Contech Precast Bridge & Structures

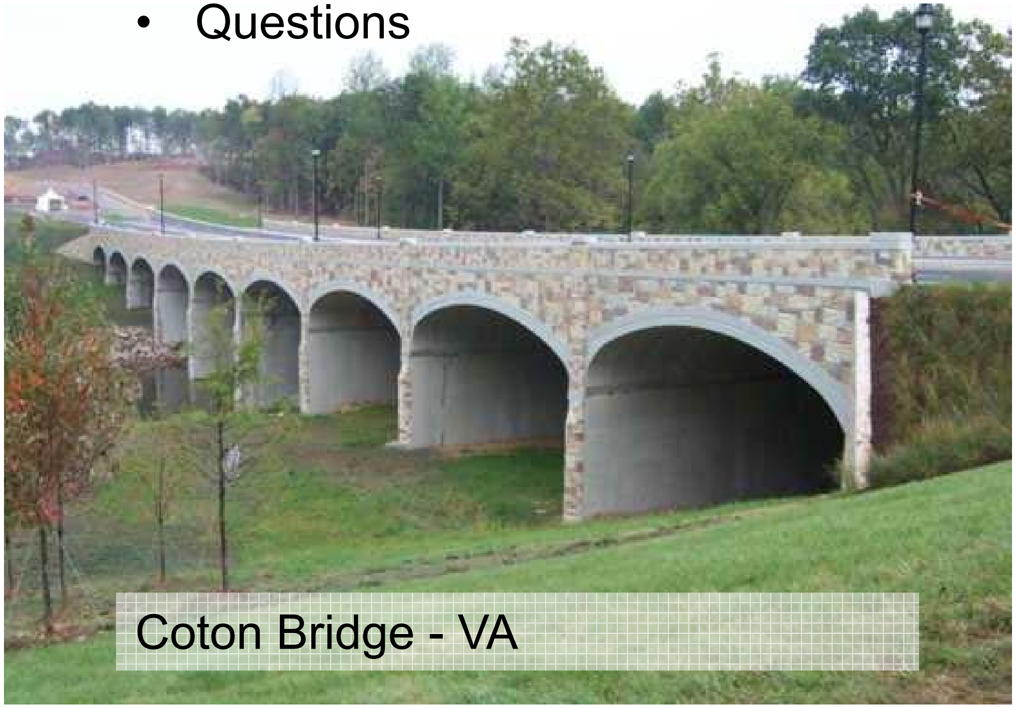
Michael Blank, PE – Bridge Consultant
Dana Hayek, EIT – Sales Engineer

CONTECH ENGINEERED SOLUTIONS

Agenda

- Intro to Contech
- Precast Arch Bridges Around the Country
- Buried Structures Design Philosophy
- Precast Design
- Production
- Installation
- Questions

Durango Drive – Las Vegas, NV



Coton Bridge - VA

Michigan Ave – Chicago, IL

CONTECH
ENGINEERED SOLUTIONS

CONTECH ENGINEERED SOLUTIONS

Contech - Your project partner with over 100 years experience!

HIGHWAY

AIRPORT

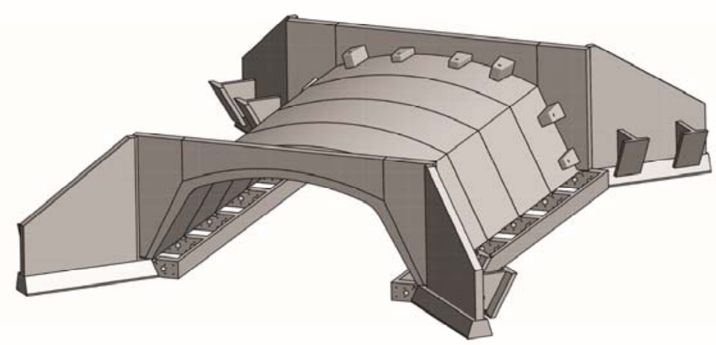
RAILWAY

MINING

MILITARY

ENERGY

Contech. Your project partner.



Building Blocks to a successful Project

Planning & Solution Development

- Project Design Worksheet
- Structure Selection
- Siting & Layout
- DYOB
- Engineer Estimate
- Site Simulation
- Proposal Preparation
- Design Build Support

Design Support

- Specifications
- Contract Drawings
- Permitting
- Structural/Fabrication Drawings
- Approval Assistance
- Custom Shape Development
- Horizontal/Vertical Alignment
- Hydraulics & Scour Support
- Foundations

Installation Support

- Preconstruction Meeting
- On-Site Installation Assistance
- Logistics Coordination

Precast	Plate	Truss
50 years	80 years	60 years
8,000 installations	50,000 installations	20,000 installations
…………………… Comprehensive Engineering Support …………………..		
……………………Installations In Every State…………………..		

CONTECH ENGINEERED SOLUTIONS

Plate, Precast & Truss Bridges

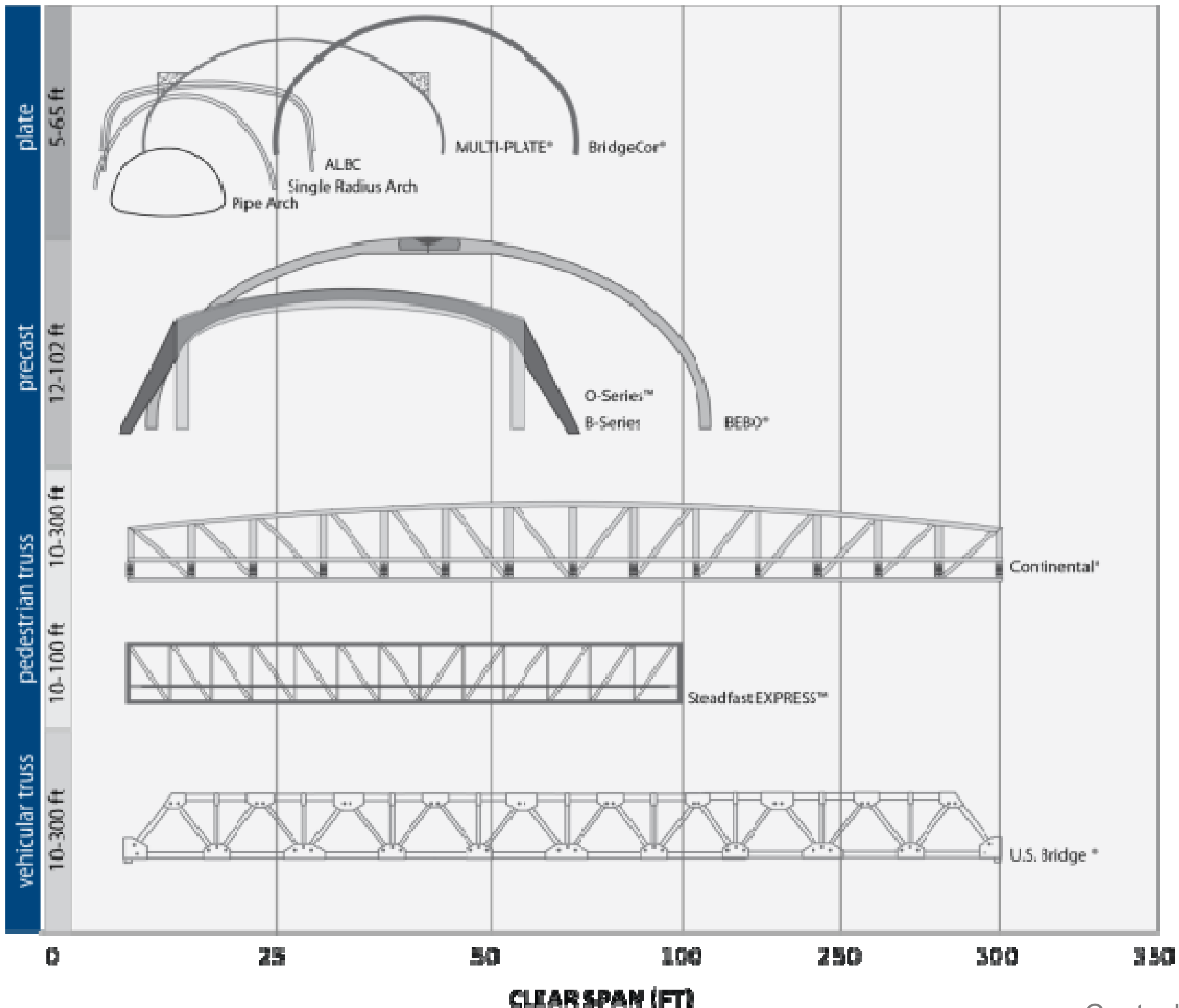
MULTI-PLATE®
Aluminum Structural Plate
Aluminum Box Culvert
SUPER-SPAN™
SUPER-PLATE®
BridgeCor™

CON/SPAN®
BEBO®

Continental® Bridges (Pedestrian)

Steadfast EXPRESS (Pedestrian)

Contech (Vehicular)



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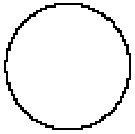
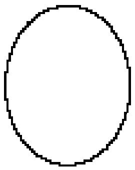
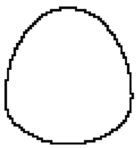
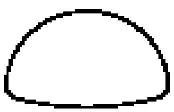
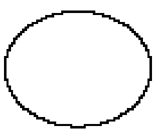
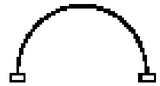
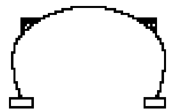
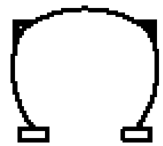
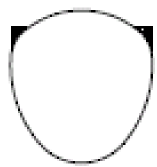
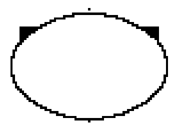
General Structural Plate Shapes

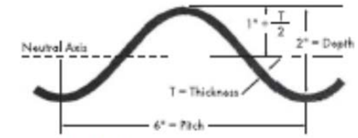
CONTECH ENGINEERED SOLUTIONS

Shapes		Sizes — Span x Rise
Round		5' to 50'
Vertical Ellipse		4'-8" x 5'-2" to 25' x 27'-7"
Underpass		12'-2" x 11'-0" to 20'-4" x 17'-9"
Pipe-Arch		6'-1" x 4'-7" to 20'-7" x 13'-2"
Horizontal Ellipse		7'-4" x 5'-6" to 14'-11" x 11'-2"

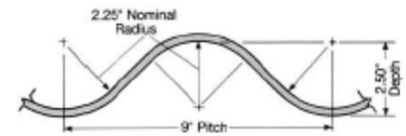
* Other Custom Size Available

Arch (single radius)		5' x 1'-9" to 54'-4 x 27'-2"
Low-Profile Arch *		5' to 65'
High-Profile Arch *		20'-1" x 9'-1" to 35'-4" x 20'-0"
Pear-Arch		23'-11" x 23'-4" to 30'-4" x 25'-10"
Pear		23'-8" x 25'-5" to 29'-11" x 31'-3"
Horizontal Ellipse		19'-4" x 12'-9" to 37'-2" x 22'-2"
Box Culvert		8'-9" x 2'-6" to 45'

* Other Custom Size Available



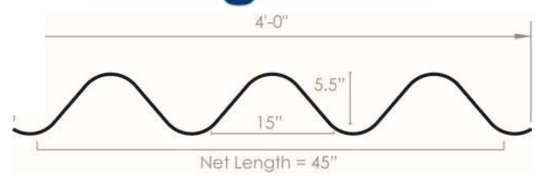
Standard 6" x 2" Corrugation



9" x 2 1/2" Corrugation

able

BridgeCor



STEEL			ALUMINUM	
GAGE	THICKNESS		GAGE	THICKNESS
12	0.111			0.100
10	0.140			0.125
8	0.170			0.150
7	0.188			0.175
5	0.218			0.200
3	0.249			0.225
1	0.280			0.250
5/16	0.318			
3/8	0.375			

CONTECH STRUCTURAL PLATE

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Plate Projects

Valdez Tidal Flats, Valdez, AK

Houston Hawk Lane, Houston, AK

Fish, Snow Machine, Vehicle and Moose Crossings in Alaska

Chokosna Pond Culvert, McCarthy, AK

West Dowling, Anchorage, AK

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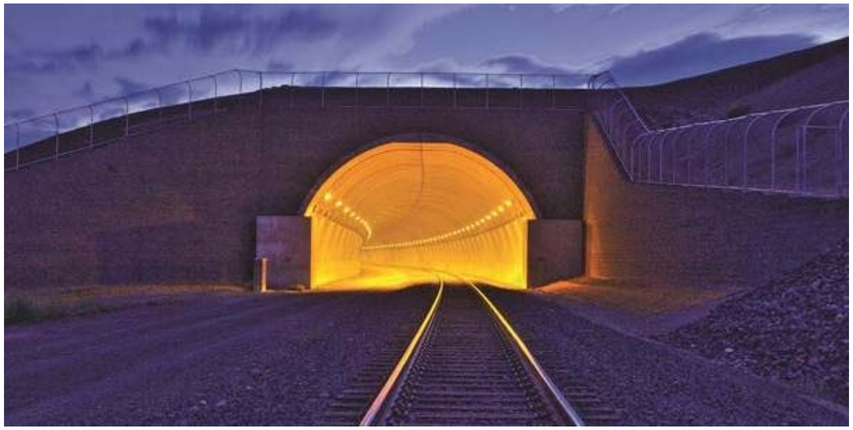
CON/SPAN O-Series

BEBO Arch Systems



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ENGINEERED SOLUTIONS

Modular Components

PRECAST FOUNDATION

PRECAST ARCH UNIT

PRECAST HEADWALL

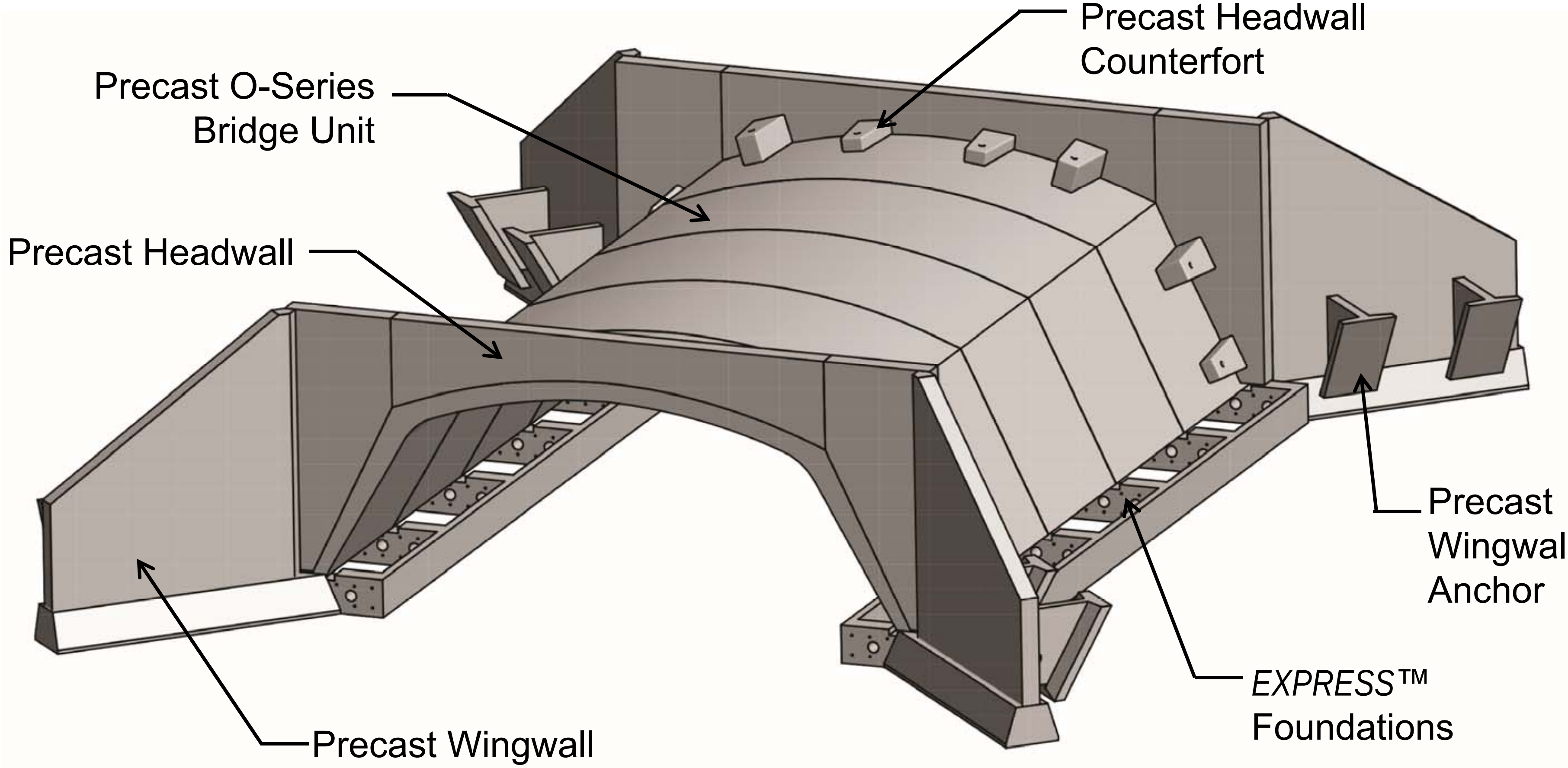
PRECAST WINGWALL

TWIN LEAF CONSTRUCTION

CURVED ALIGNMENT

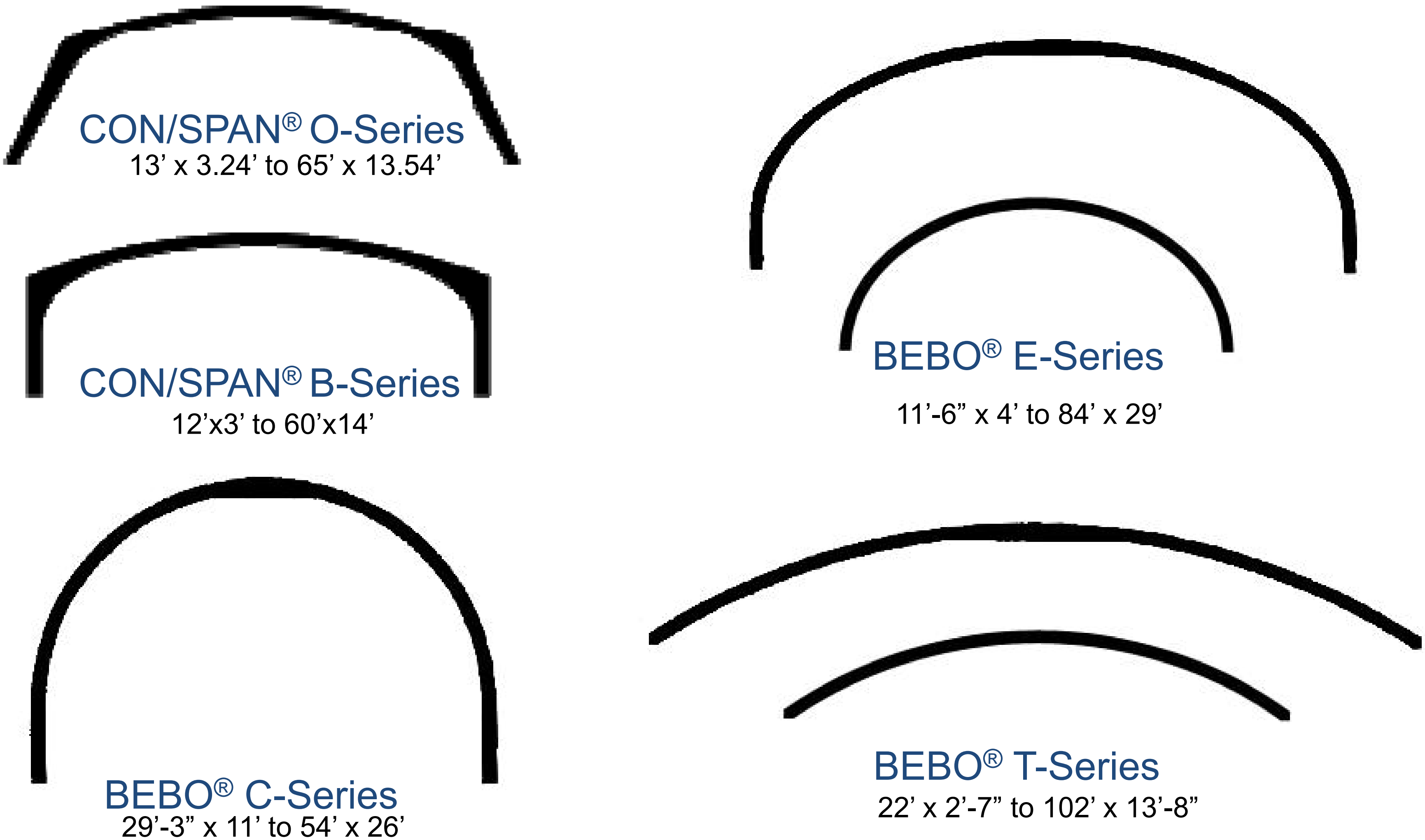
CONTECH ENGINEERED SOLUTIONS

CON SPAN O-SERIES



CONTECH ENGINEERED SOLUTIONS

Precast Bridge Arches



CONTECH ENGINEERED SOLUTIONS

CONTECH ENGINEERED SOLUTIONS

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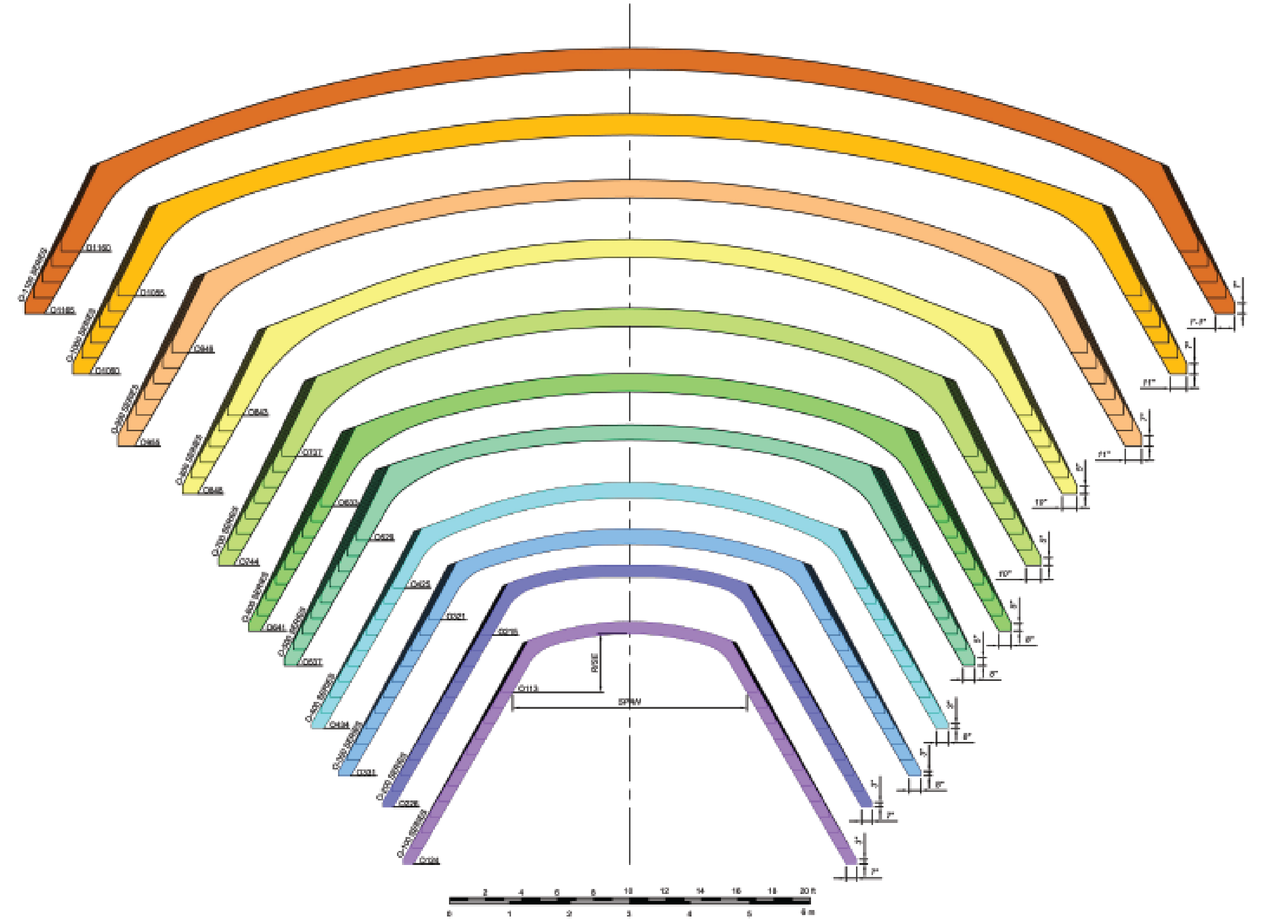
CON/SPAN O-SERIES



