



Get In; Get Out: Structural Plate Culvert and Bridge Solutions

Jonathan Mohler
Bridge Consultant, Central and South Texas



Contech: Your Project Partner

Full Design Support

- 100+ Year Experience
- All 50 DOTs
- **Local Representation**

Full Installation Support

- Over 90,000 Installations
- Pre-Construction Support
- On-Site Representation Available

Texas Team:

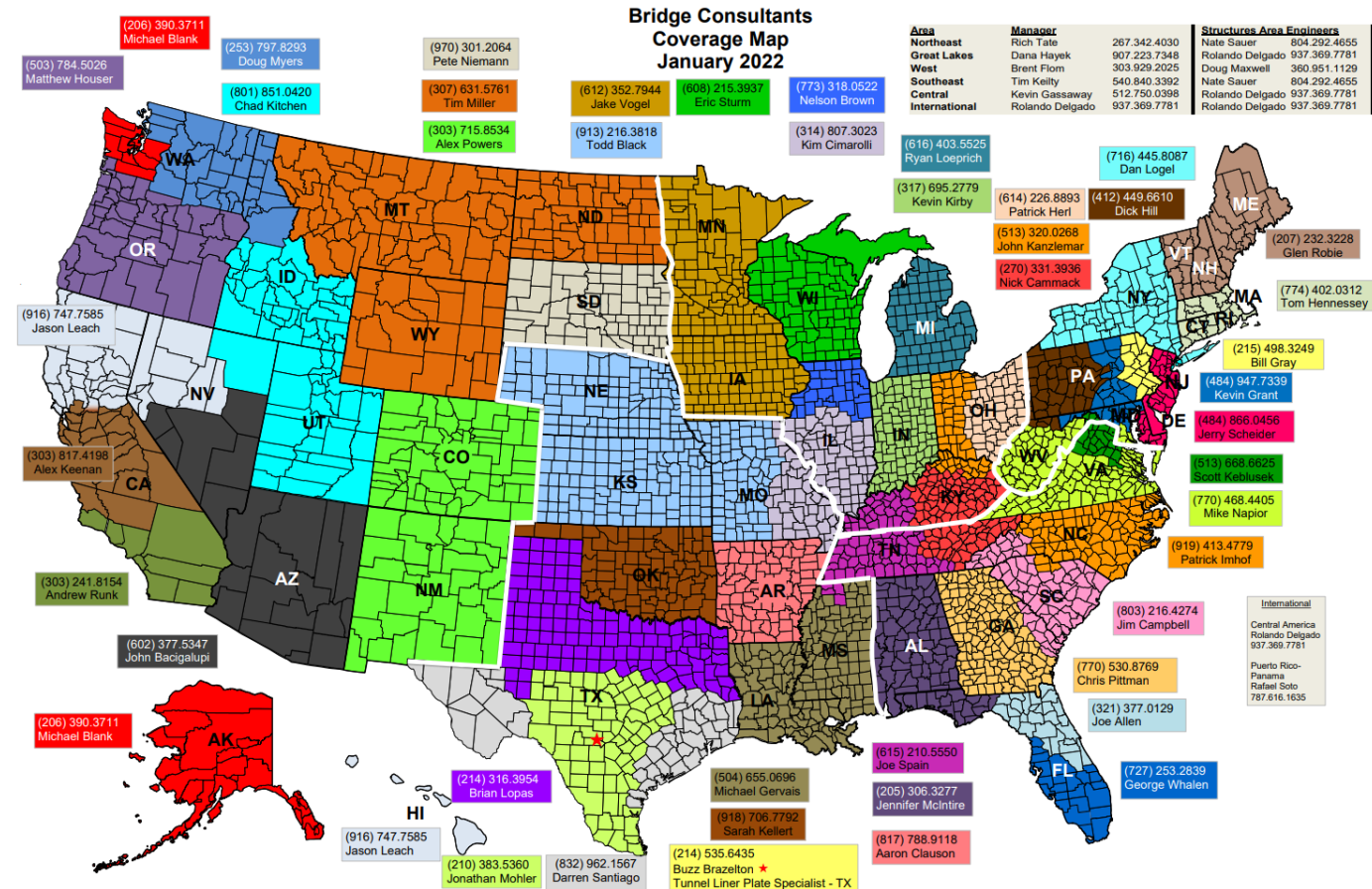
Brian Lopas – North Texas

Darren Santiago – Houston and West

Jonathan Mohler – Central and South

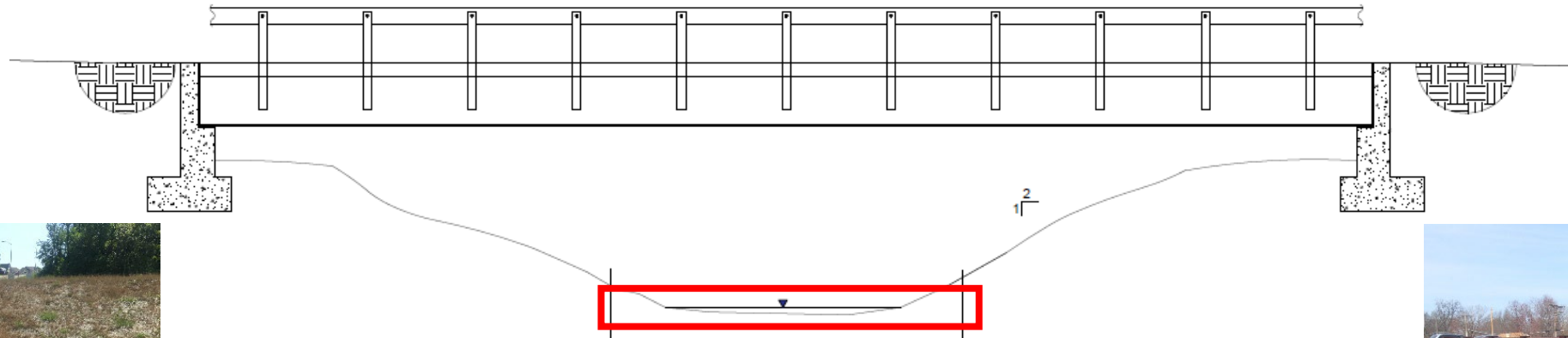
Buzz Brazelton – Tunnel Liner Plate and
Specialty Products

Kevin Gassaway – Area Director



Contech: Your Project Partner

Plate. Precast. Truss. Girder.













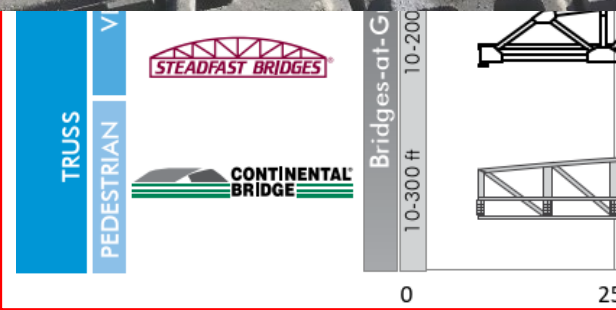
Supports FHWA
**Accelerated Bridge
Construction**
Methods



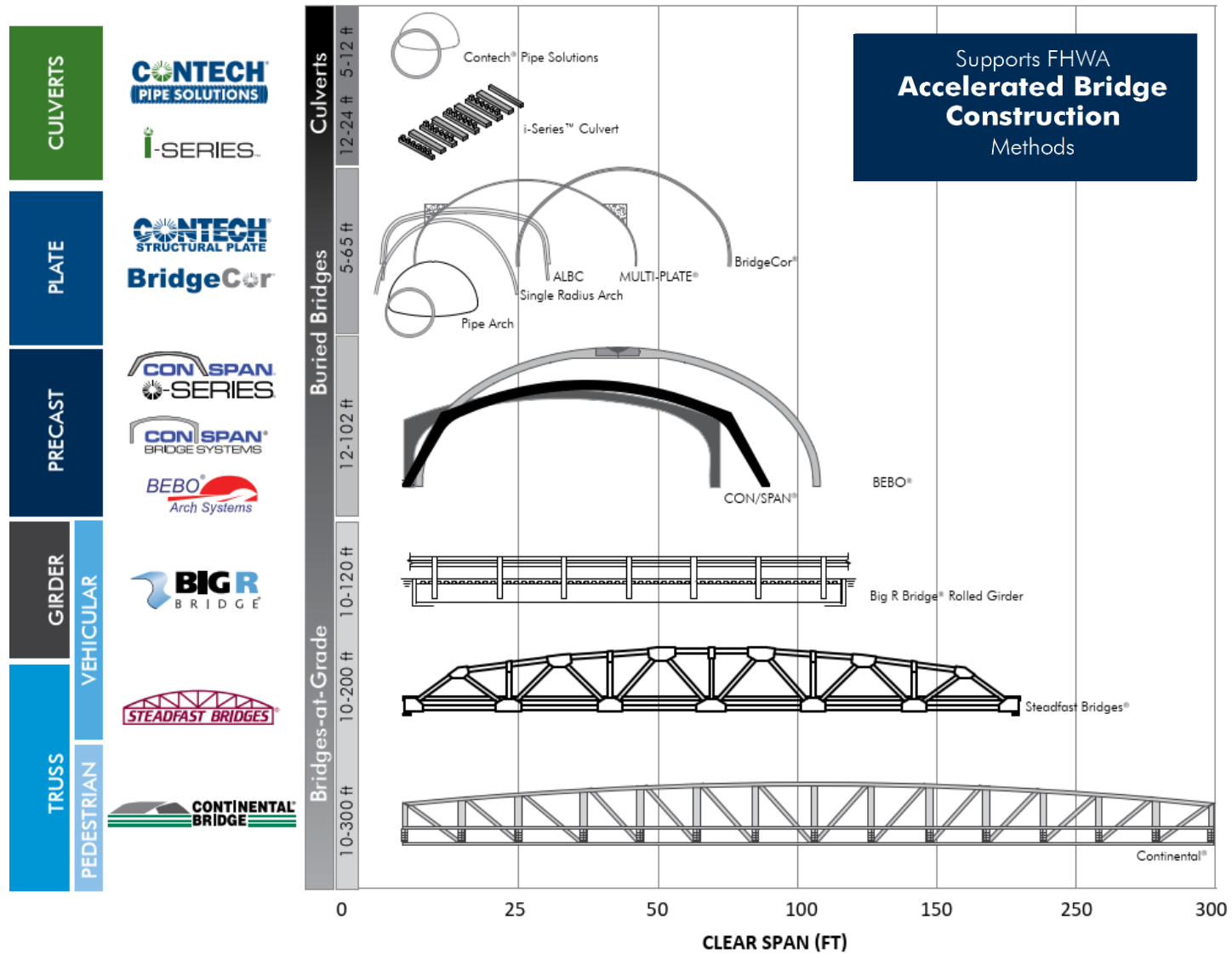
TRUSS PEDESTRIAN	 STEADFAST BRIDGES	Bridges at 10-20 ft 10-300 ft 0
	 CONTINENTAL BRIDGE	

