# Appendix F – Information Provided by Fairfax County Park Authority

- Photos of recent FCPA pedestrian bridge construction projects
- Presentation on Stream Valley Bridge crossing challenges
- Gabrielson Bridge: Bridge Details – Basis of Design
- Liberty Bell Trail Bridge Shop Drawings
- Luria Abutment Drawing for Building Permit
- Section 13000 Steel Bridge and Helical Anchor Specifications

# Fairfax County Park Authority Bridges

100-ft-long X 12-ft wide Bridge over Accotink Creek

100-ft-long X 12-ft wide Bridge over Accotink Creek

100-ft Bridge over Accotink Creek in flood

100-ft Bridge over Accotink Creek in flood

# Fairfax County Park Authority Bridges

60-ft Bridge over Pohick Creek – abutment construction

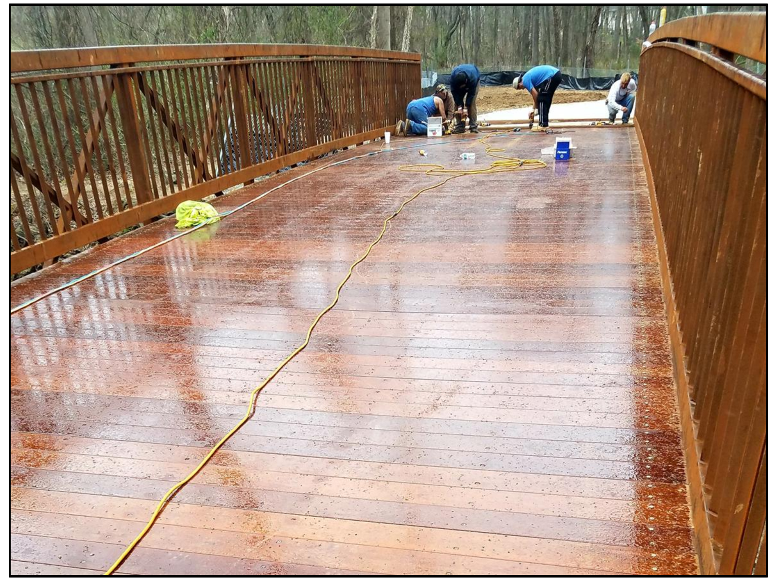
60-ft Bridge over Pohick Creek – steel truss setting

60-ft long, 10-ft wide Bridge over Pohick Creek


100-ft Bridge over Accotink Creek in flood

# Fairfax County Park Authority Bridges

60-ft long X 14-ft wide Bridge over Pohick Creek



60-ft long X 14-ft wide Bridge over Pohick Creek

60-ft long X 14-ft wide Bridge over Pohick Creek

60-ft long X 14-ft wide Bridge over Pohick Creek

# Fairfax County Park Authority Bridges

60-ft Bridge over Holmes Run
in Luria Park


# Fairfax County Park Authority Bridges

4-ft wide Bridge over South Run

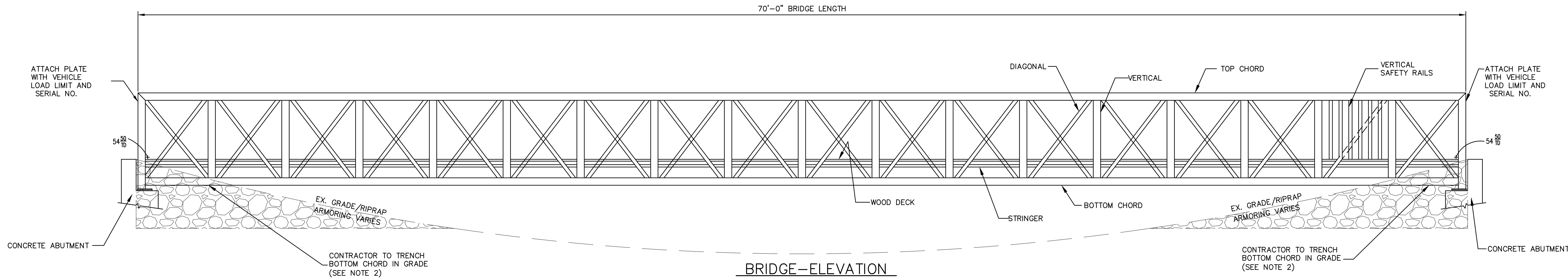
# Stream Valley Crossing Challenges

- Large watershed with flash flooding potential
- A bridge will be inundated during floods
- Large volume of debris during floods
- Bridge structures must be able to withstand significant stream loads

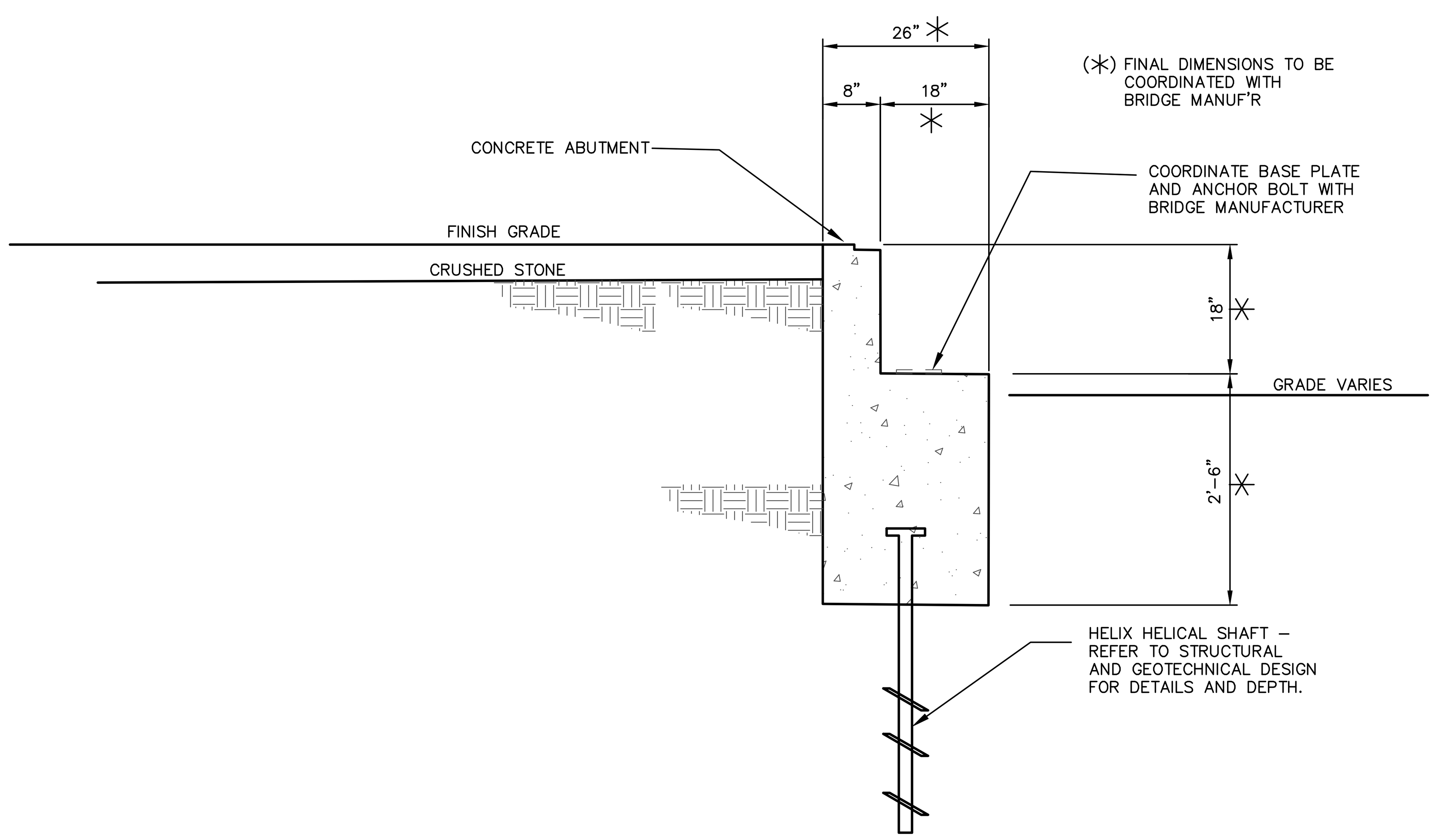
Fairfax County Park Authority

# Other Bridge Considerations

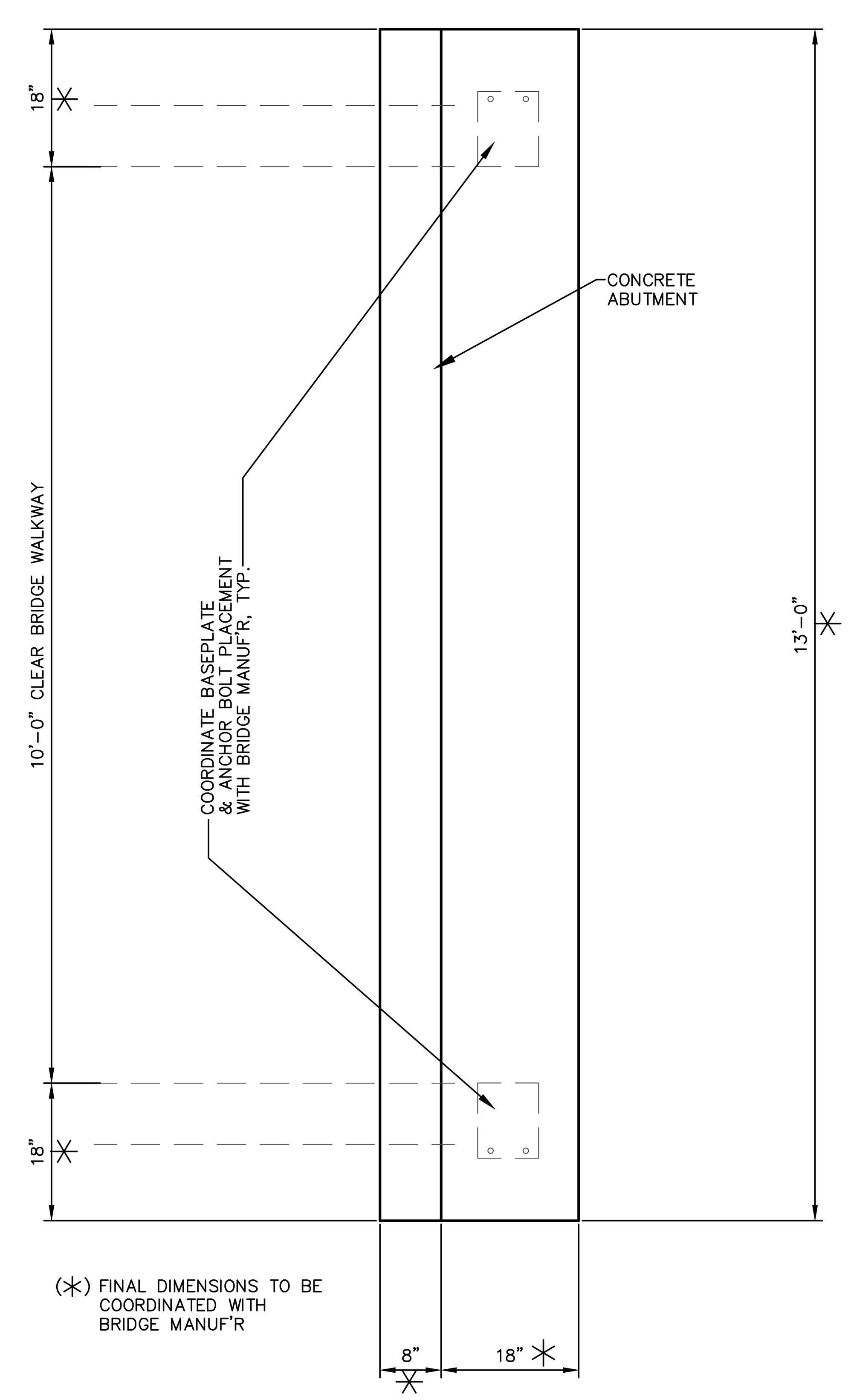
- Sufficient set back from stream bank to avoid erosion
- Low maintenance design for expected 75-year lifespan
- Deck and width per County standards or other funding requirements
- Suitable size for pedestrian, bicycle, and equestrian uses



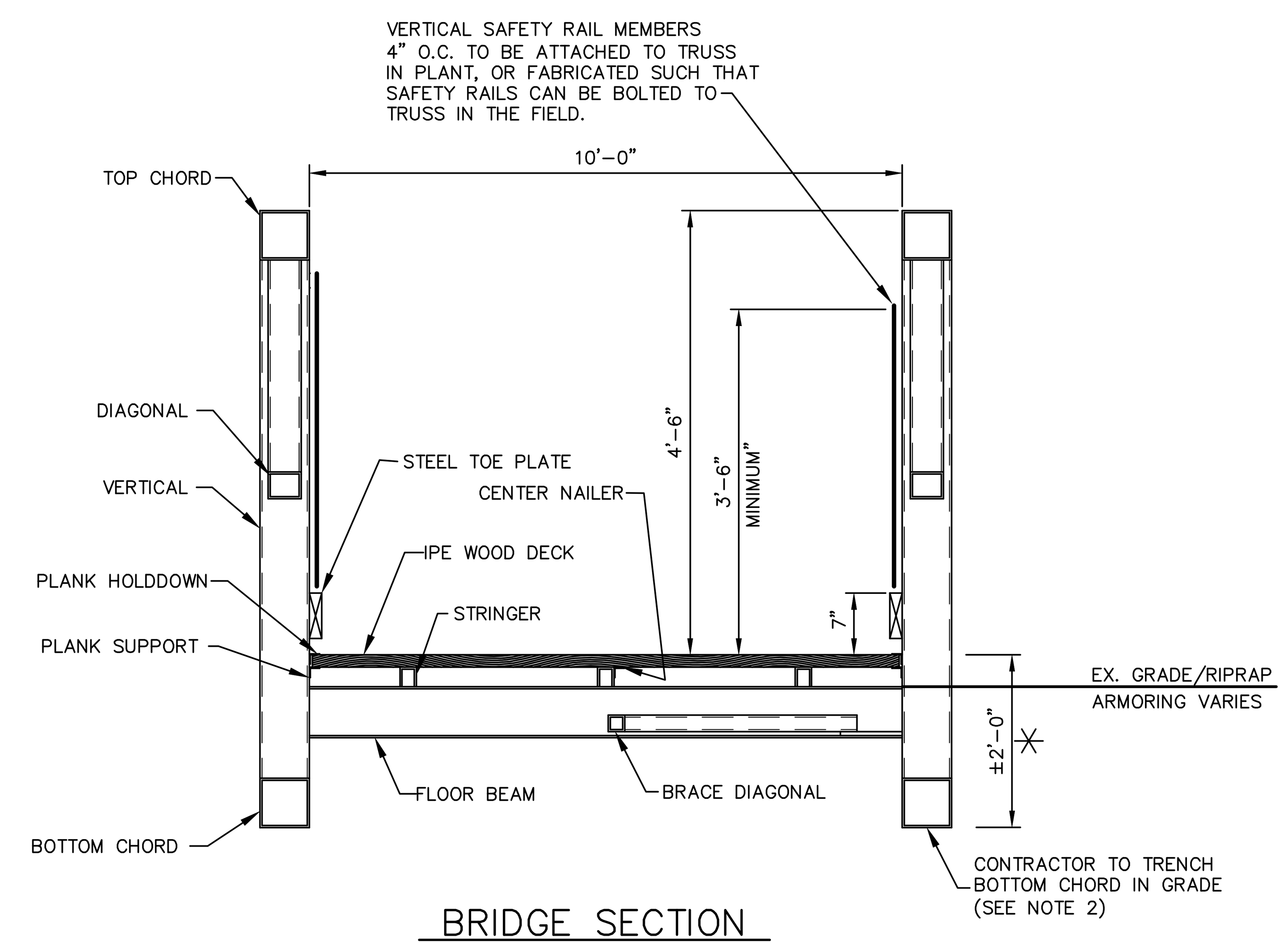

BRIDGE–ELEVATION
NOT TO SCALE




ABUTMENT SECTION VIEW
NOT TO SCALE




ABUTMENT PLAN VIEW
NOT TO SCALE




BRIDGE SECTION
NOT TO SCALE

NOTE:
1) CONTRACTOR SHALL SUBMIT COMPLETE SHOP DRAWING DOCUMENTS, INCLUDING BRIDGE, CONCRETE ABUTMENT, & HELICAL PIER, SIGNED AND SEALED BY ENGINEER CERTIFIED IN THE COMMONWEALTH OF VIRGINIA, TO OWNER FOR REVIEW AND APPROVAL PRIOR TO ORDERING MATERIALS.
2) THE PROPOSED BRIDGE DECK IS AT THE SAME ELEVATION AS THE EXISTING RIP RAP ARMORED STREAM BANK. RIP RAP STONES IN THE PATH OF THE BRIDGE BOTTOM CHORD RAIL SHALL BE REMOVED AND TRENCHED DURING CONSTRUCTION. THE MEANS AND METHODS OF CONSTRUCTION ARE AT THE DISCRETION OF THE CONTRACTOR.

**THIS SHEET NOT FOR CONSTRUCTION - INFORMATION ONLY!!!**

| PLAN STATUS | |
|---|---|
| 12/21/18 | PRELIMINARY PLAN |
| 05/07/19 | 75% PLAN |
| 06/22/19 | 100% PLAN |
| DATE | DESCRIPTION |

Bowman CONSULTING
Bowman Consulting Group, Ltd.
13461 Sunrise Valley Drive
Suite 500
Herndon, Virginia 20171
Phone: (703) 464-1000
Fax: (703) 481-9720
www.bowmanconsulting.com

FAIRFAX COUNTY PARK AUTHORITY
12055 Government Center Pkwy.
Fairfax, Virginia 22035

BRIDGE DETAILS - BASIS OF DESIGN
GABRIELSON GARDENS BRIDGE REPLACEMENT
MINOR SITE PLAN
SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

Designed By: CLL
Checked By: DP
Date: JULY 2019
Scale: N/A
FCPA Project Number: ST-000031-003
Map Section: 0311-((23))-0005
Sheet: 9 of 12
FCPA File Number:

BCG JOB NO. 4000-01-014 FILE NO. 4000-D-CD-001

# LIBERTY BELL TRAIL PEDESTRIAN BRIDGE

## BURKE, VA

## DELTA MARINE CONSTRUCTION

DRAWING INDEX

| SHEET NO. | DESCRIPTION | REV 0 | REV 1 | REV 2 | REV 3 |
|---|---|---|---|---|---|
| 1 | TITLE PAGE | 09/27/2016 | 10/11/2016 | 10/13/2016 | 10/17/2016 |
| 2 | GENERAL NOTES | 09/27/2016 | – | – | – |
| 3 | BEARING REACTION & ANCHOR BOLT LAYOUT | 09/27/2016 | – | – | – |
| 4 | ELEVATION & PLAN VIEW | 09/27/2016 | – | – | – |
| 5 | CROSS SECTION | 09/27/2016 | 10/11/2016 | – | – |
| 6 | WELD DETAILS | 09/27/2016 | 10/11/2016 | 10/13/2016 | 10/17/2016 |
| 7 | BEARING ELEVATIONS & PLATE DETAILS | 09/27/2016 | – | – | 10/17/2016 |

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60'-0" x 14'-2"

LIBERTY BELL TRAIL PEDESTRIAN BRIDGE

BURKE, VA

DELTA MARINE CONSTRUCTION

COMMONWEALTH OF VIRGINIA
MICHAEL WILLIAM PHILPOT
Lic. No.56340
PROFESSIONAL ENGINEER

10/31/16

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| BR16-00372 | |
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| DRAWN BY | RAR |
| CHECKED BY | OM |
| SHEET NO. | 1 |

## GENERAL NOTES

1) BIG R BRIDGE IS AISC QUALITY CERTIFIED BRIDGE FABRICATION – INTERMEDIATE (MAJOR) WITH A FRACTURE CRITICAL AND SOPHISTICATED PAINT ENDORSEMENT, AND CWB CERTIFIED TO CSA STANDARD W47.1 DIVISION 2.

2) DESIGN IS IN ACCORDANCE WITH THE "LRFD GUIDE SPECIFICATION FOR DESIGN OF PEDESTRIAN BRIDGES" BY AASHTO, DECEMBER 2009.

3) MATERIALS (UNLESS NOTED OTHERWISE):
   a) HSS SECTIONS: ASTM A847 WEATHERING STEEL $F_y = 50$ ksi MIN.
   b) STEEL SHAPES: ASTM A588 WEATHERING STEEL $F_y = 50$ ksi
   c) STEEL PLATES: ASTM A588 WEATHERING STEEL $F_y = 50$ ksi
   d) STRUCTURAL BOLTS: ASTM A325 TYPE 3

4) DESIGN LOADINGS:
   a) BRIDGE DEAD LOAD PLUS IPE DECKING LOAD OF 8.75 PSF.
   b) UNIFORM PEDESTRIAN LIVE LOAD OF 100 PSF.
   c) VEHICLE LIVE LOAD OF H10 TRUCK.
   d) WIND LOAD FROM 90 MPH WIND AT A MAX HEIGHT OF 32.8' ABOVE GRADE.
   e) SNOW LOAD OF 20 PSF.
   f) SEISMIC LOADING PER AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 3.10:
      SITE CLASS: D
      PGA = 0.039
      $S_s = 0.16$
      $S_1 = 0.053$
      PERIOD OF BRIDGE = $T_m = 0.062566063$ SEC
   g) STREAM CURRENT LOAD OF 75 PSF.