O-100 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O113	13	3.24
O114	14	4.10
O115	15	4.97
O116	16	5.83
O117	17	6.70
O118	18	7.56
O119	19	8.43
O120	20	9.30
O121	21	10.17
O122	22	11.03
O123	23	11.90
O124	24	12.76

O-200 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O215	15	3.23
O216	16	4.09
O217	17	4.97
O218	18	5.83
O219	19	6.70
O220	20	7.56
O221	21	8.43
O222	22	9.29
O223	23	10.16
O224	24	11.03
O225	25	11.90
O226	26	12.76

O-300 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O321	21	4.20
O322	22	5.06
O323	23	5.93
O324	24	6.80
O325	25	7.67
O326	26	8.53
O327	27	9.40
O328	28	10.26
O329	29	11.13
O330	30	11.99
O331	31	12.86

O-400 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O425	25	5.00
O426	26	5.86
O427	27	6.73
O428	28	7.59
O429	29	8.46
O430	30	9.32
O431	31	10.19
O432	32	11.06
O433	33	11.93
O434	34	12.79

O-500 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O529	29	5.58
O530	30	6.45
O531	31	7.31
O532	32	8.18
O533	33	9.04
O534	34	9.91
O535	35	10.77
O536	36	11.65
O537	37	12.51

O-600 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O633	33	6.34
O634	34	7.21
O635	35	8.08
O636	36	8.95
O637	37	9.81
O638	38	10.68
O639	39	11.54
O640	40	12.41
O641	41	13.27

O-700 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O737	37	7.19
O738	38	8.05
O739	39	8.93
O740	40	9.79
O741	41	10.66
O742	42	11.52
O743	43	12.39
O744	44	13.25

O-800 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O843	43	8.78
O844	44	9.65
O845	45	10.51
O846	46	11.38
O847	47	12.24
O848	48	13.11

O-900 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O949	49	8.58
O950	50	9.45
O951	51	10.31
O952	52	11.18
O953	53	12.04
O954	54	12.91
O955	55	13.77

O-1000 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O1055	55	8.93
O1056	56	9.79
O1057	57	10.66
O1058	58	11.53
O1059	59	12.40
O1060	60	13.54

O-1100 SERIES		
SHAPE ID	SPAN (FT)	RISE (FT)
O1161	61	10.07
O1162	62	10.94
O1163	63	11.81
O1164	64	12.68
O1165	65	13.54

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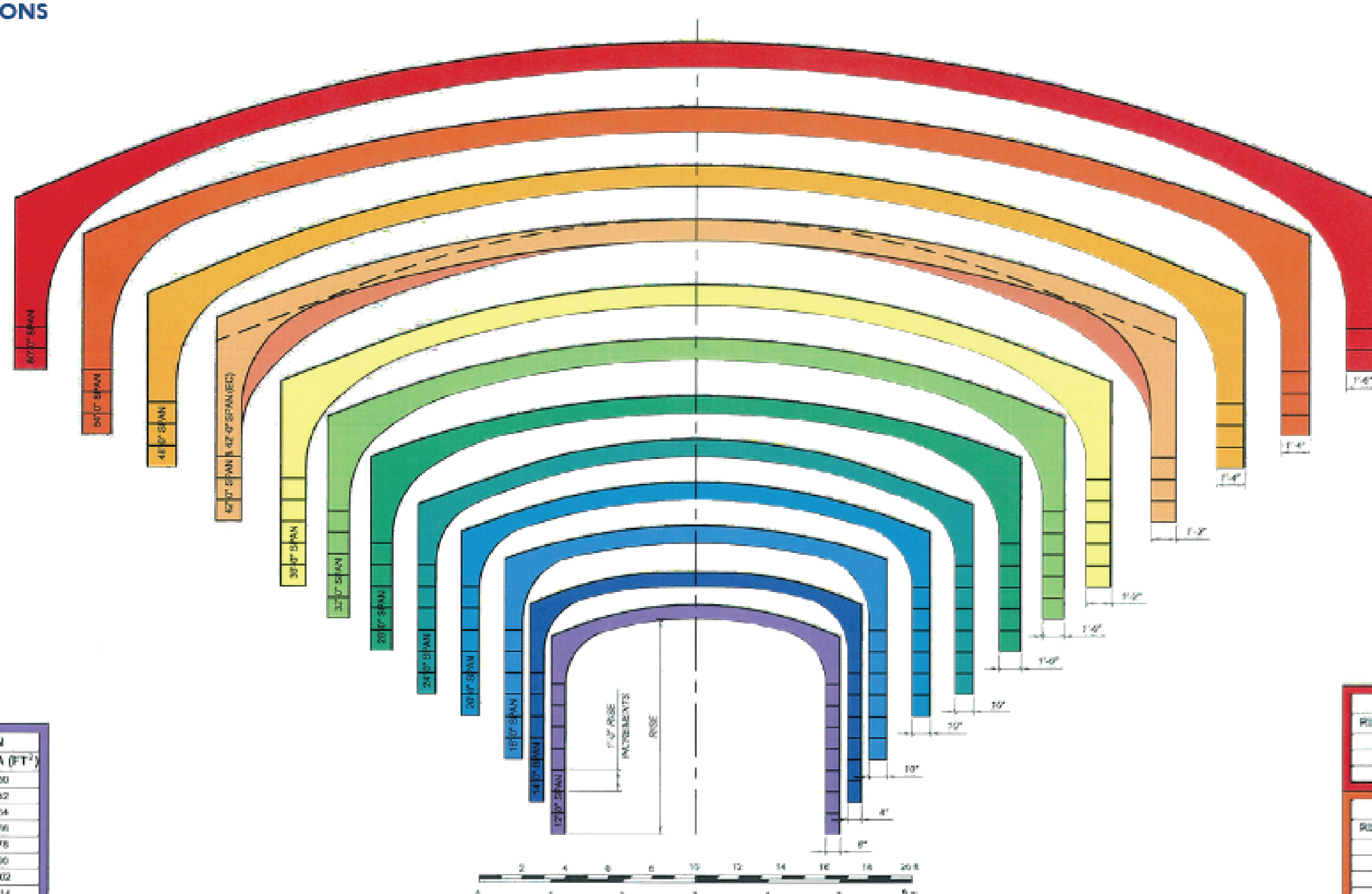
CON/SPAN BRIDGE SYSTEMS



12'-0" SPAN	
RISE (FT)	AREA (FT²)
3	30
4	42
5	54
6	66
7	78
8	90
9	102
10	114

14'-0" SPAN	
RISE (FT)	AREA (FT²)
4	50
5	64
6	78
7	92
8	106
9	120
10	134

16'-0" SPAN	
RISE (FT)	AREA (FT²)
4	55
5	71
6	87
7	103
8	119
9	135
10	151

20'-0" SPAN	
RISE (FT)	AREA (FT²)
4	65
5	85
6	105
7	125
8	145
9	165
10	185

24'-0" SPAN	
RISE (FT)	AREA (FT²)
5	96
6	119
7	143
8	167
9	191
10	215
11	239

28'-0" SPAN	
RISE (FT)	AREA (FT²)
6	139
7	167
8	195
9	223
10	251
11	279

32'-0" SPAN	
RISE (FT)	AREA (FT²)
7	184
8	216
9	248
10	280
11	312
12	344

36'-0" SPAN	
RISE (FT)	AREA (FT²)
8	232
9	268
10	304
11	340
12	376
13	412

42'-0" SPAN	
RISE (FT)	AREA (FT²)
10	357
11	399
12	441
13	483

42'-0" SPAN (EC)	
RISE (FT)	AREA (FT²)
10	334
11	376
12	418
13	460

48'-0" SPAN	
RISE (FT)	AREA (FT²)
10	388
11	436
12	483
13	531

54'-0" SPAN	
RISE (FT)	AREA (FT²)
11	491
12	546
13	599
14	653

60'-0" SPAN	
RISE (FT)	AREA (FT²)
12	575
13	635
14	694

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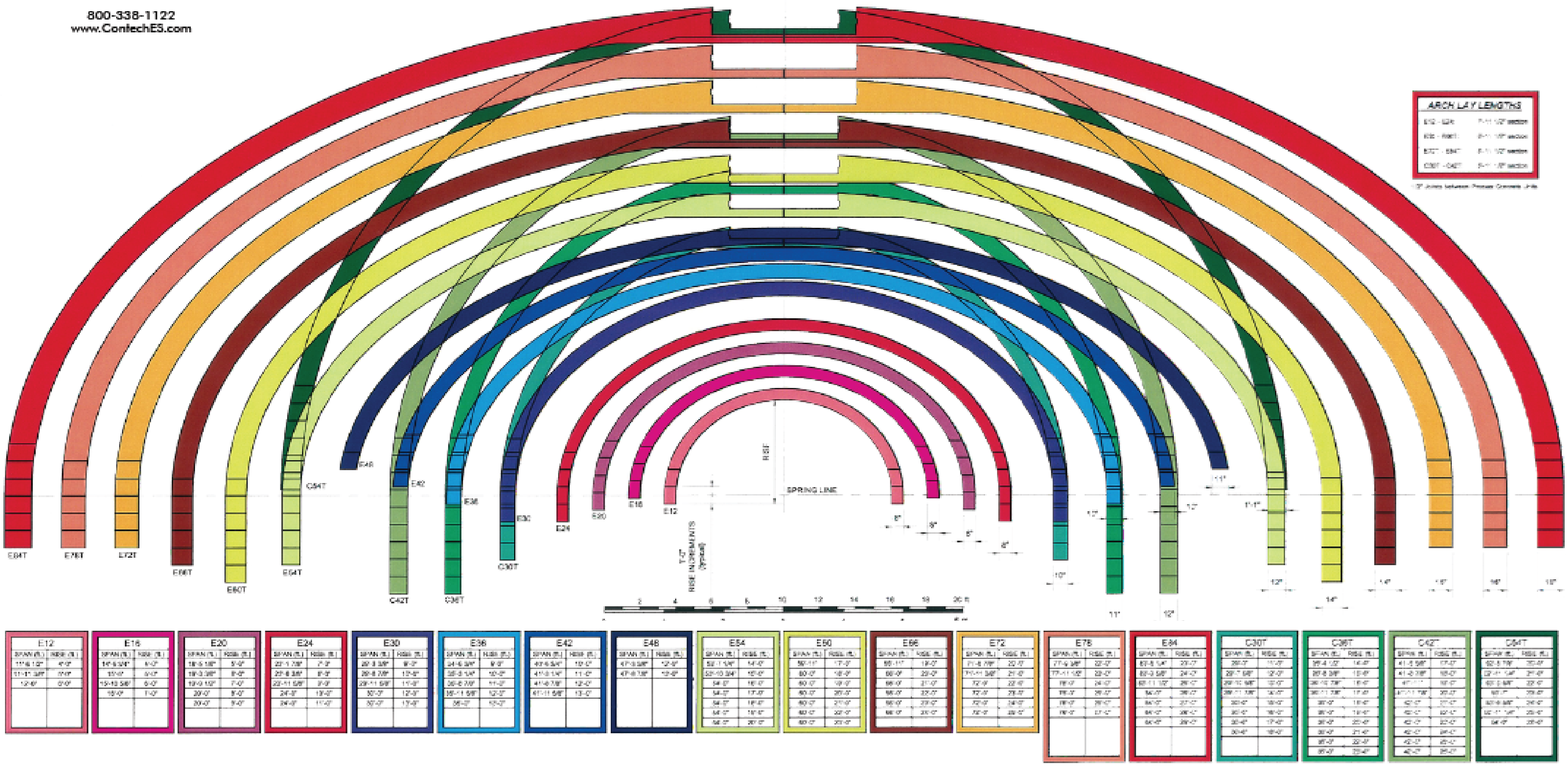
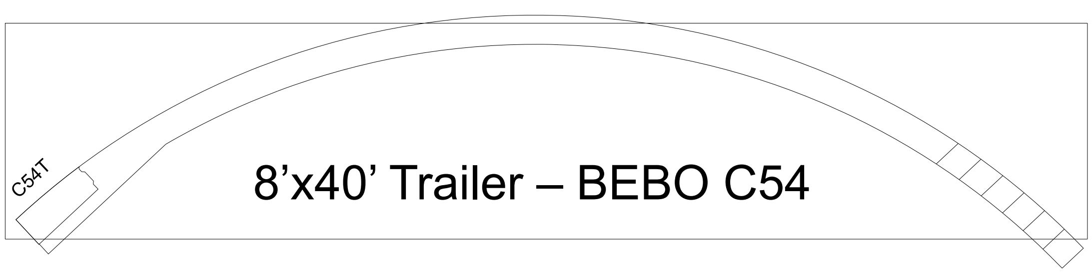
BEBO Arch Systems





8’x40’ Trailer – BEBO C54

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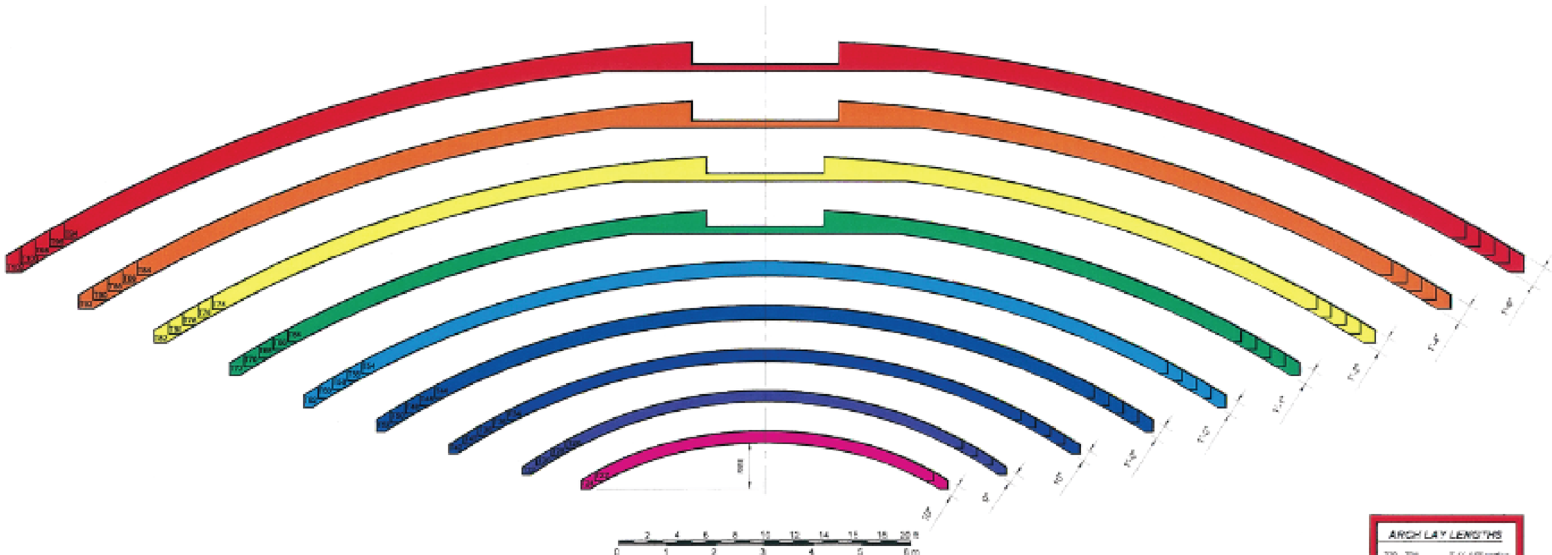
BEBO® Arch Systems



ARCH LAY LENGTHS

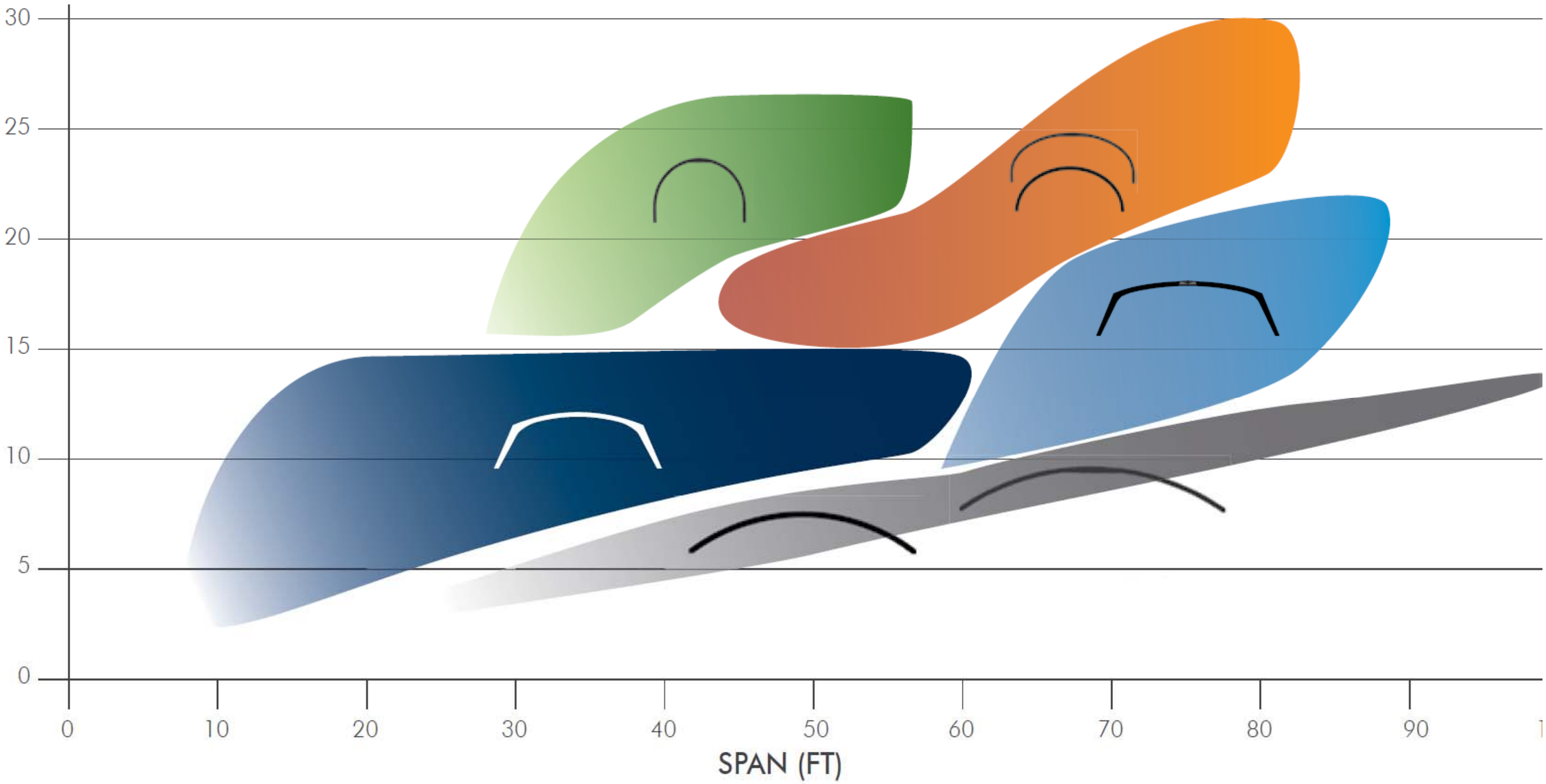
T22 - T24	3'-11 1/2" section
T26 - T42	7'-11 1/2" section
T44 - T52	[illegible] section
T54 - T62	[illegible] section
T64 - T82	[illegible] section
T84 - T102	[illegible] section