Bridges

Supports FHWA
**Accelerated Bridge
Construction**
Methods



Clear Span Bridges



Contech Structural Plate

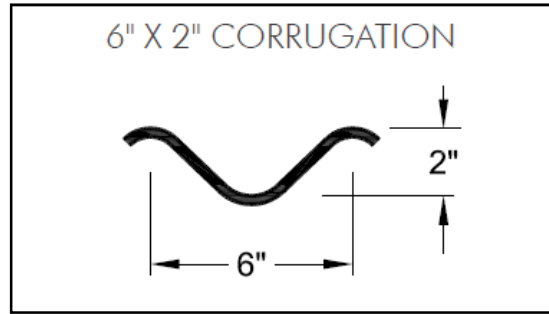
BridgeCor / MULTI -PLATE



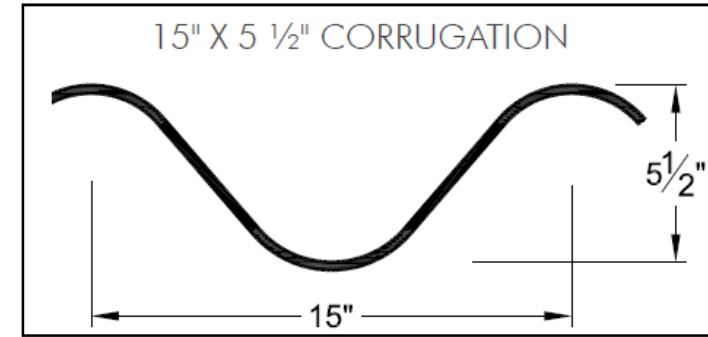
Aluminum Structural Plate



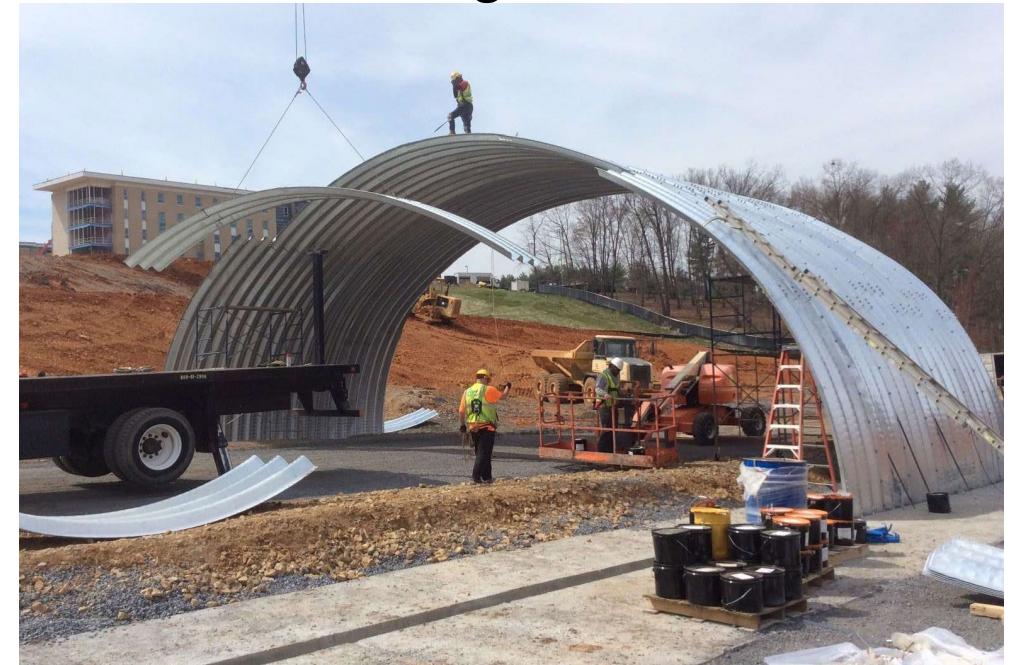
Structural Plate – Steel



MULTI-PLATE®



BridgeCor®



Aluminum Structural Plate

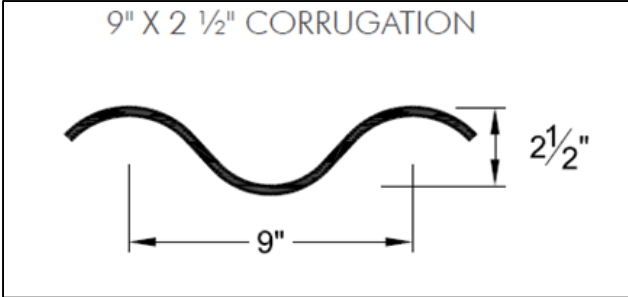
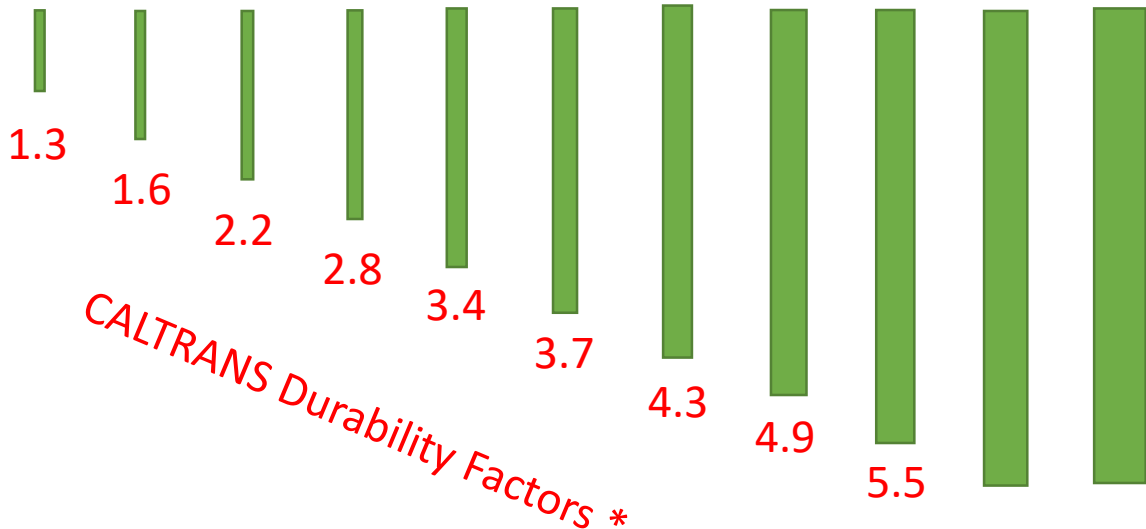


Plate Corrugations & Thickness – Structural Versatility

Galvanized Steel

CMP Gages		CMP and Plate Gages			Steel Structural Plate Gages					
16	14	12	10	8	7	5	3	1	5/16"	3/8"
.064"	.079"	.111"	.140"	.170"	.188"	.218"	.249"	.280"	.318"	.380"



Aluminum

Aluminum Structural Plate Thicknesses					
.125"	.150"	.175"	.200"	.225"	.250"

How is Steel Structural Plate different than CMP?

- Expanded thickness capabilities
 - Up to 3/8" thick
- Increased galvanizing
 - 50% more zinc coating
- Clear Span Capabilities
 - Aluminum - Up to 35'
 - Steel - Up to 80'
- Well graded/free draining select backfill material

* CALTRANS Chart for Estimating average invert life for plain galvanized culverts

Structural Plate Durability

Contributing Factors of Long-Term Durability

- pH
- Resistivity
- Hardness
- External contaminants
 - Deicing salts
 - Agricultural chemicals
- **Abrasion Levels**



Installed 1966 Bay of Fundy, ME

Recommended Environmental Ranges

STEEL

$6.0 \leq \text{pH} \leq 10.0$
Resistivity > 2,500 ohm-cm

ALUMINUM

$4.0 \leq \text{pH} \leq 9.0$
Resistivity > 500 ohm-cm

Abrasion Levels

Table 2 — FHWA Abrasion Guidelines			
Abrasion Level	Abrasion Condition	Bed Load	Flow Velocity (fps)
1	Non-Abrasive	None	Minimal
2	Low Abrasion	Minor	< 5
3	Moderate Abrasion	Moderate	5 - 15
4	Severe Abrasion	Heavy	> 15

Material Design for Durability

Steel MULTI-PLATE



Installed 1972 - Willburgh, MA

Aluminum Structural Plate

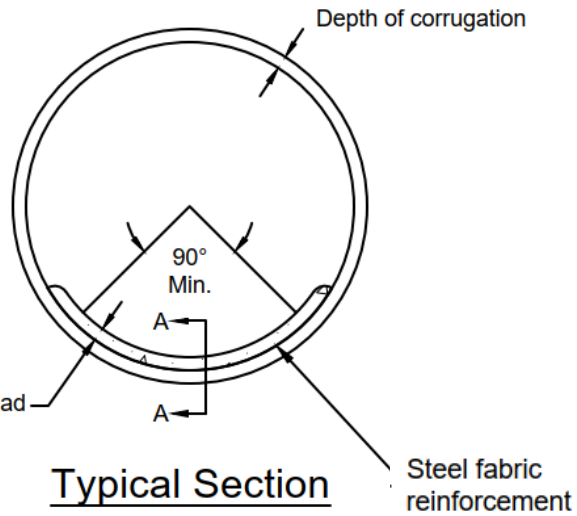


Installed 1973 - Napoleon, IN

After 50 years of service, with no visible wear, this aluminum structure will last over 75 years

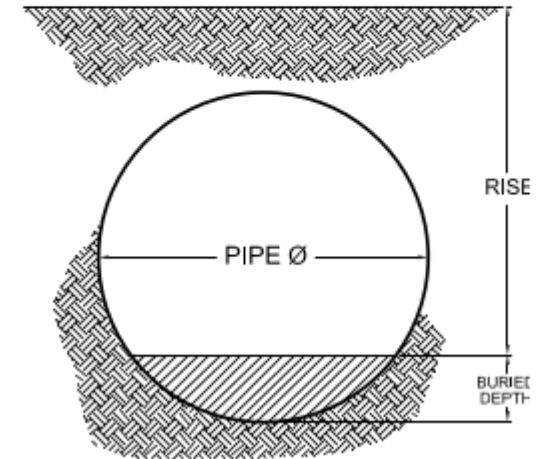
Structural Plate Durability – Supplemental Durability Enhancements