5) BRIDGE TO BE BUILT TO THE REQUIREMENTS OF AWS D1.1

6) ALL SHOP WELDING SHALL USE THE GAS METAL ARC WELDING OR FLUX CORED ARC WELDING PROCESS.

7) FINISH:
   ALL EXPOSED SURFACES OF STRUCTURAL STEEL TO BE BRUSH–OFF BLAST CLEANED IN ACCORDANCE WITH SSPC–SP7. EXPOSED SURFACES OF STEEL SHALL BE DEFINED AS THOSE SURFACES SEEN FROM THE DECK OR FROM THE OUTSIDE AND BOTTOM OF THE STRUCTURE.

8) ALL BOLTED CONNECTIONS ARE CONSIDERED TO BE PRETENSIONED OR SLIP–CRITICAL CONNECTIONS. ALL BOLTS ARE TO BE PRETENSIONED PER THE REQUIREMENTS OF SECTION 8.2 OF THE SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH–STRENGTH BOLTS BY RCSC.

9) ALL BOLTS AND NUTS SHALL BE FURNISHED IN THE AMOUNT OF 5% IN EXCESS OF THE NUMBER REQUIRED FOR EACH SIZE AND LENGTH.

10) IF BOLTS DO NOT SMOOTHLY ENGAGE UP TO SNUG–TIGHT, THERE MAY BE AN OBSTRUCTION WITHIN THE THREADS. THE BOLT SHOULD BE REMOVED, THE THREADS ON THE BOLT AND NUT CLEANED AND RETAPPED IF NECESSARY TO ALLOW SMOOTH INSTALLATION OF THE BOLT. (IF APPLICABLE)

11) MAINTENANCE NOTE: DO NOT APPLY DE–ICING OR DUST PROHIBITIVE CHEMICALS OR SALTS TO ANY PART OF THE BRIDGE STRUCTURE.

12) SHOP SPLICES:
   a) ALL TOP AND BOTTOM CHORD SHOP SPLICES TO BE COMPLETE PENETRATION TYPE WELDS.
   b) ALL SAFETY RAIL SHOP SPLICES TO BE SEAL WELDS LOCATED AT CENTERLINE OF VERTICAL.
   c) ALL STRINGER SHOP SPLICES TO BE SEAL WELDS LOCATED OVER CENTERLINE OF FLOOR BEAM.

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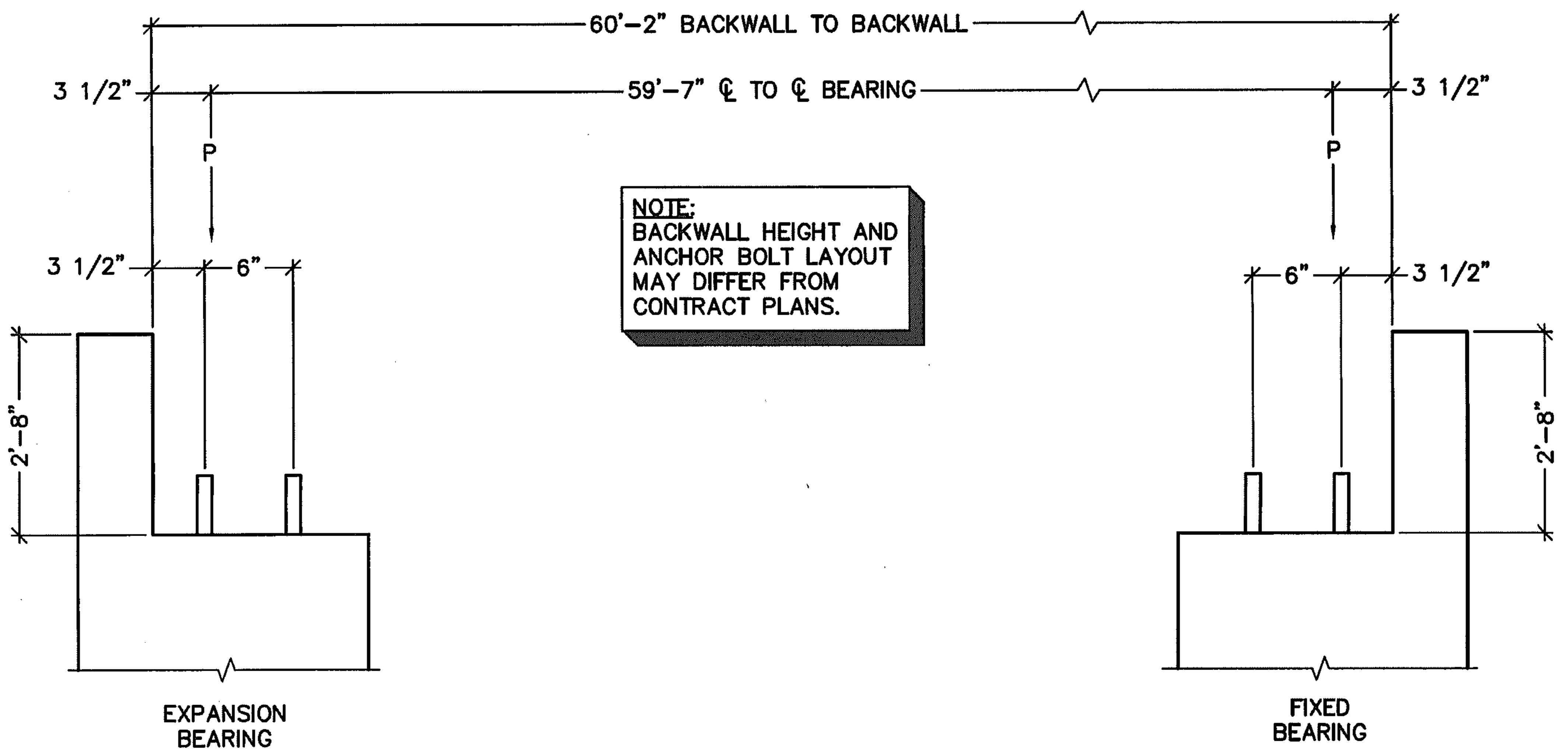
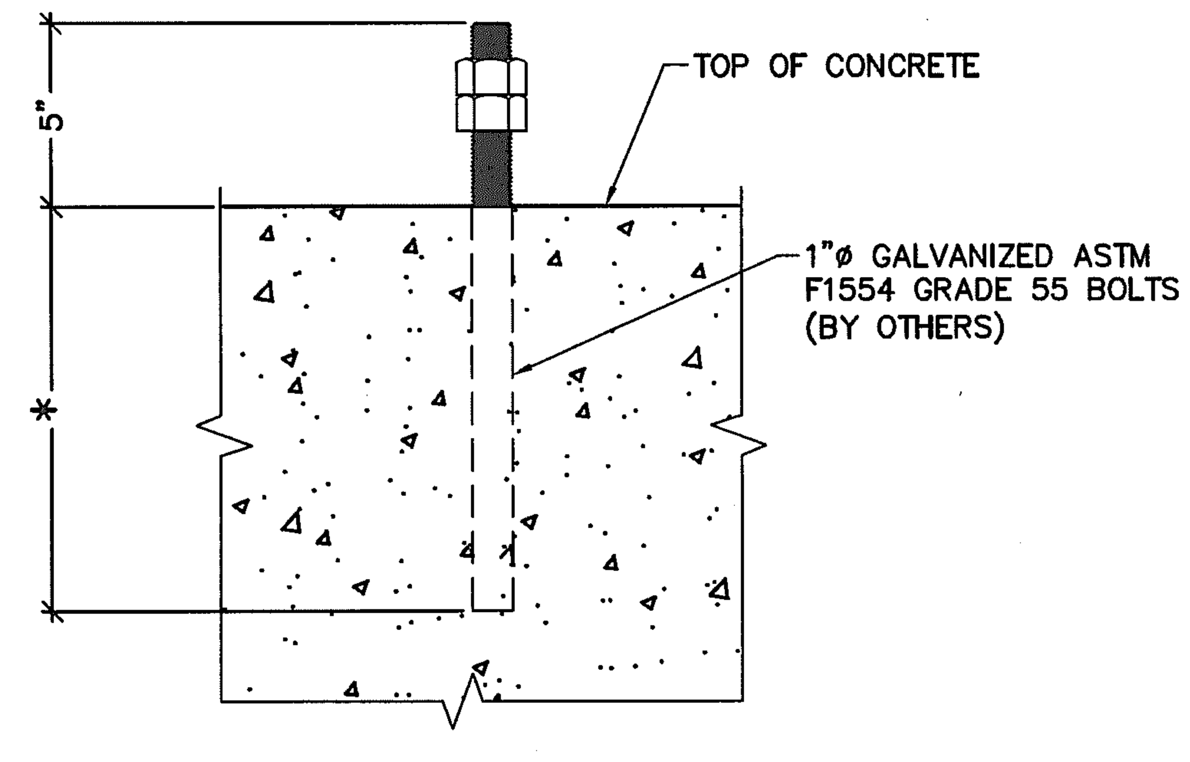


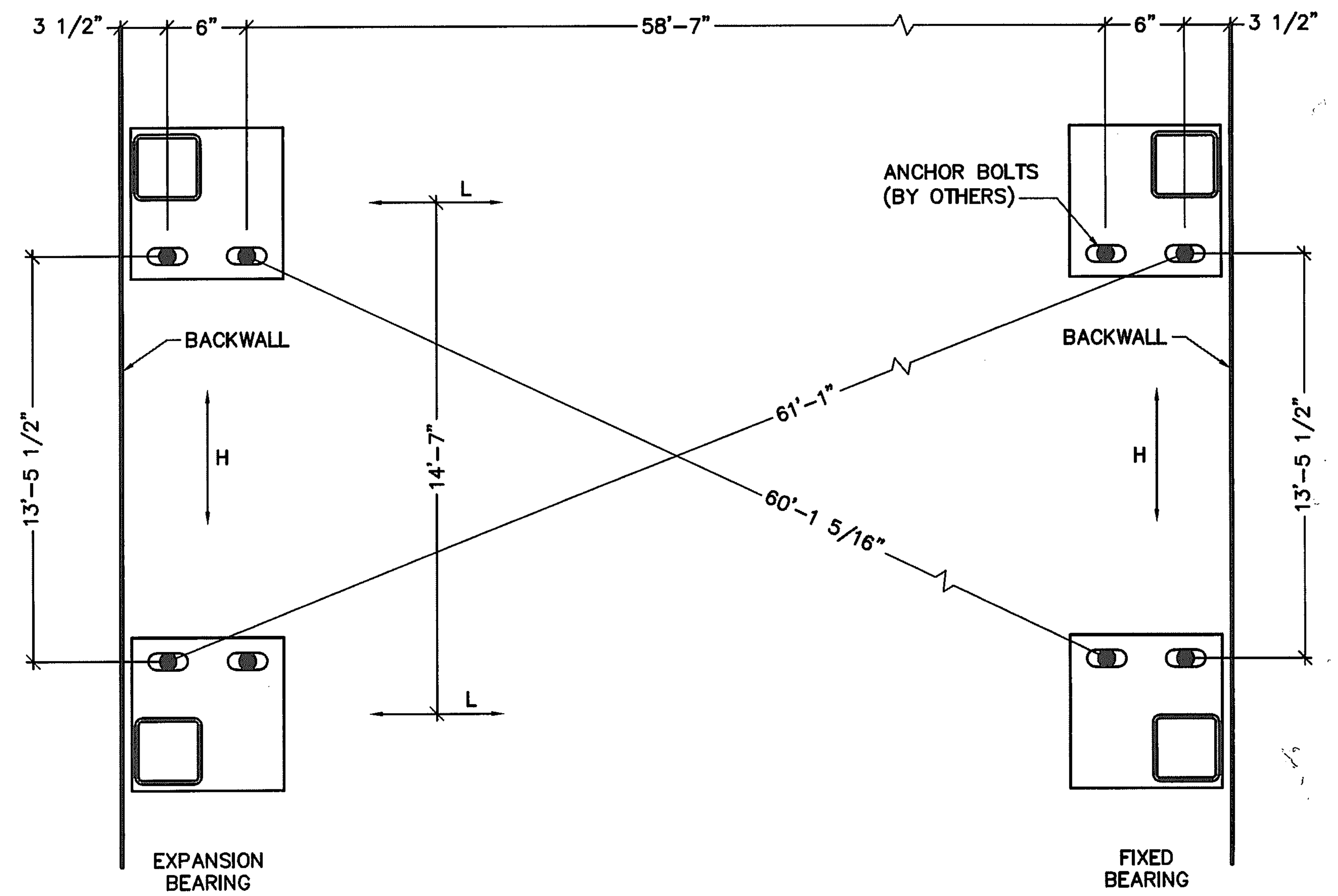

NOTE:
BACKWALL HEIGHT AND ANCHOR BOLT LAYOUT MAY DIFFER FROM CONTRACT PLANS.

ANCHOR BOLT ELEVATION LAYOUT




ANCHOR BOLT DETAIL

*NOTE:
ANCHOR BOLTS ARE DESIGNED BY BIG R BRIDGE FOR STEEL STRENGTH IN SHEAR AND TENSION OF THE ANCHOR BOLT ONLY. ALL DESIGN CONSIDERATIONS REGARDING CONCRETE BREAKOUT STRENGTH IN SHEAR AND TENSION, PULLOUT STRENGTH, CONCRETE SIDE-FACE BLOWOUT STRENGTH, CONCRETE PRYOUT STRENGTH, EMBEDMENT DEPTH, TYPE OF ANCHORAGE OR ANY OTHER CONCRETE FAILURE MODES ARE NOT CONSIDERED AND ARE NOT THE RESPONSIBILITY OF BIG R BRIDGE. IF LARGER DIAMETER BOLTS ARE REQUIRED TO MEET ANY OF THESE REQUIREMENTS, THAT INFORMATION MUST BE PROVIDED TO BIG R BRIDGE PRIOR TO BEGINNING ANY FABRICATION ON THE BRIDGE.




ANCHOR BOLT PLAN LAYOUT

| BRIDGE REACTIONS | P (LBS) | H (LBS) | L (LBS) |
|---|---|---|---|
| DEAD | 6,900 | | |
| LIVE (100 PSF) | 21,300 | | |
| VEHICLE (H10) | 12,400 | | |
| WIND (90 MPH) | ±2,000 | 8,300 | |
| OVERTURNING (20 PSF) | −6,400 | | |
| STREAM (9 FPS) | 2,400 | 10,100 | |
| SNOW (20 PSF) | 4,300 | | |
| SEISMIC | | 4,500 | 4,500 |
| THERMAL | | | 1,100 |

"P": FOUR PER BRIDGE
"H": TWO PER BRIDGE (ONE PER ABUTMENT)
"L": FOUR PER BRIDGE

| LIFTING WEIGHTS | | | |
|---|---|---|---|
| ITEM | QTY | UNIT WEIGHT (LBS) | TOTAL WEIGHT (LBS) |
| BRIDGE SECTION | 2 | 9,870 | 19,720 |
| | | | |
| LOOSE ITEMS | | – | 170 |
| | | * TOTAL BRIDGE WEIGHT: | 19,890 |

* FULL STRUCTURE NOT INCLUDING WEIGHT OF CONCRETE

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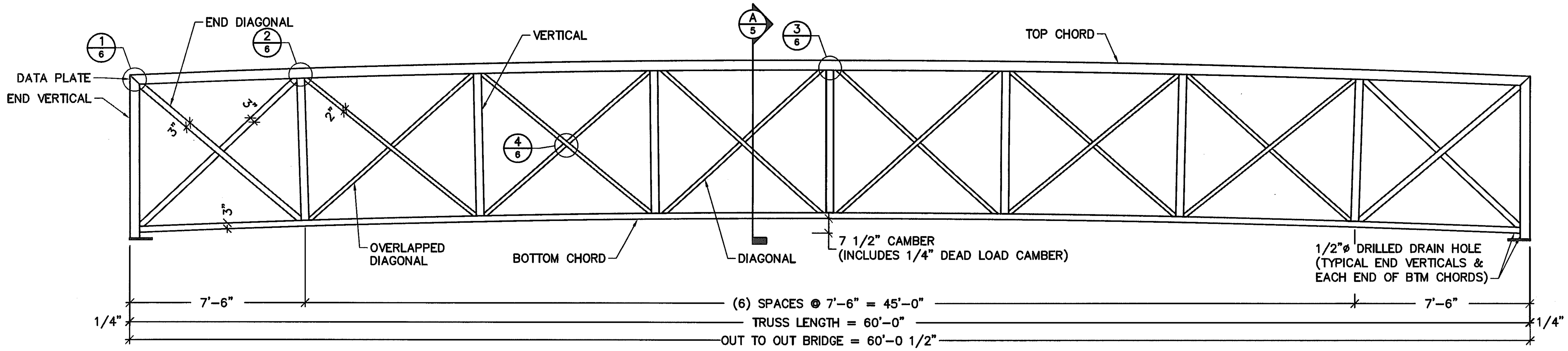
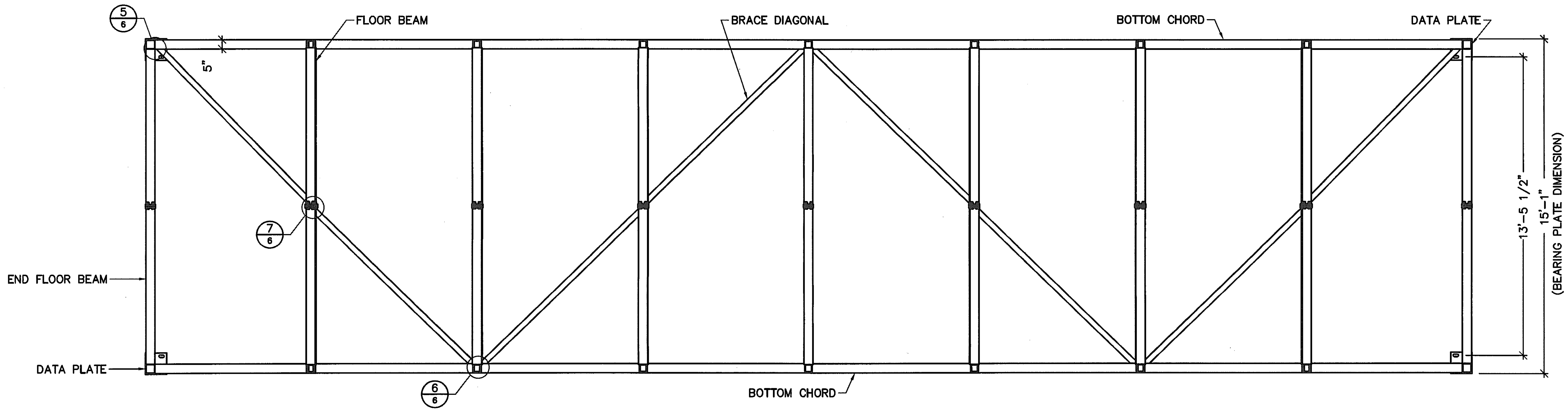



OUTSIDE ELEVATION




BOTTOM CHORD DETAIL

| MEMBERS | SIZE |
|---|---|
| TOP CHORD | HSS 5x5x1/4 |
| BOTTOM CHORD | HSS 5x3x1/4 |
| END VERTICAL | HSS 5x5x1/4 |
| VERTICAL | HSS 4x4x1/4 |
| END DIAGONAL | HSS 4x3x1/4 |
| DIAGONAL | HSS 3x2x1/4 |
| BRACE DIAGONAL | HSS 3x3x1/4 |
| END FLOOR BEAM | W 14x22 |

| MEMBERS | SIZE |
|---|---|
| FLOOR BEAM | W 14x22 |
| STRINGER | HSS 5x3x1/4 |
| END DAM | PL 1/4"x 6" |
| VERTICAL PICKETS | L 1 1/2x1 1/2x1/8 |
| TOP PICKET RAIL | HSS 1 1/2x1 1/2x3/16 |
| TOE PLATE | C5x6.7 |