1/2" Joints between Precast Concrete Units

	SPAN (FT.)	RISE (FT.)
T22	22'-0"	2'-7"
T24	24'-0"	3'-2"
T26	26'-0"	3'-2"
T28	28'-0"	3'-9"
T30	30'-0"	4'-4"
T32	32'-0"	5'-0"
T34	34'-0"	4'-0"
T36	36'-0"	4'-6"
T38	38'-0"	5'-1"
T40	40'-0"	5'-8"
T42	42'-0"	6'-4"
T44	44'-0"	5'-4"
T46	46'-0"	5'-10"
T48	48'-0"	6'-5"
T50	50'-0"	7'-0"
T52	52'-0"	7'-6"
T54	54'-0"	6'-8"
T56	56'-0"	7'-2"
T58	58'-0"	7'-9"
T60	60'-0"	8'-4"
T62	62'-0"	9'-0"
T64	64'-0"	7'-5"
T66	66'-0"	7'-11"
T68	68'-0"	8'-6"
T70	70'-0"	9'-1"
T72	72'-0"	9'-8"
T74	74'-0"	8'-8"
T76	76'-0"	9'-4"
T78	78'-0"	9'-10"
T80	80'-0"	10'-5"
T82	82'-0"	11'-1"
T84	84'-0"	10'-6"
T86	86'-0"	10'-7"
T88	88'-0"	11'-2"
T90	90'-0"	11'-9"
T92	92'-0"	12'-4"
T94	94'-0"	11'-5"
T96	96'-0"	11'-11"
T98	98'-0"	12'-6"
T100	100'-0"	13'-1"
T102	102'-0"	13'-6"

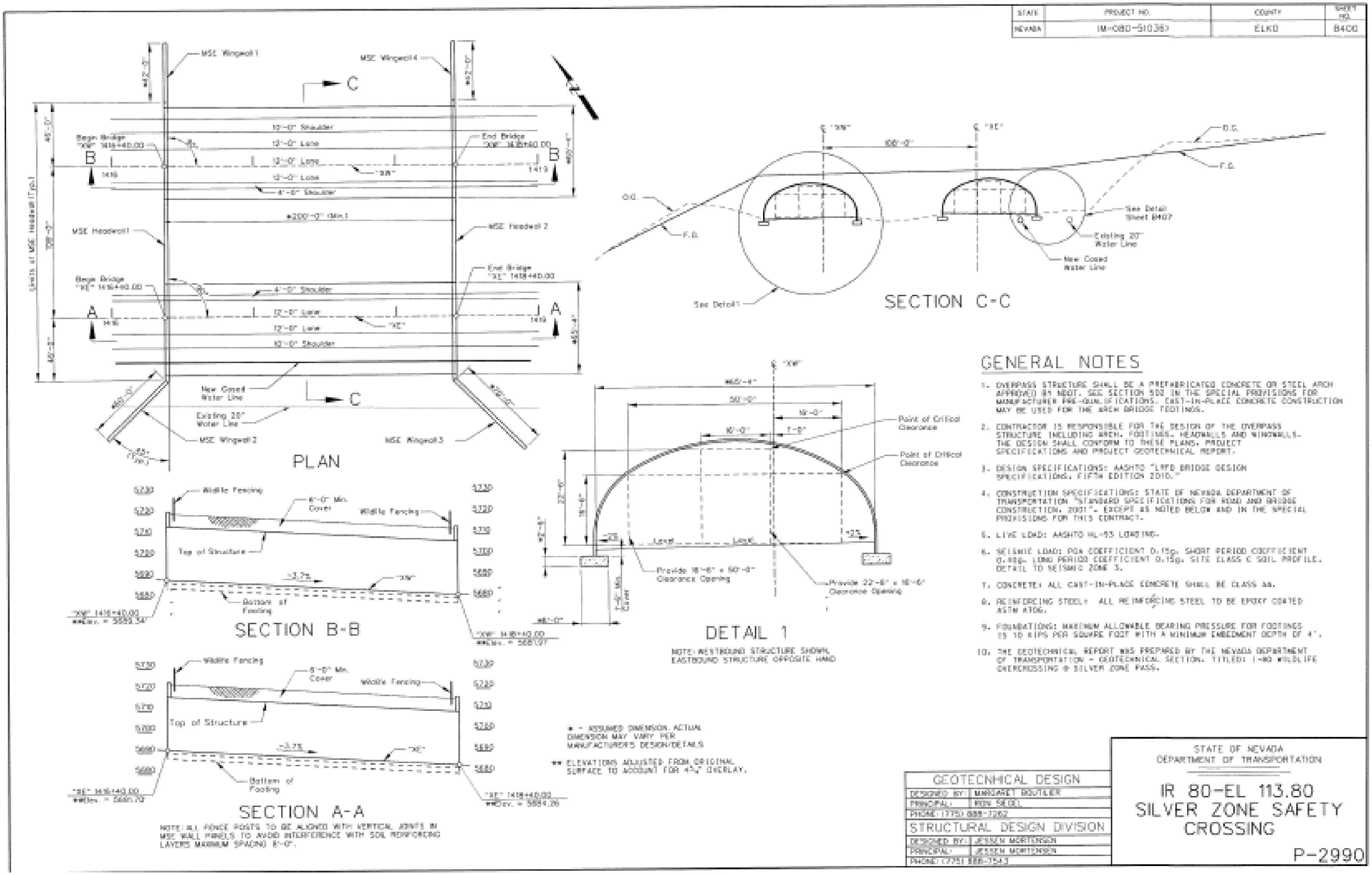
Values are rounded to the nearest inch.

Shape Versatility



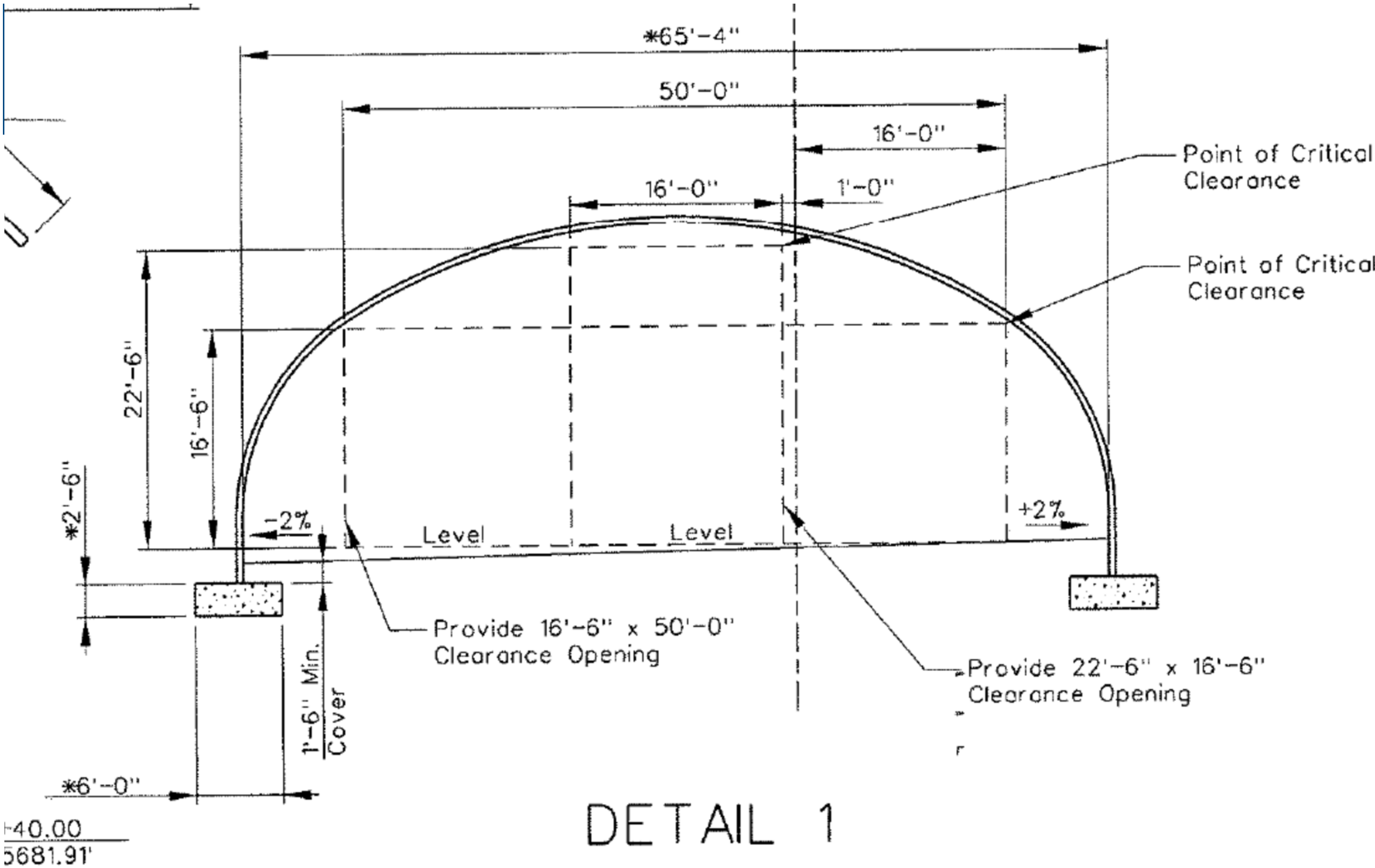
US 93 Wildlife Crossing
Wells, NV

Engineer: NDOT



I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT



DETAIL 1

NOTE: WESTBOUND STRUCTURE SHOWN, EASTBOUND STRUCTURE OPPOSITE HAND

BEBO® Arch Systems

I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT

CONTECH
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Arch Systems

I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT

I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT

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I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT

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Photo Credit: Jeff Burrell
Northern Rockies Program Coordinator, Wildlife Conservation Society

BEBO® Arch Systems

Trappers Point
Wyoming

Tacoma Community College
Tacoma, WA

Engineer: Sargent Engineers

www.ContechES.com

Greene County Airport
Greene County, OH

Engineer: RD Zande & Associates

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CON/SPAN BRIDGE SYSTEMS

Greene County Airport
Greene County, OH

Engineer: RD Zande & Associates

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CON SPAN®
BRIDGE SYSTEMS

Toledo Zoo Railway Overpass
Toledo, OH

Engineer: SSOE

CONTECH ENGINEERED SOLUTIONS

BEBO Arch Systems

U.S. 395 Over BNSF Railroad
Spokane, WA

Engineer: HDR Inc./WSDOT

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CONTECH ENGINEERED SOLUTIONS

BEBO Arch Systems

U.S. 395 Over BNSF Railroad
Spokane, WA

Engineer: HDR Inc./WSDOT

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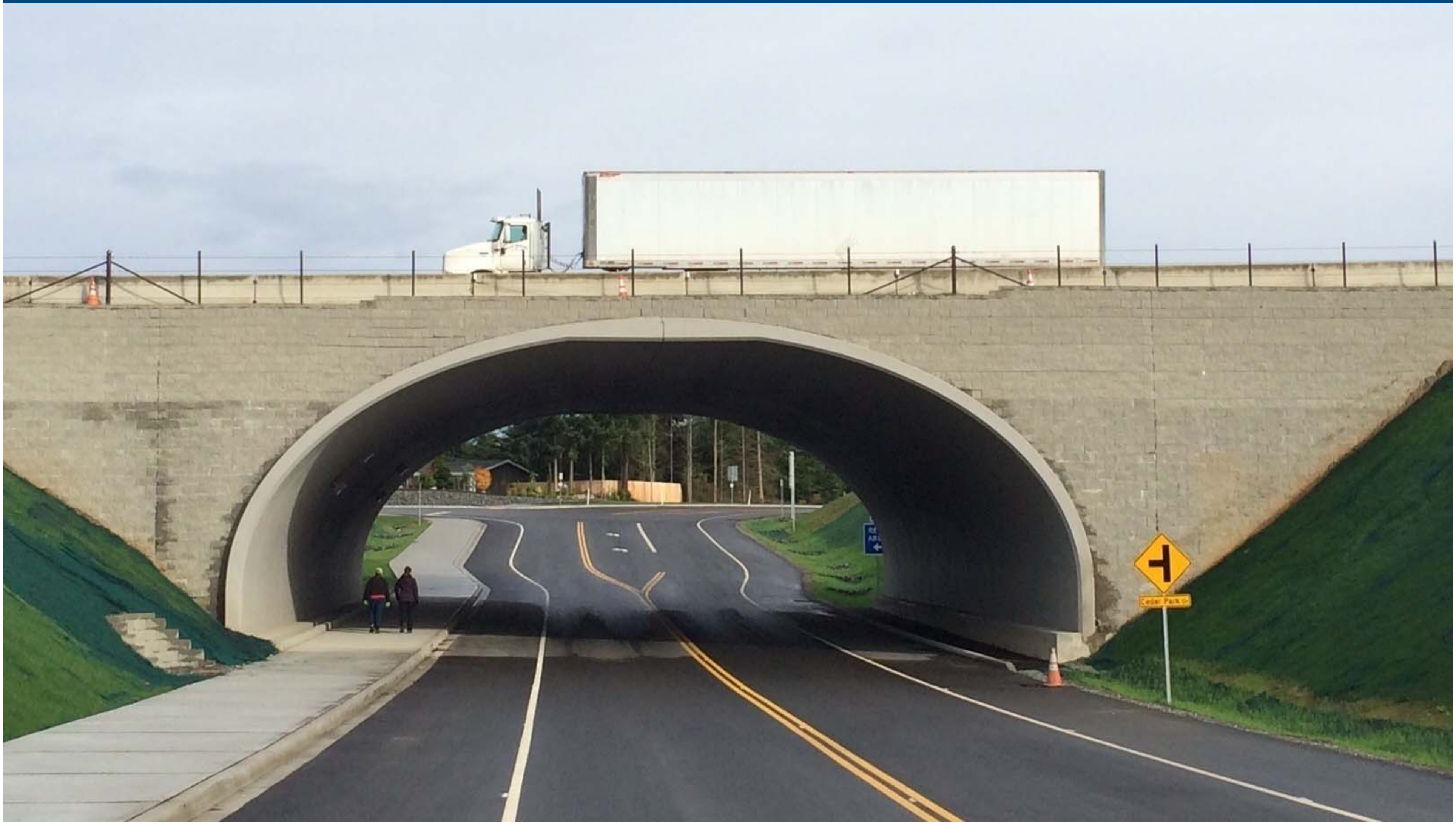
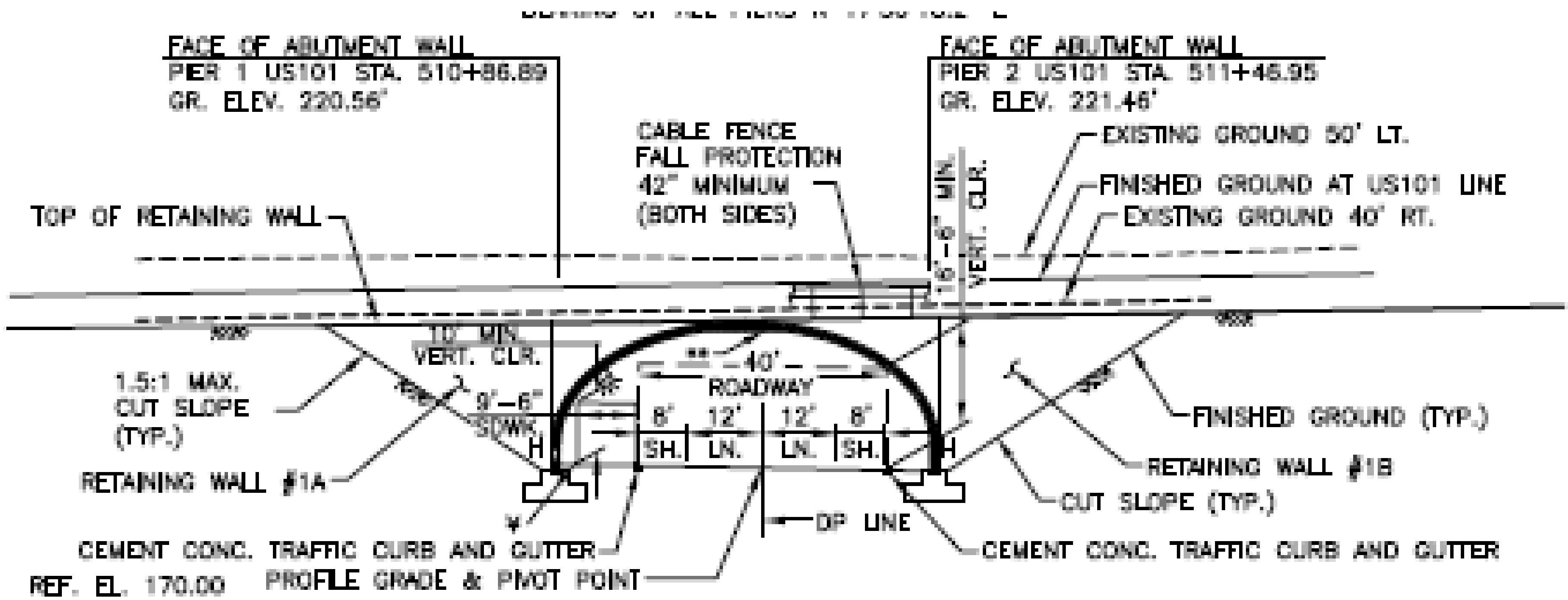


Deer Park – Hwy 101
Port Angeles, WA

Engineer: David Evans & Associates

CONTECH ENGINEERED SOLUTIONS



ELEVATION

GRADE ELEVATIONS SHOWN ARE FINISH GRADES AT TOP OF US101 LINE AND ARE EQUAL TO THE PROFILE GRADE.

