOTES:

Provide Class S concrete (f'c = 4,000 psi).
Provide Class S (HPC) concrete if shown elsewhere in the plans.
Provide Grade 60 reinforcing steel.
Provide bar laps, where required, as follows:
Uncoated ~ #4 = 1'-7"
Epoxy coated ~ #4 = 2'-5"
Deformed Welded Wire Reinforcement (WWR) (ASTM A1064) of equal size and spacing may be substituted for Bars A, AA, D, OA, P or T unless noted otherwise.

HL93 LOADING — SHEET 2 OF 2

Texas Department of Transportation — Bridge Division Standard

PRESTRESSED CONCRETE I-GIRDER SPANS (TYPE Tx28 THRU Tx54)

32' ROADWAY — 30° SKEW

SIG-32-30

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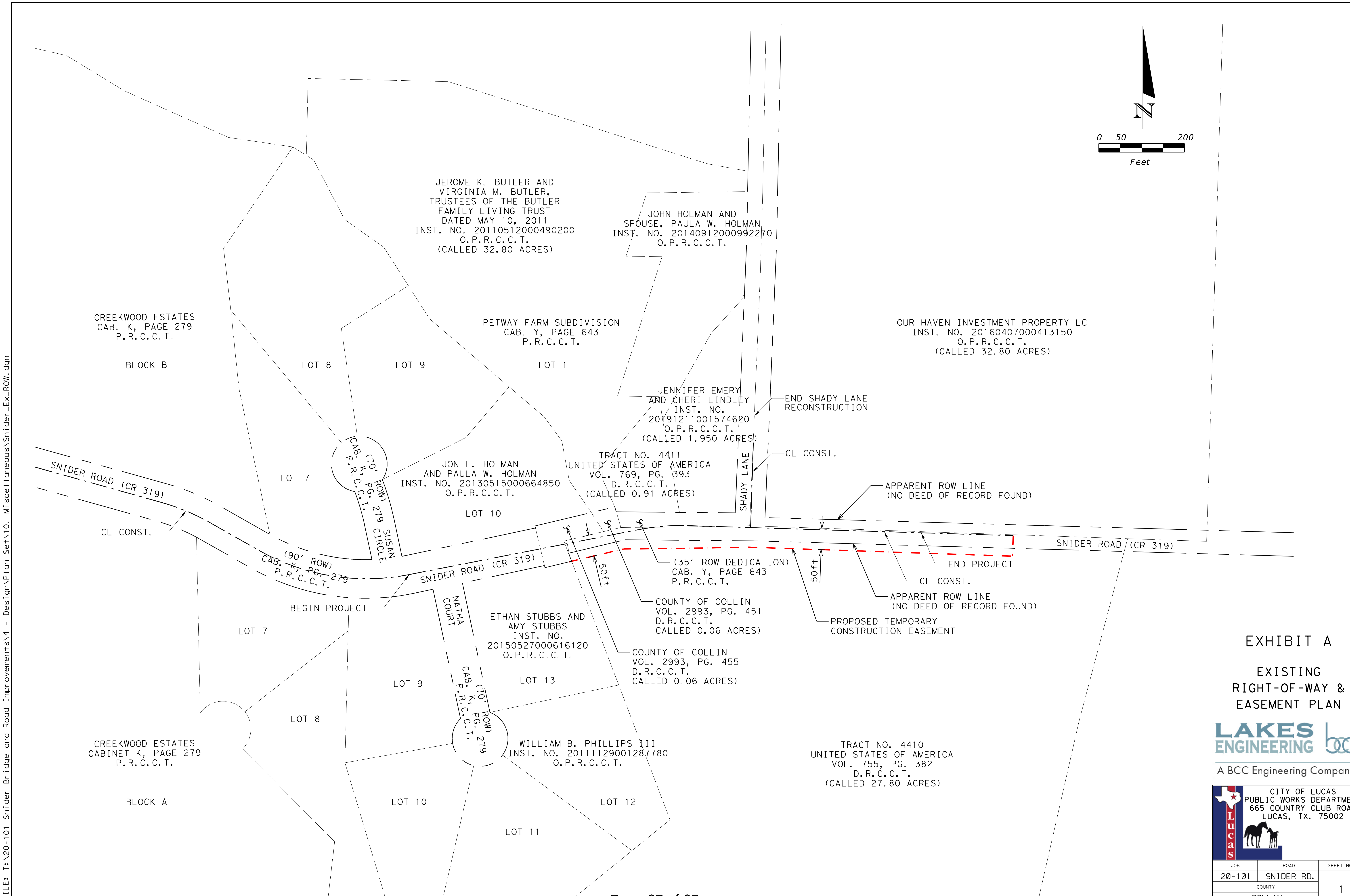
EXHIBIT A:
Existing Right-Of-Way & Easement Plan



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