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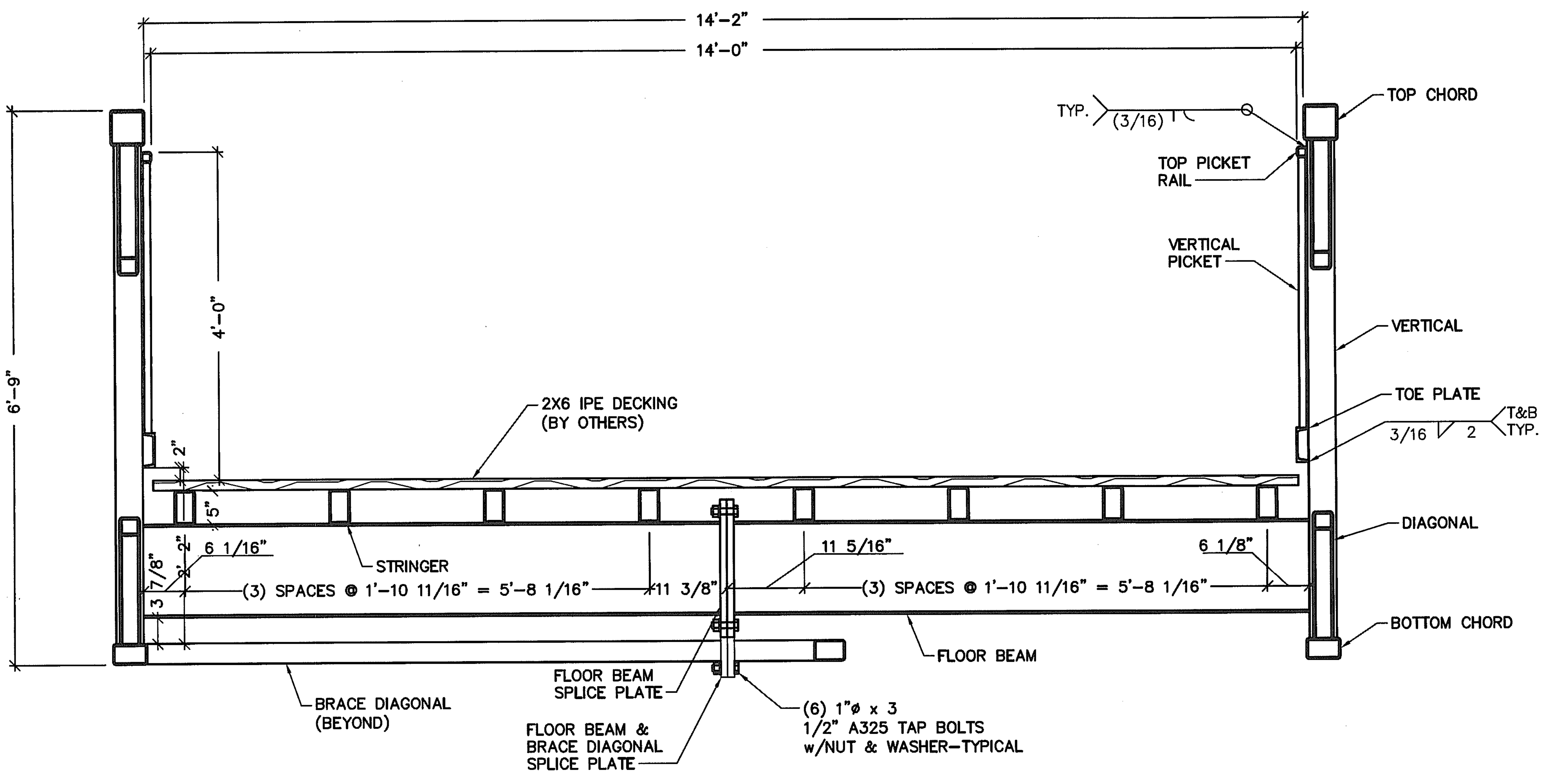


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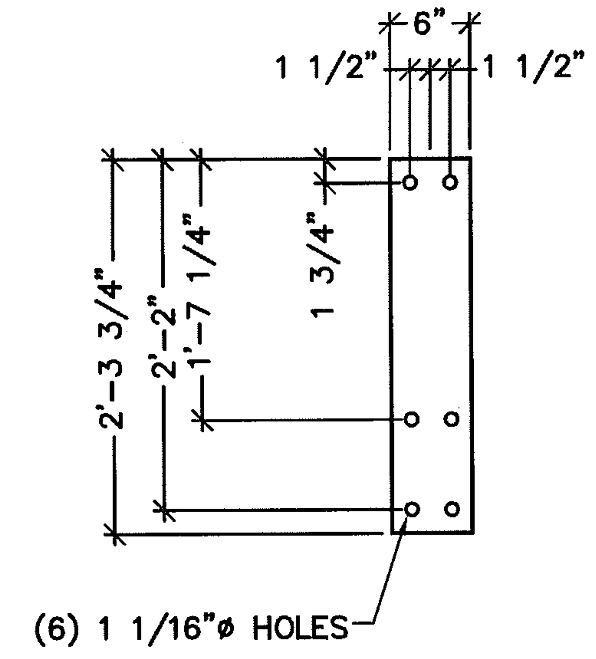
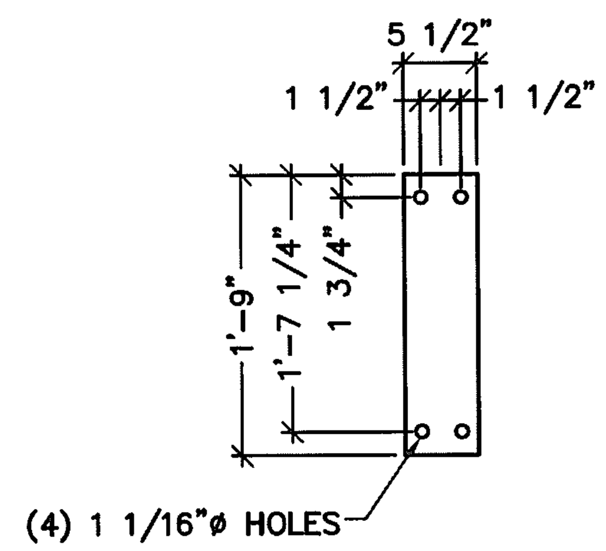
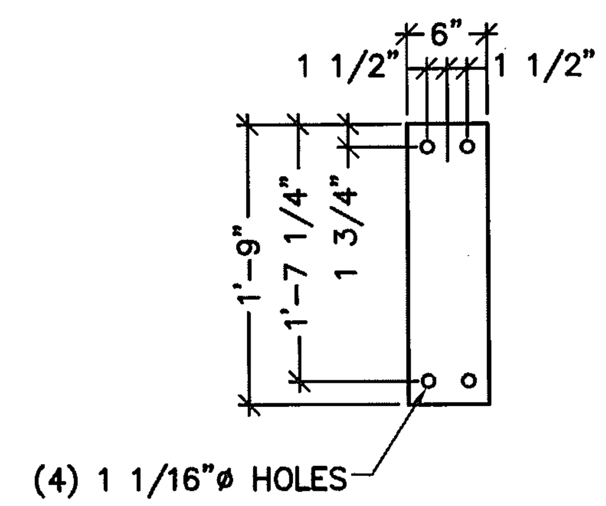


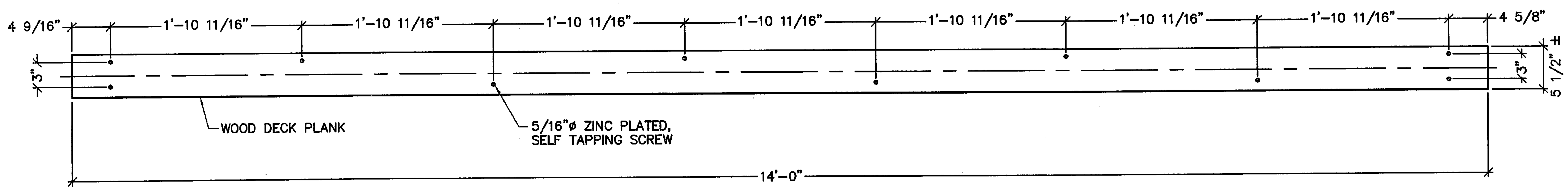

(PL 1")
FLOOR BEAM & BRACE DIAGONAL SPLICE PLATE DETAIL




(PL 1")
END FLOOR BEAM SPLICE PLATE DETAIL




(PL 1")
FLOOR BEAM SPLICE PLATE DETAIL




WOOD DECK FASTENING DETAIL (DECK BY OTHERS)

(131 PLANKS REQUIRED)

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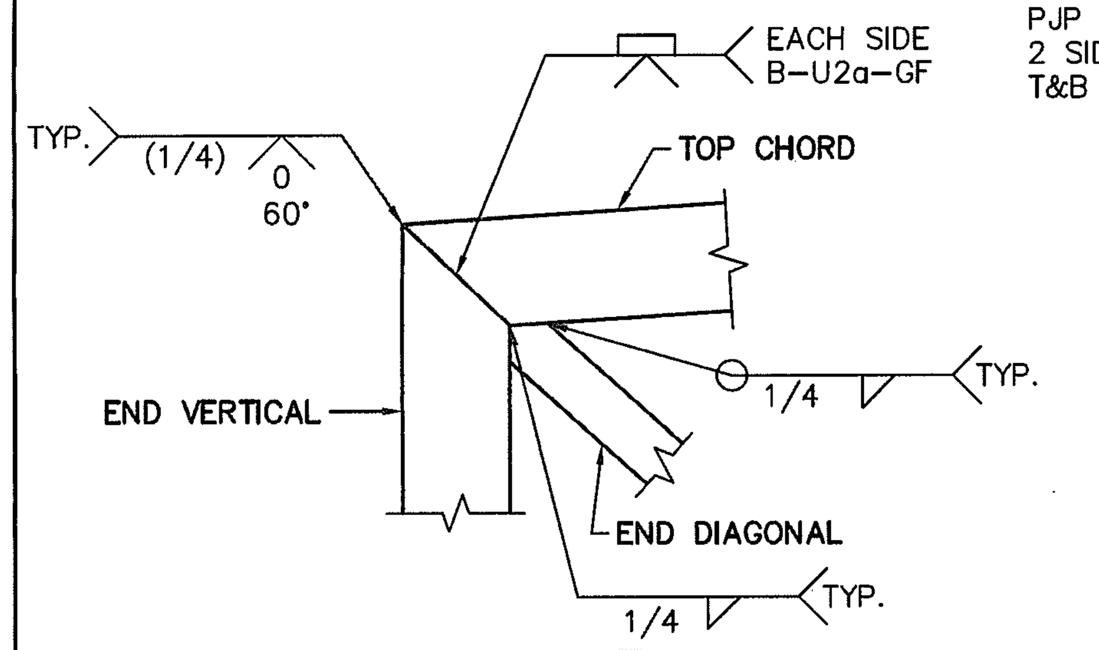


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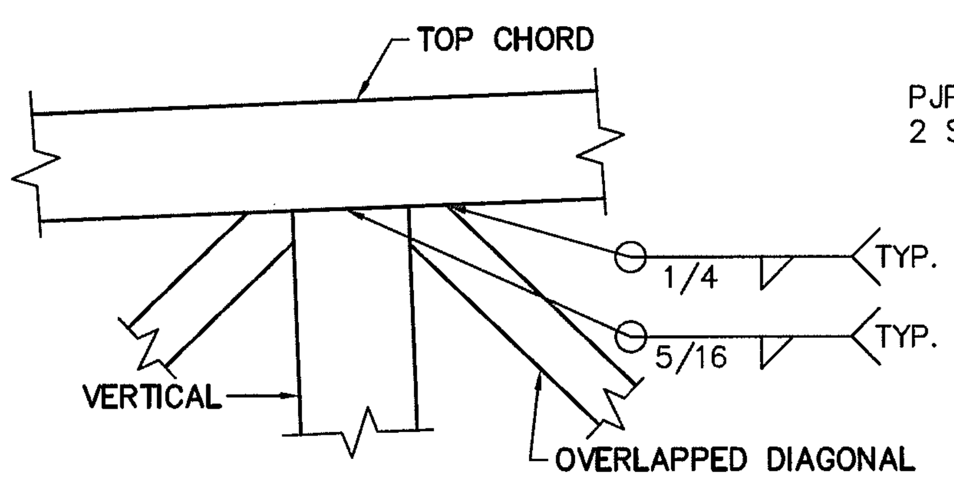


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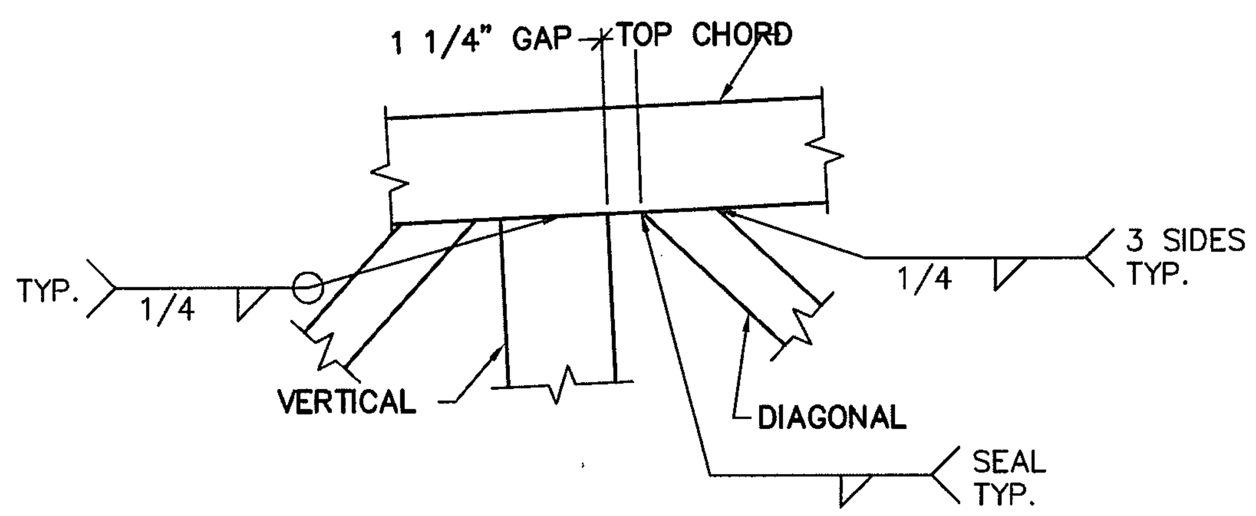


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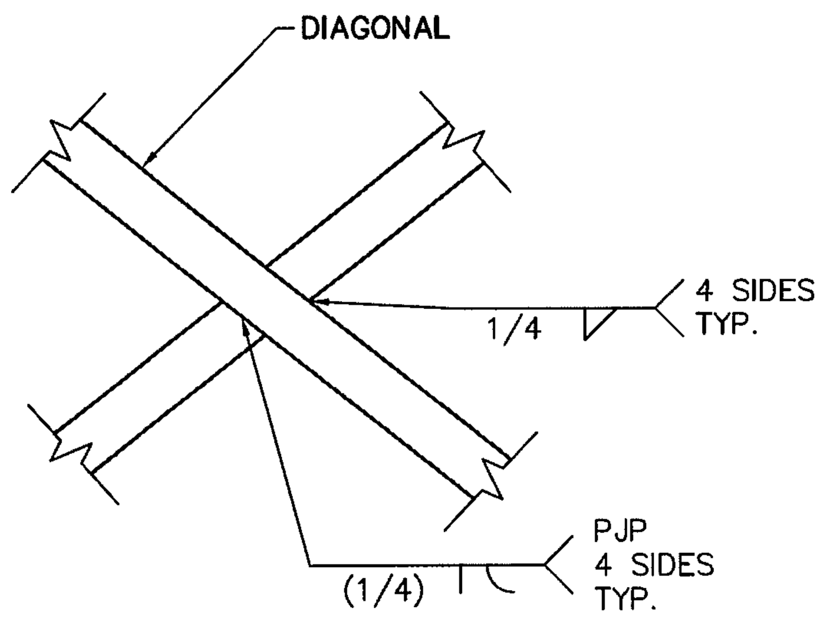


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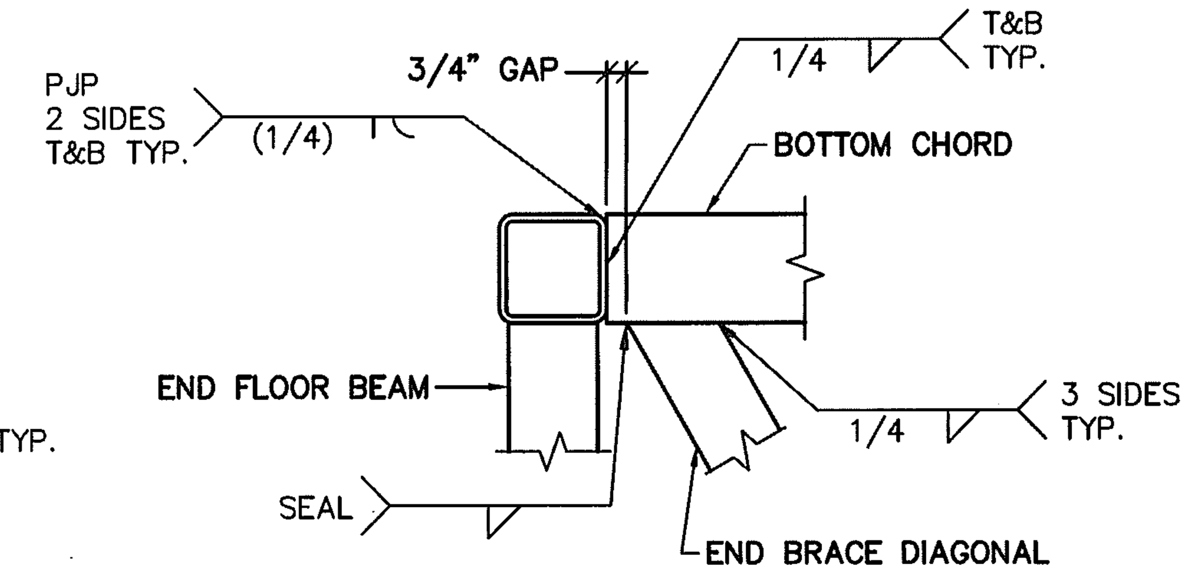


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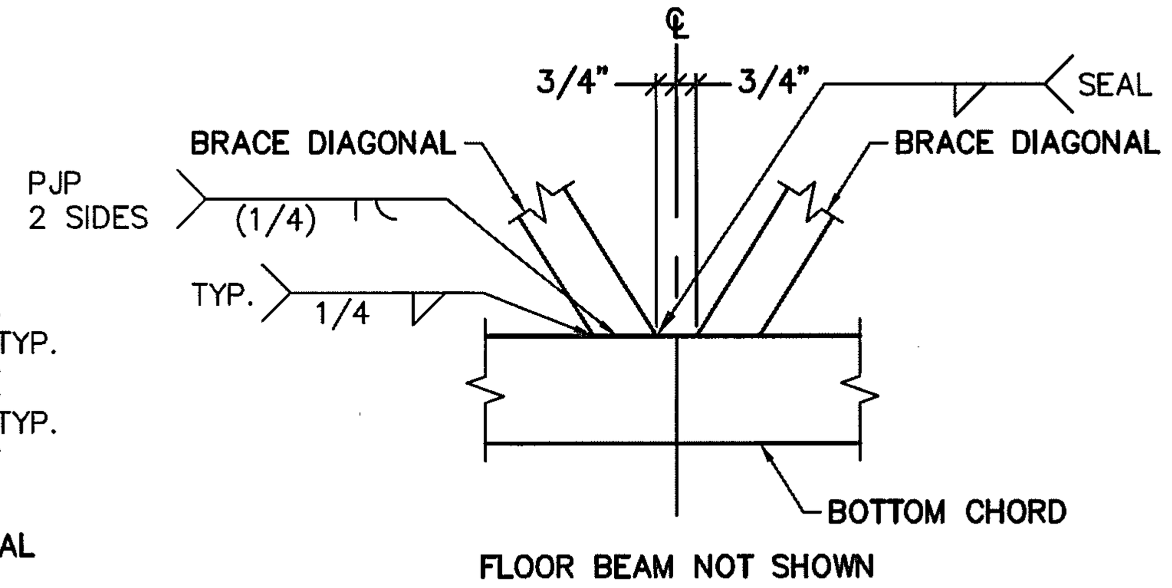


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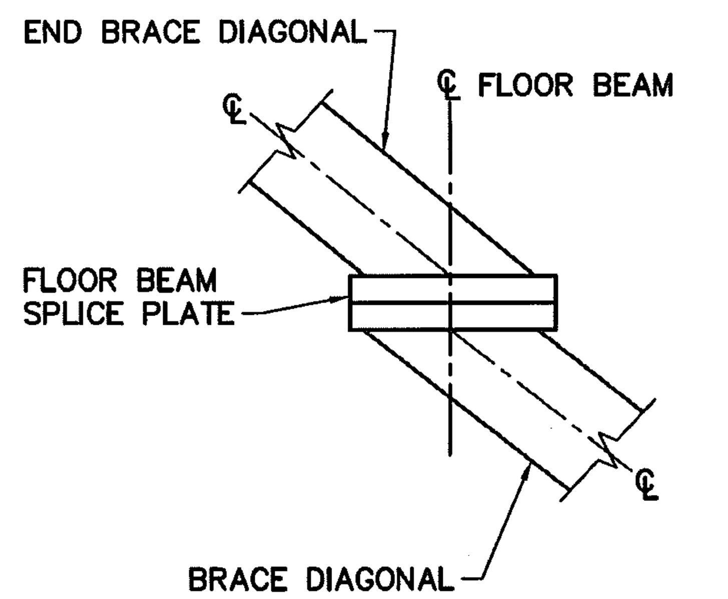