US 101 / DEER PARK ROAD

CLALLAM COUNTY
PORT ANGELES, WA

Deer Park – Hwy 101
Port Angeles, WA

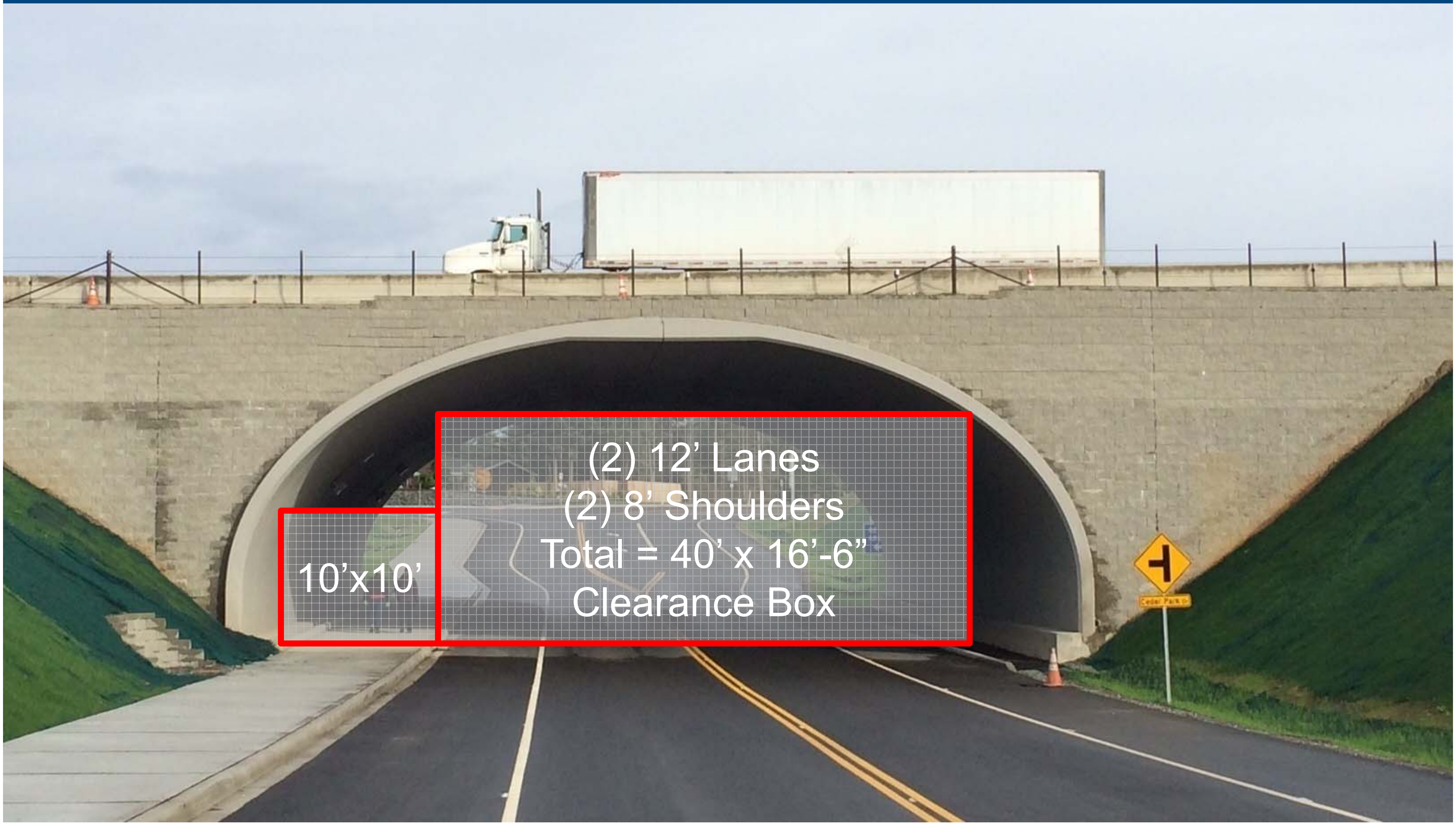
Engineer: David Evans & Associates

CONTECH ENGINEERED SOLUTIONS

BEBO® Arch Systems

Deer Park – Hwy 101
Port Angeles, WA

Engineer: David Evans & Associates



BEBO® Arch Systems

Deer Park – Hwy 101
Port Angeles, WA

Engineer: David Evans & Associates

CONTECH ENGINEERED SOLUTIONS

CON SPAN BRIDGE SYSTEMS

Bear Paw Creek
Pend Oreille County

Engineer: Pend Oreille County

www.ContechES.com

CONTECH ENGINEERED SOLUTIONS

BEBO® Arch Systems

Barker Creek

Kitsap County, WA

Engineer: GeoEngineerings

www.ContechES.com

Barker Creek
Kitsap County, WA

Engineer: GeoEngineerings

www.ContechES.com

CONTECH ENGINEERED SOLUTIONS

CON SPAN BRIDGE SYSTEMS

SR 14 Tunnel
Washougal, WA

Engineer: Wallace Engineering

www.ContechES.com

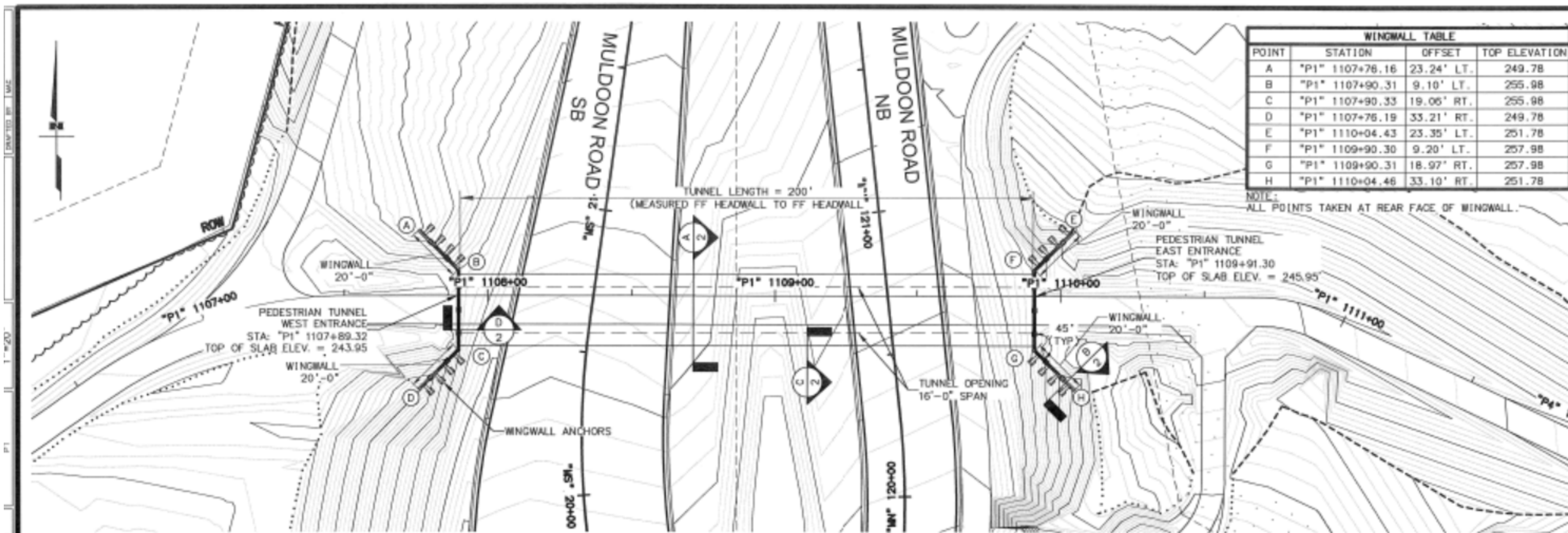
CONTECH ENGINEERED SOLUTIONS

CON SPAN BRIDGE SYSTEMS

SR 14 Tunnel
Washougal, WA

Engineer: Wallace Engineering

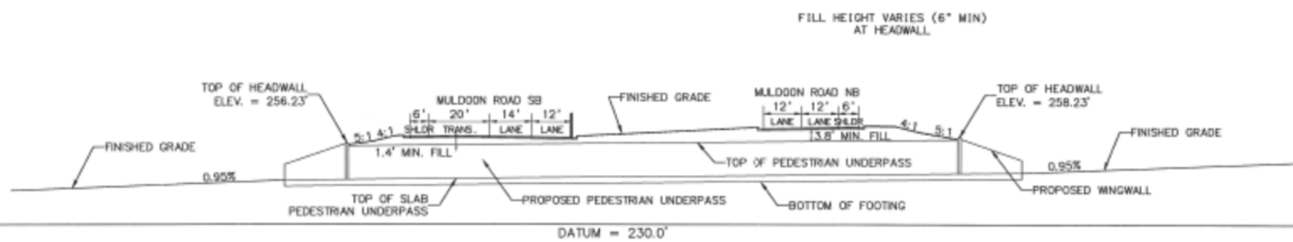
www.ContechES.com



WINGWALL TABLE			
POINT	STATION	OFFSET	TOP ELEVATION
A	"P1" 1107+76.16	23.24' LT.	249.78
B	"P1" 1107+90.31	9.10' LT.	255.98
C	"P1" 1107+90.33	19.06' RT.	255.98
D	"P1" 1107+76.19	33.21' RT.	249.78
E	"P1" 1110+04.43	23.35' LT.	251.78
F	"P1" 1109+90.30	9.20' LT.	257.98
G	"P1" 1109+90.31	18.97' RT.	257.98
H	"P1" 1110+04.46	33.10' RT.	251.78

NOTE:
ALL POINTS TAKEN AT REAR FACE OF WINGWALL.

PEDESTRIAN UNDERPASS PLAN
SCALE: 1" = 20'



PEDESTRIAN UNDERPASS ELEVATION
SCALE: 1" = 20'

GENERAL NOTES:

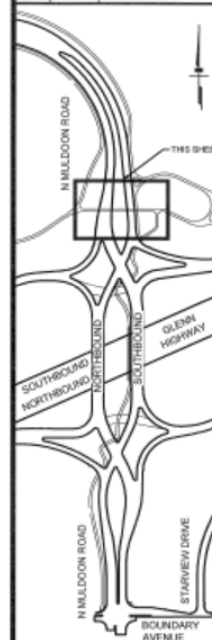
DESIGN:................................AASHTO LRFD BRIDGE DEISGN SPECIFICATIONS, 2014 EDITION, WITH LATEST INTERIM SPECIFICATIONS.
SEISMIC DESIGN PER AASHTO GUIDE SPECIFICATIONS FOR LRFD SEISMIC BRIDGE DESIGN, 2011 EDITION,
WITH LATEST INTERIM SPECIFICATIONS.
LIVE LOAD:............................ HL-93
SEISMIC PARAMETERS:.................. PGA = 0.54
Ss = 1.19
St = 0.46
SITE CLASS = C
LIQUEFACTION POTENTIAL = LOW
AASHTO 7% PROBABILITY OF EXCEEDANCE IN 75 YEARS.
REINFORCEMENT:........................ ASTM A706, GRADE 60, Fy = 60,000 PSI
SPACE REINFORCEMENT EVENLY UNLESS OTHERWISE NOTED.
USE ASTM A970 HEADED BARS, CLASS HA.
CONCRETE:............................. CLASS A CONCRETE UNLESS OTHERWISE NOTED. F'c = 4000 PSI

SHEET NO.	TOTAL SHEETS
P1	P2
STATE	YEAR
ALASKA	2015

PROJECT DESIGNATION
0001548/Z546250000
ADDENDUM NO.
ATTACHMENT NO.

REVISIONS

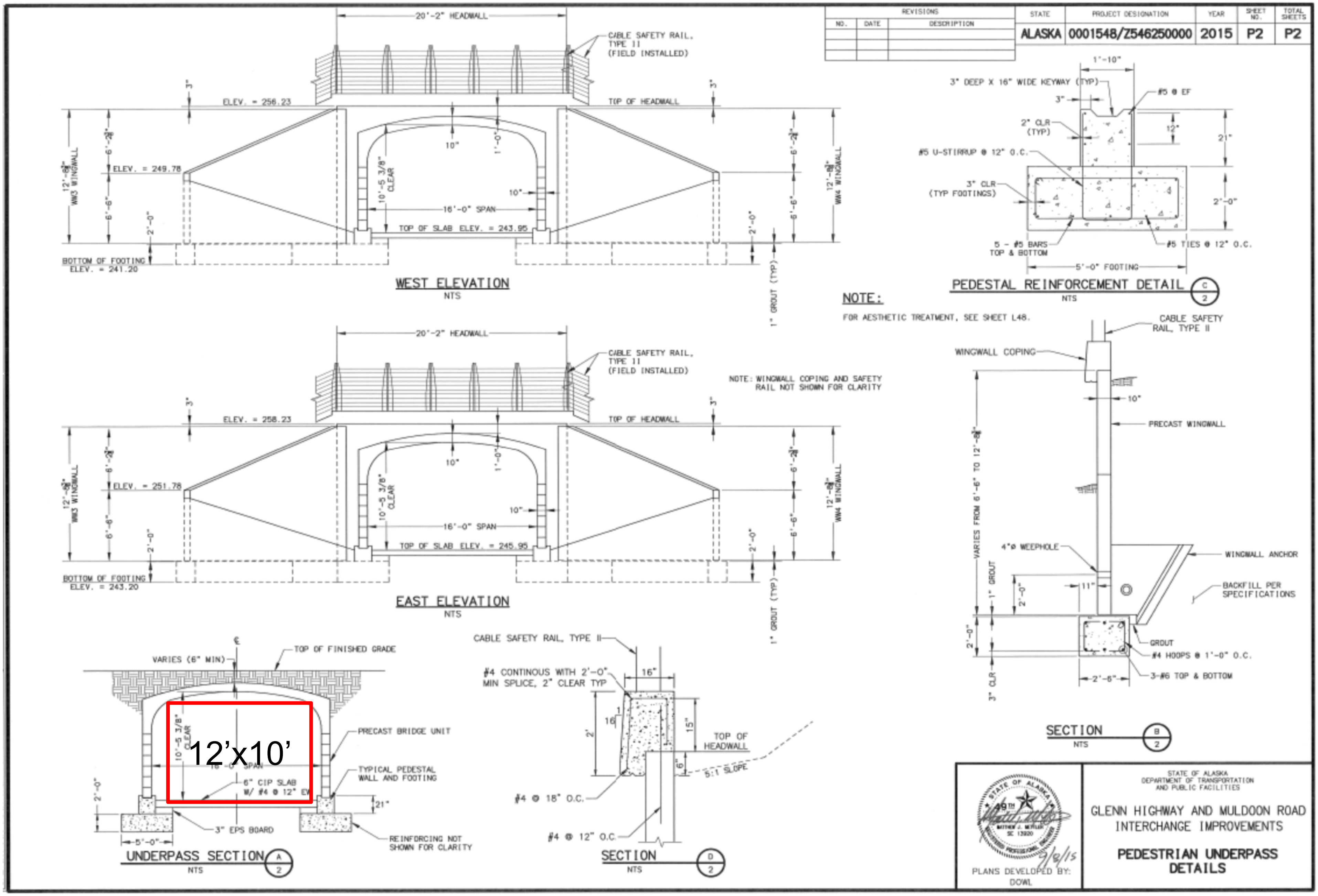
NO.	DATE	DESCRIPTION



PLANS DEVELOPED BY: DOWL
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
GLENN HIGHWAY AND MULDOON ROAD INTERCHANGE IMPROVEMENTS
PEDESTRIAN UNDERPASS PLAN AND PROFILE

Glenn Highway and Muldoon Road
Anchorage, AK

Engineer: Dowl
www.ContechES.com

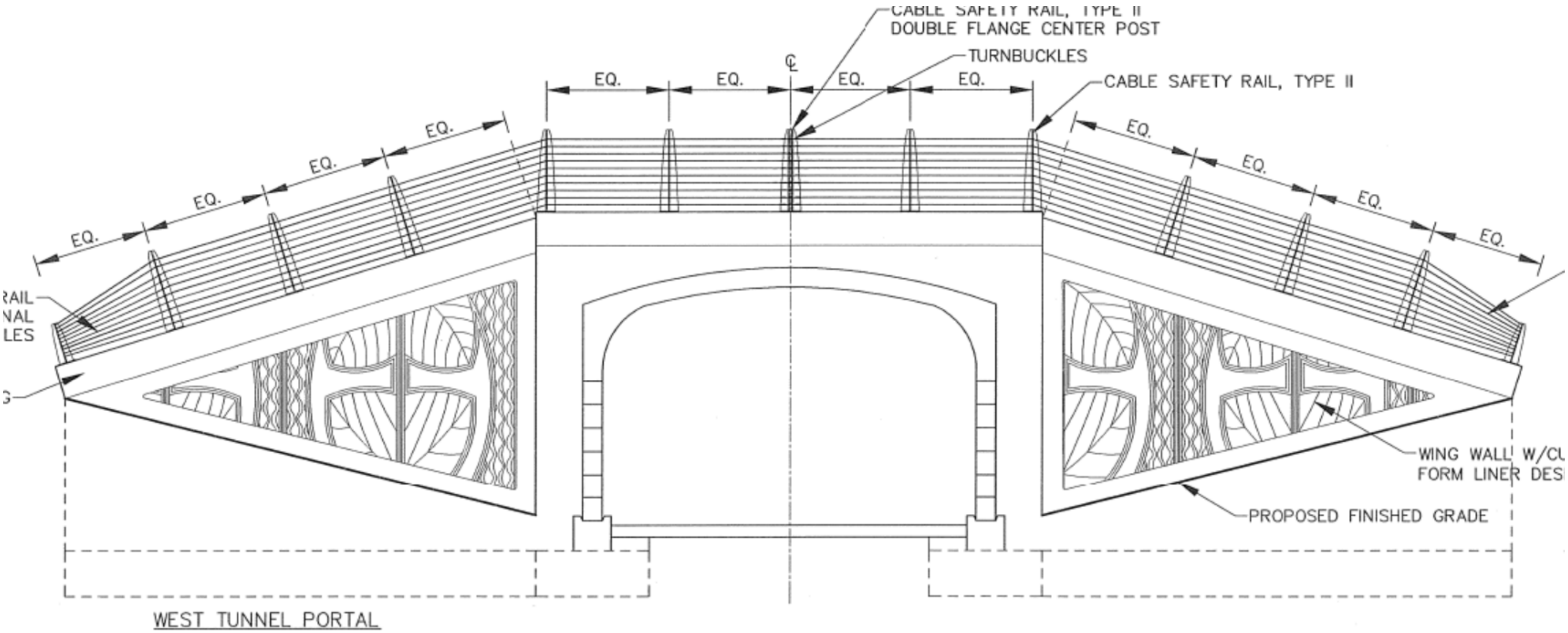


Glenn Highway and Muldoon Road

Engineer: Dowl

Anchorage, AK

www.ContechES.com



PEDESTRIAN TUNNEL WING WALL – WEST ELEVATION

1/4"=1'–0"

Glenn Highway and Muldoon Road
Anchorage, AK

Engineer: Dowl

www.ContechES.com

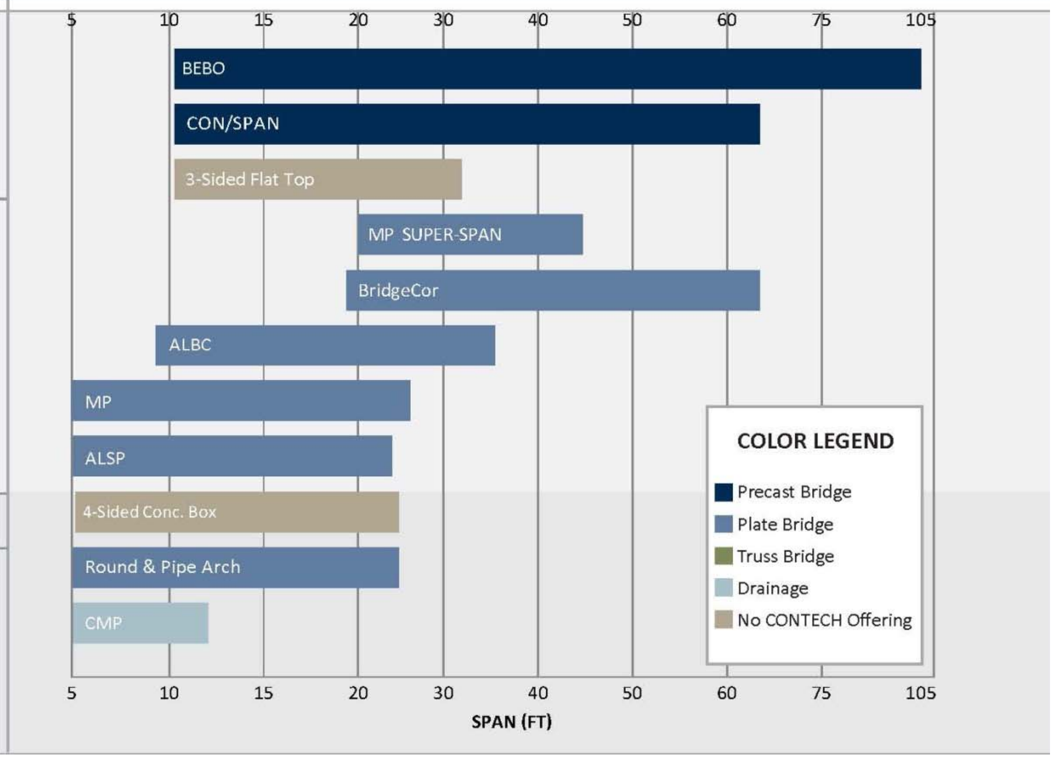
Agenda

- Intro to Contech
- Precast Arch Bridges Around the Country
- Buried Structures Design Philosophy
- Precast Design
- Production
- Installation
- Questions

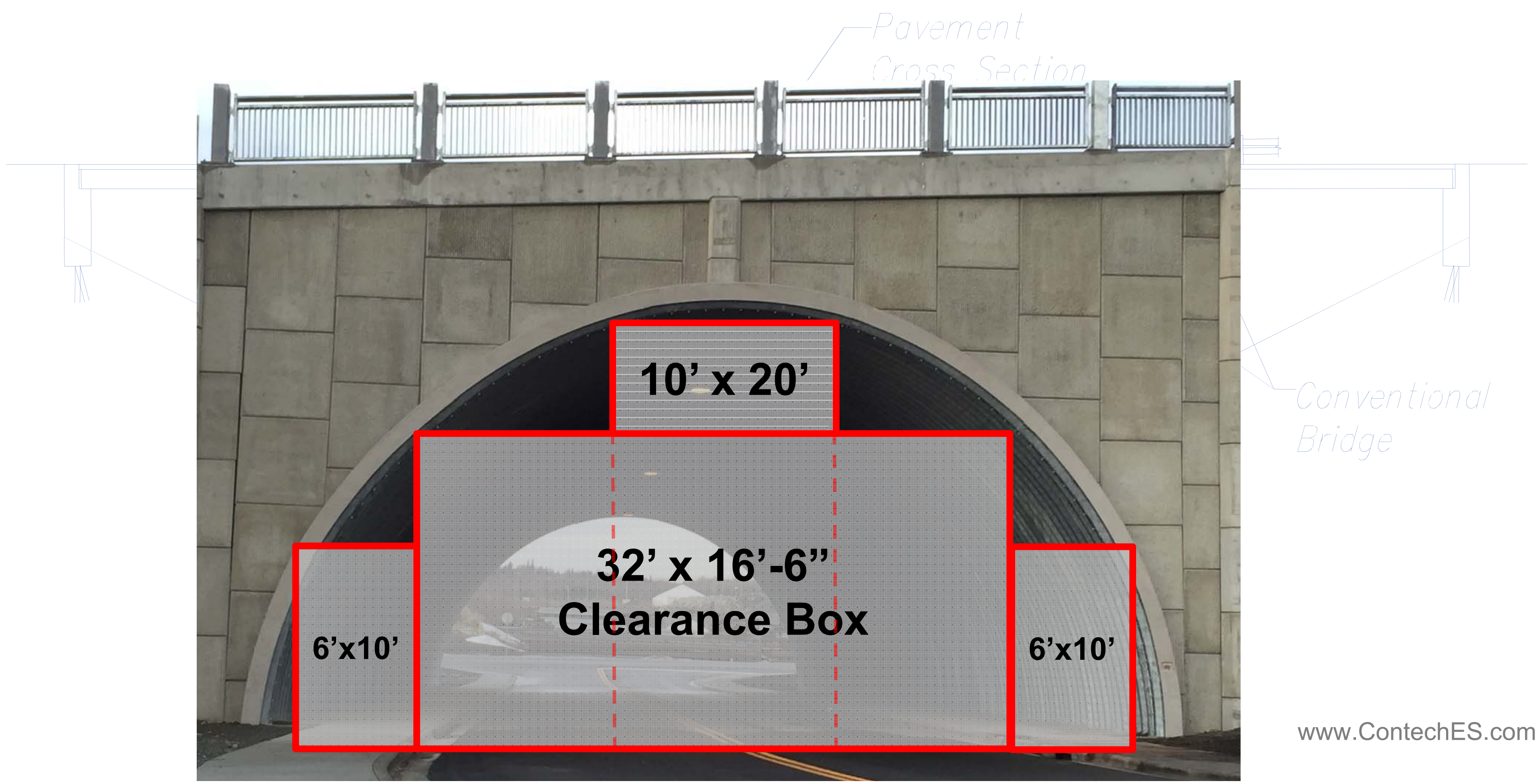
CONTECH ENGINEERED SOLUTIONS

Bridge Type Selection Chart

		PRODUCTS	SPAN
CONVENTIONAL BRIDGE	STEEL	Steel Plate Girder	80-300 ft
		Pedestrian Truss	20-300 ft
		Vehicular Truss	50-300 ft
		Rolled Beam Bridge	20-120 ft
	CONCRETE	Precast I/T Beams	40-175 ft
		Precast Box Beam	20-90 ft
BURIED BRIDGE	CONCRETE	BEBO®	12-102 ft
		CON/SPAN®	12-65 ft
		3-Sided Flat Top	12-32 ft
	METAL	MULTI-PLATE® SUPER-SPAN™	20-45 ft
		BridgeCor®	18-65 ft
		Aluminum Box Culvert	9-35 ft
		MULTI-PLATE®	5-26 ft
		Aluminum Structural Plate	5-23 ft
CULVERT	CONC	4-Sided Concrete Box	6-25 ft
	METAL	MP & ALSP Round & Pipe Arch	5-25 ft
		Corrugated Metal Pipe	5-12 ft



Buried Bridge vs. Conventional Bridge



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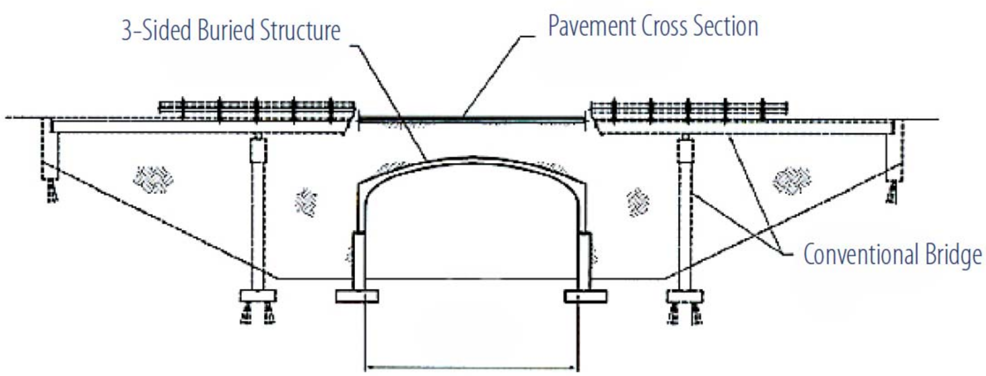
CONTECH ENGINEERED SOLUTIONS

A. Buried Bridges vs. Conventional Bridges



Maintenance Costs Add Up

Conventional Bridges Convert to Buried Bridges

- Shorter construction time/phasing means lower initial cost
- Minimal/no long term maintenance lowers overall life cycle cost
- Shorter construction time minimizes traffic disruption
- Bury utilities in backfill over structure
- Increased safety with limited/no freeze concerns & deck maintenance
- No Approach Slabs
- No Expansion Joint

Buried Bridge vs. Conventional Bridge

Before

After

During

Bridge Type Comparison Chart

	CONVENTIONAL	BURIED
Traffic Disruption*	2 YEARS	5 MONTHS
Construction Time*	2 YEARS	1 YEAR
Initial Cost*	$8 M	$5.5 M
Typical Maintenance*	Deck Overlay every 15-18 years. Total Deck Replacement every 30-35 years.	Periodic Asphalt replacement.