Paved invert or heavier gage / supplemental invert plates

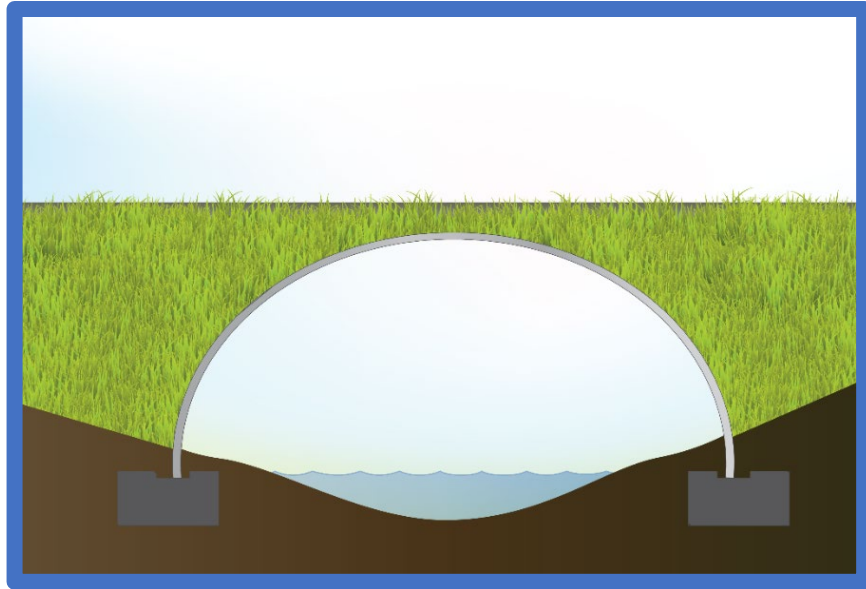


Buried invert

Buried Invert



Benefits of Clear Span Structures



Improves Long Term Durability

- No Invert - Keep normal flows away from structure
- Exposure to high flows for short duration
- Free draining backfill
- Clear span sensitive wetlands
 - Animal and Aquatic Organisms Underpasses
- Roadways and Trails – Limited durability issue

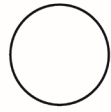
Buried Arch Structures



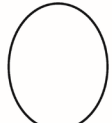
60'-4" Span X 22'-8" Rise 2-Radius Arch BridgeCor

Structural Plate Shapes

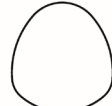
6 standard structure shapes



Round



Vertical Ellipse



Underpass



Pipe-Arch



Horizontal Ellipse



Single Radius Arch

Standard Shapes

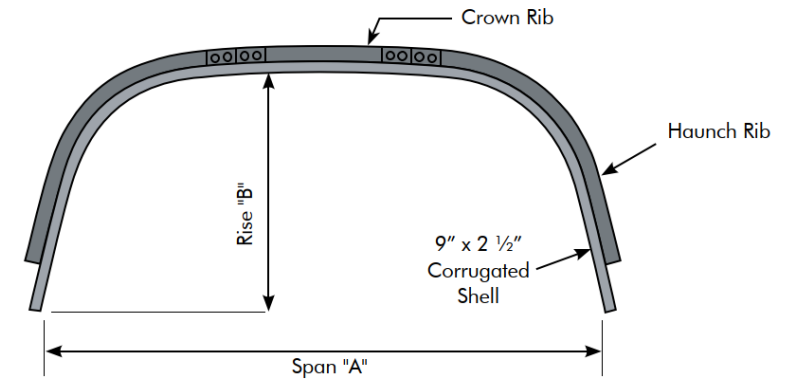
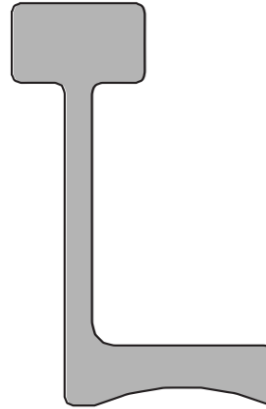
(custom shapes are available)



Aluminum Box Culvert (ALBC)

TYPE VI RIB

- Maximize hydraulics
- Min cover applications / low rise
- Reinforcing adds stiffness for HL-93 loading
- Eliminate multiple barrels to reduce maintenance
- Improved durability



Box Culvert Shell Cross Section



Foundation Alternatives



Full invert



Footing pads



CIP Reinforced concrete footings



Steel EXPRESS Foundations

Steel EXPRESS Foundations

STEEL
EXPRESS® Foundations

Stay-In-Place Form Foundation System

- Reinforcing placed at the plant
- Modular and light weight units
- Foundation arrives on truck with the structure
- Reduces road closure time
- Reduces cost and time of stream diversion
- Reduces weather risk
- Eliminates requirement for structural concrete labor
- Eliminates keyway grouting step



Structural Plate Metal Headwalls and Wingwalls

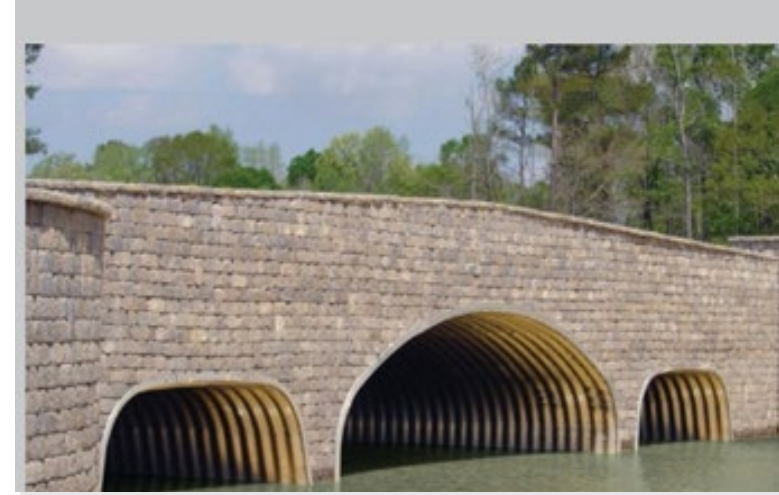


Aluminum Structural Plate Headwall/Wingwalls



Steel MULTI-PLATE Headwall/Wingwalls

Additional Structure End Treatments Options



Key Feature– Accelerated Bridge Construction

Qualifies for ABC projects

- Preassembly reduces road closure time from weeks to days
- Prepping Foundation while assembling the structure
- Structural Plate can be fully or partially assembled then lifted into place
- Light weight structure may not require a crane rental
- Backfill can start immediately after installation



Key Feature – Lightweight Construction

Light weight materials for speed of construction

- Freight economy
- Reduced equipment and labor demands
- Ideal for remote site applications
- Working under utilities
- Reduced detour time



Accelerated Bridge Manufacturing – Emergency Response

Contech can respond to emergency washouts

- CSX Railroad washout on a mainline track
- Designed, manufactured and installed a new aluminum structural plate culvert in one week



Structural Plate – In-Situ Rehabilitation / Reline

Rehabilitating our aging infrastructure

- New structure designed to handle existing loads
- Safer construction process
- Minimizes or eliminates roadway downtime



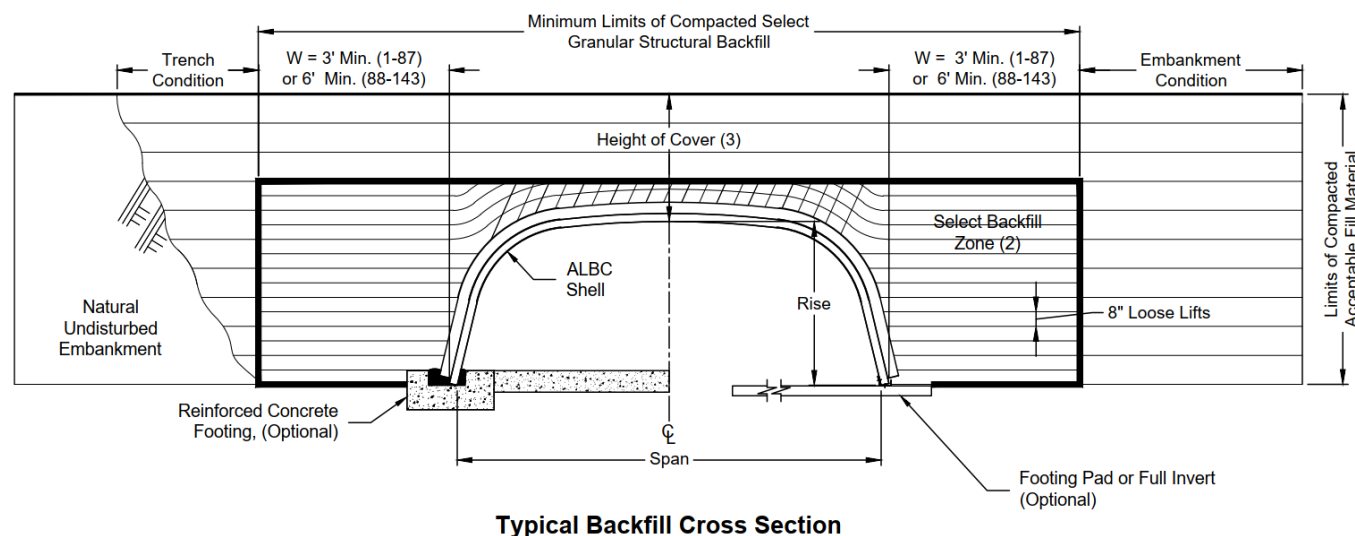
2020 NSCPA Project of the Year - Multiplate - I-94 Montana DOT – Reline 11'-4" x 10'-3" Underpass

Structural Plate – Design and Construction Standards

Structural Plate Design Standards

- Design - AASHTO LRFD Bridge Design Specifications - Section 12
- Material (Steel) - AASHTO M167 – Standard Specification for Corrugated Steel Structural Plate - ASTM A761
- Material (Aluminum) - AASHTO M219 – Standard Specification for Corrugated Aluminum Structural Plate ASTM B746
- ASTM B864 (Specific to Aluminum Box Culverts)
- Construction – AASHTO LRFD Bridge Construction Specifications – Section 26

Load Ratings – Available For All Structure Types



Structural Plate Design Guide

Structural Plate Technical Information

- Primary resource for structural plate
 - Design processes
 - Service life design guidance
 - Product details
 - Specifications
 - Design details for structure shapes
 - Max./min. height of cover information
 - Structure Plate make-up
 - Plate gage/thickness requirements
 - Reinforcing rib size/spacing
- NCSPA- National Corrugated Steel Pipe Association
 - Service life calculator (www.ncspa.org)