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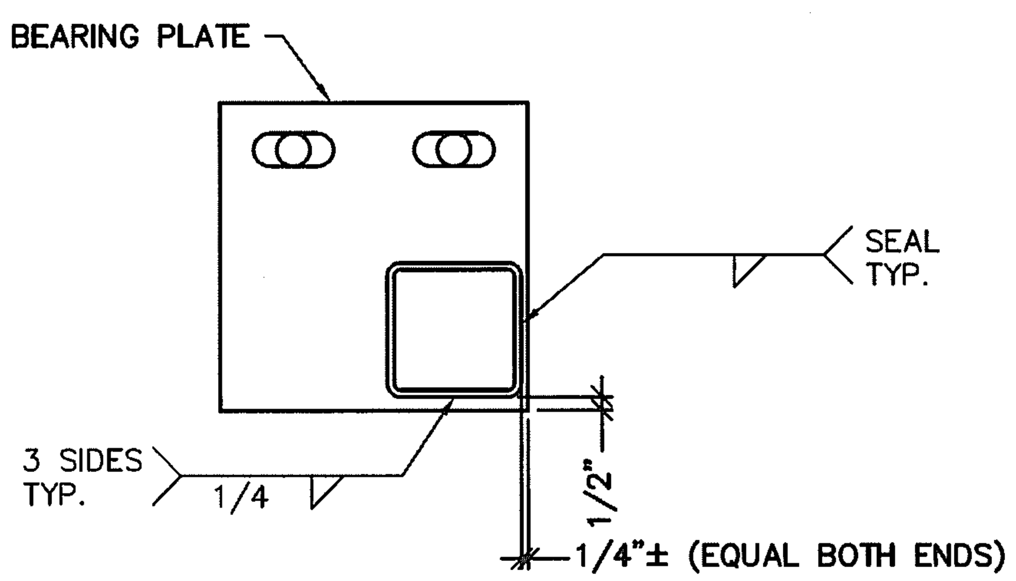
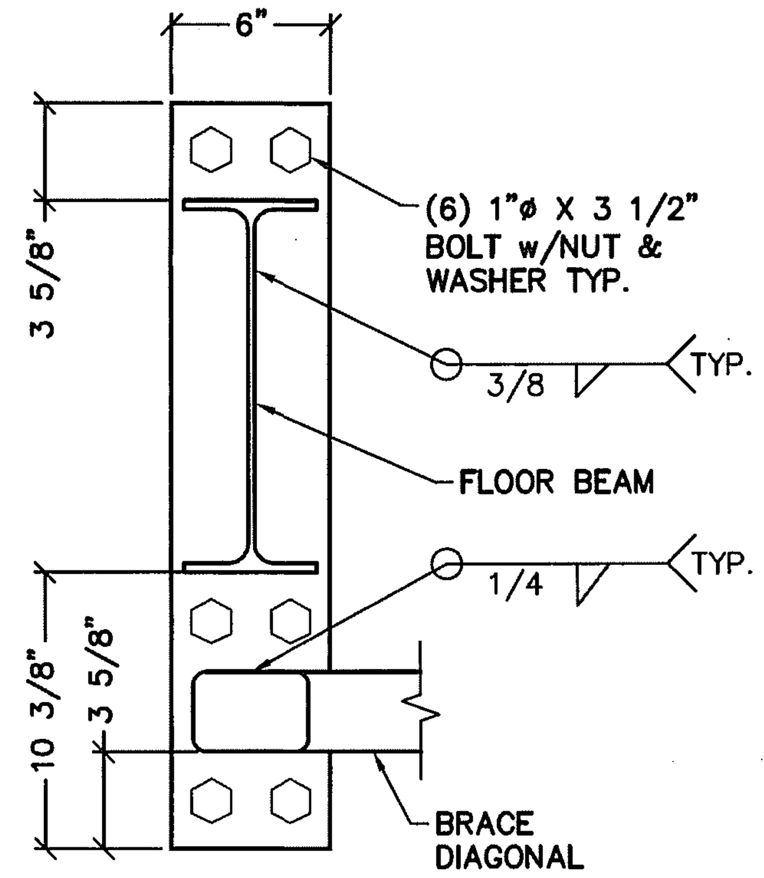
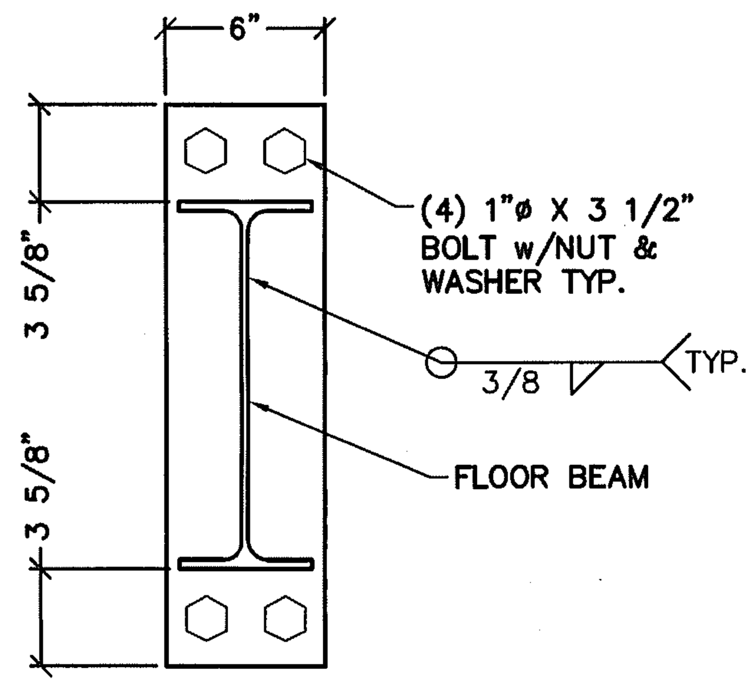


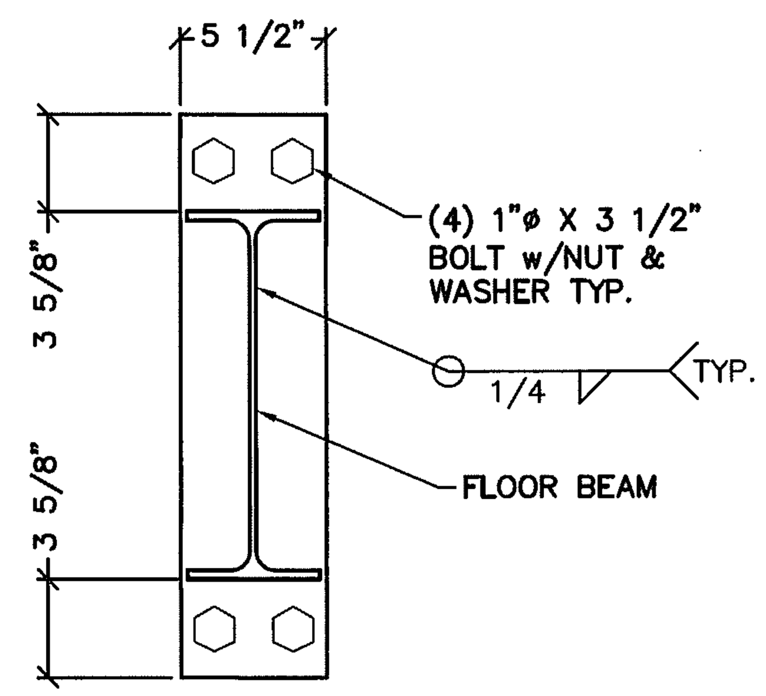

END VERTICAL WELD DETAIL



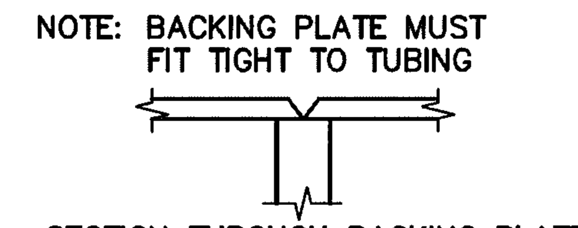

FLOOR BEAM &
BRACE DIAGONAL
SPLICE PLATE DETAIL



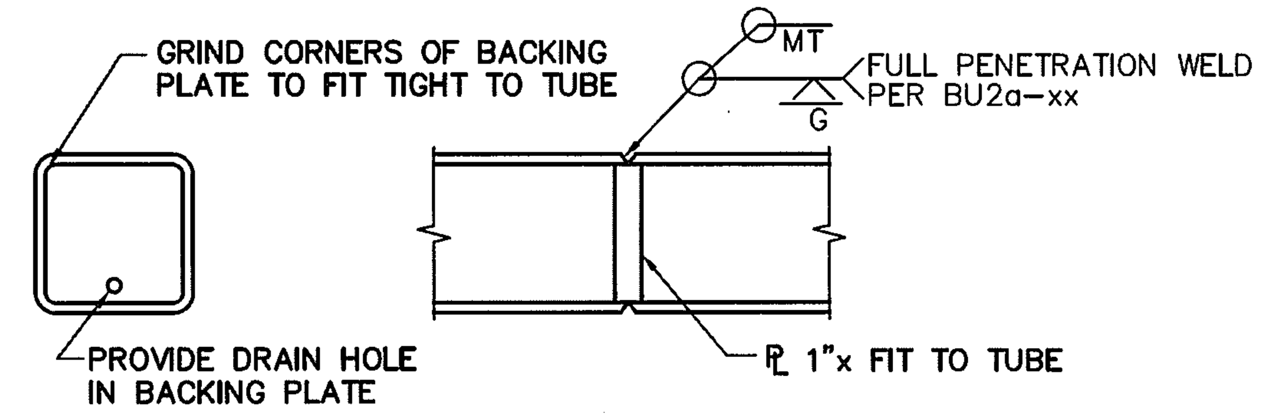

FLOOR BEAM
SPLICE PLATE DETAIL



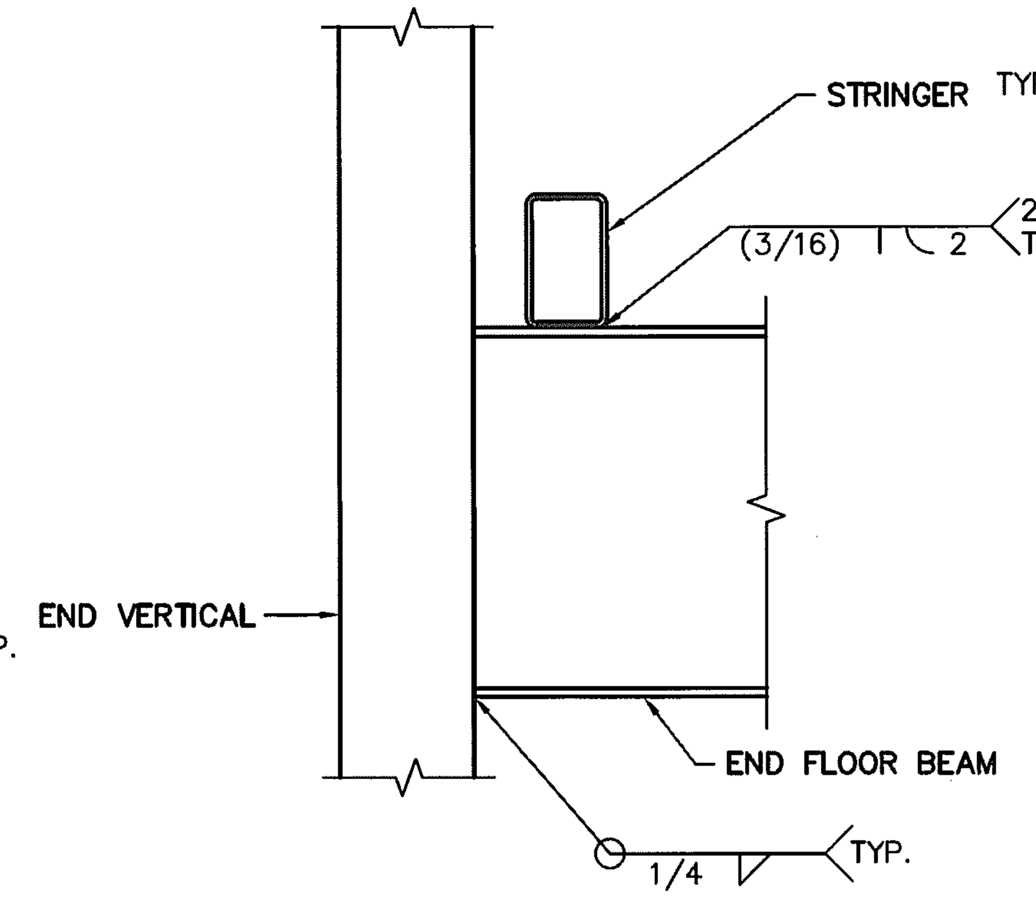

END FLOOR BEAM
SPLICE PLATE DETAIL



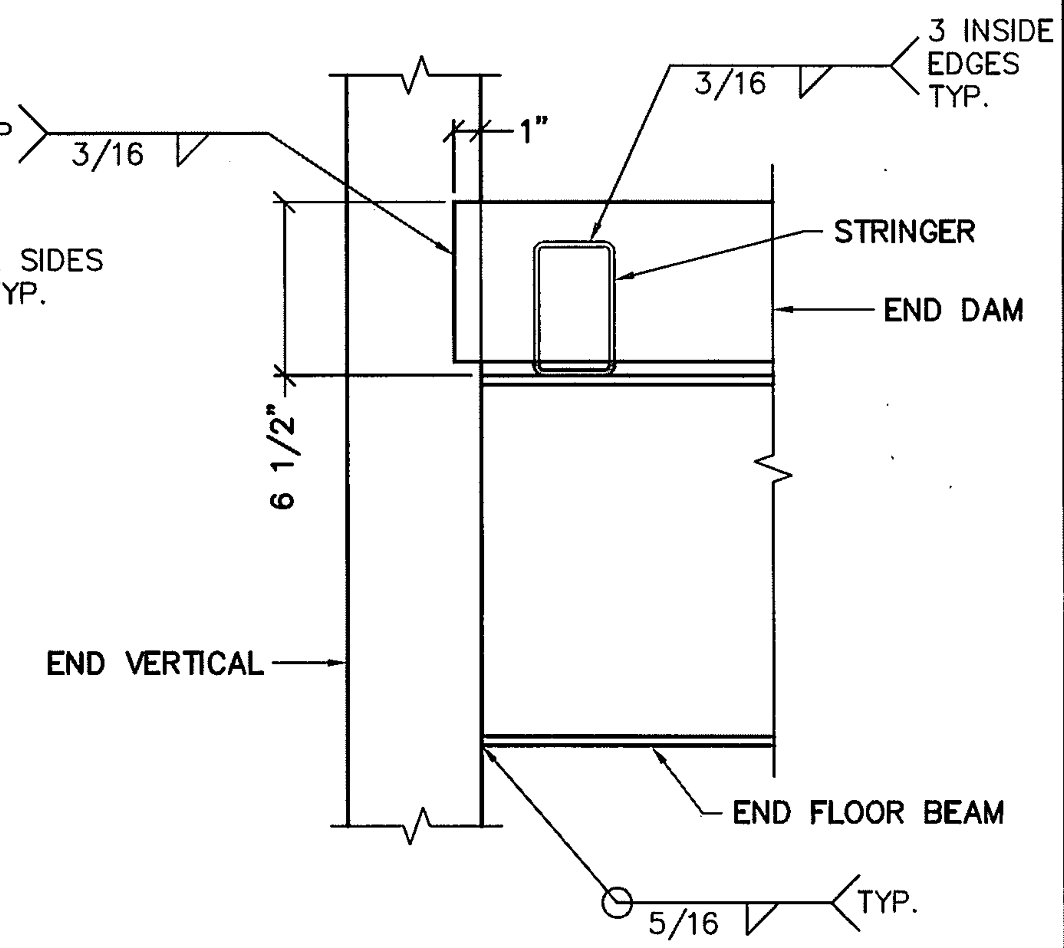

SECTION THROUGH BACKING PLATE




TYPICAL SHOP SPLICE DETAIL




FLOOR BEAM WELD DETAIL




END FLOOR BEAM WELD DETAIL

| Index | Description | Author | Date |
|---|---|---|---|
| 3 | WELD DETAIL MOVED | RAR | 10/17/2016 |

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BIG R
BRIDGE
P.O. Box 1290 · Greeley, Colorado 80632-1290
(970) 356-9600 · Fax:(970) 356-9621 · www.bigrbridge.com