*Estimated

Water Crossing Design Guidelines

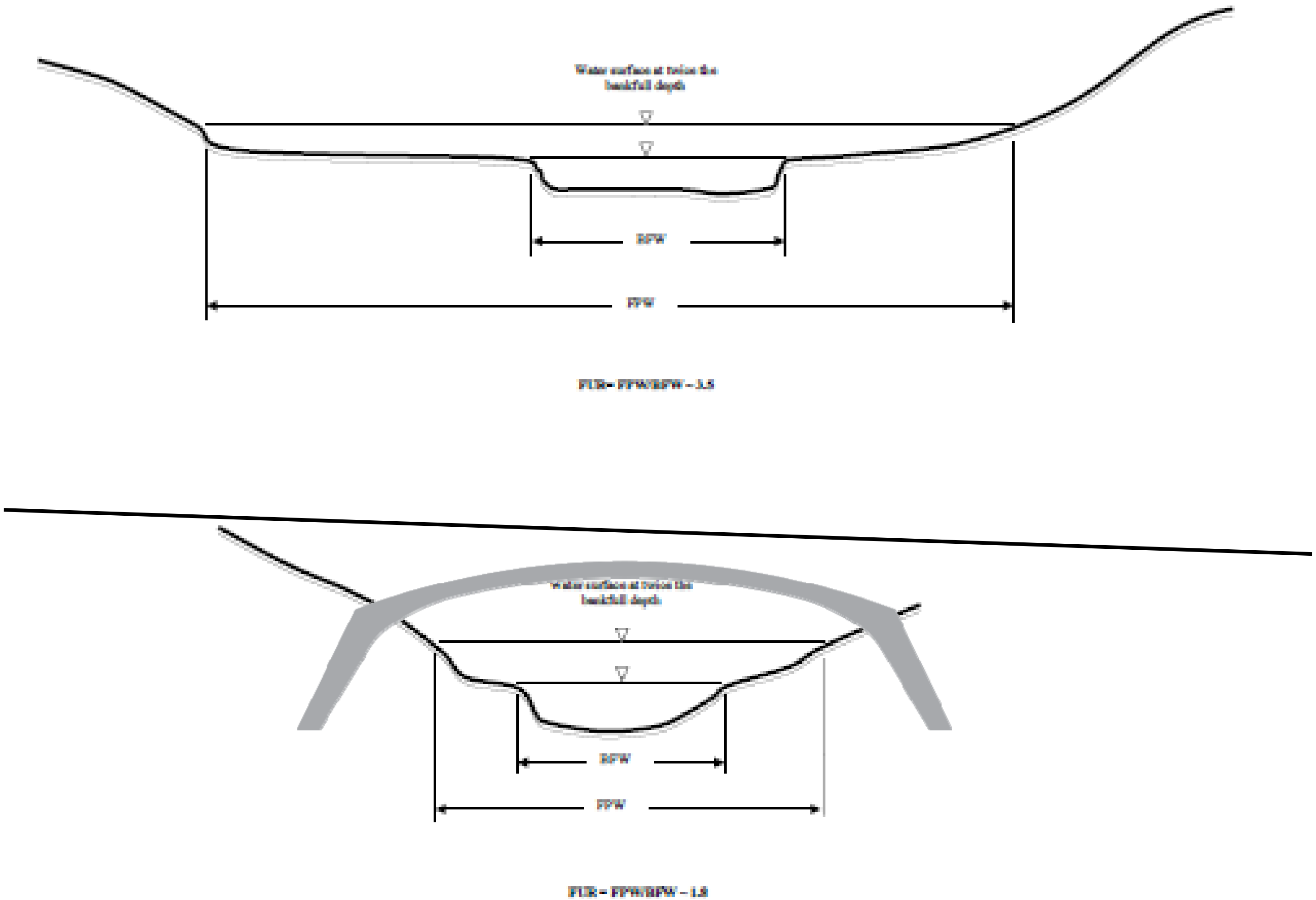
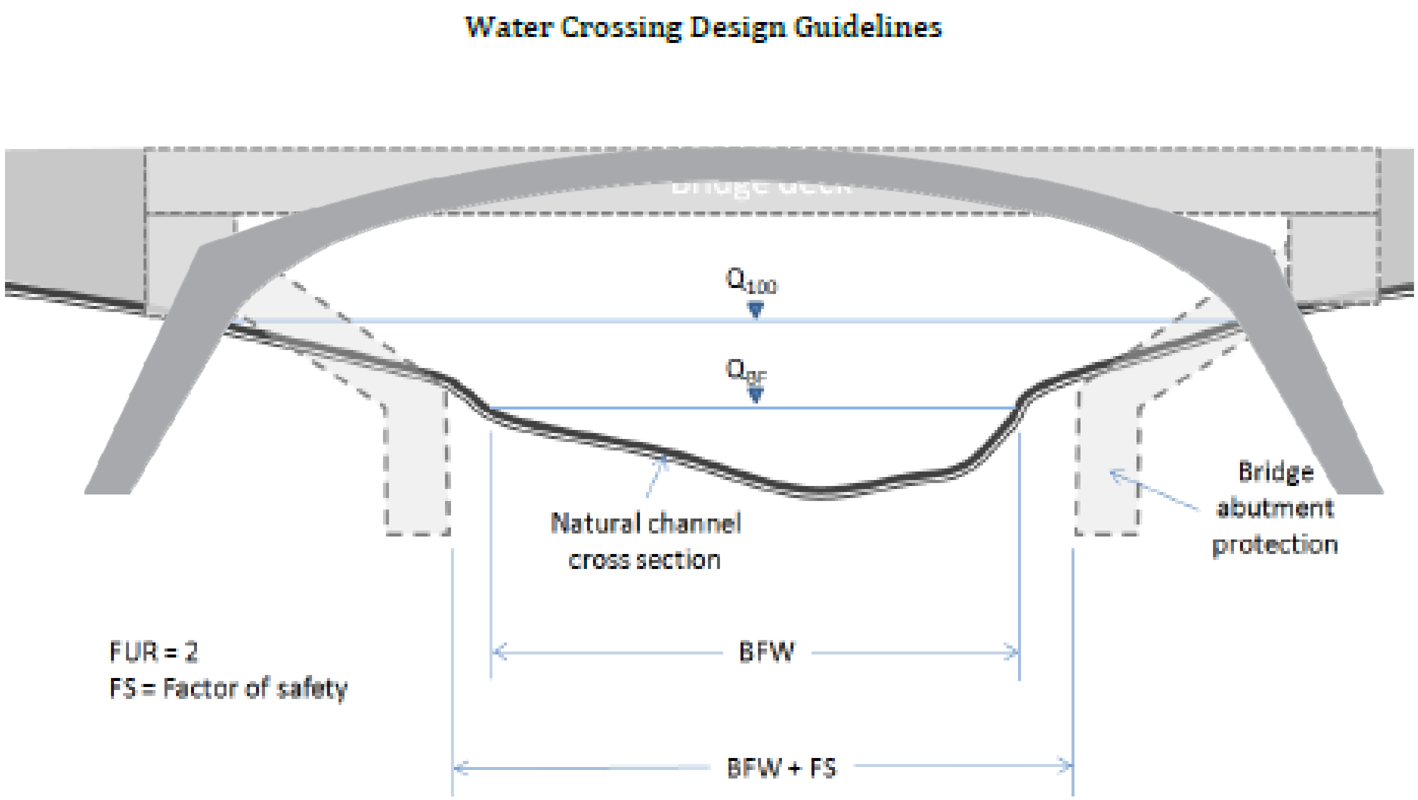


Figure 4.1: Flood-prone width and Bank-full widths for a broad floodplain and a narrow floodplain.



GOALS:

Prevent excessive backwater rise during flooding
Prevent or limit local scour
Allow free passage of woody debris
Extend safety of approach roads, allow natural channel evolution

Quiota Creek with HDR Fish Pro

CONTECH ENGINEERED SOLUTIONS

Accelerated Bridge Program (Staged Construction/Prefabrication)

U.S. Department of Transportation
Federal Highway Administration

- Reduces onsite construction time
- Reduces Mobility Impacts
- Reduces Environmental impact time
- Reduces user costs
- Improves Safety
- Improves Quality

Accelerated Bridge Program

U.S. Department of Transportation
Federal Highway Administration

***Accelerated Bridge Construction (ABC)*:**

- ABC is bridge construction that uses innovative planning, design, materials, and construction methods in a safe and cost-effective manner to reduce the onsite construction time that occurs when building new bridges or replacing and rehabilitating existing bridges

Prefabricated Bridge Elements and Systems

- PBES are structural components of a bridge that are built offsite, or near-site of a bridge and include features that reduce the onsite construction time and the mobility impact time that occurs when building new bridges or rehabilitating or replacing existing bridges relative to conventional construction methods.

Connection Details for Prefabricated Bridge Elements and Systems

March 30, 2009

Publication No. FHWA-IF-09-010

U.S. Department of Transportation
Federal Highway Administration

Priority, Market Ready Technologies and Innovations

HIGHWAYS FOR LIFE

Figure 2.4.3-1 depicts a proprietary arch system call the Con/Span® Bridge System. This system, including the arch elements, the spandrel walls, the wingwalls and the footings, can be completely made with precast concrete elements. The connections shown in Figure 2.4.3-1 are described in the following sections.

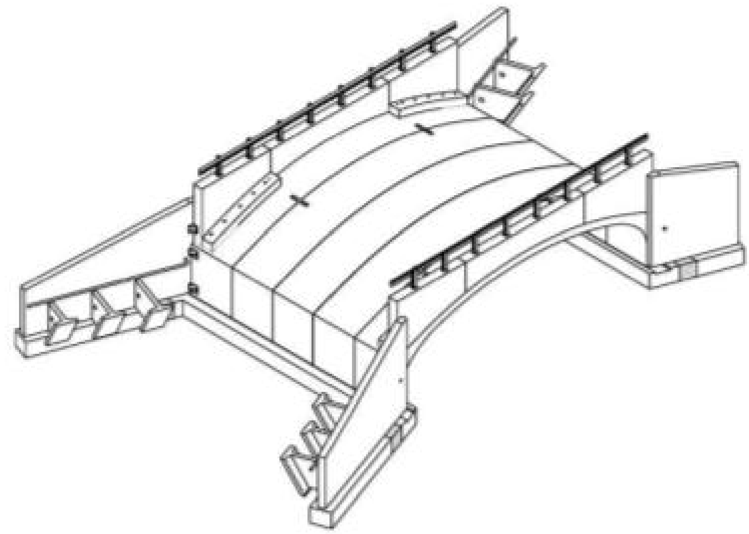


Figure 2.4.3-1 Con/Span® Bridge System

Page 2-181

"Prefabricated elements of a bridge produced off-site can be assembled quickly, and can reduce design time and cost, minimize forming, minimize lane closure time and/or possibly eliminate the need for a temporary bridge."

Agenda

- Intro to Contech
- Precast Arch Bridges Around the Country
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- Precast Design (Structural Design)
- Production
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- Questions

Standard Specifications for Highway Bridges

AASHTO LRFD Design Specifications 2015

Section 12: Soil-Corrugated Metal Structure Interaction Systems

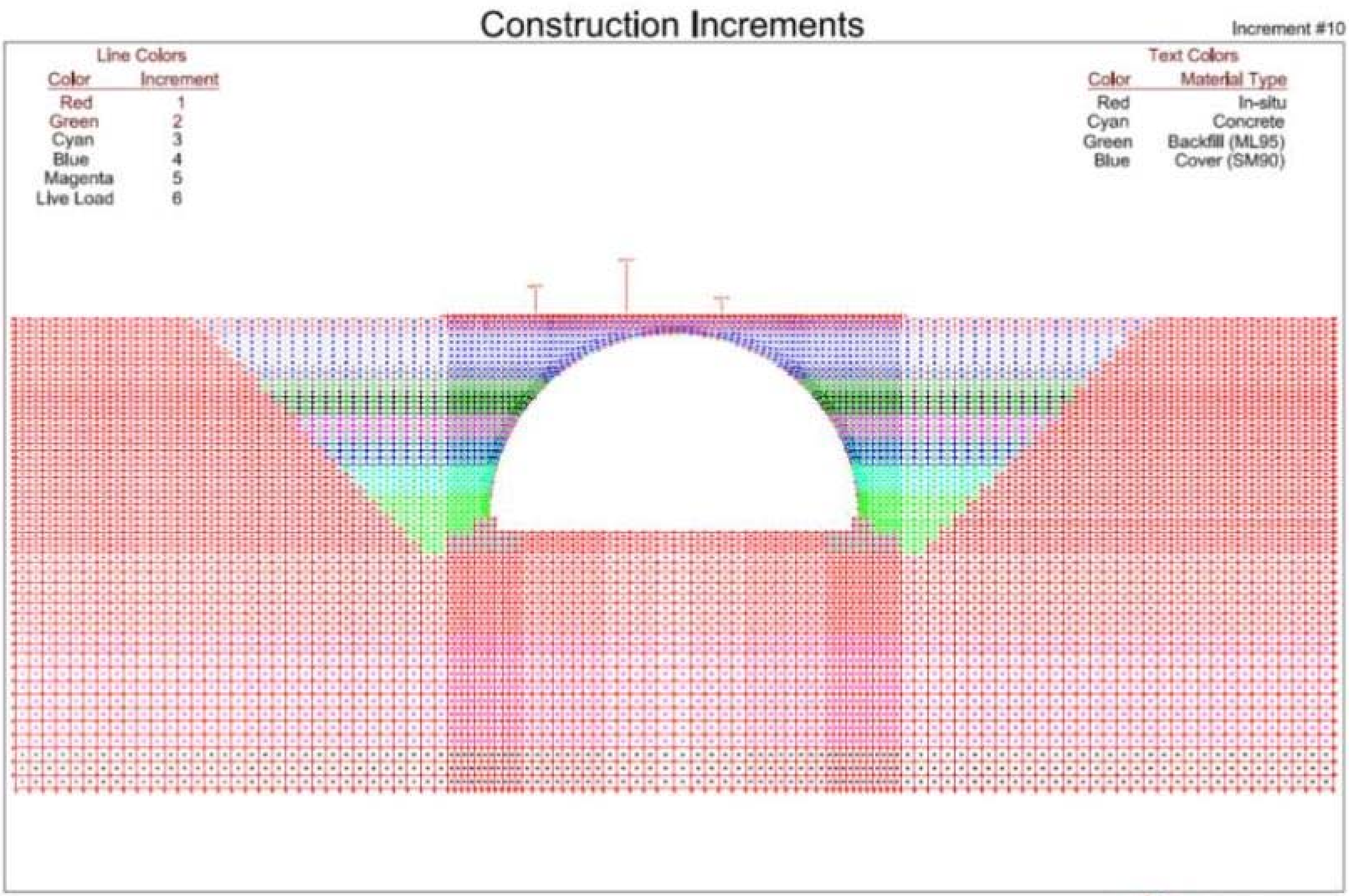
Section 16: Soil Reinforced Concrete Structure Interaction Systems

Section 16.8: Precast Reinforced Concrete Three-Sided Structures

Other Design Specifications

- AREMA Manual for Railway Engineering
- AISI - Handbook of Steel Drainage & Highway Construction Products (PLATE)
- AISC – Manual of Steel Construction (TRUSS)
- AWS – Structural and Bridge Welding Code (TRUSS)

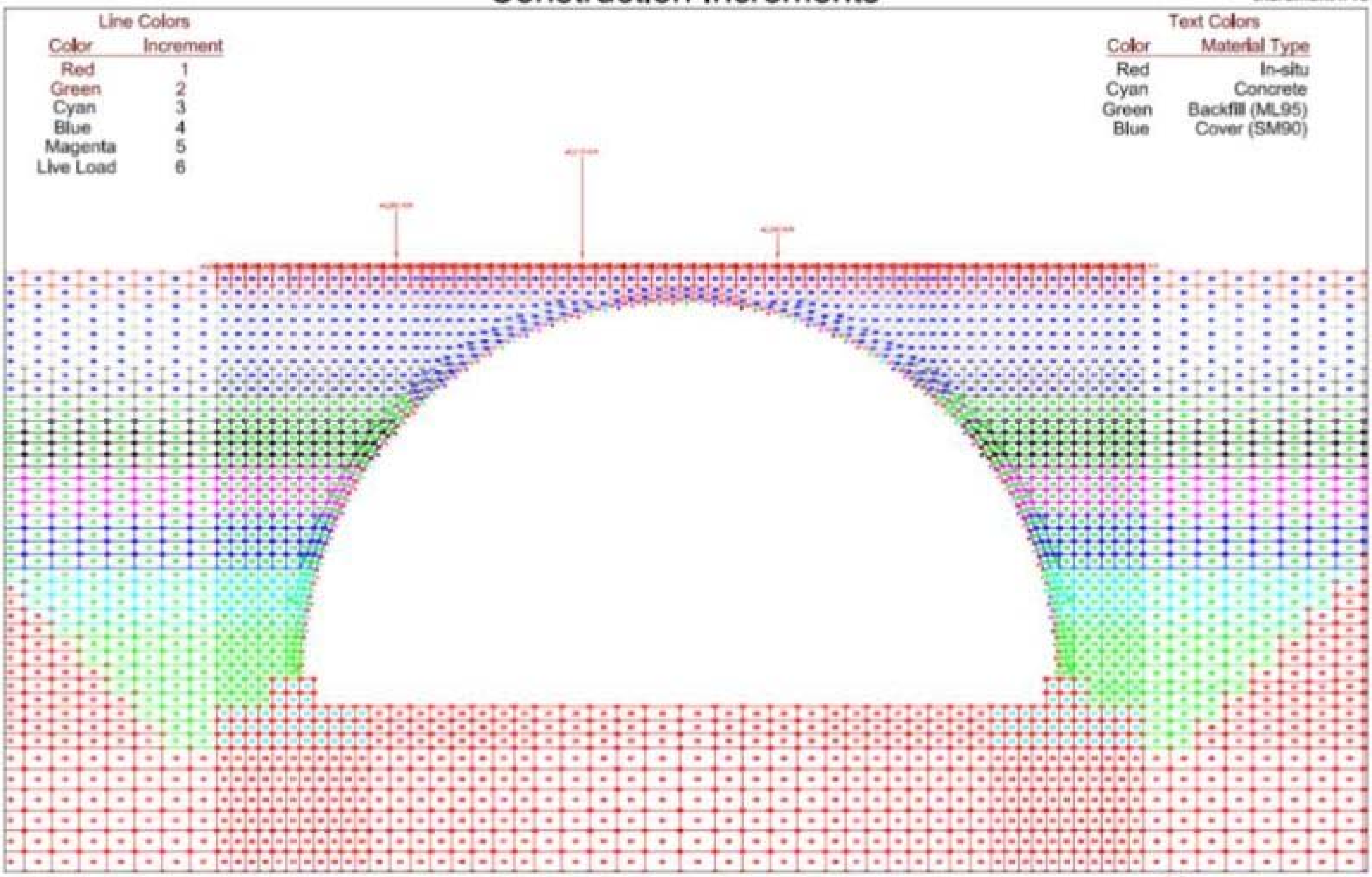
CONTECH
ENGINEERED SOLUTIONS



BEBO C54T/6 (2'-0" C, HL93)