**Structural
Plate
Design
Guide**

8th Edition



MULTI-PLATE®

Aluminum Structural Plate

Aluminum Box Culvert

SUPER-SPAN™

BridgeCor®

Steel EXPRESS® Foundations



Designer Tools – Contech Design Center

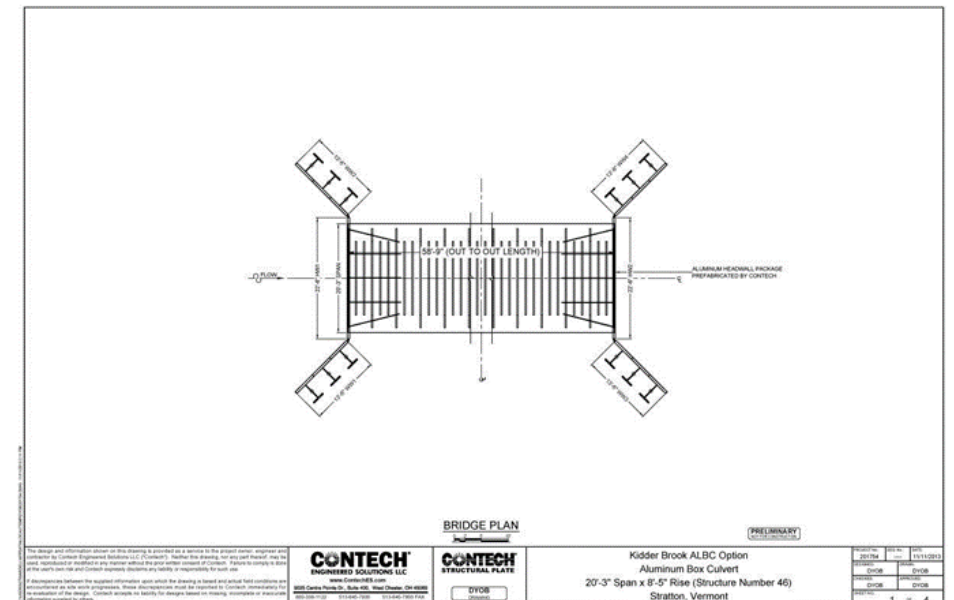
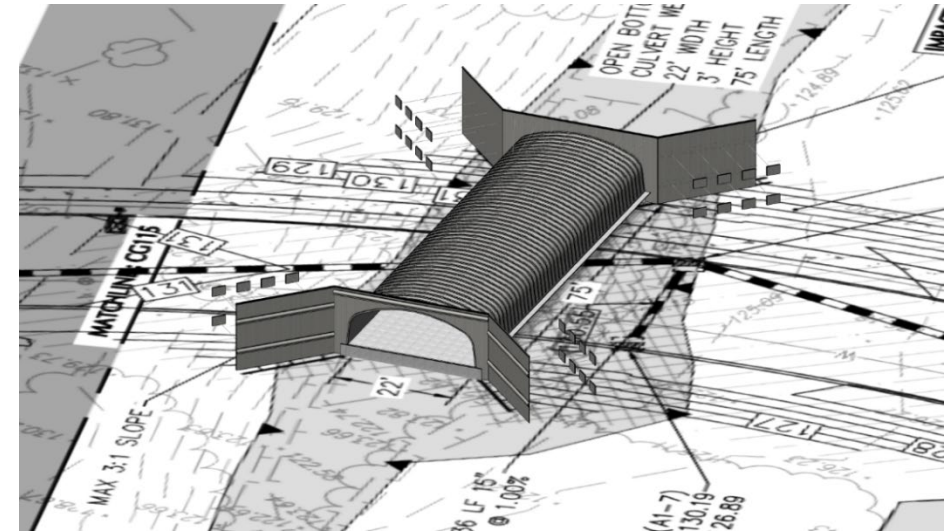
Online Design Tools

Contech makes it easy for you to "design your own project" with our convenient DYO Project tools. These interactive tools allow you to quickly and easily prepare designs and supporting documents for estimates/project meetings and be more efficient with your time.



- Available for aluminum and steel structures
- Interactive tool generates preliminary drawings and estimates
- Used for planning & client communications

<https://www.conteches.com/designcenter>





Multiplate Installation - ALBC

Aluminum Box Culvert Assembly and Installation Process

2015 11 4

Winchester, KY and Mansfield, TX Manufacturing



Bundling and shipping



Approximately 5,000 lbs.
maximum weight per lift.
Multiple lifts may be bundled
together.



Assembly drawings

Haunch and crown rib designation

- HR4 - 20 PCS. x 76" LG.
TYPE VI HAUNCH @ 8" LOCATE WHERE SHOWN
- HR - 2 PCS. x 75.375" LG.
TYPE IV HAUNCH LOCATE WHERE SHOWN
- CR8 - 20 PCS. x 125" LG.
TYPE VI CROWN @ 18" C/C
- CR3 - 2 PCS. x 125" LG.
TYPE IV CROWN LOCATE WHERE SHOWN
- CROWN CENTERLINE
- HR5 - 20 PCS. x 76" LG.
TYPE VI HAUNCH @ 18" LOCATE WHERE SHOWN
- HR2 - 2 PCS. x 75.375" LG.
TYPE IV HAUNCH LOCATE WHERE SHOWN

Custom-cut plate (numbered)

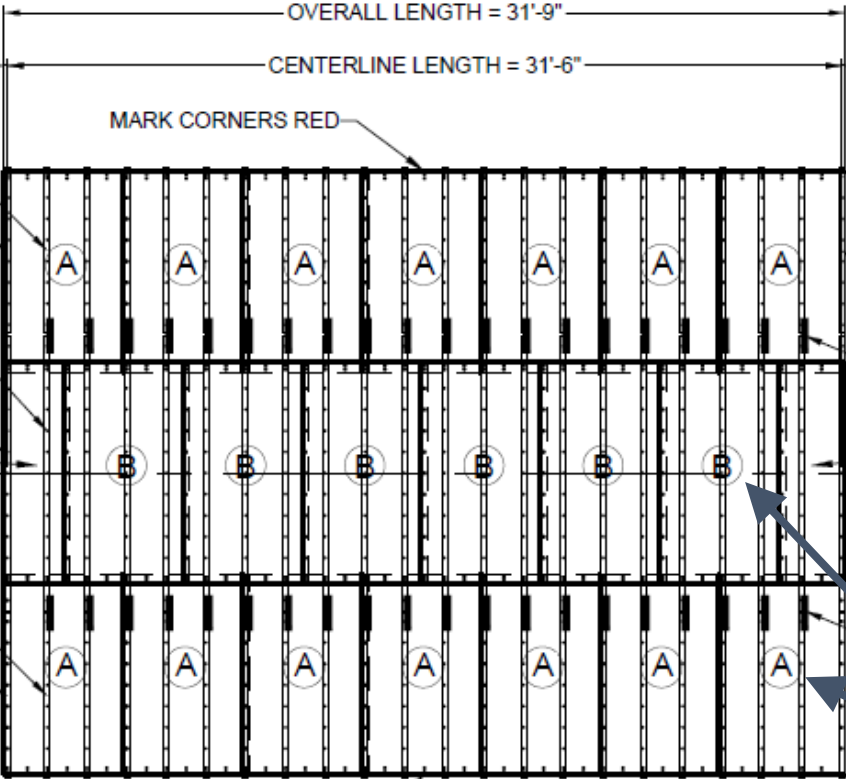
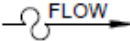


Plate length and gage

- 9N PLATE .125 THK.
- 10N PLATE .150 THK.
- 9N PLATE .125 THK.

Standard plate designation

ALBC - DEVELOPED PLAN (OUTSIDE VIEW)
18'-2" SPAN x 4'-7" RISE

Plate and rib identification in the field

Custom-cut plate
(numbered)



Rib
designation

Determining the proper bolt length

PLATE ONLY

	1 PLATE	2 PLATE	3 PLATE	4 PLATE
0.100" - 0.125" THK. PLATE		1 1/4"	1 1/4"	1 1/2"
0.150" - 0.175" THK PLATE		1 1/4"	1 1/2"	2"
0.200" - 0.250" THK. PLATE		1 1/2"	2"	2"

PLATE W/ T2 OR T4 REINFORCING RIB OR RECEIVING CHANNEL

	1 PLATE	2 PLATE	3 PLATE	4 PLATE
0.100" - 0.125" THK. PLATE	1 1/4"	1 1/2"	1 1/2"	2"
0.150" - 0.175" THK PLATE	1 1/4"	1-1/2"	2"	2"
0.200" - 0.225" THK. PLATE	1 1/2"	2"	2"	2"
0.250" THK. PLATE	1 1/2"	2"	2"	2 1/2"

PLATE W/ T6 REINFORCING RIB

	1 PLATE	2 PLATE	3 PLATE	4 PLATE
0.100" - 0.125" THK. PLATE	1 1/2"	2"	2"	2"
0.150" - 0.175" THK PLATE	2"	2"	2"	2 1/2"
0.200" - 0.225" THK. PLATE	2"	2"	2 1/2"	2 1/2"
0.250" THK. PLATE	2"	2"	2 1/2"	2 1/2"

2-Plate laps



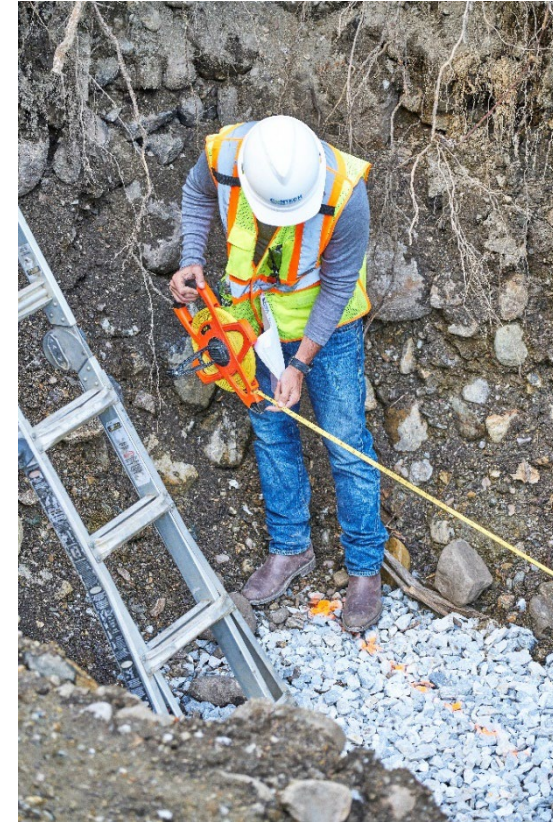
3-Plate lap with
reinforcing rib
(Not yet attached)