# 60'-0" x 14'-2"

## LIBERTY BELL TRAIL PEDESTRIAN BRIDGE

BURKE, VA

DELTA MARINE CONSTRUCTION

COMMONWEALTH OF VIRGINIA
MICHAEL WILLIAM PHILPOT
Lic. No.56343
PROFESSIONAL ENGINEER
10/31/16

| BR16-00372 |
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| DRAWN BY<br>RAR |
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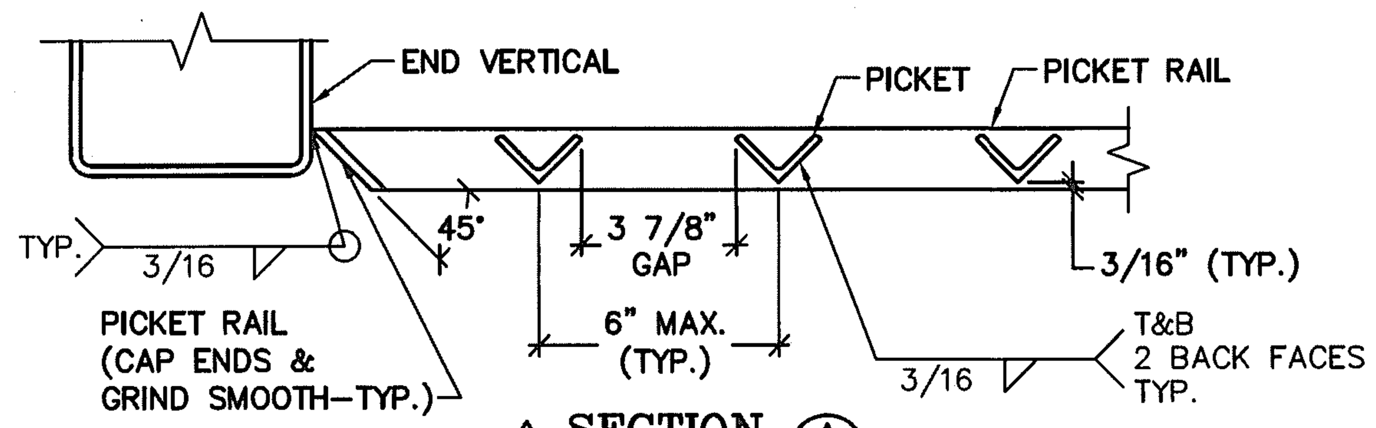
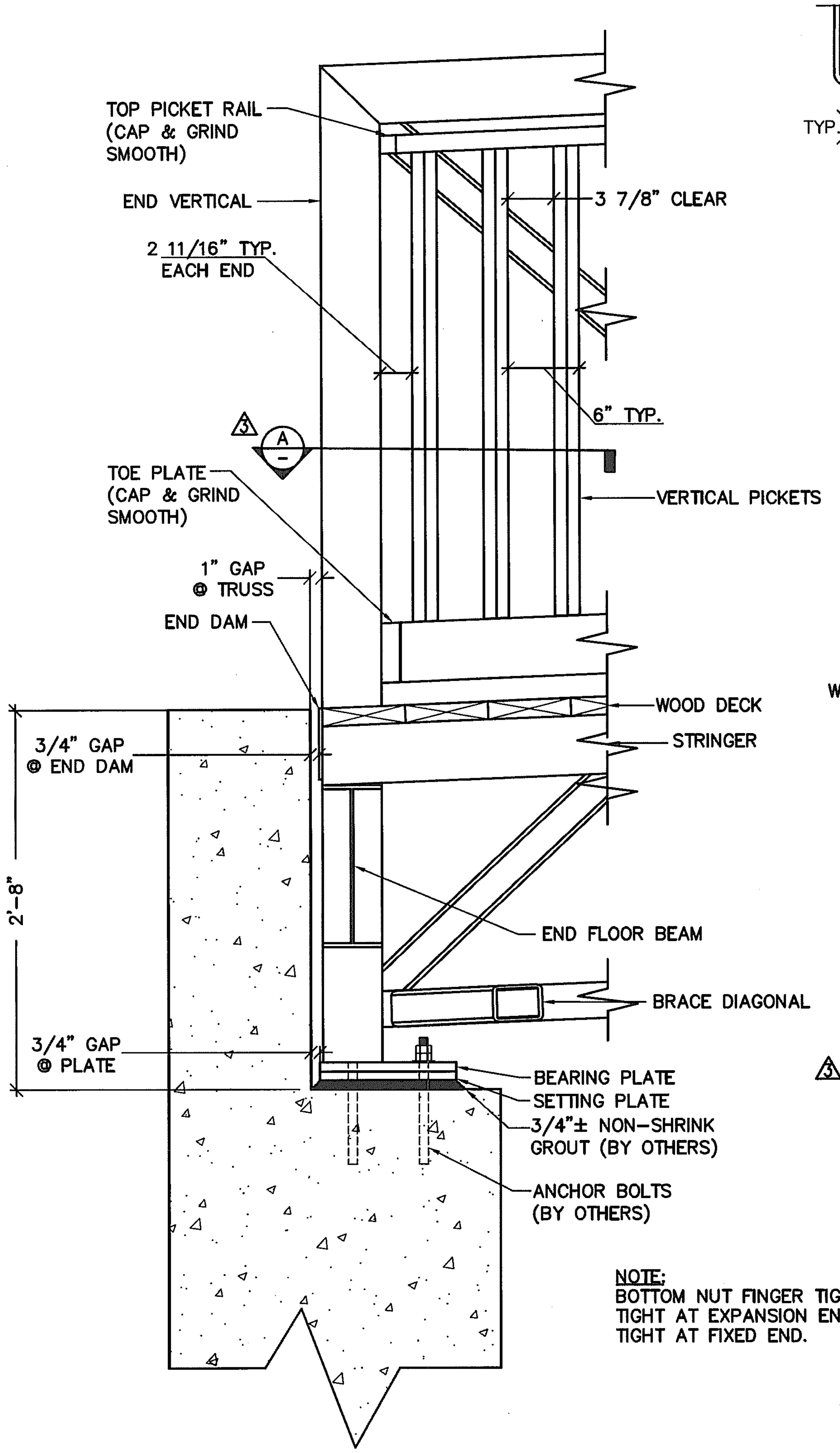
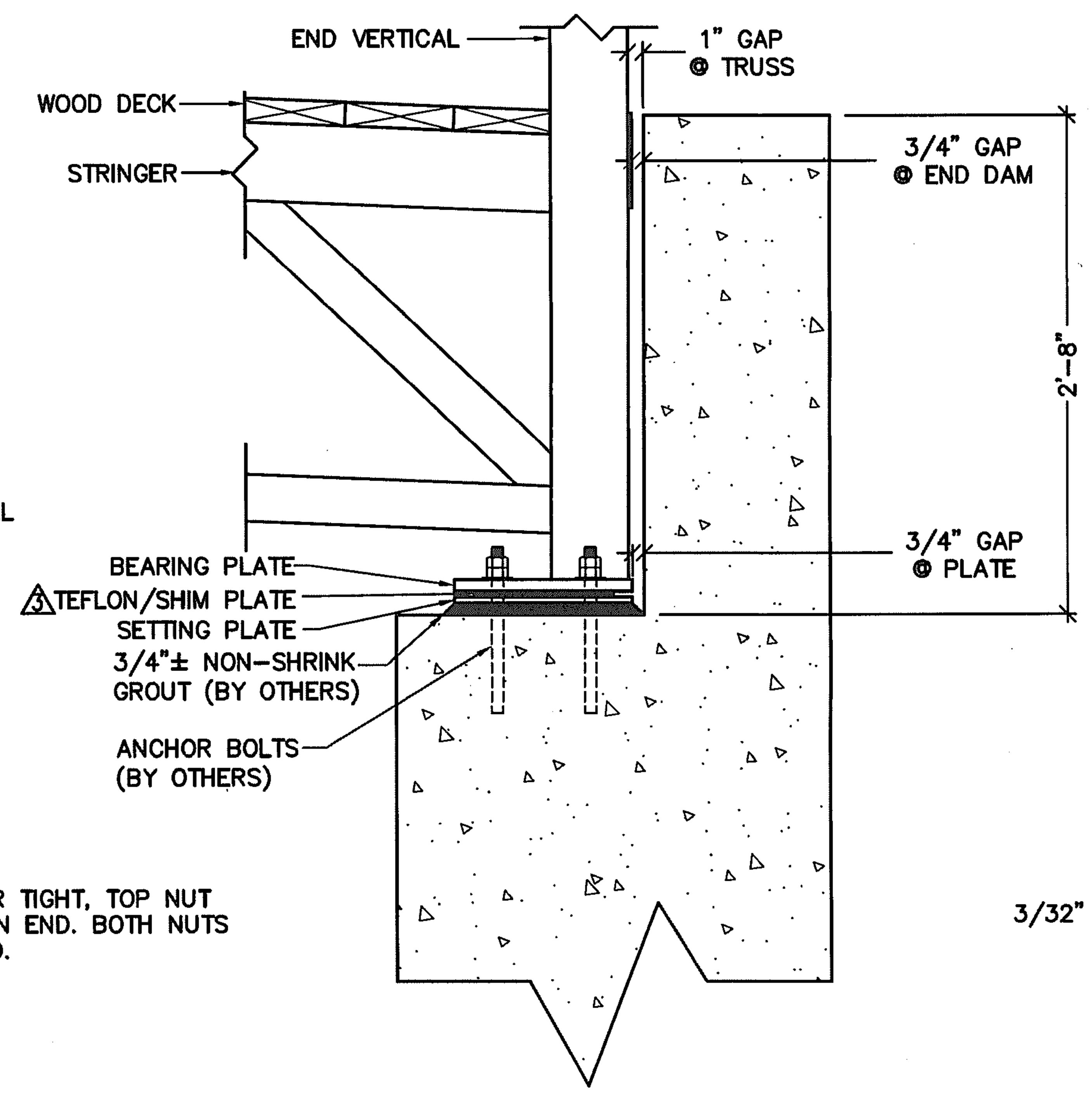



SECTION A

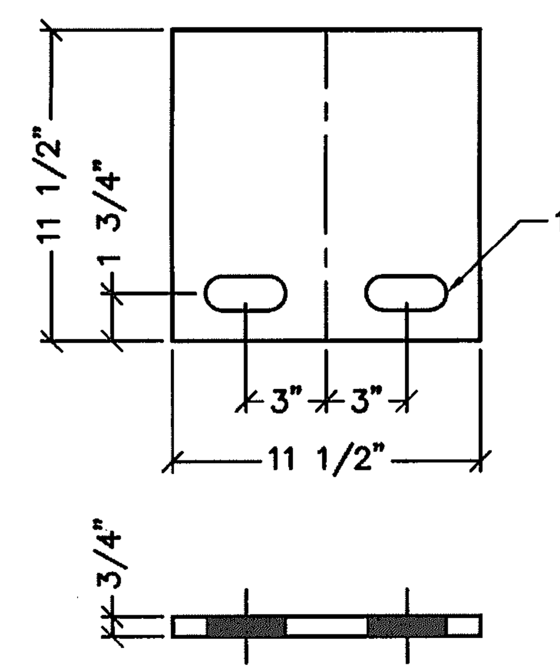



INSIDE ELEVATION
(FIXED)

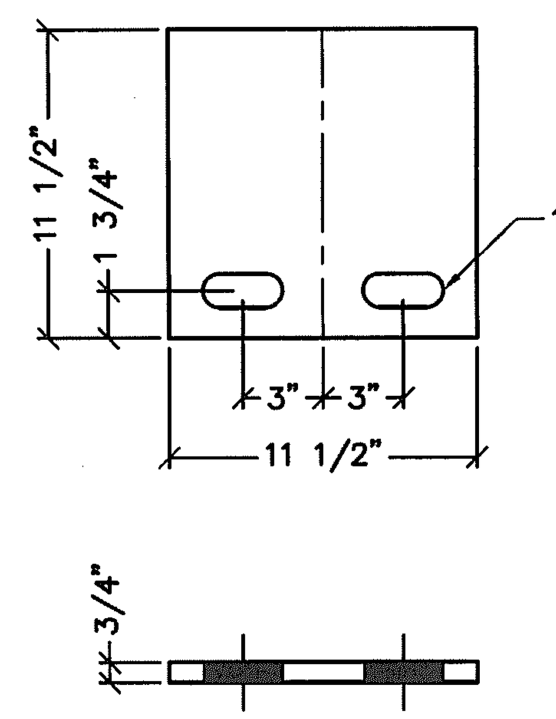
NOTE:
BOTTOM NUT FINGER TIGHT, TOP NUT TIGHT AT EXPANSION END. BOTH NUTS TIGHT AT FIXED END.



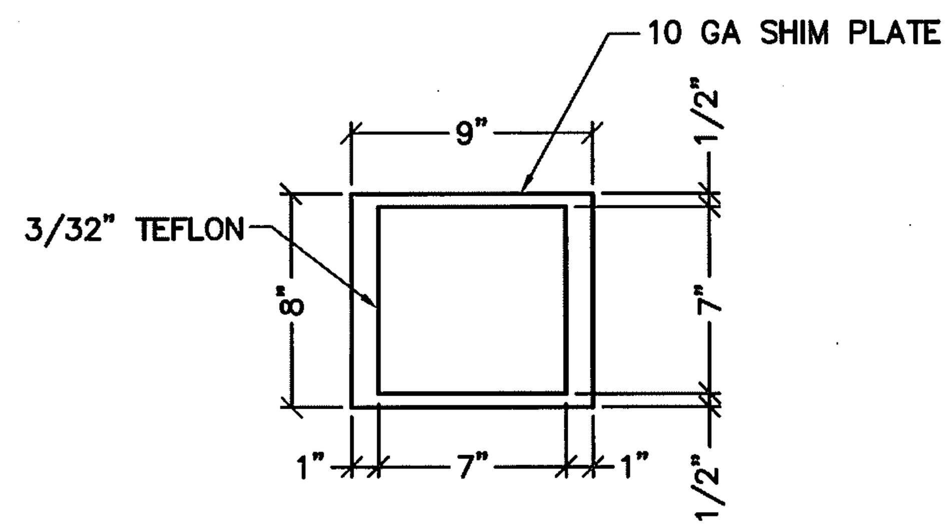

OUTSIDE ELEVATION
(EXPANSION)



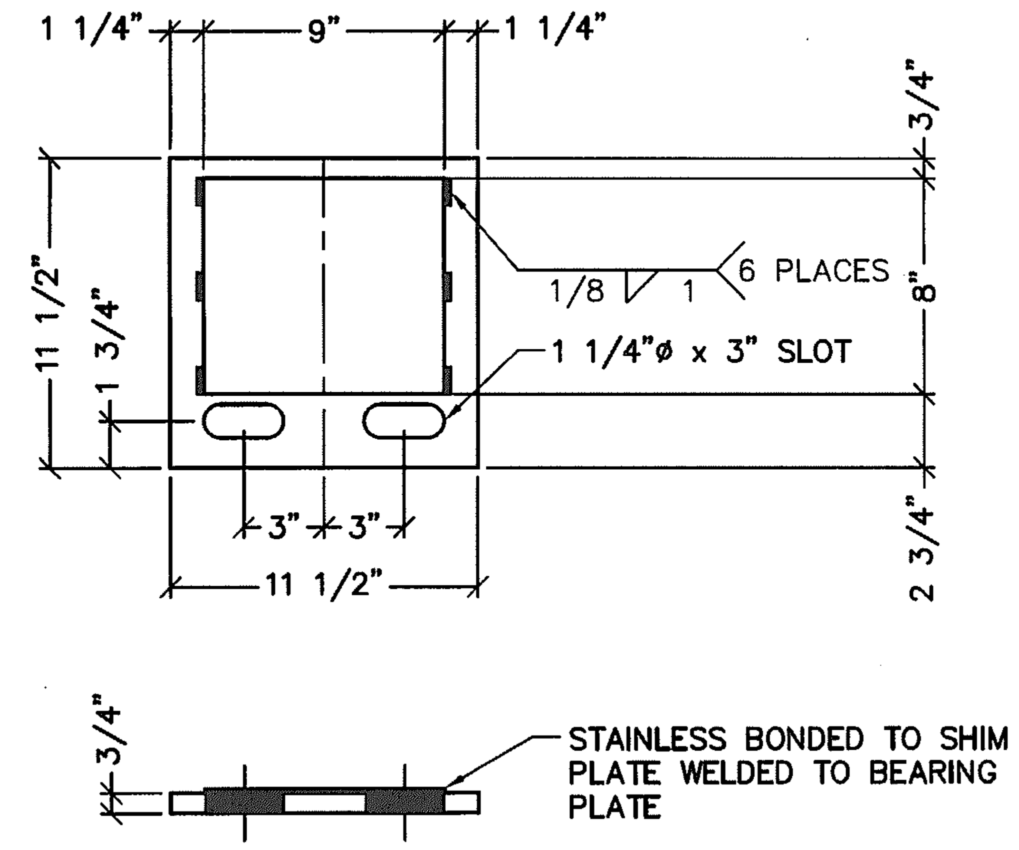

FIXED END BEARING PLATE
(2) REQUIRED



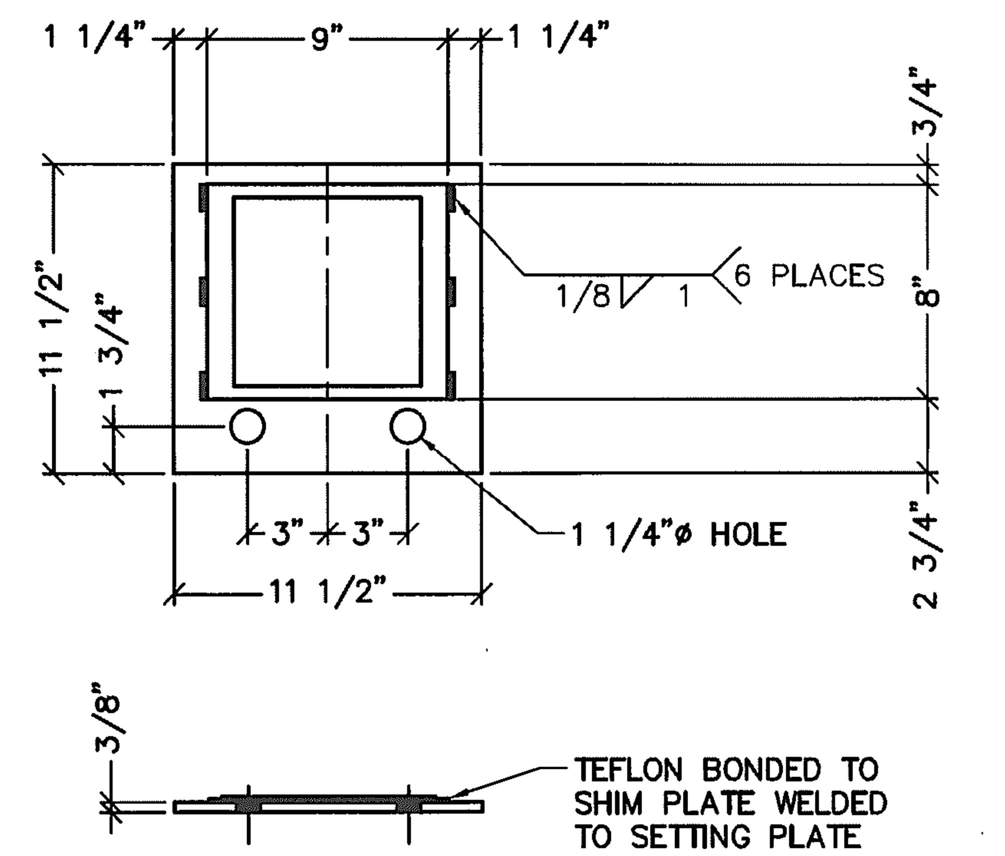

FIXED END SETTING PLATE
(2) REQUIRED




TEFLON/SHIM PLATE LAYOUT
(2) REQUIRED




EXPANSION END BEARING PLATE
(2) REQUIRED




EXPANSION END SETTING PLATE
(2) REQUIRED

| Index | Description | Author | Date |
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| 3 | WELD DETAIL MOVED | RAR | 10/17/2016 |