Construction Increments

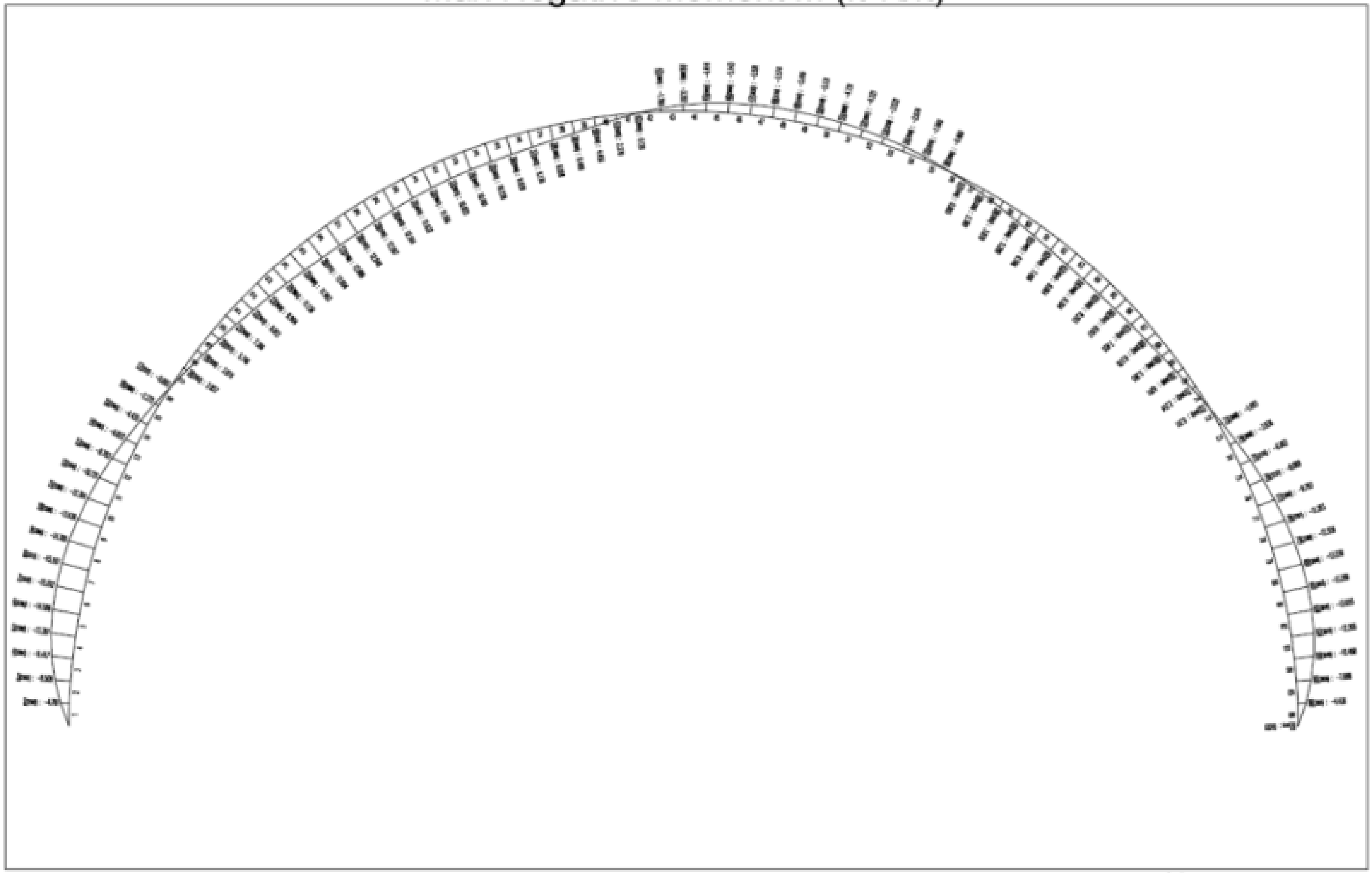
Increment #10



BEBO C54T/6 (2'-0" C, HL93)

Max Negative Moment M (ft*K/ft)

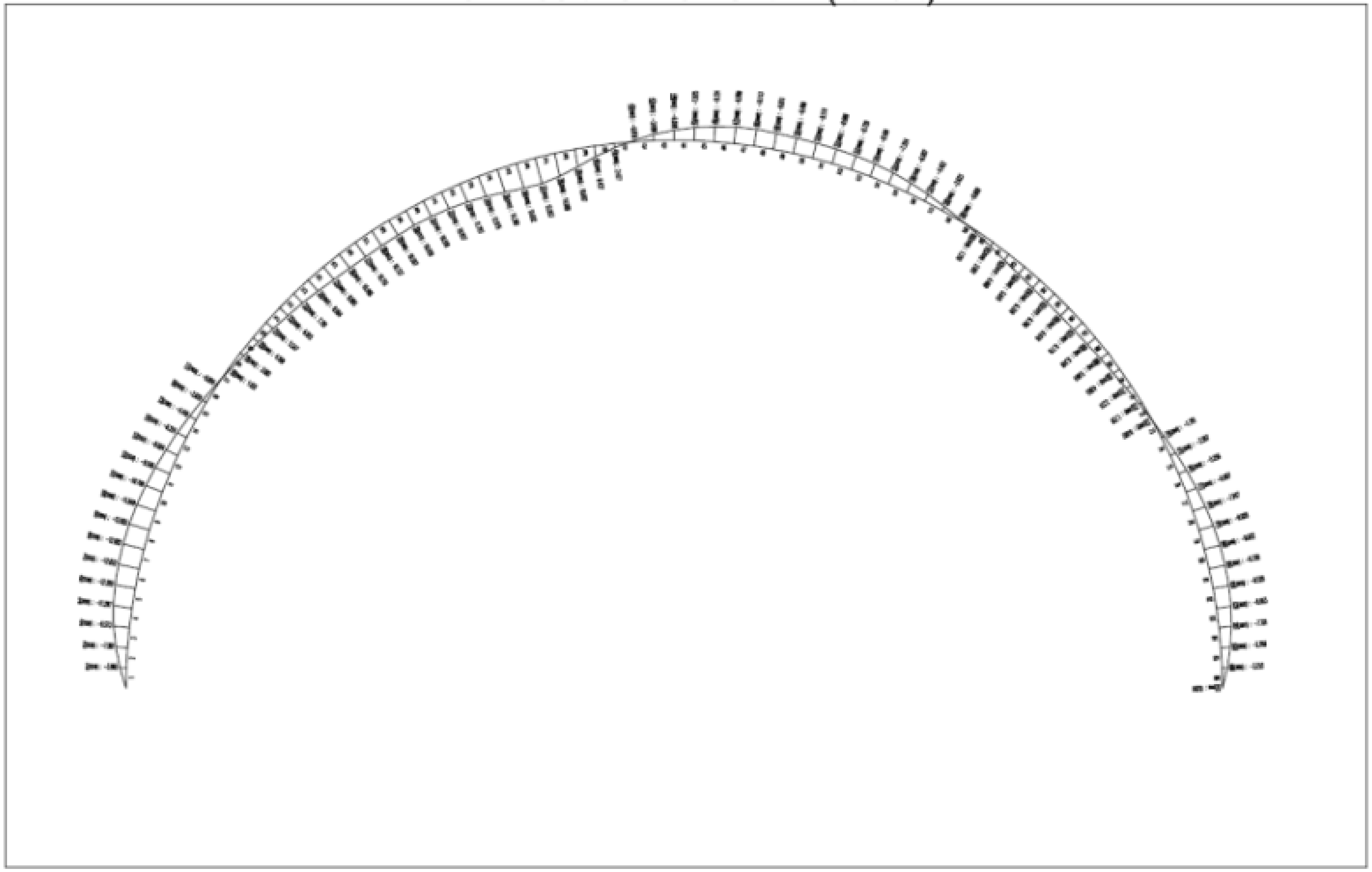
Increment #10



BEBO C54T/6 (5'-0"C, HL93)

Max Positive Moment M (ft*K/ft)

Increment #10



BEBO C54T/6 (2'-0" C, HL93)

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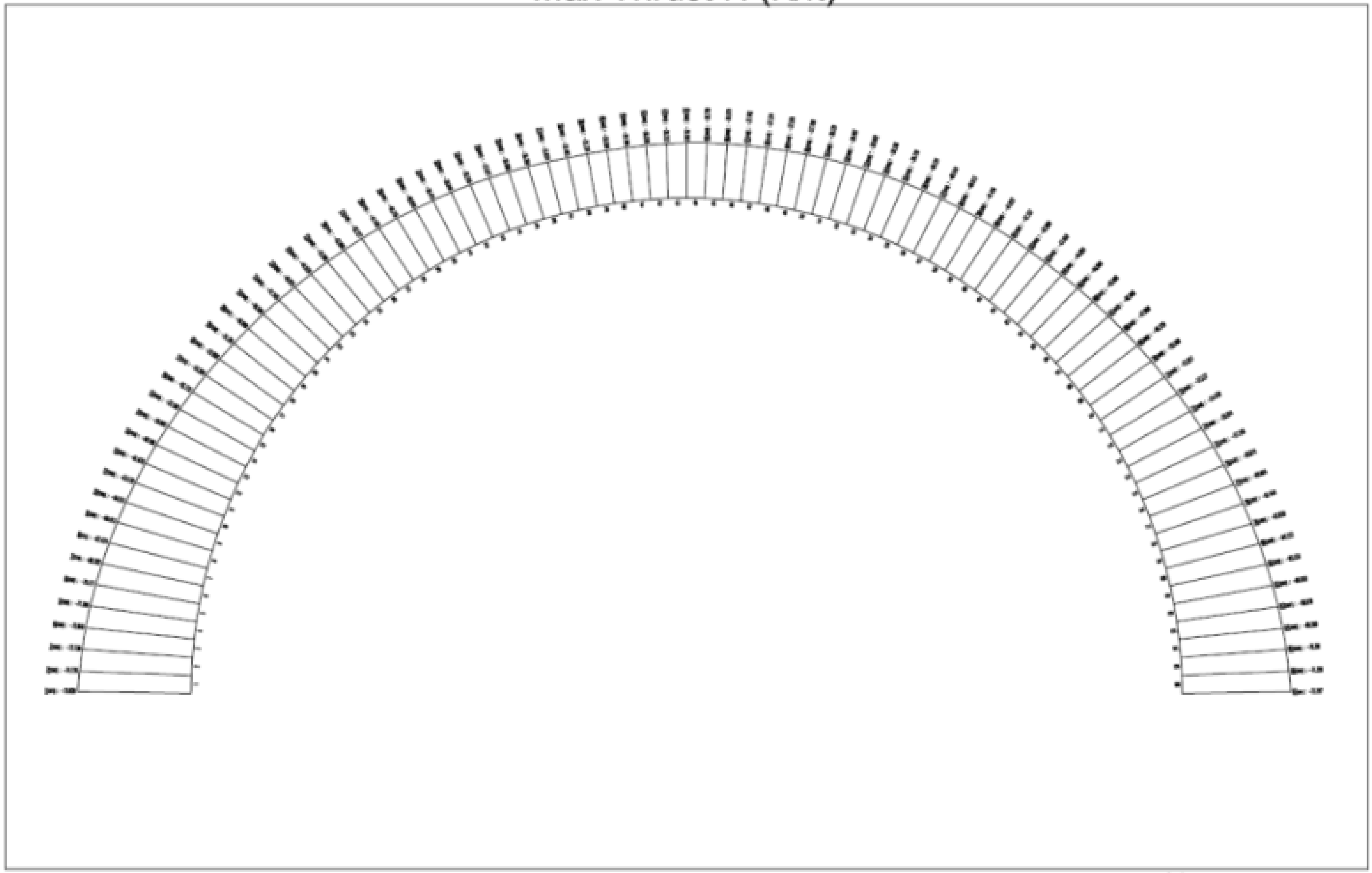
Max Thrust N (K/ft)

Increment #10

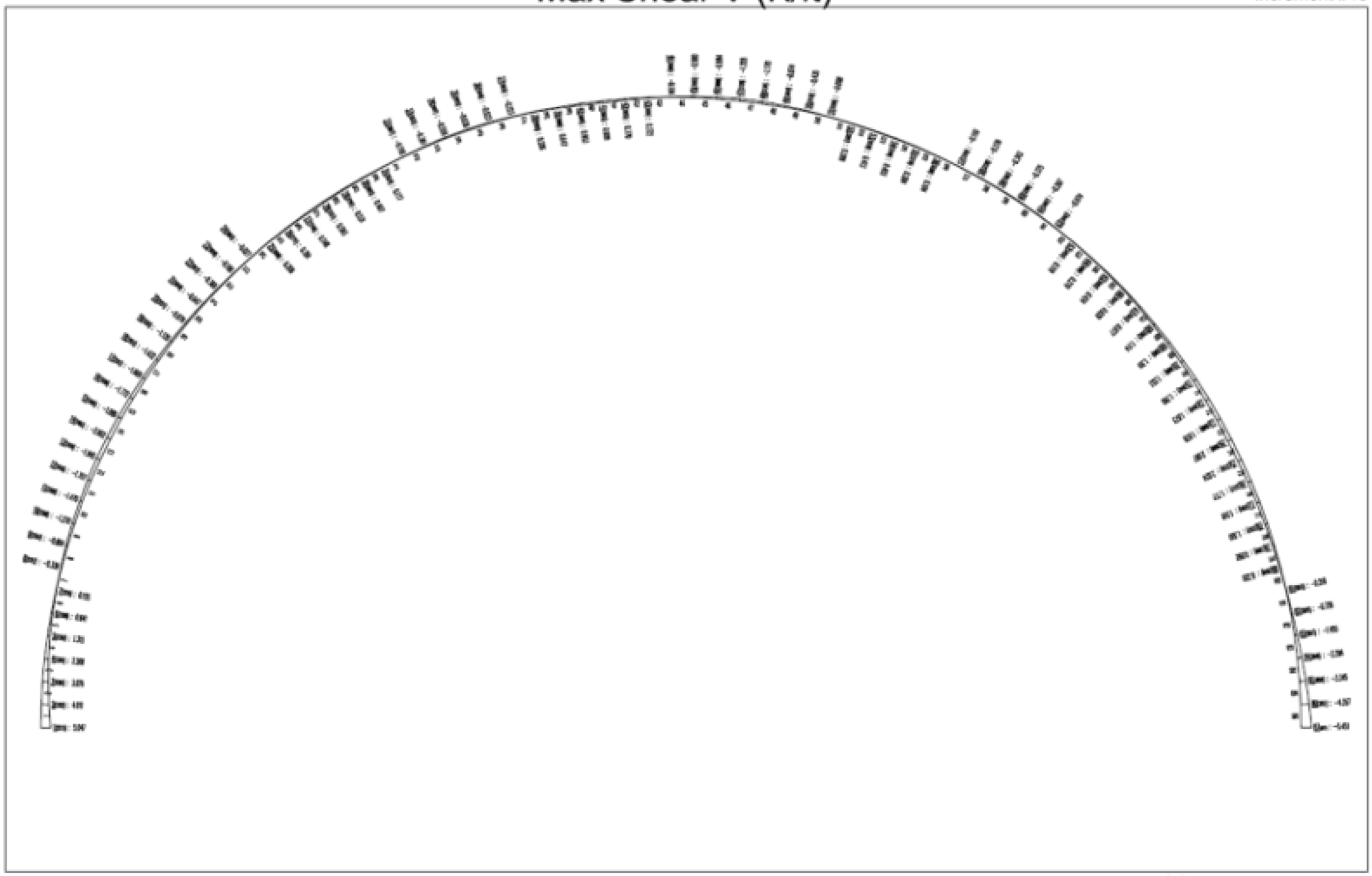


BEBO C54T/6 (5'-0"C, HL93)

CONTECH ENGINEERED SOLUTIONS

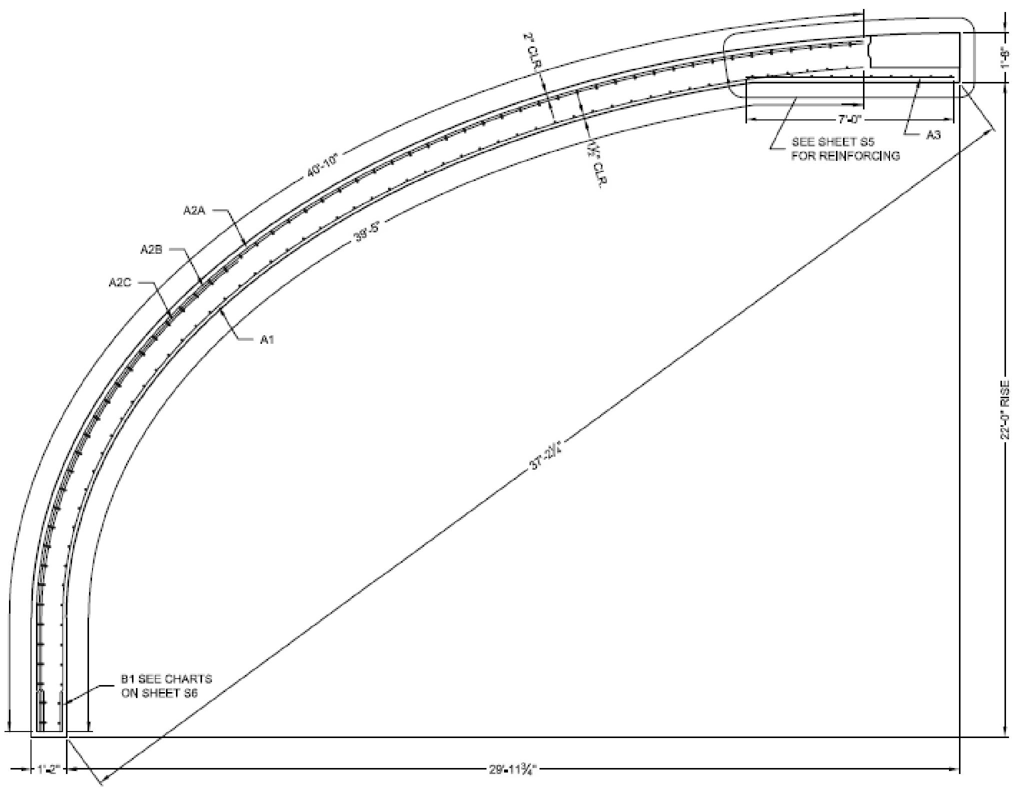
Max Shear V (K/ft)

Increment #10



BEBO C54T/6 (5'-0"C, HL93)

NOTES:
1. MINIMUM 28-DAY CONCRETE COMPRESSIVE STRENGTH SHALL BE 7000 PSI.
2. OVERLAP LENGTH SHALL BE MEASURED FROM LAST CROSSWIRE.
3. DIMENSIONS SHOWN ARE FOR FORM SYSTEM "E60T".
4. MINIMUM YIELD STRENGTH FOR WELDED WIRE FABRIC SHALL BE 65,000 PSI.
5. REINFORCING SHALL BE LIMITED TO A MAXIMUM OF THREE LAYERS OF REINFORCING (WWF OR BARS) PER AREA (A1 OR A3).
6. ALL EDGES OF PRECAST TO HAVE A ¾" CHAMFER.
7. SPACING OF LONGITUDINAL REINFORCEMENT MUST BE A MAXIMUM OF 8" O.C. FOR MULTIPLE LAYERS OF MESH, ONLY THE OUTER MOST LAYER MUST BE A MAXIMUM OF 8" O.C.
8. ALL REINFORCING BARS SHALL BE EPOXY COATED IN ACCORDANCE WITH ASTM 9-07.3.
9. ALL WELDED WIRE FABRIC SHALL BE GALVANIZED.



PRECAST UNIT REINFORCEMENT

INTERIOR UNITS C3A, C3B & C4A

WEIGHT OF REQUIRED MESH REINFORCEMENT = 502 LBS/FT

SHEET NO.	CIRCUMFERENTIAL AREA REQ'D (IN^2/FT)	LONGITUDINAL AREA REQ'D (IN^2/FT)	MESH SIZE	LENGTH (FT)	CIRCUMFERENTIAL AREA REQ'D (IN^2/FT)	LONGITUDINAL AREA REQ'D (IN^2/FT)
1	A1 = 0.84	0.13		39'-5"		
2	A2A = 0.84	0.13		40'-10"		
3	A2B = 0.84	0.13		40'-10"		
4	A2C = 0.36	0.13		18'-0"		
5	A3 = 0.48	0.13		7'-0"		

DESIGN LOADING: HL-93 + SEISMIC (PGA 0.37) COVER = 1'-6" MIN. \ 10'-6" MAX. (9'-6" MAX AT ROADWAY)

APPROVED

MARK	DATE	REVISION DESCRIPTION	BY
1	8/19/2013	APPROVED	JAL

CONTECH ENGINEERING, PROFESSIONAL CORPORATION
5670 Greenwood Plaza Blvd., Suite 530, Greenwood Village, CO 80111
800-526-3999 720-587-2700 720-587-2651 FAX

BEBO® Arch Systems

FABRICATION DRAWING

US101 / DEER PARK ROAD

CLALLAM COUNTY, WASHINGTON

PROJECT No.: 400852	SEQ. No.: 002	DATE: 7/29/2013
DESIGNED: JAL	DRAWN: KKC	
CHECKED: DLW	APPROVED: MGC	
SHEET NO.: S2 OF S15		

CONTECH ENGINEERED SOLUTIONS

Seismic Design

- AASHTO LRFD - Seismic effect for buried structures need not be considered, except where they cross active faults.
  - History of good performance under seismic loading
  - Constrained by surrounding soil
  - Greater degree of redundancy
  - Backfill Specifications

- WSDOT

For precast reinforced concrete three sided structures with span lengths greater than 20 feet, the AASHTO LRFD Bridge Design Specification Section 12.6.1 exemption from seismic loading shall not apply, and such three sided structures shall be designed for seismic loads in accordance with other provisions of the current AASHTO LRFD Bridge Design Specifications. FHWA Publication No. FHWA-NHI-09-010 *Technical Manual for Design and Construction of Road Tunnels Civil Elements*, dated November 2008, may also be used as a design specification reference for the seismic design requirement.

CONTECH ENGINEERED SOLUTIONS

Seismic Design

SEISMIC DESIGN AND ANALYSIS
OF BURIED STRUCTURES
USING CANDE-2007

Report Prepared

for

CONTECH Construction Products, Inc.

by

Dr. Michael G. Katona

March 2009

1

NCHRP
REPORT 611

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Calculate Maximum Free-field Shear Strain

2.3.2 Moderate Burial Condition (Method 2)

This method is applicable for burial depths less than 75 feet, representing the vast majority of culvert installations worldwide. Here, the maximum free-field shear strain is given by the familiar elastic stress-strain relationship for shear,

$$\gamma_{max} = \tau_{max}/G \qquad \text{Equation 2.3.2}$$

where, $\tau_{max} = (PGA/g)\sigma_v R_d$ = max earthquake shear stress in region of culvert

PGA/g = non-dimensional peak ground acceleration of design earthquake

$\sigma_v = z\omega_{soil}$ = overburden stress at base of culvert

$z = (H + rise)$ = depth from surface to base of culvert (H = cover height)

ω_{soil} = weight density of soil

$$R_d = \begin{Bmatrix} 1 - 0.00233z, \text{ for } z < 30 \text{ feet} \\ 1.174 - 0.00814z, \text{ for } 30 \text{ feet} < z < 75 \text{ feet} \end{Bmatrix} = \text{acceleration reduction factor}$$

G = Shear modulus of soil surrounding the culvert.