Site preparation

Verify bearing capacity meets minimum requirements of structure design



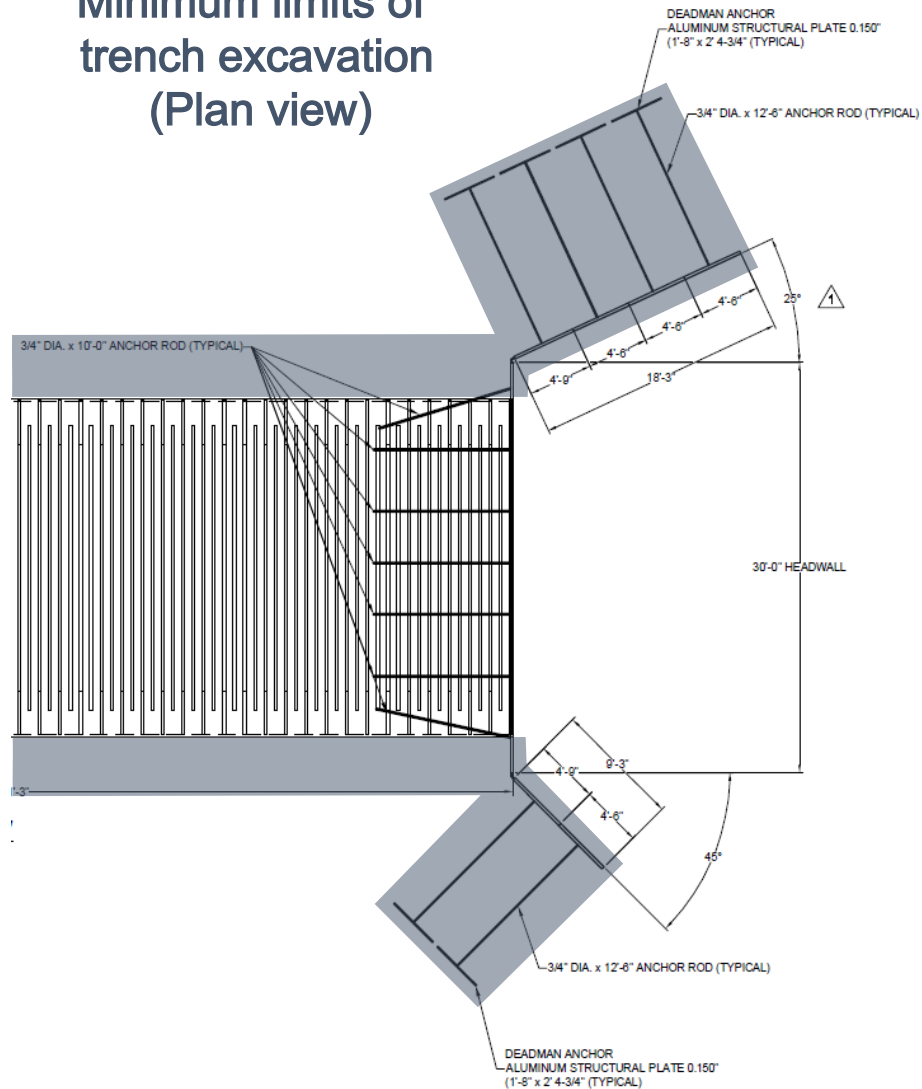
Site preparation



Trench should allow for full depth and length of the headwall and wingwall panels

Site preparation

Minimum limits of trench excavation
(Plan view)



Equipment provided by Contech



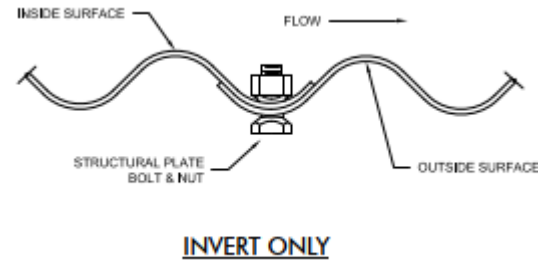
Recommended tools for assembly



Safety



Proper bolting and torque requirements



Proper nut orientation –
Rounded end faces
the bolt head



Place nuts on shell exterior to prevent using
impact driver overhead

Invert assembly process



Torque all
invert bolts to
100-150 ft-lbs



Assembly of shell



Assembly of shell continued



Installation of ribs at circumferential seams



Installation of ribs at circumferential seams



Installation of remaining ribs



Installation of rib splices

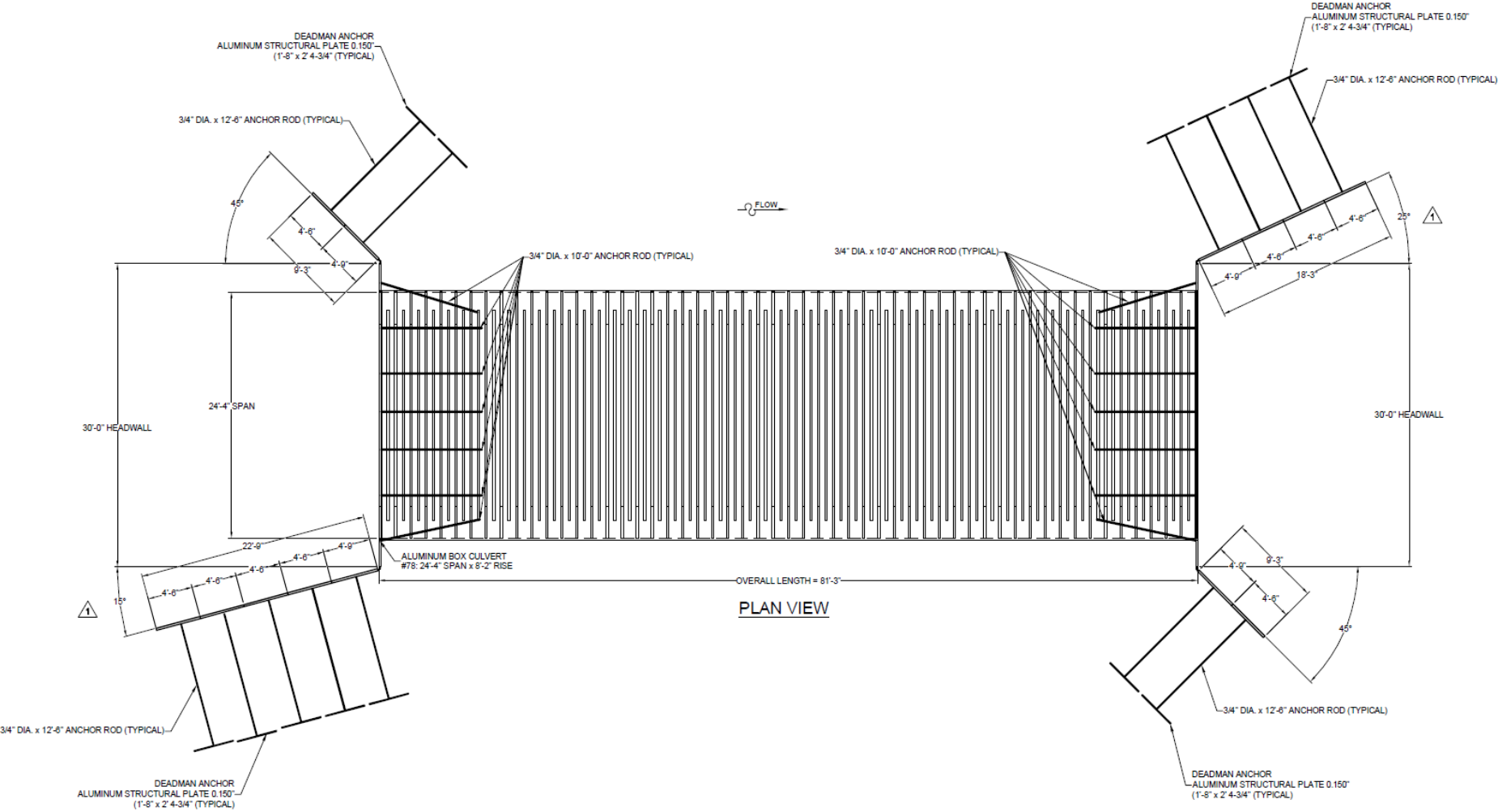


Proper end rib orientation for aluminum headwall



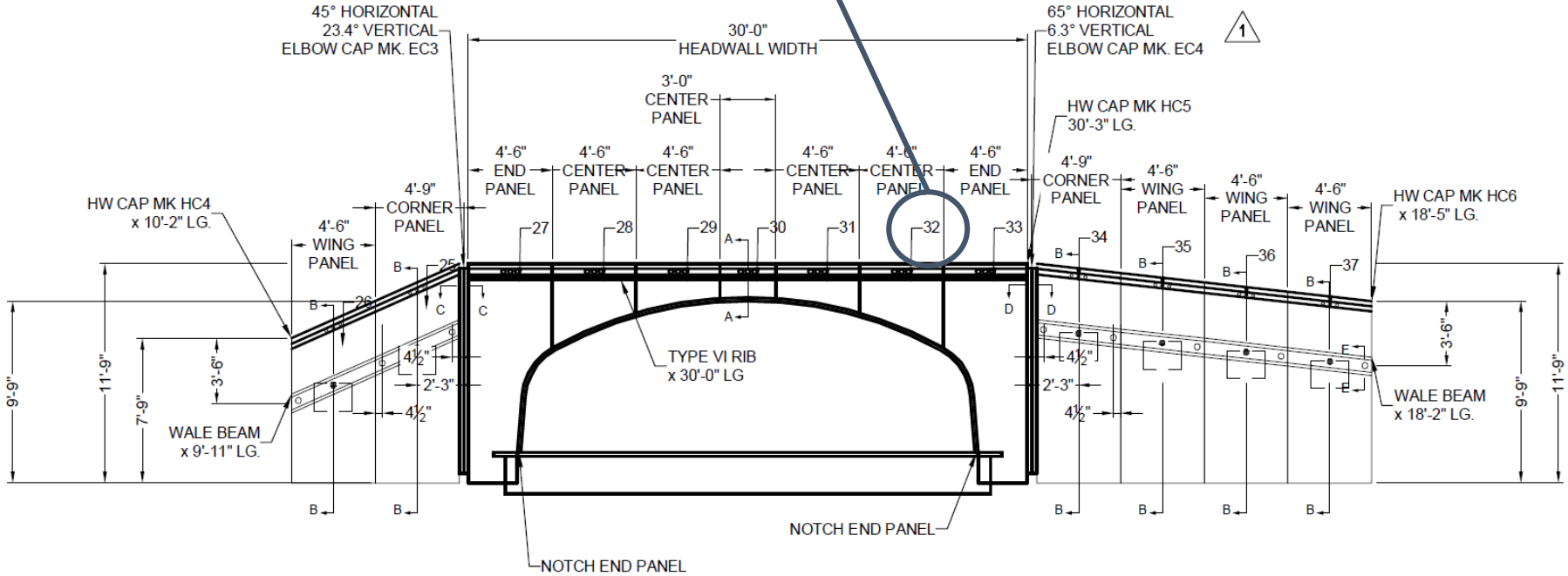
**Proper Orientation of
End Rib To Receive
Aluminum Headwall**