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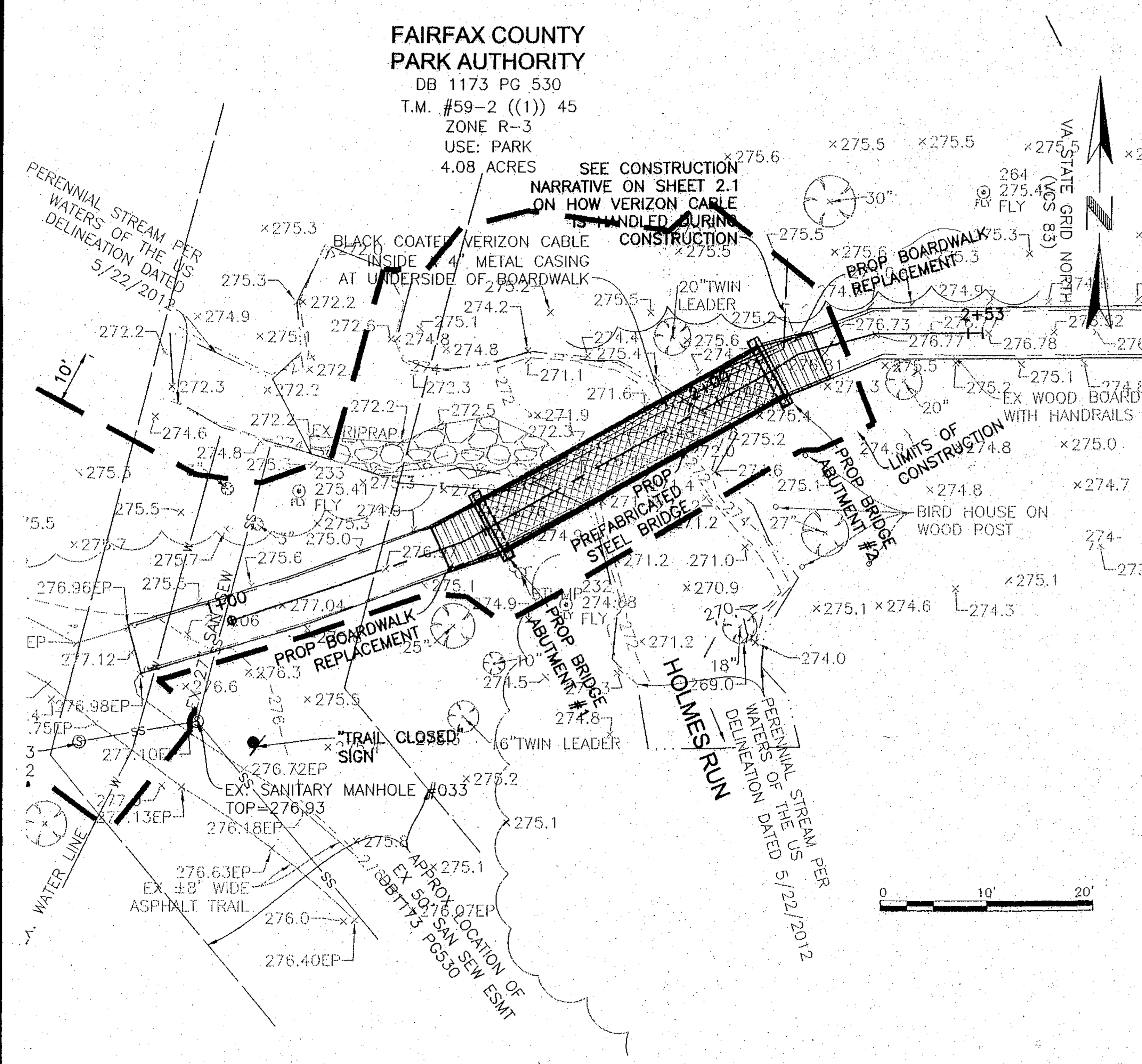
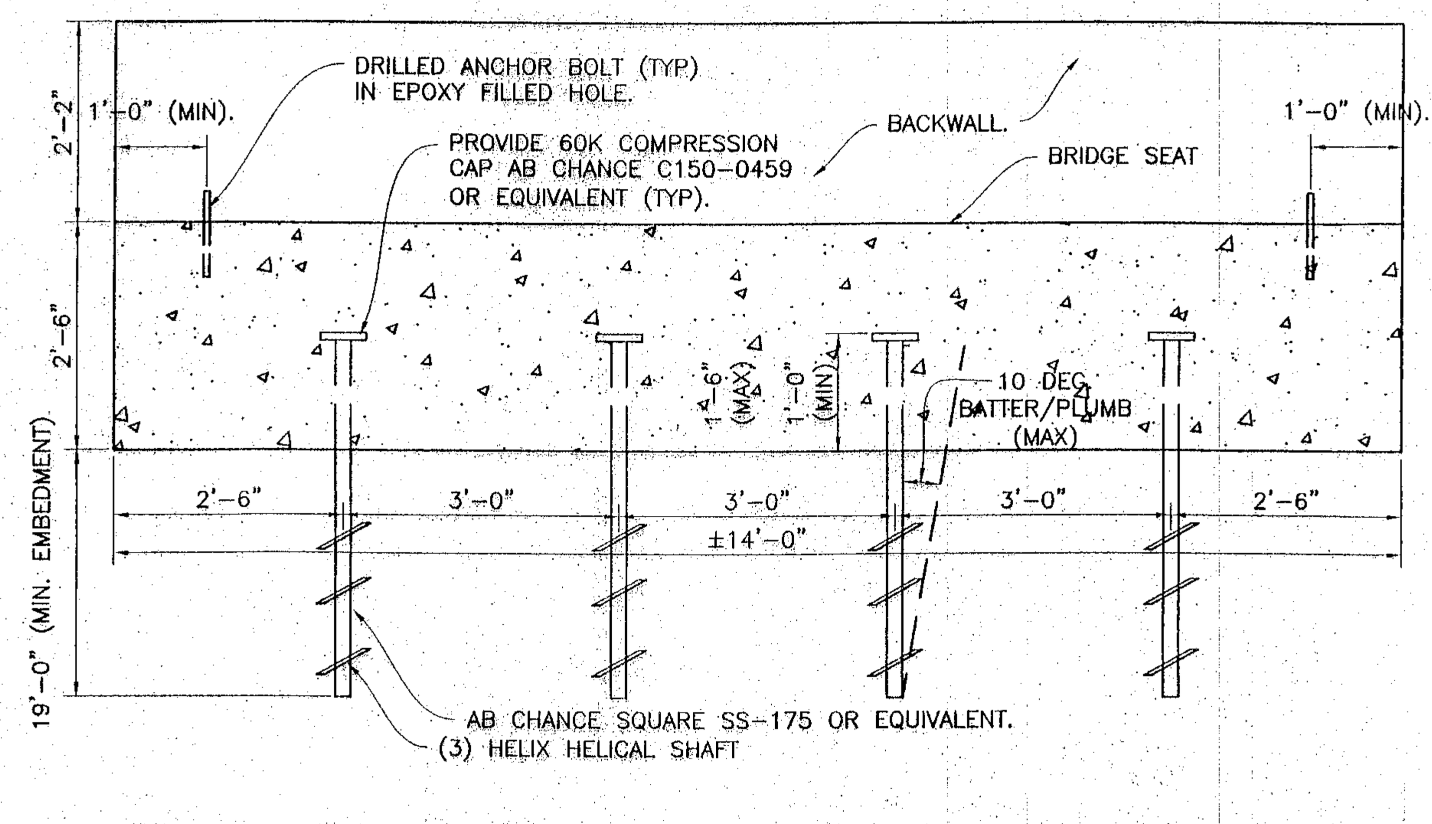
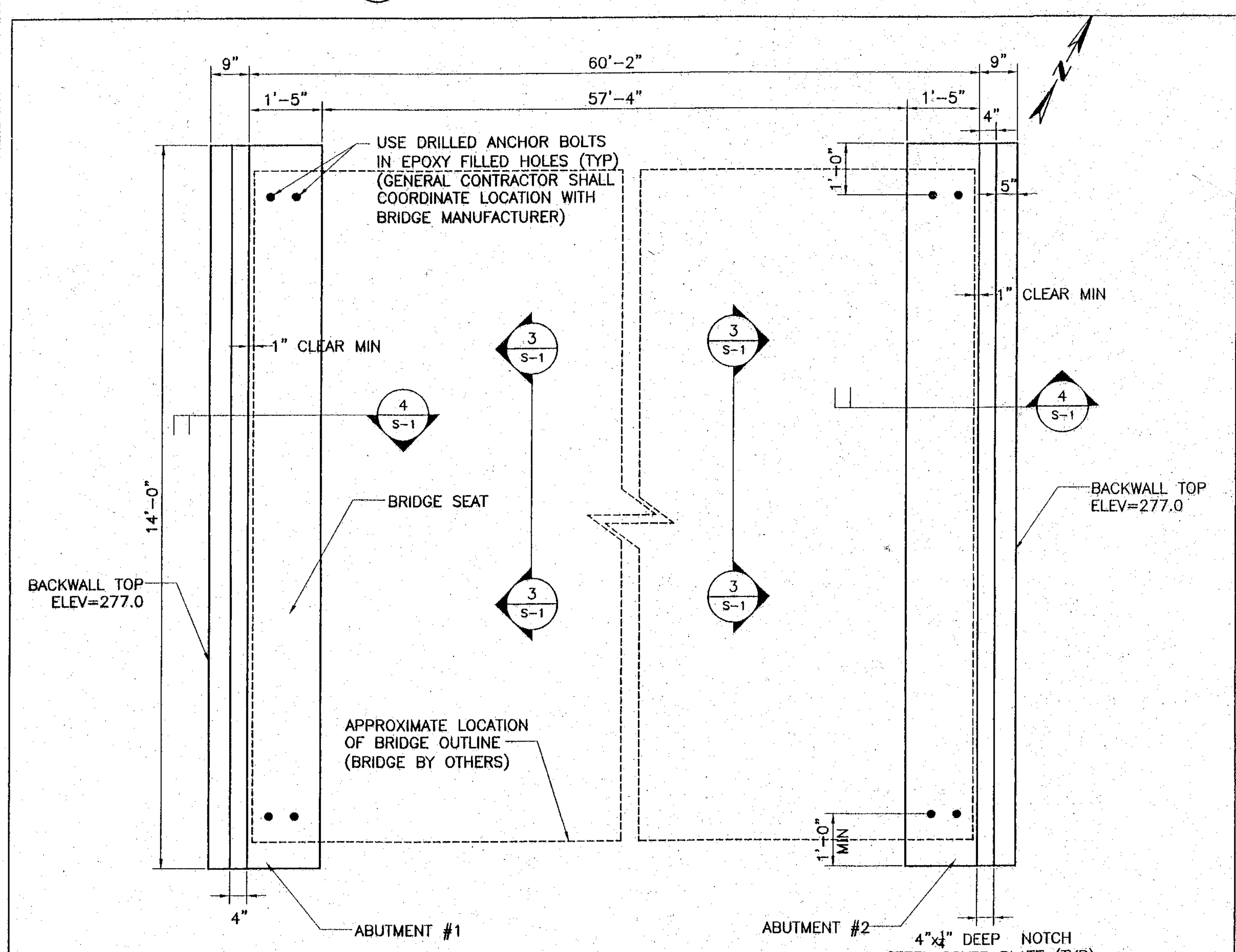


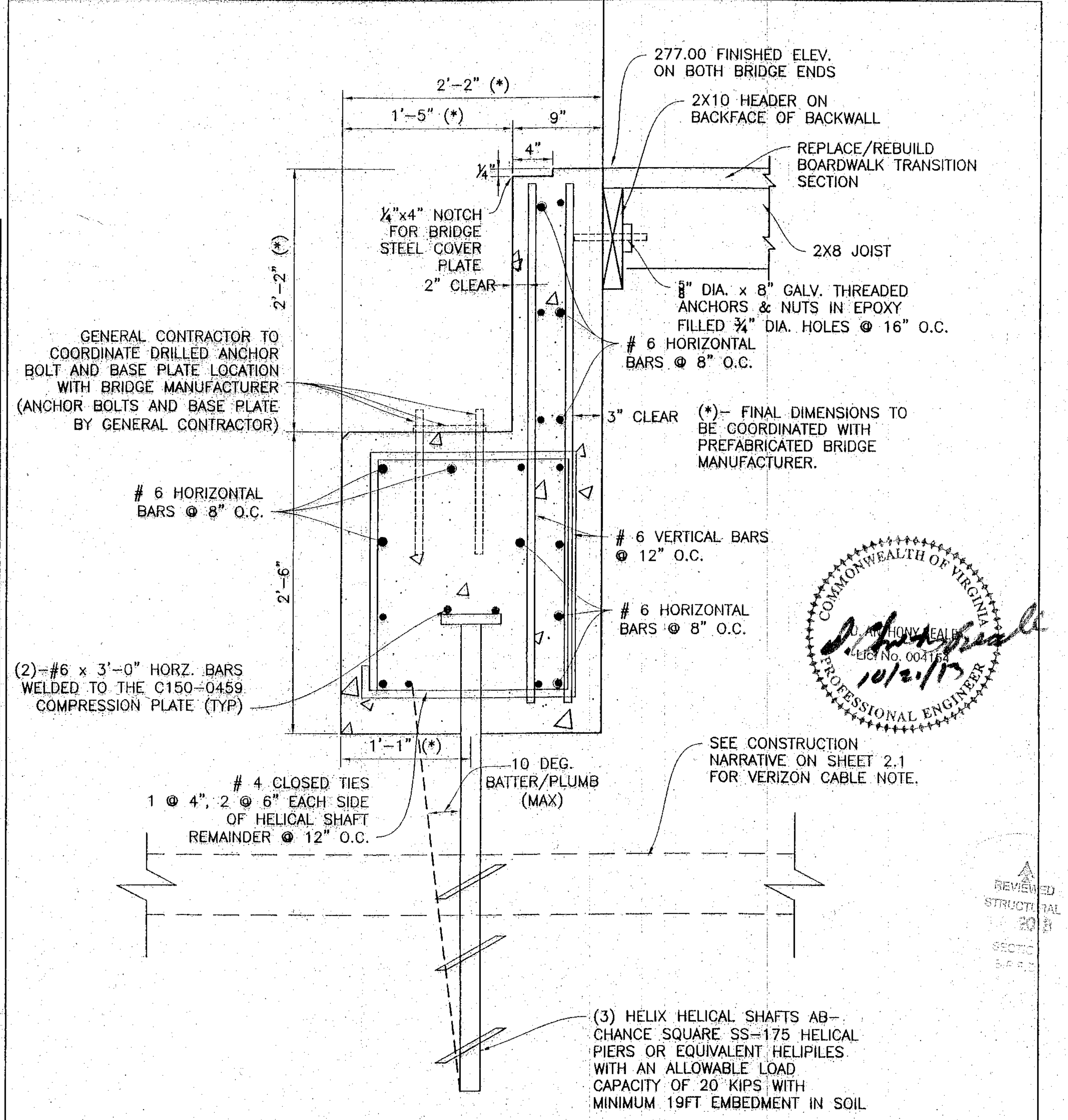

1 S1 BRIDGE LOCATION PLAN
SCALE: 1" = 20'-0"




3 S1 ELEVATION OF BRIDGE ABUTMENT
SCALE: N.T.S.




2 S1 PLAN BRIDGE ABUTMENT SIZE & LOCATION
SCALE: 1" = 2'-0"




4 S1 SECTION OF BRIDGE ABUTMENT AT BRIDGE BEARING
SCALE: N.T.S.

# STRUCTURAL NOTES FOR ABUTMENTS AND BOARDWALK FOOTINGS:

## DESIGN LOADS:

CODE: VUSBC, 2009 INTERNATIONAL BUILDING CODE

BRIDGE DECK: 50 PSF DEAD LOAD
100 PSF LIVE LOAD
OR
50 PSF DEAD LOAD
10,000 lbs VEHICULAR LOAD W/ IMPACT (AASHTO H5)

WIND: WIND SPEED (3 SEC GUST) = 90 MPH
USE 30 PSF ON VERTICAL SURFACE AS THOUGH FULLY ENCLOSED

SEISMIC: IE = 1.0, SS = 0.16, S1 = 0.053, SOIL SITE CLASS = D, SDS = 0.178, SD1 = 0.091
DESIGN CATEGORY = B

LATERAL ACTIVE EARTH LOAD: ABUTMENTS DESIGNED FOR 45 PCF ACTIVE EQUIVALENT FLUID PRESSURE.

A SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING SERVICES REPORT WAS PREPARED FOR THIS PROJECT BY BURGESS & NIPLE, INC. VIRGINIA DATED JUNE 26TH, 2012. ALL RECOMMENDATIONS CONTAINED IN THE REPORT SHALL BE FOLLOWED. A MAXIMUM ALLOWABLE SOIL BEARING PRESSURE OF 1500 PSF WAS USED FOR DESIGN PURPOSES AS STATED IN THE REPORT.

## HELICAL PIER ANCHORS:

EACH ABUTMENTS SHALL BE SUPPORTED ON .(4)- ABCHANCE SS-175 HELICAL PIERS OR EQUIVALENT HELIPILES WITH AN ALLOWABLE LOAD CAPACITY OF 20 KIPS ACHIEVED BY THE REQUIRED TORQUE DEVELOPED DURING ANCHORING AS RECOMMENDED BY THE MANUFACTURER. HELICAL PIERS SHALL INCLUDE 60 K COMPRESSION CAP ASSEMBLY C150-0459 WITH (2)-#6 HORIZONTAL RE-BARS WELDED ON THE PLATE.

ALL HELICAL PIER STEEL SHALL BE HOT DIPPED GALVANIZED ACCORDING TO ASTM A153.
THE CONTRACTOR SHALL SUBMIT A RECORD OF HELICAL PIER SIZE, CONFIGURATION, TORQUE ACHIEVED AT APPROPRIATE INTERVALS AND AT TERMINATION DEPTH.

## BACKFILL:

SATISFACTORY BACKFILL MATERIALS SHALL INCLUDE GP, GW, GM, GC, SW, SM, SC, SP AND SC-SP BUT EXCLUDE HIGHLY PLASTIC CLAY AND SILT CH, MH, ML, CL, OL AND OH PER SOIL GROUPS DEFINED BY ASTM D-2487. BACKFILL SHALL BE FREE OF TOPSOIL, ORGANIC CONTAMINATED SOIL AND ROCK FRAGMENTS HAVING A MAJOR DIMENSION GREATER THAN 2". ALL MATERIALS SUITABLE FOR BACKFILL ARE SUBJECT TO THE FOLLOWING RESTRICTIONS:

MAXIMUM DRY DENSITY ASTM D-1557 105 PCF
LIQUID LIMIT =< 40
PLASTICITY INDEX =< 15

COMPACTION EQUIPMENT USED BEHIND THE ABUTMENT OR WINGWALLS SHOULD BE RESTRICTED TO LIGHT COMPACTION EQUIPMENT SUCH AS HAND-OPERATED TAMPERS OR JUMPING JACKS TO PREVENT CRACKING OF WALLS. CONCRETE WALL SHALL CURE AT LEAST 28 DAYS OR UNTIL 100% OF THE DESIGN STRENGTH HAS BEEN ATTAINED PRIOR TO BEGINNING BACKFILL ACTIVITIES.

## CONCRETE:

ALL CONCRETE WORK SHALL BE FURNISHED AND INSTALLED IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE'S ACI-318 AND 301, LATEST EDITION, AND THE CONCRETE REINFORCING STEEL INSTITUTE'S DESIGN HANDBOOK STANDARDS. CONCRETE SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.

MINIMUM CONCRETE COVER OVER REINFORCING STEEL SHALL BE AS FOLLOWS:
3" FOR BOTTOM SURFACES POURED ON THE GROUND;
2" FOR FORMED SURFACES IN CONTACT WITH THE GROUND
OR EXPOSED TO WEATHER

USE AIR-ENTERING ADMIXTURE IN ALL CONCRETE, PROVIDING 6% ENTRAINED TOTAL AIR CONTENT, PLUS OR MINUS 1%.

## REINFORCING STEEL:

DEFORMED REINFORCING BARS SHALL CONFORM TO ASTM A615, GRADE 60. REINFORCING BAR SPLICES SHALL BE LAPPED A MINIMUM OF 42 BAR DIAMETERS.

POSITION, SUPPORT AND SECURE REINFORCEMENT AGAINST DISPLACEMENT. LOCATE AND SUPPORT WITH METAL CHAIRS, RUNNERS, BOLSTERS, SPACERS, AND HANGERS, AS REQUIRED.

## CONSTRUCTION BRACING:

CONTRACTOR SHALL ADEQUATELY BRACE FORMS AND CONCRETE WALLS TO WITHSTAND WIND AND CONSTRUCTION LOADS UNTIL THE BRIDGE IS INSTALLED AND SECURELY IN PLACE.

## SPECIAL INSPECTIONS:

THE FOLLOWING MATERIALS AND WORK REQUIRE SPECIAL INSPECTIONS:
FOUNDATION SUBGRADE
CONCRETE INCLUDING REBAR

| NO. | DESCRIPTION | REV. | APPROVED |
| --- | --- | --- | --- |
| | | | |

REVISION APPROVED BY
OFFICE OF SITE DESIGN SERVICES

FAIRFAX COUNTY PARK AUTHORITY
12055 Government Center Pkwy.
Fairfax, Virginia 22035

BRIDGE ABUTMENT PLAN AND SECTIONS
HOLMES RUN SV
LURIA PARK BOARDWALK RENOVATIONS
PROVIDENCE DISTRICT #1
FAIRFAX COUNTY, VA

| FCPA REVISIONS | |
| --- | --- |
| Subject | Date |

C-4827

**Section 13000**

# PREFABRICATED STEEL BRIDGE

## 1.0 GENERAL

All work under this section is subject to the Special and General Conditions and Instructions to Bidders forming a part of these specifications, as well as to applicable provisions of the current Fairfax County Public Facilities Manual, the Virginia Department of Transportation (VDOT) Road and Bridge Specifications, and the American Institute of Steel Construction (AISC), or AASHTO Load and Resistance Factor (AASHTO LRFD). The Contractor shall be responsible for and be governed by all requirements there under.

## 2.0 SCOPE

This work consists of providing and installing a prefabricated steel structure, wood deck, pedestrian, bicycle, and light vehicular bridge shown on the plans and specified herein. Truss and Abutment Details shown are preliminary and for bidding purposes only.

Bridge manufacturer shall supply all necessary engineering documents needed to obtain a building permit including a complete Truss Shop Drawing and Abutment Design Package, with supporting computations and graphics, signed and sealed by a Professional Engineer registered in the Commonwealth of Virginia, who shall certify that the design fulfills and complies with those design intents and specifications, for review and approval by the Owner, prior to ordering materials and construction. The cost to prepare this work is part of this bid and the responsibility of the contractor.

## 3.0 GENERAL FEATURES OF BRIDGE

### 3.1 Span

Bridge shall be 60’ (straight line dimension) and shall be measured from each end of the bridge structure.

### 3.2 Width

Bridge width shall be a minimum of 14’-0” as measured from the inside face of the handrails.

3.3 Bridge System Type

Bridge shall be designed as a ‘Continental Bridge’ Half-Through Pony System, Link truss style or equal, that has two diagonals per panel in an ‘X’ pattern and plumb end vertical members. Interior vertical members shall be perpendicular to the chord faces.

3.3.1 Floor beam shall be attached per manufacturer’s specifications

3.3.2 The bridge manufacturer shall determine the distance from the top of the deck to the top and bottom truss members based upon structural and/or shipping requirements.

3.3.3 The top of the top chord shall not be less than 54 inches above deck (measured from the high point of deck) on this bridge that will be used for pedestrian and bicycle traffic.

3.4 Member Components

All members of the vertical trusses (top and bottom chords, verticals and diagonals) shall be fabricated from structural steel shapes or square and/or rectangular structural steel tubing. Other structural members and bracing shall be fabricated from structural steel shapes or square and rectangular structural steel. To provide lateral support for the top flange of open shape stringers (w-shapes or channels), a minimum of one stiffener shall be provided in each stringer at every floor beam location.

3.5 Attachments

3.5.1 Safety Rails

Vertical safety rails or pickets shall be placed on the structure to a minimum height 48” above the deck surface. The pickets shall be spaced so as to prevent a 4” sphere from passing through the truss. Pickets shall be welded to the truss and may be placed on the inside or outside of the structure at the bridge fabricators’ option. The top of the vertical pickets shall have a continuous cap angle or some other means to prevent bridge users from cutting or scraping their hands.

The rail / picket safety system shall be designed for an infill loading of 200 pounds, applied horizontally at right angles, to a one square foot area at any point in the system.

All rails shall have a smooth inside surface with no protrusions or depressions. All ends of angles and tubes shall be closed and ground smooth.

3.5.2 Toe Plate
A 5" steel channel toe plate shall be located 2" above the floor deck on both sides of the walkway.

3.6 Camber

The bridge shall have a vertical camber dimension at mid-span equal to 100% of the full dead load deflection plus 1% of the full length of the bridge.

3.7 Elevation Difference

The bridge abutments shall be constructed at the same elevation on both ends of the bridge.

## 4.0 ENGINEERING STANDARDS

Structural design of the bridge structure shall be performed by or under the direct supervision of a Virginia licensed Professional Engineer and done in accordance with recognized engineering practices and principals. All shop drawings and calculations shall be sealed by the Professional Engineer.

4.1 Design Loads

4.1.1 Dead Load

Normal bridge load as calculated by the bridge designer.

4.1.2 Live Loads

4.1.2.1 Pedestrian Live Load

Bridge members, including trusses, stringers and deck shall be designed for an evenly distributed pedestrian live load of 100 pounds per square foot of bridge walkway area. The pedestrian live load shall be applied in those areas of the walkway so as to produce maximum stress in the member being designed. No live load reductions shall be allowed.

4.1.2.2 Vehicle Live Load

Bridge shall be designed to withstand a moving concentrated load of a vehicle weighing up to 20,000 pounds (H10) with impact load (per AASHTO). The vehicle load shall be in addition to 20 pounds per square foot evenly distributed live load (snow). The vehicle load shall be distributed such that 80% of the load is on the rear axle (per AASHTO).

4.1.3 Lateral Loads

4.1.3.1 Wind Load

Bridge shall be designed for a minimum wind load of 30 pounds per square foot for a Design Wind Speed (V3) of 90 miles per hour. The wind load shall be calculated on the entire vertical surface of the bridge as if fully enclosed. The effect of wind forces tending to overturn the structure shall be calculated assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be 20 pounds per square foot of deck.