The theoretical basis of this approach is centered on the expression for maximum free-field shear stress τ_{max}, which is discussed in the following paragraph and illustrated in Figure 2.3.1

Seismic Design

Figure 3.1-1 Illustration of typical load steps for static loading.

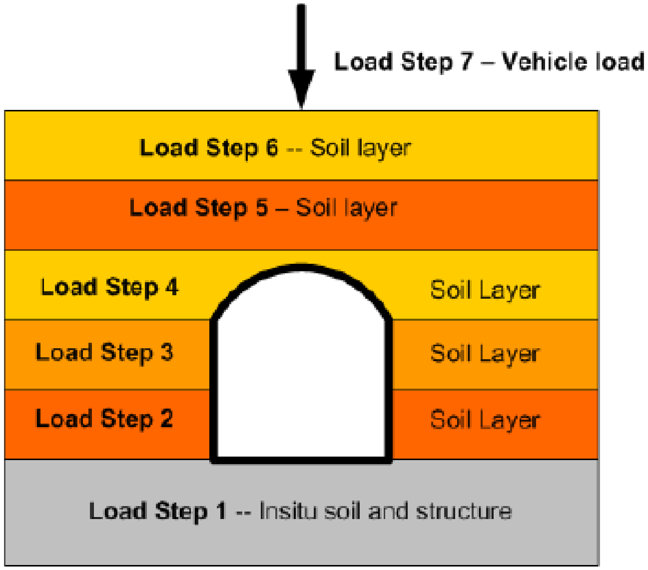
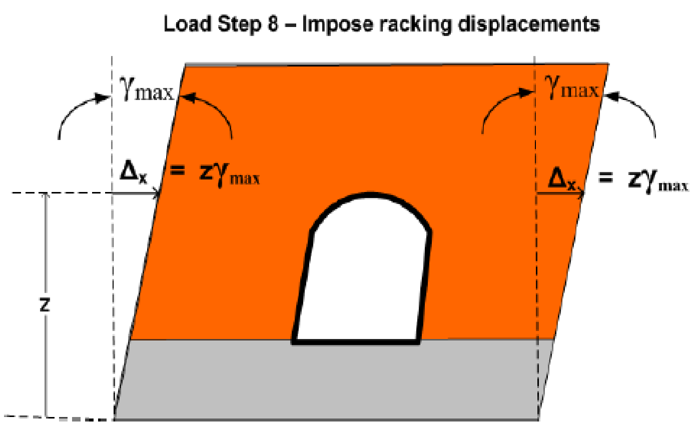


Figure 3.1-2 Illustration of applying seismic loading in last load step.



CONTECH CONSTRUCTION PRODUCTS INC.

Project:	DEER PARK	Page:	
Location:	PORT ANGELES, WA	Date:	7/8/13
Product:		By	JAL
Client:		Checked:	

- SEISMIC CALCULATIONS → PER DR MICHAEL KATONA'S APPROACH FOR CANDE 2007

1.) IDENTIFY DESIGN EARTHQUAKE FOR SITE IN QUESTION

2.) CALCULATE THE MAXIMUM FREE FIELD SHEAR STRAIN (γ_{MAX}) AT THE CULVERT LOCATION.

3.) CREATE A FINITE ELEMENT MODEL USING INCREMENTAL CONSTRUCTION, SOIL & VEHICULAR LOADS.

4.) USE MODEL TO ANALYZE A SEISMIC EVENT BY SPECIFYING DISPLACEMENT BOUNDARY CONDITIONS (ΔX) USING FREE FIELD SHEAR STRAIN.

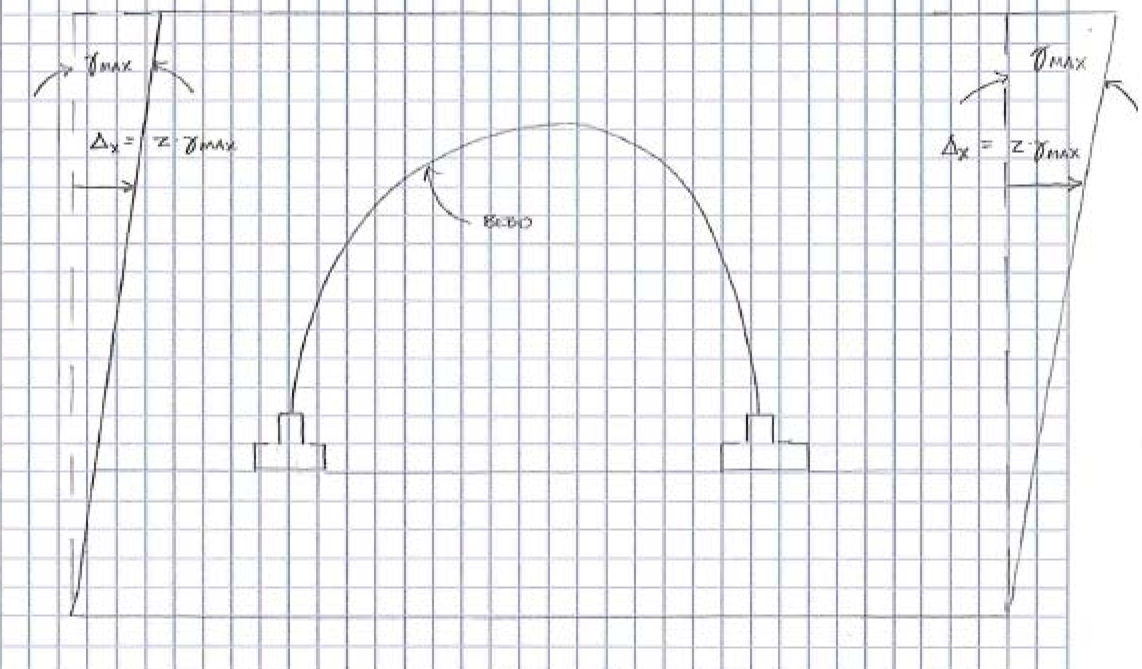
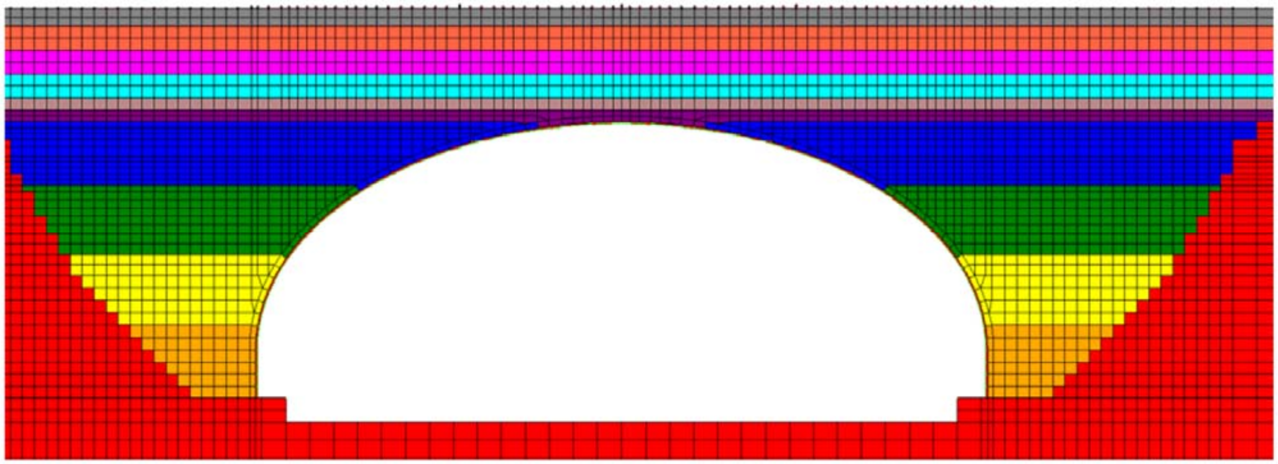


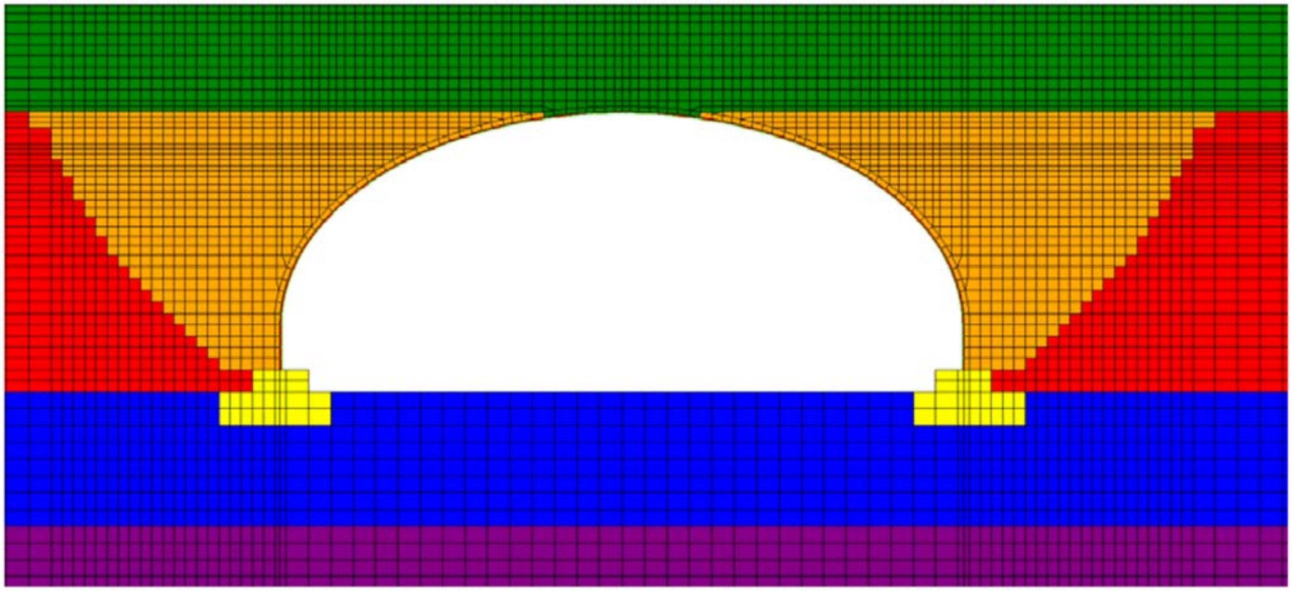
ILLUSTRATION OF SEISMIC "RACKING" DISPLACEMENTS ON BEBO STRUCTURE

Seismic Design

Construction Increments for both load Cases



Soil Materials for both load Cases



Agenda

- Intro to Contech
- Precast Arch Bridges Around the Country
- Buried Structures Design Philosophy
- Precast Design
- Production
- Installation
- Working with Contech
- Questions

Production

- Products typically produced by a Certified Plant
- Quality Control
  - Wood form vs Steel form
  - Constructability Tolerance
  - Longevity of structure
- Contech QA/QC Reports
- Contech Field Rep
- Buy America

- Outer mesh being lifted


BEBO
CONTECH
C54T
20 LBS.

- QC checking reinforcement before closing form

CONTECH ENGINEERED SOLUTIONS

- Setting inside form

- Top of closed form

CONTECH ENGINEERED SOLUTIONS

PRODUCTION DAILY QUALITY CONTROL CHECKLIST

SETUP & CASTING ARCH UNITS

(Tolerances ± ½" maximum)

Producer: ______________________

Job Name: ______________________ Job Number: ______________________

Item Produced: ______________________ Date Produced: ______________________

All form surfaces cleaned, including catwalk and base frame ______ ☐
Check if Soffit is square ______ ☐
Check area of steel with gauge and print ______ ☐
Soffit thoroughly cleaned ______ ☐

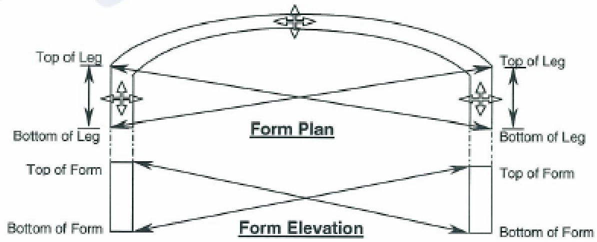
Note: *These check sheets are* ***generic****. Please* ***add*** *type of inserts, spacing, blockouts, etc. On post-pour sheets, note cosmetic finish, dimensions and insert locations.* ***Always*** *note everything you think might be relevant.*

Check PVC pipes: Lift Holes ______ ☐
Weep Holes ______ ☐
Cable Holes ______ ☐

Check laps of mesh (12" minimum) ______ ☐
Check all clear spacers (2" or 1.5") ______ ☐
Check if cage chaired from soffit ______ ☐
Check leg lengths ______ ☐
Check if inside form is centered ______ ☐
Check top ties on form ______ ☐
Check bottom bolts on form ______ ☐
Check for gaps inside and outside of soffit ______ ☐
Check reinforcing after form is closed, ensure proper spacing ______ ☐
Check Special Items (skews, blockouts, etc.) ______ ☐

Before pour/ vibration: | | **After pour/ vibration:**

Check span on form
Check rise on form
Check if form is square
Check thickness of unit
Check lay lengths @ 5 points
Check finish for high spots



Authorized by: ______________________ Date: ______________
All items addressed by: ______________________ Date: ______________

PRODUCTION DAILY QUALITY CONTROL CHECKLIST

STRIPPING ARCH UNITS

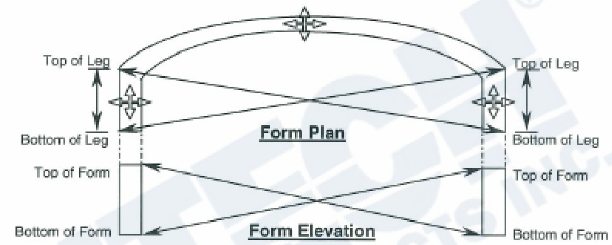
(Tolerances ± ½" maximum)

Producer: ______________________

Job Name: ______________________ Job Number: ______________________

Item Produced: ______________________ Date Produced: ______________________

Note: *These check sheets are* ***generic****. Please* ***add*** *type of inserts, spacing, blockouts, etc. On post-pour sheets, note cosmetic finish, dimensions and insert locations.* ***Always*** *note everything you think might be relevant.*



After Unit is pulled from form

List span dimension ______ ☐
List rise dimension ______ ☐
List square dimension ______ ☐
Check thickness ______ ☐
Check leg lengths ______ ☐
Check lay lengths at 5 points (bottom of leg, top of leg, and center of unit ______ ☐
Identify any patchwork needed after unit is stripped ______ ☐
Lifting loops cut and patched (at the appropriate time) ______ ☐
Proper stencil applied ______ ☐
Check finishing for high spots ______ ☐

Authorized by: ______________________ Date: ______________
All items addressed by: ______________________ Date: ______________

CONTECH ENGINEERED SOLUTIONS

- Pouring concrete is safely done off the back catwalk

- Moving unit up and away from form using to cranes

Typical arch section loaded on a truck.
Note: the offset overhang on the passage side.

CONTECH ENGINEERED SOLUTIONS

Headwall

Wingwalls

Agenda

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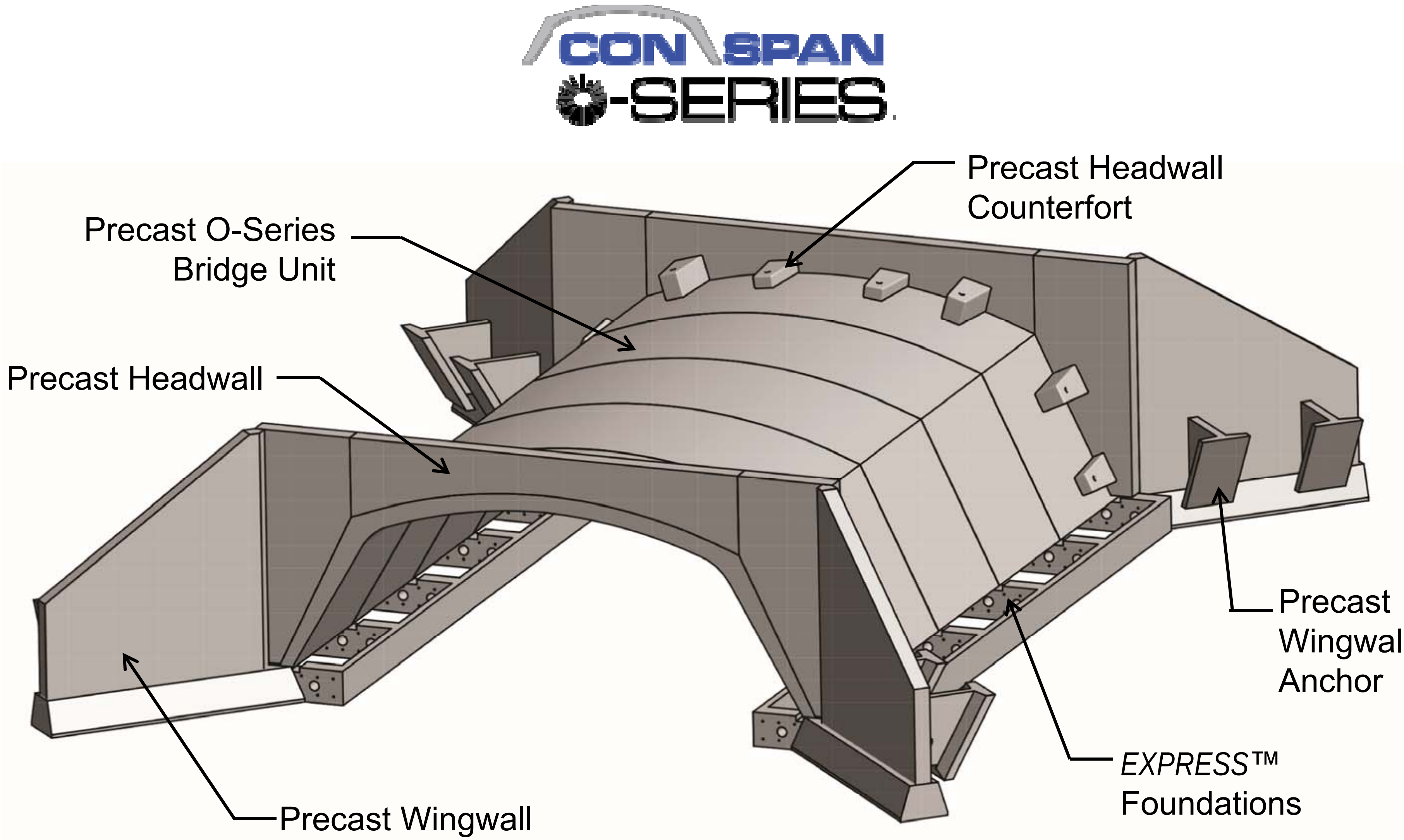
- Questions


CON SPAN
-SERIES
Precast Headwall
Counterfort
Precast O-Series
Bridge Unit
Precast Headwall
Precast
Wingwall
Anchor
EXPRESS™
Foundations
Precast Wingwall

CONTECH ENGINEERED SOLUTIONS

CONSPAN BRIDGE SYSTEMS

Back & Beyond
Snohomish Co, WA

Engineer: LDC

www.ContechES.com

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Indianola

Kitsap Co, WA

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CONTECH ENGINEERED SOLUTIONS