Headwall/Wingwall Assembly Drawings

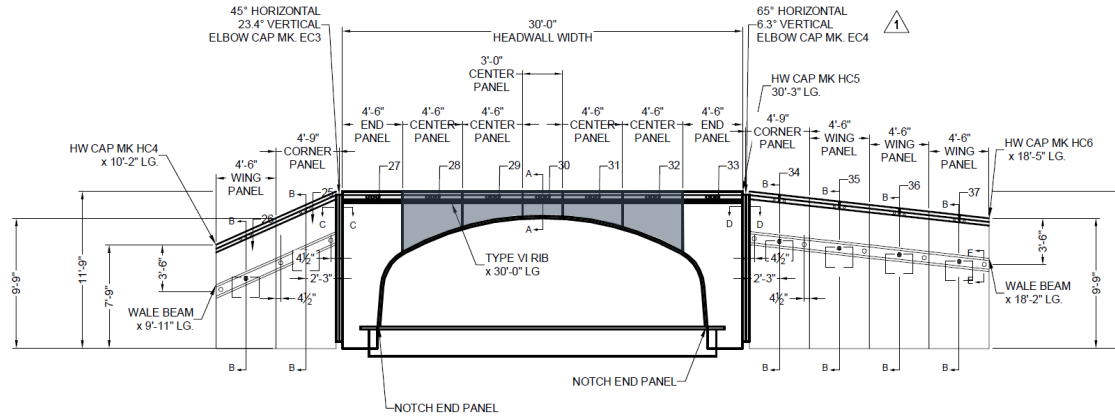


Headwall/Wingwall Assembly Drawings

Plate identification number



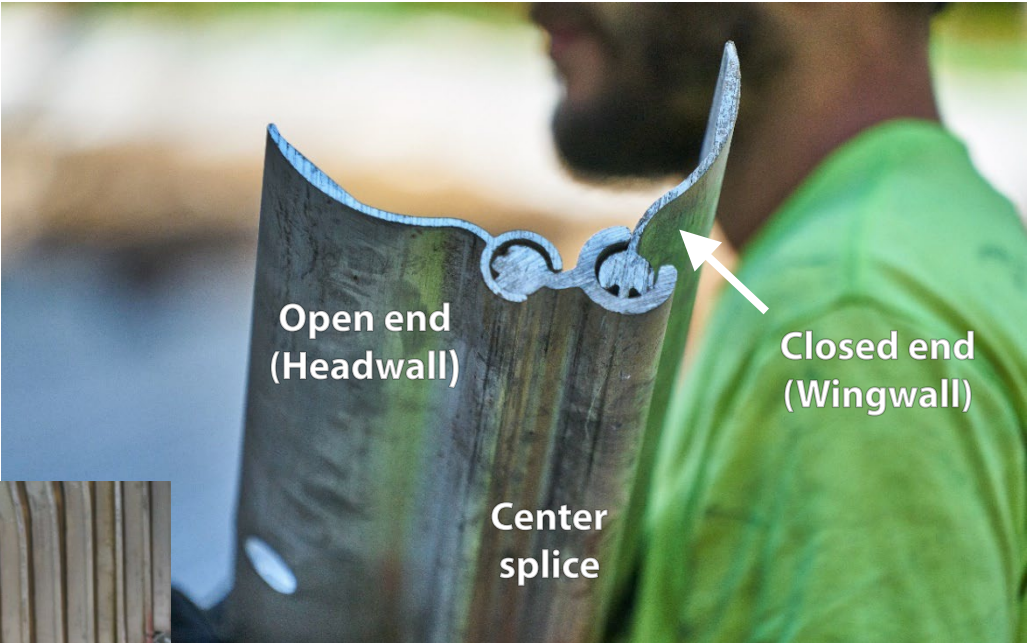
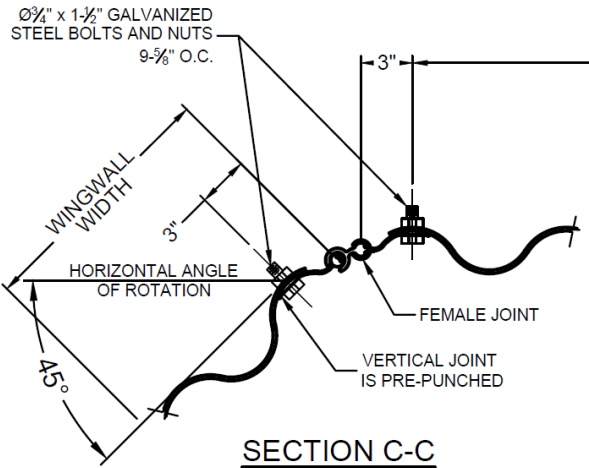
Headwall assembly – Center panels



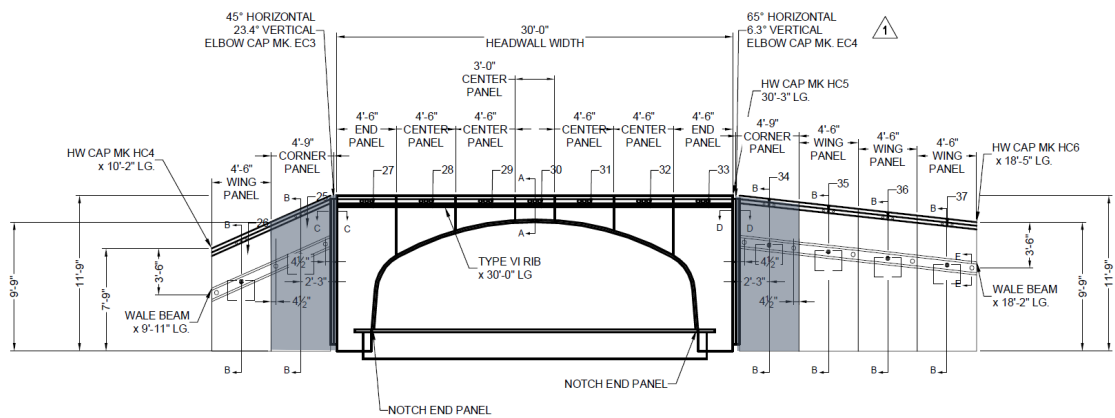
Ensure that Center Panels are level before bolting to end rib



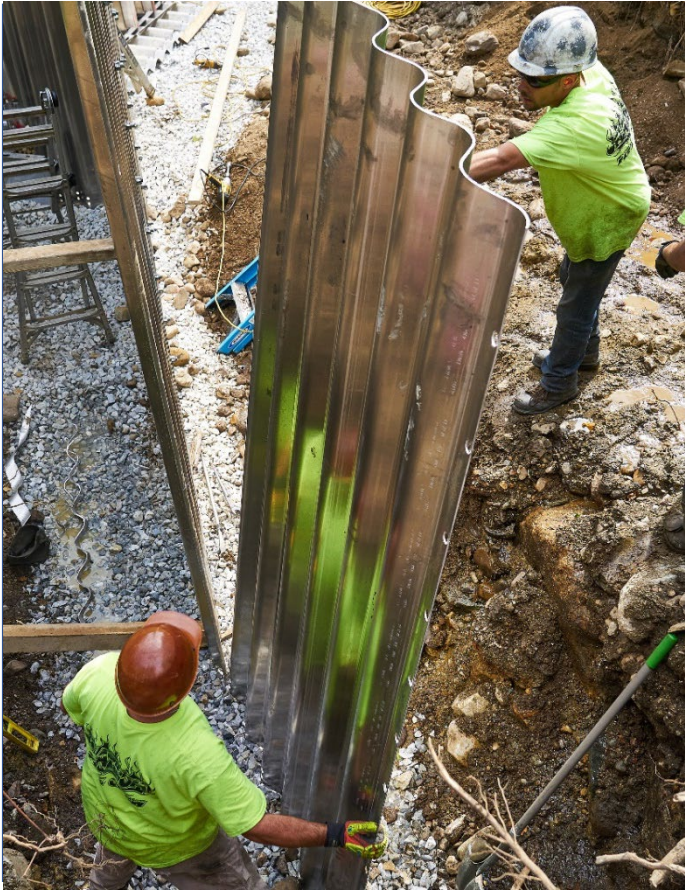
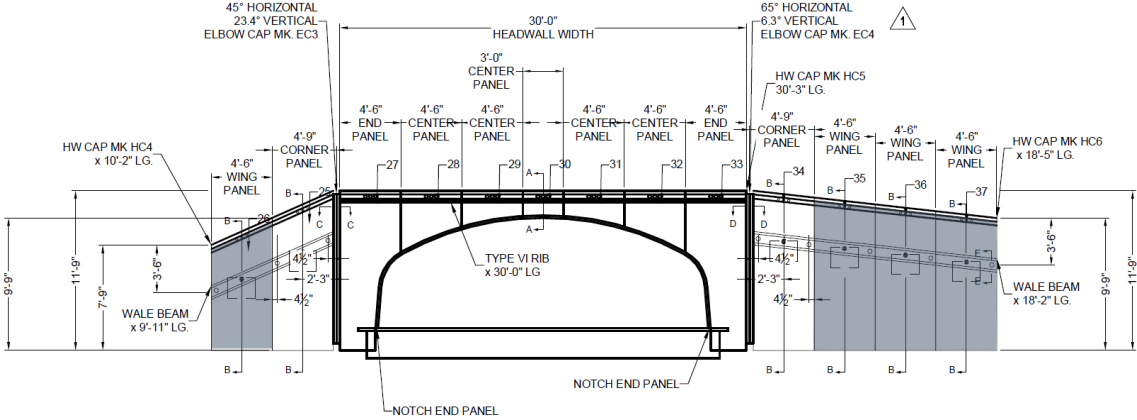
Headwall Corner Joint