4.1.3.2 Seismic Load

Bridge shall be designed for earthquake spectral response acceleration factors of 0.16 for short periods and 0.053 for one second periods, and as per local / state codes, whichever is greater.

4.1.3.3 Stream Current Load

Assuming bridge is completely inundated, bridge shall be designed for a horizontal load of 75 pounds per square foot, based on water velocity of 6 miles per hour or 9 feet per second. Water pressure shall be calculated on the entire vertical surface of the bridge, assuming the surface is completely filled with floating debris. Note that unlike wind or seismic loads, stream current pressure is only one directional. The bridge spans north-south and the stream flow is from east to west at the bridge crossing.

4.1.4 Temperature Loads

4.1.4.1 Bridge shall be designed to accommodate a temperature differential of 120 degrees Fahrenheit. Slip pads of UHMW polyethylene shall be placed between the smooth surface of the setting plate and the smooth bearing pads of the bridge. A minimum of one (1) inch, and a maximum of one and one-half (1-1/2) inch of clearance shall be provided between the bridge and the concrete abutments.

4.1.5 Top Chord, Guard & Railing Loads

4.1.5.1 Bridge truss top chord, guards and handrails shall be designed for 50 pounds per lineal foot or a 200 pound point load, whichever produces greater stresses, applied in any direction at any point along their length.

4.2 Design Limitations

4.2.1 Deflection

4.2.1.1 Vertical Deflections

The vertical deflection of the main trusses due to service pedestrian live load shall not exceed L/400 of the span length. Service pedestrian live load shall be a minimum of 600 pounds per linear foot of bridge length.

The vertical deflection of the main trusses due to vehicular loads shall not exceed L/800 of the span length.

The deflection of the floor system members (floor beams and stringers) due to pedestrian live load shall not exceed L/360 of their respective spans.

4.2.1.2 Horizontal Deflection

The horizontal deflection of the structure due to lateral wind or seismic loads shall not exceed L/500 of the span.

4.2.2 Minimum Thickness of Metal

The minimum thickness of all structural steel members shall be 3/16” normal and be in accordance with the AISC Manual of Steel Constructions’ “Standard Mill Practice Guidelines”. For ASTM A500 and ASTM A847 tubing, the section properties used for design shall be per the Steel Tube Institute of North America’s Hollow Structural Sections “Dimensions and Section Properties”.

4.2.3 Vibration

The bridge design shall be tuned to have a minimum fundamental frequency of 3 Hz. It shall be the responsibility of the Contractor / Truss Manufacturer to demonstrate compliance with the specifications

4.3 Governing Design Codes / References

Structural members shall be designed in accordance with recognized engineering practices and principals as follows:

4.3.1 Structural Steel Allowable Stresses

American Institute of Steel Construction (AISC).

Structural steel design shall be in accordance with those sections of the “Manual of Steel Construction: Allowable Stress Design” related to design requirements and allowable stresses.

Or

AASHTO -Load and Resistance Factor (AASHTO LRFD)

4.3.2 Welded Tubular Connections

American National Standards Institute / American Welding Society (ANSI/AWS).

All welded tubular connections shall be checked, when within applicable
limits, for the limiting failure modes outlined in the ANSI/AWS Dl.1

Structural Welding Code.

As well, all field welds shall be performed in accordance with Fairfax County Standards.

All tubular joints shall be plain unstiffened joints (made without the use of reinforcing plates) except as follows:

• Floor beams hung beneath the lower chord of the structure may be connected with or without stiffener (or gusset) plates, as required by design.

• Floor beams which frame directly into the truss verticals (H-Section bridges) may be designed with or without end stiffening plates as required by design.

• Where chords, end floor beams and in high profiles the top end struts weld to the end verticals, the end verticals (or connections) may require stiffening to transfer the forces from these members into the end vertical. The connection of bridge end posts to top chord shall be a mitered joint with the exposed welds ground smooth.

• Truss vertical to chord connections.

NOTE: The effects of fabrication tolerances shall be accounted for in the design of the structure. Special attention shall be given to the actual fit-up gap at welded truss joints.

4.3.4 Wood

(AF&PA).

Sawn lumber shall be designed in accordance with the ANSIJAF&PA NDS, "National Design Standard for Wood Construction", as published by the American Forest & Paper Association or the "Timber Construction Manual" as published by the Institute of Timber Construction (AITC). Design properties for naturally durable hardwoods shall be in accordance with "Tropical Timbers of the World" as published by the U.S. Forest Products Laboratory.

4.3.5 Top Chord Stability

Structural Stability Research Council (SSRC), formerly Column Research Council.

The top chord shall be considered as a column with elastic lateral supports at the panel joints. The critical buckling force of the column, so determined, shall exceed the maximum force from dead load and live load (uniform or vehicular) in any panel of the top chord by not less than 50 percent for parallel chord truss bridges or 100 percent for bowstring bridges. The design approach to prevent top chord buckling shall be as outlined by E.C. Holt's, or Lutz-Fisher Equation research in conjunction with the Column Research Council on the stability of the top chord of a half-through truss.

For uniformly loaded bridges, the vertical truss members, the floor beams and their connections (transverse frames) shall be proportioned to resist a lateral force of not less than 0.01 times the top chord compressive load, but not less than 0.004 times that top chord load, applied at the top chord panel points of each truss. The top chord is determined by using the larger top chord axial force in the members on either side of the "U-frame" being analyzed. For end frames, the same concept applies except the transverse force is 1% of the axial load in the end post member.

The bending forces in the transverse frames, as determined above, act in conjunction with all forces produced by the actual bridge loads as determined by an appropriate analysis which assumes that the floor beams are "fixed" to the trusses at each end.

NOTE: The effects of three dimensional loading (including "U-frame" requirements) shall be considered from a three dimensional analysis of the bridge.

## 5.0 MATERIALS

### 5.1 Steel

#### 5.1.1 Unpainted Weathering Steel

Bridges which are not to be painted shall be fabricated from high strength, low alloy, atmospheric corrosion resistant ASTM A847 cold-formed welded square and rectangular tubing and/or ASTM A588, or ASTM A242, ASTM A606 plate and structural steel shapes (Fy = 50,000 psi). The minimum corrosion index of atmospheric corrosion resistant steel, as determined in accordance with ASTM Gl0l, shall be 5.8.

### 5.2 Decking

5.2.1 Minimum acceptable decking shall be 2x6 with a nominal thickness (minimum: 1 1/2" x 5 1/2") planks unless approved otherwise. Final stock dimensions to be determined by manufacturer in accordance with design loads.

5.2.2 Wood decking shall be naturally durable hardwood Ipe (Tabebuia Spp) LapachoGroup or Cumaru (Dipteryx Odora). All planks shall be partially air dried to a moisture content of 15% to 20%, and shall be supplied S4S (surfaced four sides) with one face “hit or miss” allowed up to 10% of the total length, E4E (eased four edges), with the edges eased to a radius of 1/8”.

5.2.3 Measured at 30% moisture content, the width and thickness shall not vary from specified dimensions by more than ± 0.04 inches. All planks shall be supplied with the end sealed with “Anchorseal” Mobil CER-M or an equal wax log sealer.

5.2.4 All planks shall be graded as FEQ-CAH (First Export Quality — Clear All Heart) or F1F (First One Face) grading rules, defined as follows:

- Lumber shall be graded both faces and both edges.
- Lumber shall be straight grained and parallel cut without heart center.
- Lumber shall be all heartwood.
- Lumber shall be in sound condition.
- Allowable Imperfections are:

All faces: Natural drying checks, discoloration caused by weathering or chemical reaction, maximum bow or spring of 0.08 inch per timbers’ length. On one face only: firm sapwood, worm holes not going through to the other face, closed knots with maximum of one knot per 4 foot of timber length, rowy grain and tear-out.

- Imperfections not allowed:

Longitudinal heart cracks, internal cracks, soft sap wood, splits, end splits, ring shades, fungi affects (blue to gray, brown to red, white to yellow, or incipient decay), deformation (twisting or cupping) which cannot be removed using normal installation methods and tools.

5.2.5 All planks shall meet or exceed the following mechanical properties (based on the 2” standard) as defined by the U.S. Forest Products Laboratory publications and testing data:

| MC% | Modulus of Rupture | Modulus of Elasticity | Max. Crush Strength |
|---|---|---|---|
| 12% | 27,270 psi | 3,030,000 psi | 13,720 psi |

Janka side harness is 3540 lbs. at 12% moisture content.
Average air-dry density is 62 to 81 pcf.

Basic specific gravity is 0.80-0.91.

All planks shall be naturally fire resistant without the use of any fire resistant preservatives to meet NFPA Class A and UBC Class I.

5.2.6 Planks shall be supplied that meet or exceed the Static Coefficient of Friction for both Neolite and leather shoes in accordance with ASTM Test Method C 1028-89.

| | FORCE IN POUNDS | |
|---|---|---|
| SHOE MATERIAL | DRY | WET |
| Neolite | 0.73 | 0.69 |
| Leather | 0.55 | 0.79 |

5.3 Wood Decking Attachment

- At time of installation, planks shall be placed tight together with no gaps.
- Every plank shall be attached with at least one fastener at each end.
- All fasteners to be zinc plated. Hex-head bolts, with a steel plank hold down, shall be used at the ends of planks. Self-tapping screws or carriage bolts shall be used as interior connection fasteners when required. Power actuated fasteners will not be allowed.
- Planks shall be drilled prior to installation of bolts and/or screws.
- In addition to at least one fastener at each end of every plank (typical for all installations), planks for bridges with widths of 72” to 120” shall have one fastener near the center of the bridge width. Bridges wider than 120” shall have two fasteners located at a minimum of two interior stringer locations, approximately at the third points of the bridge width.

NOTE: Attachments at the ends of the planks may be modified as required when obstructions, such as interior safety system elements, prevent installation of the specified hold down system.

## 6.0 <u>WELDING</u>

6.1 Welding

Welding and weld procedure qualification tests shall conform to the provisions of ANSI/AWS Dl.1 “Structural Welding Code”, current edition. Filler metal shall be in accordance with the applicable AWS Filler Metal Specification (i.e. AWS A5.28 for the GMAW Process). For exposed, bare, unpainted applications of corrosion resistant steels (i.e. ASTM A588 and A847), the filler metal shall be in accordance with AWS Dl. 1, Section 3.7.3.

### 6.2 Welders

Welders shall be properly accredited operators, each of whom shall submit certification of satisfactorily passing AWS standard qualification tests for all positions with unlimited thickness of base metal, have a minimum of 6 months experience in welding tubular structures, and have demonstrated the ability to make uniform sound welds of the type required.

## 7.0 SUBMITTALS

### 7.1 Submittal Drawings

Schematic drawings and diagrams shall be submitted to the Owner for their review after receipt of order. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the work to be done. All relative design information such as member sizes, bridge reactions and general notes shall be clearly specified on the drawings.

### 7.2 Structural Calculations

Structural calculations for the bridge superstructures shall be submitted by the bridge manufacturer and reviewed by the approving engineer. All calculations shall be signed and sealed by a Professional Engineer who is licensed in Virginia. The calculations shall include all design information necessary to determine the structural adequacy of the bridge. The calculations shall include the following:

- All AISC allowable stress checks for axial, bending and shear forces in the critical member of each truss member type (i.e. top chord, bottom chord, floor beam, vertical, etc.).

- Checks for the critical connection failure modes for each truss member type (i.e. vertical, diagonal, floor beam, etc.). Special attention shall be given to all welded tube on tube connections (see Section 4.3.2 for design check requirements).

- All bolted splice connections, if applicable

- Main truss deflection checks.

- U-Frame stiffness checks (used to determine ‘K’ factors for out-of-plane buckling of the top chord) for all half through or “pony” truss bridges.

- Deck design.

NOTE: The analysis and design of triangulated truss bridges shall account for moments induced in members due to joint fixity where applicable. Moments due to both truss deflection and joint eccentricity must be considered.

7.3 Welder certifications in compliance with AWS standard qualification tests.

7.4 Welding procedures in compliance with Section 6.1.

## 8.0 FABRICATION

### 8.1 General Requirements

#### 8.1.1 Drain Holes

When the collection of water inside a structural tube is a possibility, either during construction or during service, the tube shall be provided with a drain hole at its lowest point to let water out.

#### 8.1.2 Welds

Special attention shall be given to developing sufficient weld throats on tubular members. Fillet weld details shall be in accordance with AWS D1.1, Section 3.9 (See AWS Figure 3.2). Unless determined otherwise by testing, the loss factor “Z” for heel welds shall be in accordance with AWS Table 2.8. Fillet welds which run onto the radius of a tube shall be built-up to obtain the full throat thickness (See Figure 7.1). The maximum root openings of fillet welds shall not exceed 3/16” in conformance with AWS D1.1, Section 5.22. Weld size or effective throat dimensions shall be increased in accordance with this same section when applicable.

The fabricator shall have verified that the throat thickness of partial joint penetration groove welds (primarily matched edge welds or the flare- bevel-groove welds on under hung floor beams) shall be obtainable with their fit-up and weld procedures. Matched edge welds shall be “flushed” out when required to obtain the full throat or branch member wall thickness.

For full penetration butt welds of tubular members, the backing material shall be fabricated prior to installation in the tube so as to be continuous around the full tube perimeter, including corners. Backing may be of four types:

• A “box” welded up from four (4) plates.
• Two “channel” sections, bent to fit inside the radius of the tube, welded together with full penetration welds.
• A smaller tube section which slides inside the spliced tube.
• A solid plate cut to fit the inside radius of the tube.

Corners of the “box” backing, made from four plates, shall be welded and ground to match the inside corner radii of the chords. The solid plate option shall require a weep hole either in the chord wall above the “high- side” of the plate or in the plate itself. In all types of backing, the minimum fit-up tolerances for backing must be maintained at the corners of the tubes as well as across the “flats”.

8.2 Quality Certification

8.2.1 Bridge shall be fabricated by a fabricator who is currently certified by the American Institute of Steel Construction to have the personnel, organization, experience, capability and commitment to produce fabricated structural steel for the category “Simple Steel Bridges” as set forth in the AISC Certification Program. Quality control shall be in accordance with procedures outlined for AISC certification.

8.2.2 The bridge fabricator shall be considered an “Approved Fabricator”, as defined under Chapter 17, Structural Tests and Special Inspections, of the 2003 International Building Code (IBC). The fabricator shall provide documentation and testing results as necessary to obtain approval from the Fairfax County Building Official to be considered an Approved Fabricator. The fabricator shall also, at the completion of the project, provide the Owner with an “Inspection Certificate”, as defined in Chapter 17 of the IBC, for the pre-manufactured bridge.

## 9.0 FINISHING

9.1 Blast Cleaning

9.1.1 Bare applications of enhanced corrosion resistant steels.

To aid in providing a uniformly “weathered” appearance, all exposed surfaces of steel shall be blast cleaned in accordance with Steel Structures Painting Council Surface Preparation Specifications No. 7, Brush-Off Blast Cleaning, SSPC-SP7, latest edition.

Exposed surfaces of steel shall be defined as those surfaces seen from the deck and from outside of the structure. Stringers, floor beams, lower brace diagonals and the inside face of the truss below deck and bottom face of the bottom chord need not be blasted.

## 10.0 DELIVERY AND ERECTION

### 10.1 Delivery

Delivery shall be made to a location nearest the site that is readily accessible to normal over-the-road tractor/trailer equipment. All trucks delivering bridge materials shall be unloaded at the time of arrival. Hauling permits and freight charges shall be the responsibility of the bridge manufacturer.

### 10.2 Erection

The manufacturer will provide detailed, written instruction in the proper lifting procedures and splicing procedures (if required). The method and sequence of erection shall be the responsibility of the General Contractor. The bridge manufacturer shall provide written inspection and maintenance procedures to be followed by the bridge owner. Unloading, splicing, bolting and proper lifting equipment shall be the responsibility of the General Contractor.

## 11.0 BEARING

### 11.1 Bearing Devices

Bridge bearings shall consist of steel setting or side plate placed on the abutment with a grout pad. The bridge bearing plate, which is welded to the bridge structure, shall bear on a Teflon pad and this setting plate. One end of the bridge will be fixed by fully tightening the nuts on the anchor bolts at that end. The opposite end shall have finger tight nuts to allow movement under thermal expansion or contraction.

The bridge bearing shall sit in a recessed pocket on the concrete abutment. Minimum 28-day strength for the abutment concrete shall be 4000 psi. The bearing seat shall be a minimum of 18”wide, final width to be determined by the bridge manufacturer. The step height (from bottom of bearing to top-of-deck) shall be determined by the bridge manufacturer.

## 12.0 FOUNDATIONS

Unless specified otherwise, the bridge manufacturer shall determine the number, diameter, minimum grade and finish of all anchor bolts. The anchor bolts shall be designed to resist all horizontal and uplift forces to be transferred by the superstructure to the supporting foundations. The General Contractor shall provide all materials for (including anchor bolts) and construction of the bridge supporting foundations. The General Contractor shall install the anchor bolts in accordance with the bridge manufacturer's anchor bolt spacing dimensions.

## 13.0 WARRANTY

The bridge manufacturer shall warrant steel structure(s) to be free of design, material and workmanship defects for a period of fifteen years from the date of delivery. Naturally durable hardwood decking and hardwood attachments shall carry a fifteen-year warranty against rot, termite damage or fungal decay. This warranty shall not cover defects in the bridge caused by abuse, misuse, overloading, accident, improper maintenance, alteration or any other cause not the result of defective materials or workmanship.

**END OF SECTION**

## Section 13100

## Helical Pile Installation

### 1. GENERAL

1.1 Purpose of Specification

The purpose of this specification is to detail the furnishing of all designs, materials, tools, equipment, labor and supervision, and installation techniques necessary to install Helical Piles as detailed on the drawings, including connection details. This shall include provisions for load testing that may be part of the scope of work

1.2 Scope of Work

This work consists of furnishing all necessary engineering and design services (if required), supervision, labor, tools, materials, and equipment to perform all work necessary to install the Helical Piles, per the specifications described herein, and as shown on the drawings. The Contractor shall install a Helical Pile that will develop the load capacities as detailed on the drawings. This may also include provisions for load testing to verify Helical Pile capacity and deflection, if part of the scope of work.

1.3 Qualifications of the Helical Pile Contractor

The Helical Pile Contractor shall be experienced in performing design and construction of Helical Piles and shall furnish all materials, labor, and supervision to perform the work. The Contractor shall be trained and certified by the helical pile manufacturer in the proper methods of design and installation of Helical Piles. The Contractor shall provide names of on-site personnel materially involved with the work, including those who carry documented certification from the helical pile manufacturer. At a minimum, these personnel shall include foreman, machine operator, and project engineer/manager.

1.4 Related Project Specifications

Section 13000 - Fiber Reinforced Polymer (Fiberglass) Bridges

1.5 Definitions

All “Types” in this section refer to products by CHANCE Civil Construction or equivalent.

**Coupling:** Central steel shaft connection means formed as integral part of the plain extension shaft material. For square shaft & round shaft Helical Piles, couplings are internal or external sleeves, or hot upset forged sockets.

**Coupling Bolt(s):** High strength, structural steel fasteners used to connect Helical Pile segments together. For Square shaft segments, the coupling bolt transfers axial load. For round shaft segments, the coupling bolts transfer both axial and torsional forces.

**Helical Extension:** Helical Pile foundation component installed immediately following the lead or starter section, if required. This component consists of one or more helical plates welded to a central steel shaft of finite length. Function is to increase bearing area.

**Helix Plate:** Generally round steel plate formed into a ramped spiral. The helical shape provides the means to install the helical pile, plus the plate transfers load to soil in end bearing. Helix plates are available in various diameters and thickness.

**HELICAL PULLDOWN® Micropile:** A small diameter, soil displacement, cast-in-place Helical Pile, in which most of the applied load is resisted by the central steel shaft and steel reinforcement, if installed. Load transfer to soil is both end bearing and friction.

**Helical Pile:** A bearing type foundation element consisting of a lead or starter section, helical extension (if so required by site conditions), plain extension section(s), and a pile cap. A.k.a. helical screw pile, screw pile, helical screw foundation.

**Installation Torque(T):** The resistance generated by a Helical Pile when installed into soil. The installation resistance is a function of the soil type, and size and shape of the various components of the Helical Pile.

**Lead Section:** The first Helical Pile foundation component installed into the soil, consisting of single or multiple helix plates welded to a central steel shaft. A.k.a. Starter Section.

**Pile Cap:** Connection means by which structural loads are transferred to the Helical Pile. The type of connection varies depending upon the requirements of the project and type of Helical Pile material used.

**Round Shaft (RS): R**ound steel pipe central **S**haft elements ranging in diameter from 2-7/8" to 10". A.k.a. Hollow Shaft (Type HS), Type T/C, Type PIF.

**Plain Extension:** Central steel shaft segment without helix plates. It is installed following the installation of the lead section or helical extension (if used). The segments are connected with integral couplings and bolts. Plain extensions are used to extend the helix plates beyond the specified minimum depth and into competent load bearing stratum.