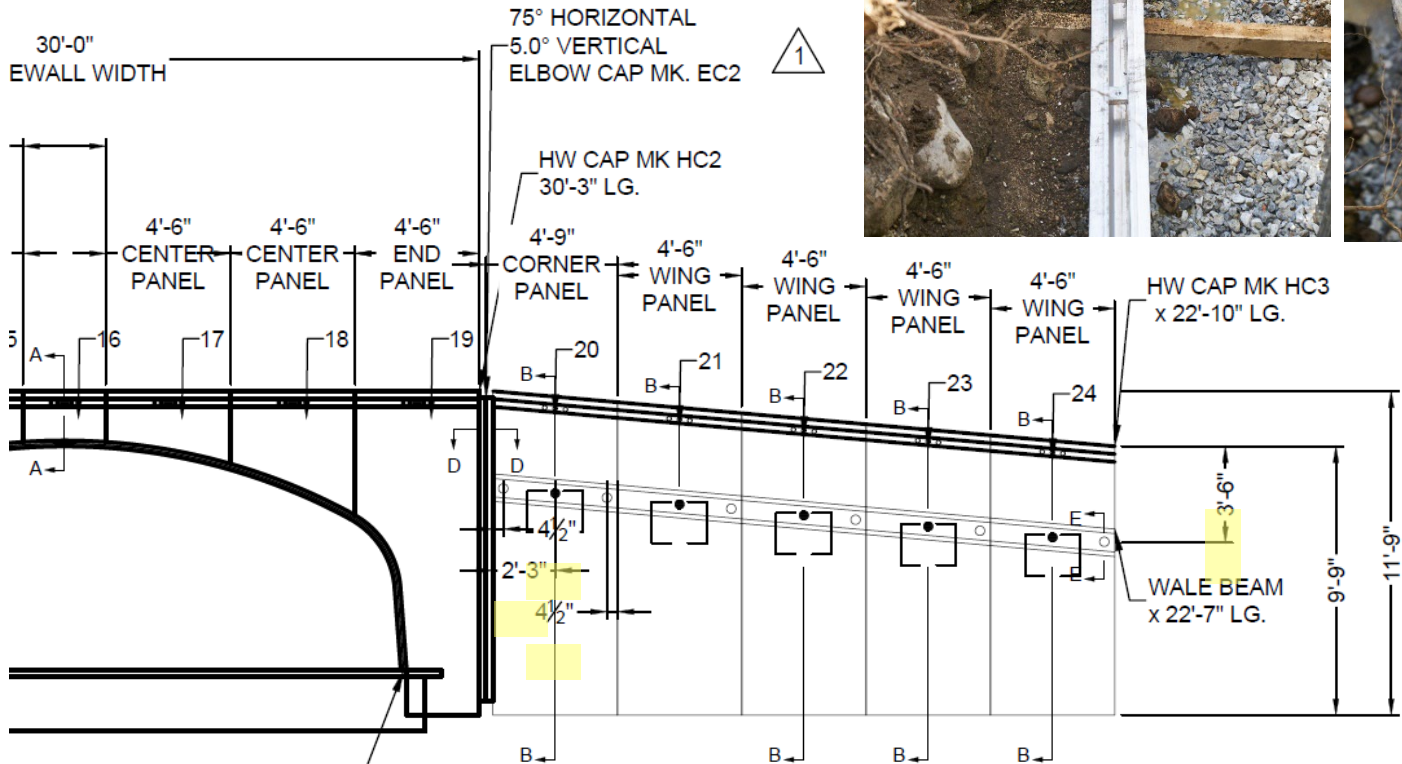
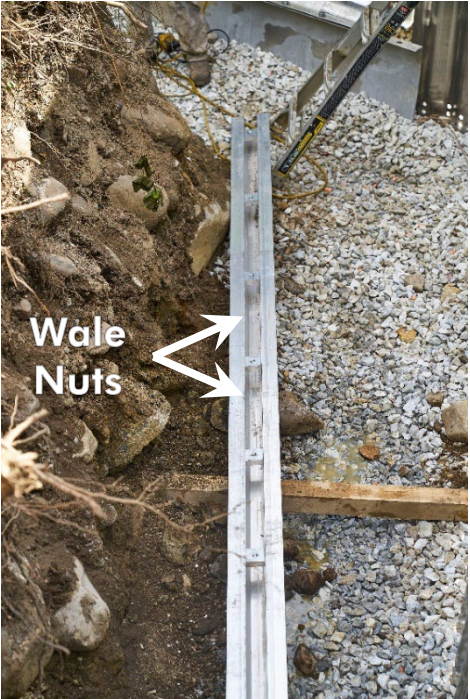
Wingwall Assembly – Corner Panels



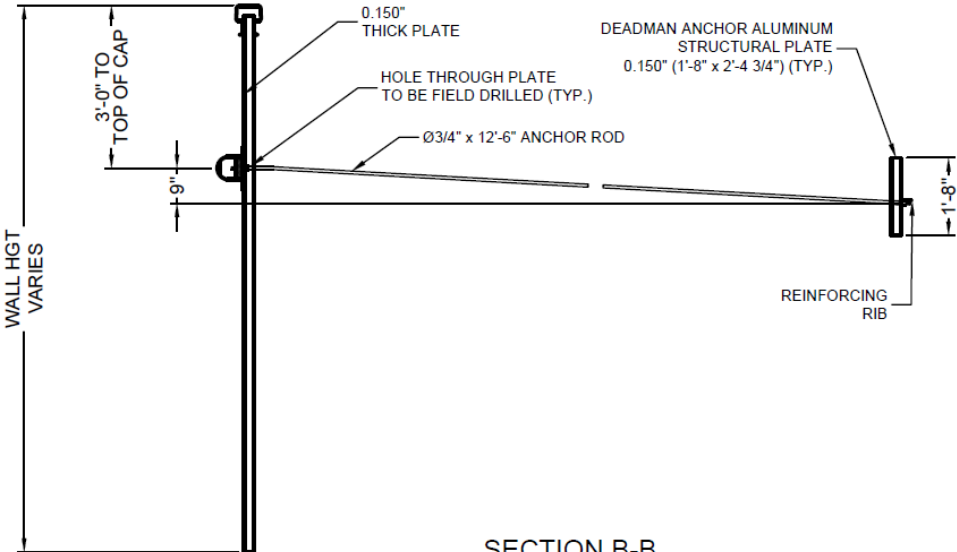
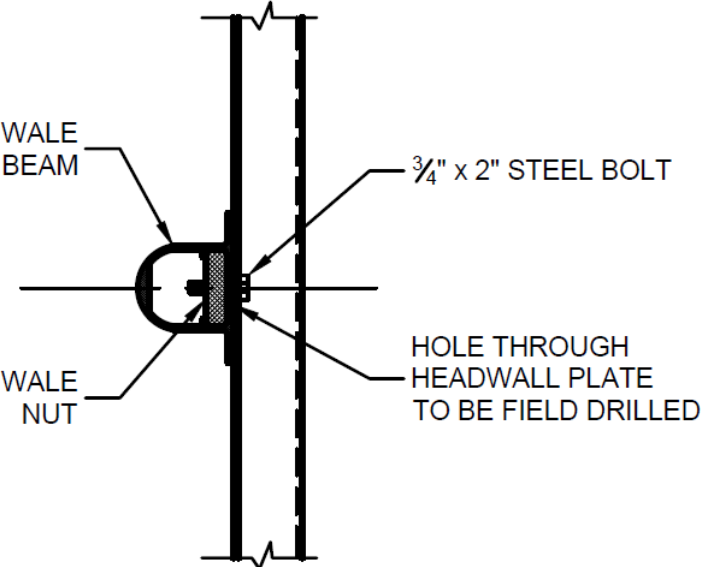
Wingwall Assembly – Wing Panels