**Safety Factor:** The ratio of the ultimate capacity to the working or design load used for the design of any structural element.

**Square Shaft (SS):** Solid steel, round-cornered-**S**quare central **S**haft elements ranging in size from 1-1/4" to 2-1/4". A.k.a. Type SQ.

**Torque Strength Rating:** The maximum torque energy that can be applied to the helical pile foundation during installation in soil, a.k.a. allowable, or safe torque.

1.6 Allowable Tolerances

The tolerances quoted in this section are suggested maximums. The actual values established for a particular project will depend on the structural application.

1.6.1 Centerline of Helical Piles shall not be more than 3 inches from indicated plan location.

1.6.2 Helical Pile plumbness shall be within 2° of design alignment.

1.6.3 Top elevation of Helical Pile shall be within +1 inch to –2 inches of the design vertical elevation.

1.7 Quality Assurance

1.7.1 Helical Piles shall be installed by authorized helical pile manufacturer certified Contractor. These Contractors shall have satisfied the certification requirements relative to the technical aspects of the product and installation procedures as therein specified. Certification documents shall be provided upon request to the Owner or their representative.

1.7.2 The Contractor shall employ an adequate number of skilled workers who are experienced in the necessary crafts and who are familiar with the specified requirements and methods needed for proper performance of the work of this specification.

1.7.3 All Helical Piles shall be installed in the presence of a designated representative of the Owner unless said representative informs the Contractor otherwise. The designated representative shall have the right of access to any and all field installation records and test reports.

1.7.4 Helical Pile components as specified therein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO Standards Number shall be presented upon request to the Owner or their representative.

1.7.5 The manufacturer shall provide a standard one-year warranty on materials and workmanship of the product.

1.7.6 Design of Helical Piles shall be performed by an entity as required in accordance with existing local code requirements or established local practices. This design work may be performed by a licensed professional engineer, a Contractor certified by helical pile manufacturer, or designer depending upon local requirements or practices.

## 2 REFERENCED CODES AND STANDARDS

a. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. In case of conflict, the particular requirements of this specification shall prevail. The latest publication as of the issue of this specification shall govern, unless indicated otherwise.

**2.1 American Society for Testing and Materials (ASTM):**

2.1.1 ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.
2.1.2 ASTM A36/A36M Structural Steel.
2.1.3 ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2.1.4 ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware.
2.1.5 ASTM A252 Welded and Seamless Steel Pipe Piles.
2.1.6 ASTM A775 Electrostatic Epoxy Coating
2.1.7 ASTM A193/A193M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
2.1.8 ASTM A320/A320M Alloy-Steel Bolting Materials for Low Temperature Service.
2.1.9 ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
2.1.10 ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
2.1.11 ASTM A513 Standard Specification for Electric Resistance Welded Carbon and Alloy Steel Mechanical Tubing.
2.1.12 ASTM A536 Standard Specifications for Ductile Iron Castings
2.1.13 ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality.
2.1.14 ASTM A618 Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
2.1.15 ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.
2.1.16 ASTM A958 Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Wrought Grades.
2.1.17 ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability.
2.1.18 ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load.
2.1.19 ASTM D3689 Method of Testing Individual Piles Under Static Axial Tensile Load.

**2.2 American Welding Society (AWS):**

2.2.1 AWS D1.1 Structural Welding Code – Steel.
2.2.2 AWS D1.2 Structural Welding Code – Reinforcing Steel.

**2.3 American Society of Civil Engineers (ASCE):**

2.3.1 ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.

**2.4 Deep Foundations Institute (DFI):**

2.4.1 *Guide to Drafting a Specification for High Capacity Drilled and Grouted Micropiles for Structural Support*, 1st Edition, Copyright 2001 by the Deep Foundation Institute (DFI).

**2.5 Society of Automotive Engineers (SAE):**

2.5.1 SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners.

## 3 SUBMITTALS

**3.1 Construction Submittals**

3.1.1 The Contractor shall prepare and submit to the Owner, for review and approval, working drawings and design calculations for the Helical Piles intended for use per the General and Special Conditions. All submittals shall be signed and sealed by a Registered Professional Engineer currently licensed in the State of Virginia.

3.1.2 The Contractor shall submit a detailed description of the construction procedures proposed for use to the Owner for review. This shall include a list of major equipment to be used.

3.1.3 The Working Drawings shall include the following:

- 3.1.3.a Helical Pile number, location and pattern by assigned identification number
- 3.1.3.b Helical Pile design load
- 3.1.3.c Type and size of central steel shaft
- 3.1.3.d Helix configuration (number and diameter of helix plates)
- 3.1.3.e Minimum effective installation torque
- 3.1.3.f Minimum overall length
- 3.1.3.g Inclination of Helical Pile
- 3.1.3.h Cut-off elevation
- 3.1.3.i Helical Pile attachment to structure relative to grade beam, column pad, pile cap, etc.

*If the number of helix plates per Helical Pile required for the project is not shown on the Working Drawings, the Contractor shall have the option of performing subsurface tests using methods subject to the review and acceptance of the Owner. The data collected along with other information pertinent to the project site shall be used to determine the required helix configuration.*

3.1.4 The Contractor shall submit shop drawings for all Helical Pile components, including corrosion protection and pile top attachment to the Owner for review and approval. This includes Helical Pile lead/starter and extension section identification (manufacturer's catalog numbers).

3.1.5 The Contractor shall submit to the Owner copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty five (45) working days of the date submitted. Helical Pile installation and testing shall not proceed until the Owner has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:

3.1.5.a Name of project and Contractor
3.1.5.b Name of testing agency
3.1.5.c Identification (serial number) of device calibrated
3.1.5.d Description of calibrated testing equipment
3.1.5.e Date of calibration
3.1.5.f Calibration data

3.1.6 Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner a reasonable time to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

**3.2 Installation Records**

The Contractor shall provide the Owner copies of Helical Pile installation records within 24 hours after each installation is completed. Records shall be prepared in accordance with the specified division of responsibilities as noted in Table-1. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information.

3.2.1 Name of project and Contractor
3.2.2 Name of Contractor's supervisor during installation
3.2.3 Date and time of installation
3.2.4 Name and model of installation equipment
3.2.5 Type of torque indicator used
3.2.6 Location of Helical Pile by assigned identification number
3.2.7 Actual Helical Pile type and configuration – including lead section (number and size of helix plates), number and type of extension sections (manufacturer's SKU numbers)
3.2.8 Helical Pile installation duration and observations
3.2.9 Total length of installed Helical Pile
3.2.10 Cut-off elevation
3.2.11 Inclination of Helical Pile
3.2.12 Installation torque at one-foot intervals for the final 10 feet
3.2.13 Comments pertaining to interruptions, obstructions, or other relevant information
3.2.14 Rated load capacities

**3.3 Closeout Submittals**

3.3.1 Warranty: Warranty documents specified herein
3.3.1.a Project Warranty: Refer to Conditions of the Contract for project warranty provisions

Warranty Period: 1 year commencing on date of Substantial Completion

3.3.1.b Manufacturer's Warranty: Submit, for Owner's Acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under Contract Document.

# 4 PRODUCTS AND MATERIALS

## 4.1 Central Steel Shaft:

The central steel shaft, consisting of lead sections, helical extensions, and plain extensions, shall be Square shaft(Square Shaft) or RS (Round Shaft) or a combination of the two (SS to RS Combo Pile) as manufactured by CHANCE Civil Construction (Centralia and Independence, MO) or equivalent.

4.1.1 *SS5 1-1/2" Material*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting dimensional and workmanship requirements of ASTM A29. The bar shall be modified medium carbon steel grade (similar to AISI 1044) with improved strength due to fine grain size.

4.1.1.a Torque strength rating = 5,500 ft-lb
4.1.1.b Minimum yield strength = 70 ksi

4.1.2 *SS125 1-1/4"; SS1375 1-3/8"; SS150 1-1/2"; SS175 1-3/4; SS200 2"; SS225 2-1/4" Material*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar shall be High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size.

4.1.2.a Torque strength rating: SS125 = 4,000 ft-lb; SS1375 = 5,500 ft-lb; SS150 = 7,000 ft-lb; SS175 = 11,000 ft-lb; SS200 = 16,000 ft-lb; SS225 = 23,000 ft-lb
4.1.2.b Minimum yield strength = 90 ksi

4.1.3 *Type RS2875 2-7/8" OD Material*: Structural steel tube or pipe, welded or seamless, in compliance with ASTM A500 or A513. Wall thickness is 0.165", 0.203" or 0.262".

4.1.3.a Torque strength rating: RS2875.165 = 4,500 ft-lb; RS2875.203 = 5,500 ft-lb; RS2875.262 = 7,500 ft-lb.
4.1.3.b Minimum yield strength = 50 ksi

4.1.4 *Type RS3500 3-1/2" OD Material*: Shall be structural steel tube or pipe, seamless or straight-seam welded, per ASTM A53, A252, ASTM A500, or ASTM A618. Wall thickness is 0.300" (schedule 80).

4.1.4.a Torque strength rating = 13,000 ft-lb
4.1.4.b Minimum yield strength = 50 ksi

4.1.5 *Type RS4500 4-1/2" OD Material*: Shall be structural steel tube or pipe, seamless or straight-seam welded, per ASTM A500 or A513. Wall thickness is 0.337" (schedule 80).

4.1.5.a Torque strength rating = 23,000 ft-lb
4.1.5.b Minimum yield strength = 50 ksi

4.1.6 *SS to RS2875 Combo Pile Material*: Shall be Square Shaft and RS2875 material as described above with a welded adapter for the transition from SS to RS2875.

4.1.7 *SS to RS3500 Combo Pile Material*: Shall be Square Shaft and RS3500 material as described above with a welded adapter for the transition from SS to RS3500.

4.1.8 *SS to RS4500 Combo Pile Material*: Shall be Square Shaft and RS4500 material as described above with a welded adapter for the transition from SS to RS4500.

**4.2 Helix Bearing Plate:**

Shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall conform to the following ASTM specifications.

4.2.1 *SS5 Material*: Per ASTM A572, or A1018, or A656 with minimum yield strength of 50 ksi. Plate thickness is 3/8".
4.2.2 *SS125 and SS1375 Material*: Per ASTM A572 with minimum yield strength of 50 ksi. Plate thickness is 3/8" or ½".
4.2.3 *SS150 and SS175 Material*: Per ASTM A656 or A1018 with minimum yield strength of 80 ksi. Plate thickness is 3/8" or ½".
4.2.4 *SS200 and SS225 Material*: Per ASTM A656 or A1018 with minimum yield strength of 80 ksi. Plate thickness is ½".
4.2.5 *RS2875 Material*: Per ASTM A36, or A572, with minimum yield strength of 36 ksi. Plate thickness is 3/8" or ½".
4.2.6 *RS3500 Material*: Per ASTM A36, or A572, or A1018, or A656 depending on helix diameter, per the minimum yield strength requirements cited above. Plate thickness is 3/8" or ½".
4.2.7 *RS4500 Material*: Per ASTM A572 with minimum yield strength of 50 ksi. Plate thickness is ½".

**4.3 Bolts:**

The size and type of bolts used to connect the central steel shaft sections together shall conform to the following ASTM specifications.

4.3.1 *SS125 1-1/4" Material*: 5/8" diameter bolt (2 per coupling) per SAE J429 Grade 8.
4.3.2 *SS1375 1-3/8" Material*: ¾" diameter bolt (2 per coupling) per SAE J429 Grade 8.
4.3.3 *SS5 and SS150 1-1/2" Material*: ¾" diameter bolt per ASTM A320 Grade L7 or ASTM A325.
4.3.4 *SS175 1-3/4" Material*: 7/8" diameter bolt per ASTM A193 Grade B7.
4.3.5 *SS200 2" Material*: 1-1/8" diameter bolt per ASTM A193 Grade B7.
4.3.6 *SS225 2-1/4" Material*: 1-1/4" diameter bolt per ASTM A193 Grade B7.
4.3.7 *RS2875 2-7/8" OD Material*: ¾" diameter bolts (2 or 4 per coupling) per SAE J429 Grade 5 or 8.
4.3.8 *RS3500 3-1/2" OD Material*: ¾" diameter bolts (3 or 4 per coupling) per SAE J429 Grade 5 or 8.
4.3.9 *RS4500 4-1/2" OD Material*: ¾" diameter bolts (4 per coupling) per SAE J429 Grade 8.

**4.4 Couplings:**

For type SS5, SS150, SS175, SS200, and SS225 material, the coupling shall be formed as an integral part of the plain and helical extension material as hot upset forged sockets. For Type SS125 and SS1375 material, the coupling shall be a cast steel sleeve with two holes for connecting shaft sections together.

For Type RS2875, RS3500, and RS4500 material, the couplings shall either be formed as an integral part of the plain and helical extension material as hot forge expanded sockets, or as internal sleeve wrought steel connectors. The steel connectors can be either tubing or solid steel bar with holes for connecting shaft sections together.

**4.5 Plates, Shapes, or Pile Caps:**

Depending on the application, the pile cap shall be a welded assembly consisting of structural steel plates and shapes designed to fit the pile and transfer the applied load. Structural steel plates and shapes for HELICAL PILE top attachments shall conform to ASTM A36 or ASTM A572 Grade 50.

**4.6 Corrosion Protection**

4.6.1 Galvanization: All Hubbell Power Systems, Inc./A. B. Chance Square shaftmaterial (or equivalent) shall be hot-dipped galvanized in accordance with ASTM A153 after fabrication. All Hubbell Power Systems, Inc./A. B. Chance Type RS material (or equivalent) shall be hot-dipped galvanized in accordance with ASTM A153 or A123 as specified after fabrication.

## 5 EXECUTION

**5.1 Site Conditions**

5.1.1 Prior to commencing Helical Pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where Helical Piles may commence without restriction.

5.1.2 The Contractor shall verify that all Helical Piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

5.1.3 In the event of a discrepancy, the Contractor shall notify the Owner. The Contractor shall not proceed with Helical Pile installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Owner.

**5.2 Installation Equipment**

5.2.1 Shall be rotary type, hydraulic power driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.

*Helical Piles should be installed with high torque, low RPM torque motors, which allow the helical screw plates to advance with minimal soil disturbance.*

5.2.2 Equipment shall be capable of applying adequate down pressure (crowd) and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper Helical Pile alignment.

**5.3 Installation Tooling**

5.3.1 Shall consist of a Kelly Bar Adapter (KBA) and Square shaft or RS drive tools as manufactured by CHANCE Civil Construction or equivalent and used in accordance with the manufacturers written installation instructions.

*Installation tooling should be maintained in good working order and safe to operate at all times. Flange bolts and nuts should be regularly inspected for proper tightening torque. Bolts, connecting pins, and retainers should be periodically inspected for wear and/or damage and replaced with identical items provided by the manufacturer. Heed all warning labels. Worn or damaged tooling should be replaced.*

5.3.2 A torque indicator shall be used during Helical Pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. Torque indicators may be available from the helical pile manufacturer.

- 5.3.2.a Shall be capable of providing continuous measurement of applied torque throughout the installation.
- 5.3.2.b Shall be capable of torque measurements in increments of at least 500 ft-lb

5.3.2.c Shall be calibrated prior to pre-production testing or start of work. Torque indicators which are an integral part of the installation equipment, shall be calibrated on-site. Torque indicators which are mounted in-line with the installation tooling, shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures.

5.3.2.d Shall be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

## 5.4 Installation Procedures

5.4.1 *<u>Central Steel Shaft:</u> (Lead and Extension Sections)*

5.4.1.a The Helical Pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.

5.4.1.b The lead section shall be positioned at the location as shown on the working drawings. Battered Helical Piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required batter angle shall be established. The Helical Pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 20 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt(s) and nut torqued to 40 ft-lb.

5.4.1.c Sufficient down pressure shall be applied to uniformly advance the Helical Pile sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

## 5.5 Termination Criteria

5.5.1 The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.

5.5.2 The minimum installation torque and minimum overall length criteria as shown on the working drawings shall be satisfied prior to terminating the Helical Pile installation.

5.5.3 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:

5.5.3.a Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:

5.5.3.b Remove the existing Helical Pile and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.

*It is generally not recommended to re-use Square shaftHelical Pile shaft material after it has been permanently twisted during a previous installation. Likewise, it is generally not recommended to re-use Type RS Helical Pile shaft material after the coupling bolt holes have been noticeably elongated during a previous installation.*

5.5.3.c If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:

5.5.3.d Install the Helical Pile deeper using additional extension sections, or:

5.5.3.e Remove the existing Helical Pile and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.

5.5.3.f De-rate the load capacity of the Helical Pile and install additional Helical Pile(s). The de-rated capacity and additional Helical Pile location shall be subject to the review and acceptance of the Owner.

5.5.4 If the Helical Pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the Helical Pile re-installed. If the obstruction can't be removed, the Helical Pile shall be installed at an adjacent location, subject to review and acceptance of the Owner.

5.5.5 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the Helical Pile to facilitate extension removal.

5.5.6 The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

*The average torque can be empirically related to the Helical Pile's ultimate capacity in end-bearing. This well-known attribute of helical piles can be used as a production control method to indicate the Helical Pile's end-bearing capacity.*

# APPENDIX

## TABLE-1A

MECHANICAL STRENGTH RATINGS – SQUARE SHAFT HELICAL PILES

| RATING TYPE | CENTRAL STEEL SHAFT PRODUCT FAMILY | | | | | | |
|---|---|---|---|---|---|---|---|
| | **SS125 1-1/4" RCS** | **SS1375 1-3/8" RCS** | **SS5 1-1/2" RCS** | **SS150 1-1/2" RCS** | **SS175 1-3/4" RCS** | **SS200 2" RCS** | **SS225 2-1/4" RCS** |
| **Torque Strength Rating (ft-lb)** | 4,000 | 5,500 | 5,500 | 7,000 | 11,000 | 16,000 | 23,000 |
| **Ultimate Strength Per Helix (kip) (Tension/Compression)** | *30 | *35 | *40 | *40 | *50 | 60 | 60 |
| **Uplift/Compression Capacity Limit¹ (kip)** | 40 | 55 | 55 | 70 | 110 | #150 | #200 |
| **Ultimate Tension Strength² (kip)** | 60 | 75 | 70 | 70 | 100 | 150 | b. 200 |

*** For 14" Dia. 3/8" Thick Helix Plates, Reduce the Ultimate Capacity by 20%**

**1 - Based on torque rating – Uplift/Compression Capacity Limit = Torque Rating x Kt**

**"Default" Kt for Square shaft= 10**

**2 – Based on mechanical strength of coupling**

**# - Based on mechanical strength of coupling bolt**

**NOTE: Actual installed capacities are dependent on site specific soil conditions.**

# APPENDIX

## TABLE-1B

MECHANICAL STRENGTH RATINGS – ROUND SHAFT HELICAL PILES

| **RATING TYPE** | **CENTRAL STEEL SHAFT PRODUCT FAMILY** | | | | |
|---|---|---|---|---|---|
| | **RS2875.165 2-7/8" OD Pipe Shaft** | **RS2875.203 2-7/8" OD Pipe Shaft** | **RS2875.262 2-7/8" OD Pipe Shaft** | **RS3500.300 3-1/2" OD Pipe Shaft** | **RS4500.337 4-1/2" OD Pipe Shaft** |
| **Torque Strength Rating (ft-lb)** | 4,500 | 5,500 | 7,500 | 13,000 | 23,000 |
| **Ultimate Strength Per Helix (kip) (Tension/Compression)** | *40 | *40 | *40 | 50 | 60 |
| **Uplift/Compression Capacity Limit[1] (kip)** | 36 | 44 | 60 | 91 | 138 |
| **Ultimate Tension Strength[2] (kip)** | 50 | 60 | 100 | 120 | 140 |

*** For 14" Dia. 3/8" Thick Helix Plates, Reduce the Ultimate Capacity by 20%**

**1 - Based on torque rating – Uplift/Compression Capacity Limit = Torque Rating x Kt**

**"Default" Kt for Type RS2875 Series = 8, for Type RS3500.300 = 7, for Type RS4500.337 = 6**

**2 – Based on mechanical strength of coupling**

**NOTE: Actual installed capacities are dependent on site specific soil conditions.**

# APPENDIX

## TABLE-2

### GUIDANCE OF GROUND AGGRESSIVENESS CLASSIFICATION

Soil tests may be performed to measure the aggressiveness of the soil environment, especially if field observations indicate corrosion of existing structures. The most common and simplest tests are for electrical resistivity, pH, chloride, and sulfates. The designation for these tests and the critical values defining whether an aggressive soil environment exists, are as shown below. Per FHWA-RD-89-198, the ground is considered aggressive if any one of these indicators shows critical values.

| Property | Test Designation | Critical Values |
|---|---|---|
| Resistivity | ASTM G 57<br>AASHTO T-288 | below 2,000 ohm-cm |
| pH | ASTM G 51<br>AASHTO T-289 | below 5 |
| Sulfate | ASTM D 516M<br>ASTM D 4327 | above 200 ppm |
| Chloride | ASTM D 512<br>ASTM D 4327<br>AASHTO T-291 | above 100 ppm |
| Organic Content | AASHTO T-267 | 1% max |