Wale Beams



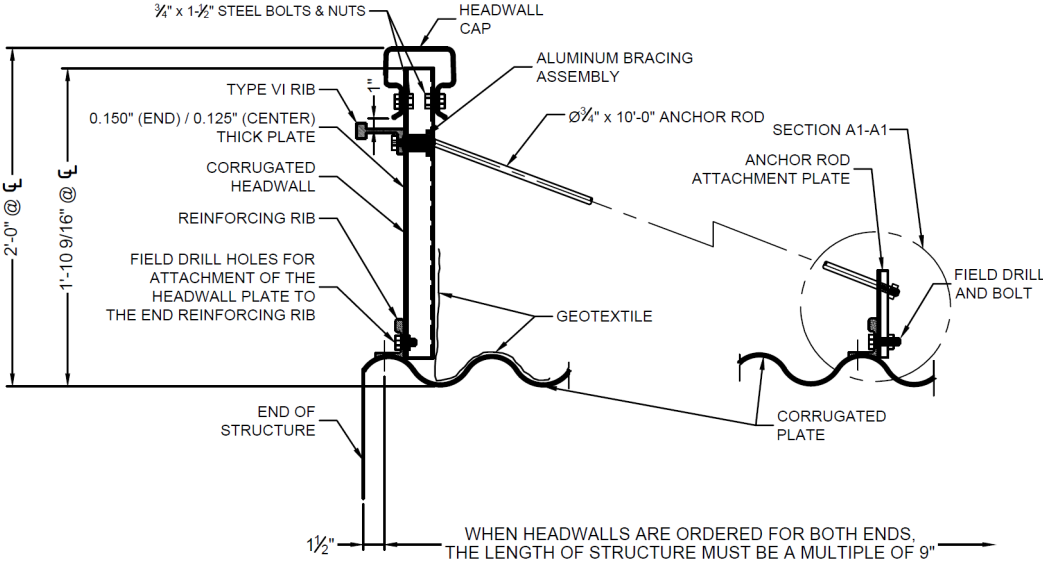
Wale Beams and Dead Man Anchors



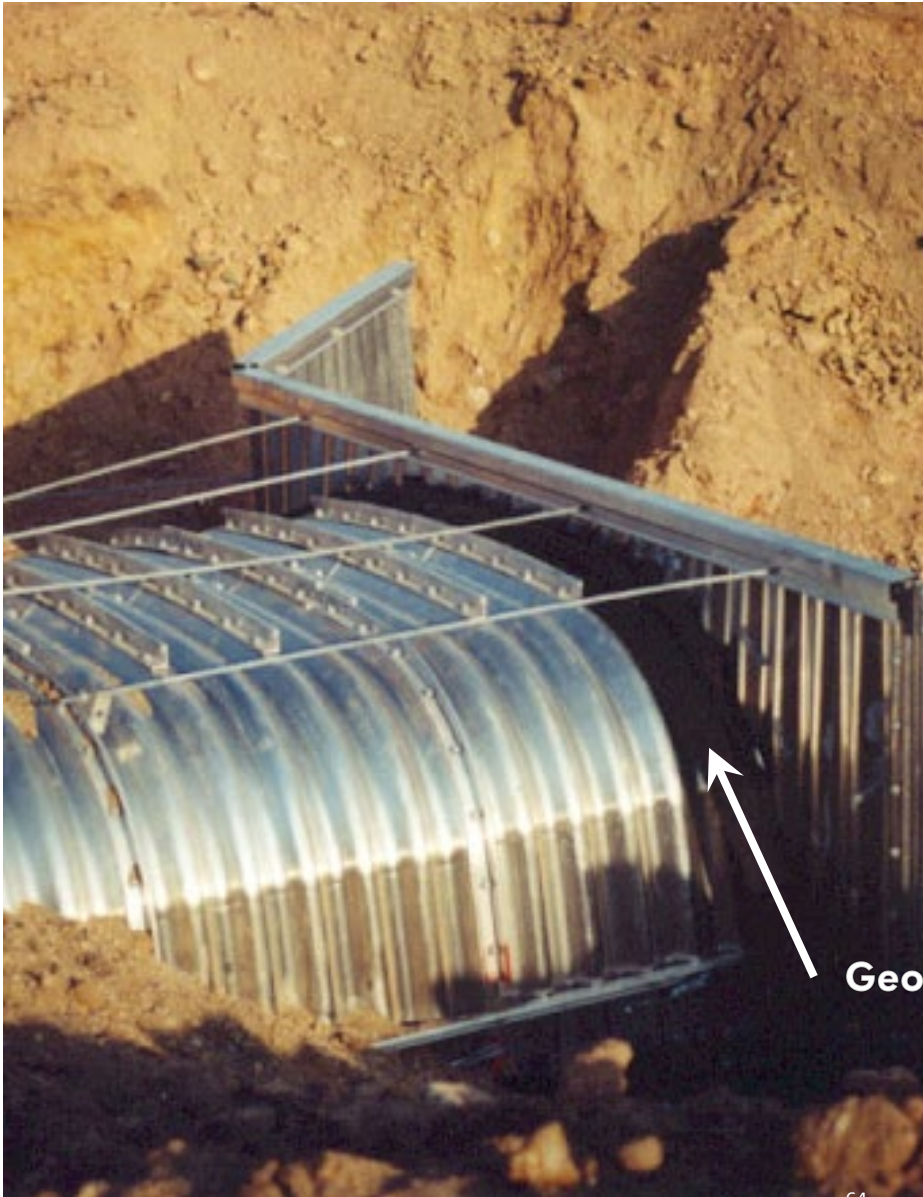
SECTION B-B
DEADMAN ANCHOR ATTACHMENT



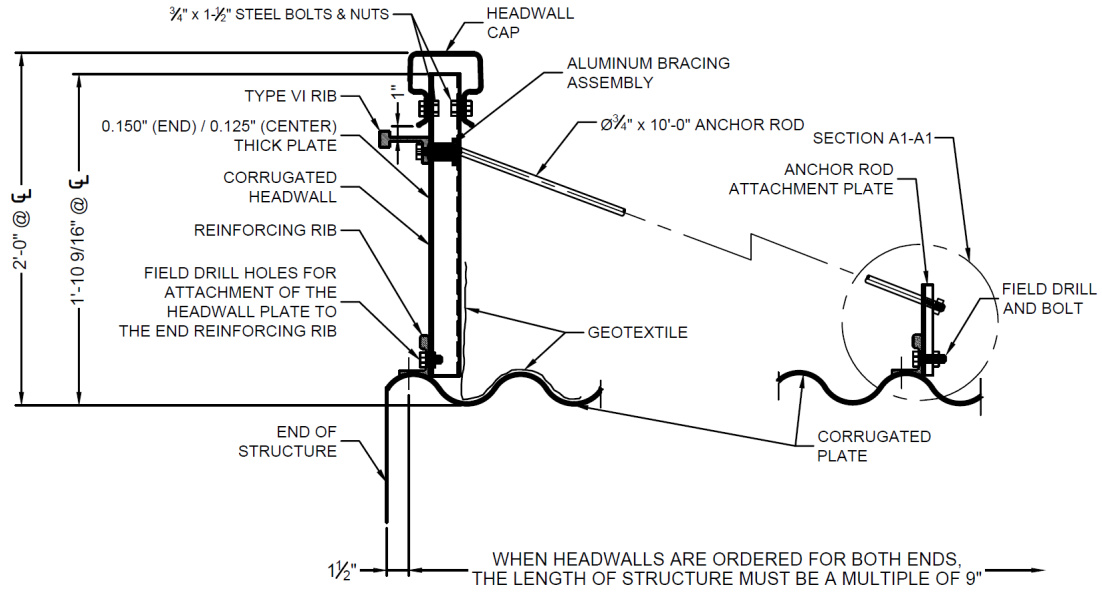
Headwall Anchor Rod Attachment



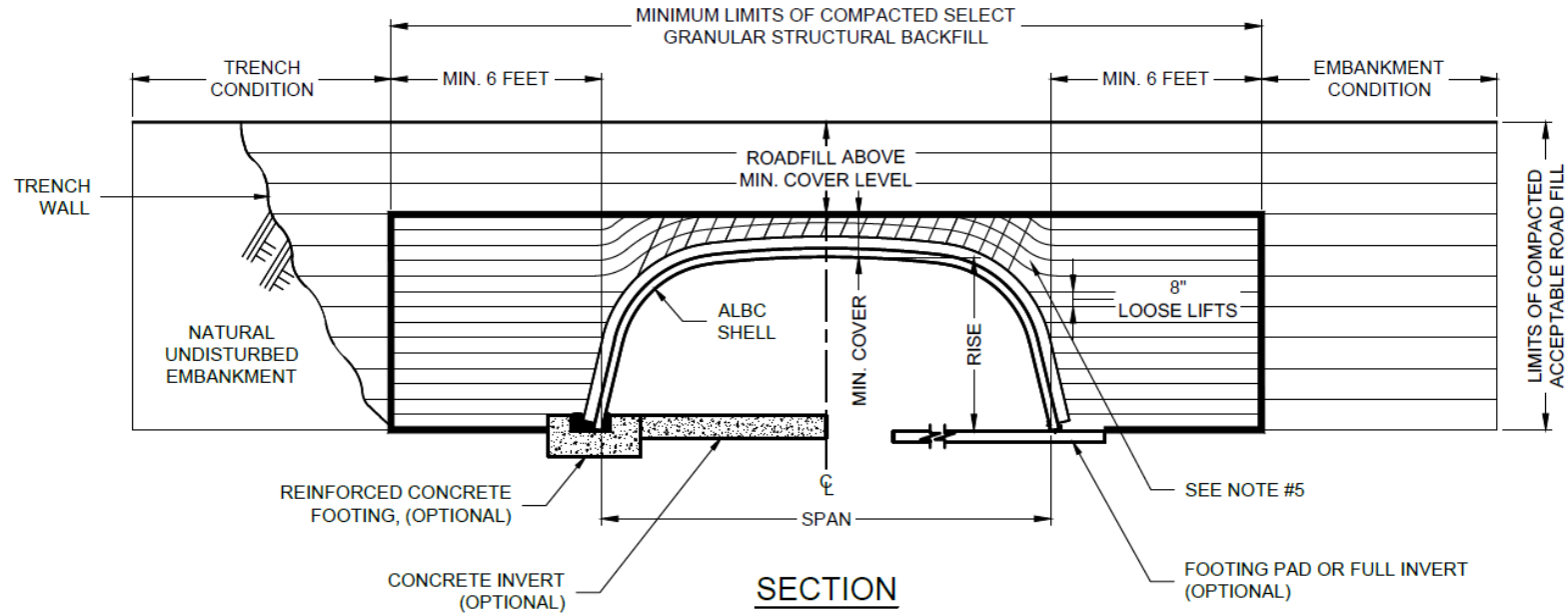
Geotextile placement - Headwall connection



Geotextile Fabric



Backfilling



SELECT GRANULAR STRUCTURAL BACKFILL LIMITS.



INITIAL LIFTS OVER THE CROWN OF STRUCTURE AS INDICATED BY SHADED AREA TO BE COMPACTED TO REQUIRED DENSITY WITH HAND OPERATED EQUIPMENT OR WITH LIGHTWEIGHT(D-4 OR LIGHTER) EQUIPMENT.

STRUCTURAL PLATE BACKFILL GROUP CLASSIFICATION, REFERENCE AASHTO M-145				
GROUP CLASSIFICATION	A-1-a	A-1-b	A-2-4	A-2-5
Sieve Analysis Percent Passing				
No. 10 (2.000 mm)	50 max.	----	----	----
No. 40 (0.425 mm)	30 max.	50 max.	----	----
No. 200 (0.075 mm)	15 max.	25 max.	35 max.	35 max.
Atterberg Limits for Fraction Passing No. 40 (0.425 mm)				
Liquid Limits	----	----	40 max.	41 min.
Plasticity Index	6 max.	6 max.	10 max.	10 max.
Usual Materials	Stone Fragment, Gravel and Sand		Silty or Clayey Gravel and Sand	

Reference the most current version of ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), for comparable soil groups.

Backfilling

Key backfilling criteria

- 8" maximum loose lifts placed in a balance fashion; symmetrically on each side
- Compact to minimum 90% density per AASHTO T180 (Modified Proctor)
- Use lightweight compaction equipment only in the select backfill envelope
- Lightweight tracked vehicles (D4 or lighter) above the structure until minimum cover is achieved



Final Cover – Examples of small equipment



Crossing over the Structure of the dozer

– Keep 12” under the tracks

Keep heavy equipment off the structure. A dozer on tracks or lighter piece of equipment can cross over the structure only after a minimum of compacted 12” of select material is over the structure





Get In; Get Out: Structural Plate Culvert and Bridge Solutions

Grayson County – Judge Elliot Drive
– Pottsboro, TX



Installed Cost Comparison

24' Roadway Width (excludes deck/roadway)

	RCB	Bridge-at-Grade		Buried Bridges	
Bid Item	<u>CIP or Precast</u>	<u>Concrete Slab Beam (5SB15)</u>	<u>Big R Modular Rolled Girder</u>	<u>ALBC #52</u>	<u>CON/SPAN O325</u>
Size	2 – 9' x 8'	40' span (197.5 LF)	40' span	20'-10" span x 8'-1" rise (31.5 LF)	25' span x 7'-8" rise, 31.5 LF
Material / Installation (Est.)	✓	✓	✓	✓	✓
Foundation	✓	✓ (varies)	✓ (varies)	✓	✓
End Treatment	✓	✗	✗	✓	✓
Backfill	✓	✓	✓	✓	✓
Estimated Installed Price	\$155,000	\$170,000	\$190,000	\$150,000	\$275,000

Estimated Life Cycle Cost

After 25 years

	RCB	Bridge-at-Grade		Buried Bridges	
Bid Item	<u>CIP or Precast</u>	<u>Concrete slab beam</u>	<u>Big R Modular Rolled Girder</u>	<u>ALBC #52</u>	<u>CON/SPAN O325</u>
Size	2 – 9' x 8'	40' span	40' span	20'-10" span x 8'-1" rise	25' span x 7'-8" rise, 31.5 LF
Estimated Maintenance	\$15,000 / yr	\$125,000	\$125,000	N/A	N/A
Estimated Installed Price	\$155,000	\$170,000	\$190,000	\$150,000	\$275,000
Estimate Life Cycle Cost	\$342,000	\$295,000	\$315,000	\$150,000	\$275,000



Contech. Your project partner.

- From project conception through installation
- One-on-one Project Consultation
- More in-depth, technical information for a specific product or solution
- Help with tools such as DYOB and Structural Plate Design Guide
- Provide preliminary estimates
- Assist with plans and specifications



Options & Support
Specific to Your Project Needs

Questions? Come See Us a Booth 637!

CROSSINGS. CULVERTS. BRIDGES. CONTECH.