BEBO® Arch Systems

U.S. 395 Over BNSF Railroad
Spokane, WA

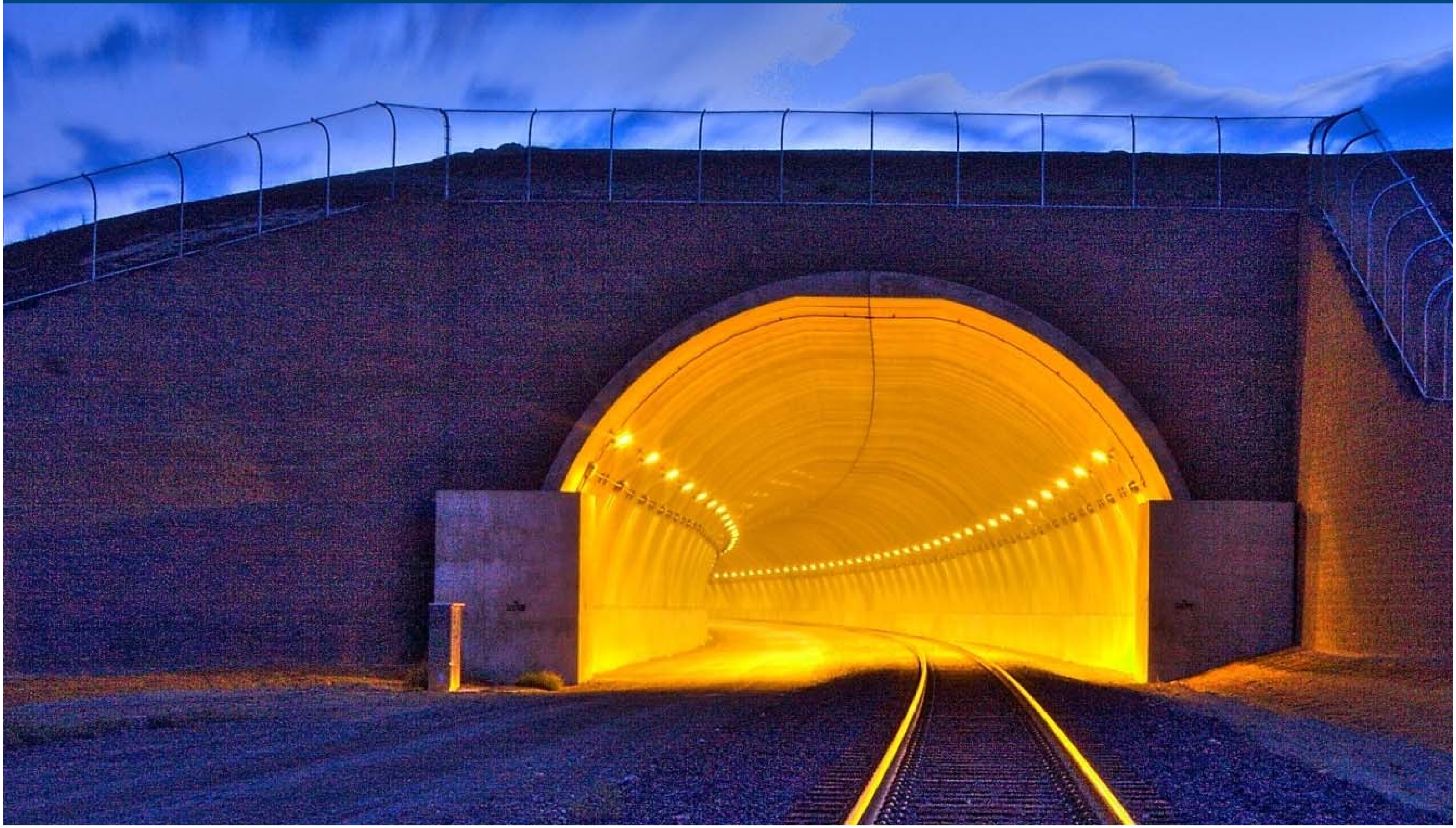
Engineer: HDR Inc./WSDOT

www.ContechES.com

U.S. 395 Over BNSF Railroad
Spokane, WA

Engineer: HDR Inc./WSDOT

CONTECH ENGINEERED SOLUTIONS



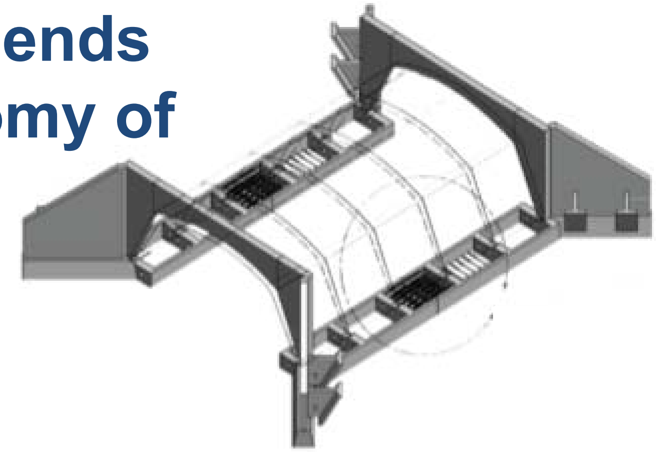
BEBO Arch Systems

U.S. 395 Over BNSF Railroad
Spokane, WA

Engineer: HDR Inc./WSDOT

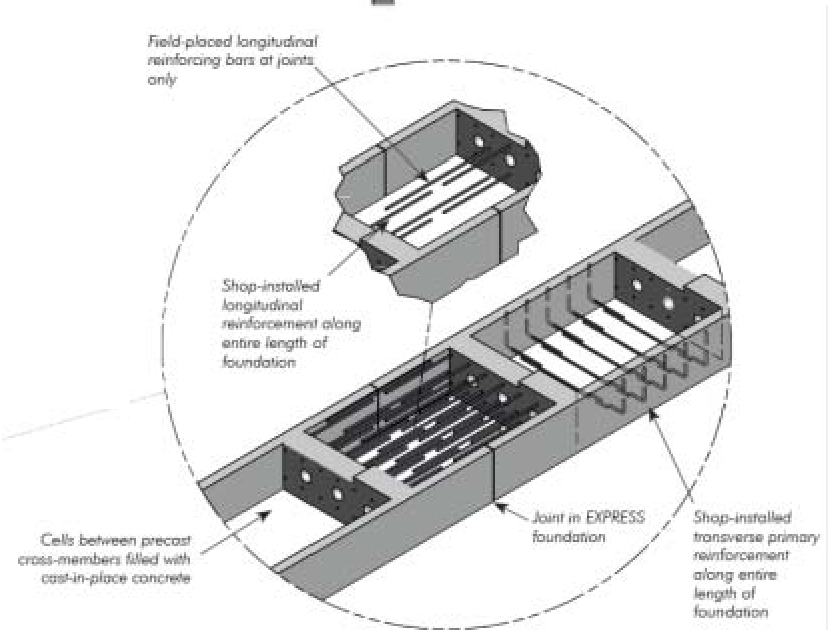
EXPRESS™ Foundations

A precast foundation system that blends the speed of precast with the economy of cast-in-place



Benefits to You:

- Provides ease and speed of installation
- Alleviates hazardous working conditions
- Minimal reinforcement to be placed on site
- Pick weights and sizes customized to your equipment



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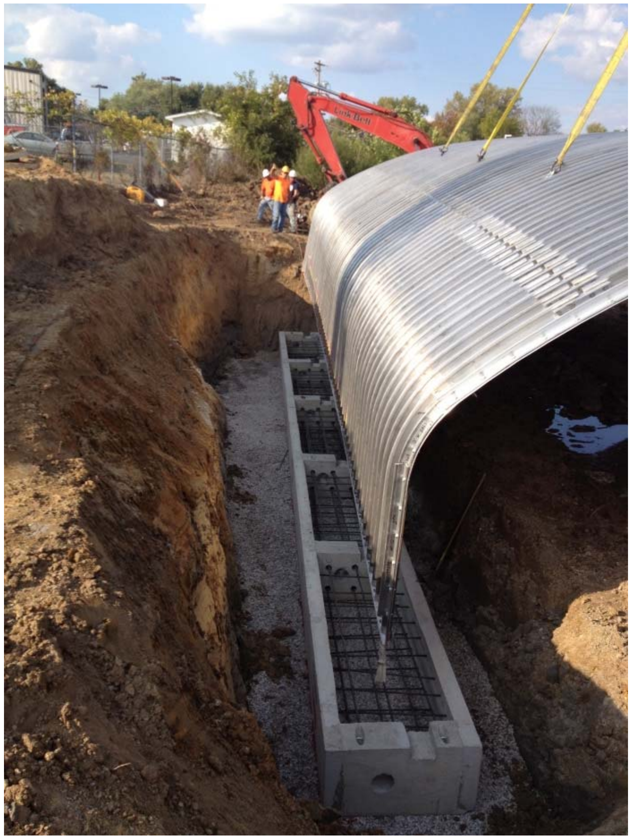
Aluminum Box Culvert on EXPRESS Foundations



200 East Minor Arterial - UDOT
Logan, Utah

Madigan Bypass Realignment – Murray Creek Culvert Replacement
JBLM, WA

CONTECH ENGINEERED SOLUTIONS

Madigan Bypass Realignment – Murray Creek Culvert Replacement
JBLM, WA

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ENGINEERED SOLUTIONS

Madigan Bypass Realignment – Murray Creek Culvert Replacement
JBLM, WA

CONTECH ENGINEERED SOLUTIONS

BEBO® Arch Systems

CON/SPAN O-SERIES + EXPRESS Foundations = ABC

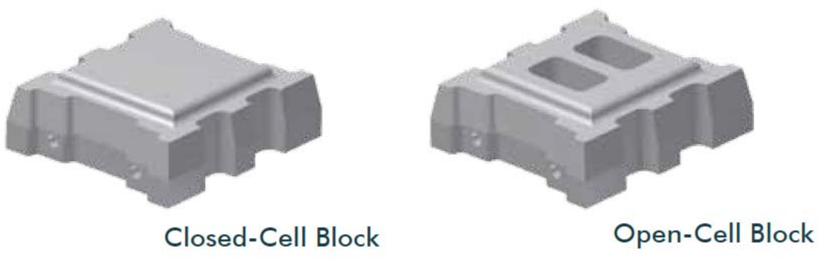
BridgeCor®

CONTECH® STRUCTURAL PLATE

Many of our bridge products can be combined with Express Foundations to help you meet the goal of Accelerated Bridge Construction.

Armortec Hard Armor

ArmorFlex – Articulating Concrete Blocks



A-Jacks – Concrete Armoring Units

Revegitation – Before & After

Speed of Installation

ARMORTEC
Erosion Control Solutions

CONTECH ENGINEERED SOLUTIONS

Armortec – Articulated Concrete Blocks

SCOUR PROTECTION

CHANNEL LINING

DAM OVERTOPPING

OUTLET PROTECTION

ARMORTEC™ Erosion Control Solutions

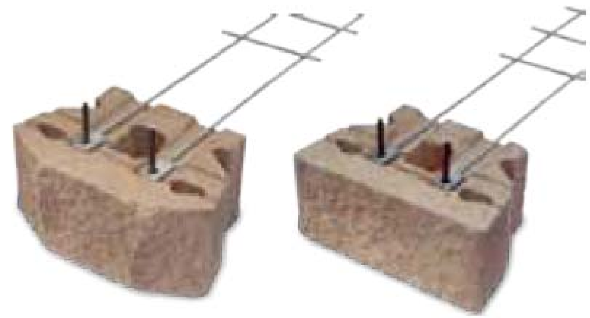
KEYSTONE RETAINING WALL SYSTEMS

Keystone Retaining Walls

Keystone
with Geogrid Reinforcement

EXTENSIBLE.

Keysteel™



INEXTENSIBLE.

CONTECH ENGINEERED SOLUTIONS

KEYSTONE® RETAINING WALL SYSTEMS

Keystone Retaining Walls

END TREATMENTS

ABUTMENTS

RETAINING WALLS

Agenda

- Intro to Contech
- Precast Arch Bridges Around the Country
- Buried Structures Design Philosophy
- Precast Design
- Production
- Installation
- Working with Contech
- Questions

CONTECH ENGINEERED SOLUTIONS

Contech. Your project partner.

- Summary & Overview Bridge Portfolio
- Innovative Bridge Developments
- Engineering Support & Design Tools
- Contech's Consultative Approach

Options & Support Specific to Your Project Needs

Solution Development	Design Support	Installation Support
• Project Design Worksheet • Structure Selection • Siting & Layout • DYOB • Engineer Estimate • Site Simulation • Proposal Preparation • Design Build Support	• Specifications • Contract Drawings • Permitting • Structural/Fabrication Drawings • Approval Assistance • Custom Shape Development • Horizontal/Vertical Alignment • Hydraulics & Scour Support • Foundations	• Preconstruction Meeting • On-Site Installation Assistance • Logistics Coordination

CONTECH ENGINEERED SOLUTIONS

Building Blocks to a successful Project

Solution Development | Design Support | Installation

Photo Site Simulation

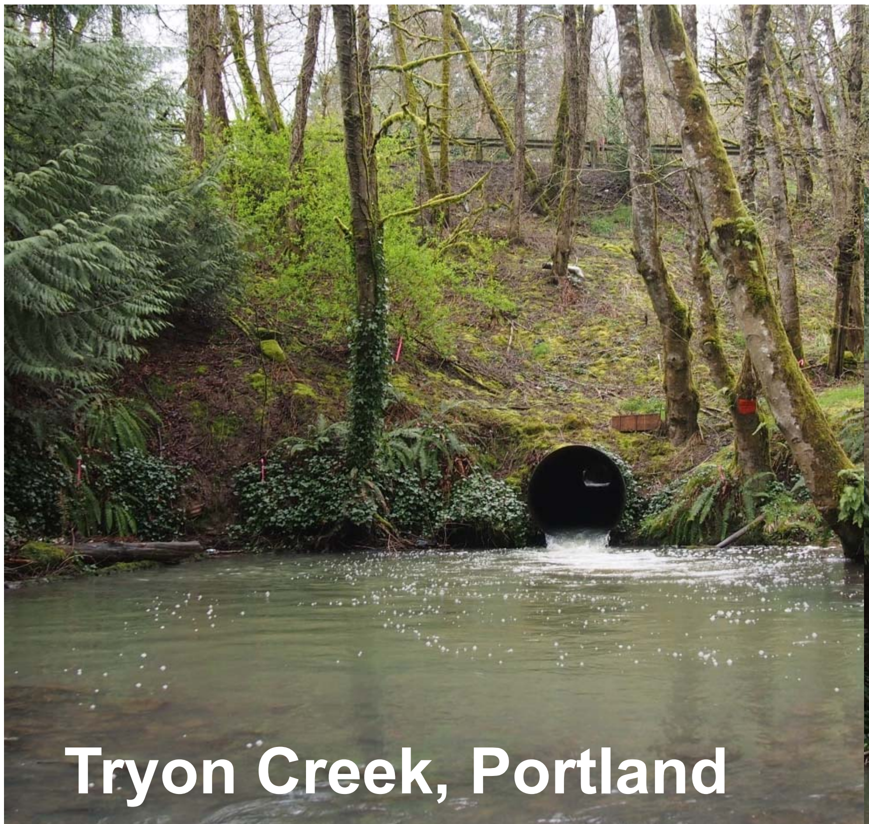
Chico Creek – Mason County
Existing

- Funding
- Public Meeting
- Construction Open House

Building Blocks to a successful Project

Solution Development | Design Support | Installation

Photo Site Simulation



Building Blocks to a successful Project

Solution Development | Design Support | Installation

CONTECH
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Design Your Own Bridge

DYOB® Design Your Own Bridge

DYOB® is Contech Engineered Solutions' exclusive online design to
bridge. Use this tool to create a drawing of your precast CON/SPAN

Enter information and specs in the form fields below. We'll process
mail you a schematic of your bridge. (All fields must be completed
accurate representation). Please allow an hour for your request to b

*Required Fields

Contact Information

First Name *
Last Name *
Title
Role in Project * — Select —
Company
Address *
Address Continued
City *
State * — Select —
Zip *
Country
e-mail *
Phone *
Fax
How did you hear about CONTECH®, CON/SPAN® and/or BEBO® bridges? * — Select —
If other, please specify:

Project Information

Project Title *
Project Location - City *
Project Location - County *
Project Location - State * — Select —
End Market * — Select —
End Sub-Market * N/A
Funding * — Select —

Bridge Design Parameters

See the sketch below for reference.
Use decimal feet (eg. 3.25 not 3' 4").
If your project does not fit within the range for any parameter, contact CONTECH at 800-338-1122.

CON/SPAN® O-Series | BEBO® C Series | BEBO® E Series

Series *
If you need assistance selecting a series click here for the series selection chart.
— Select —
Shape * N/A
Rise * Select shape. ft.
Length * Range is 8 to 500 ft. ft.

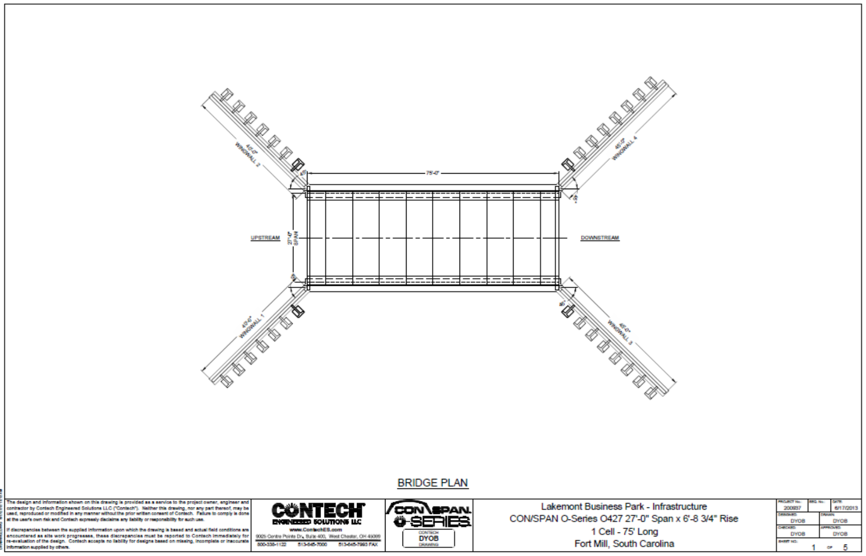
Headwall Parameters

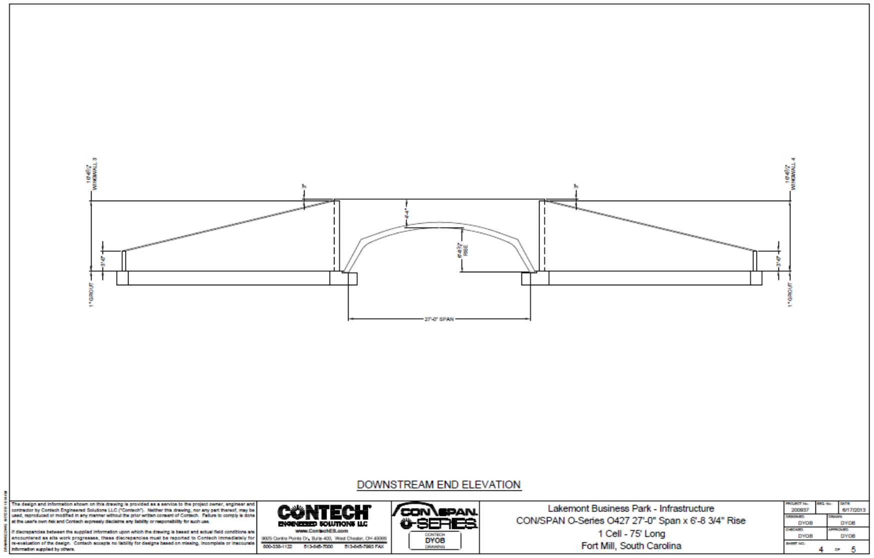
Upstream Height * Range is 1 to 5 ft. ft.
Downstream Height * Range is 1 to 5 ft. ft.

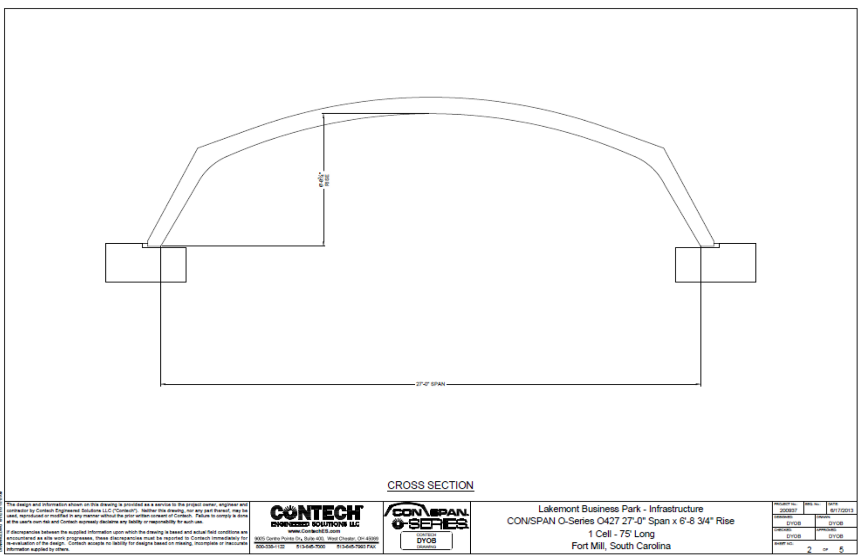
Wingwall Parameters

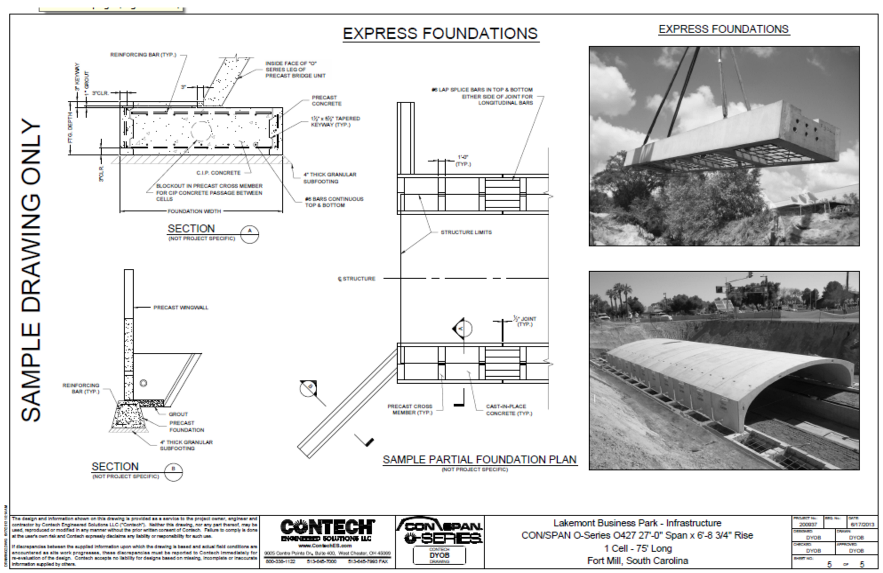
Length - Range is 8 to 50 ft. *
1 ft. 2 ft. 3 ft. 4 ft.

CONTECH ENGINEERED SOLUTIONS

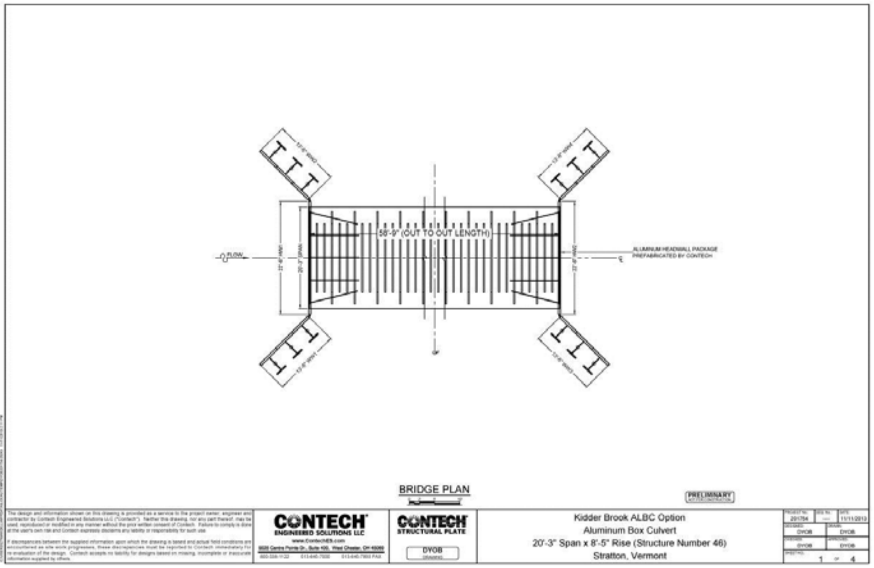


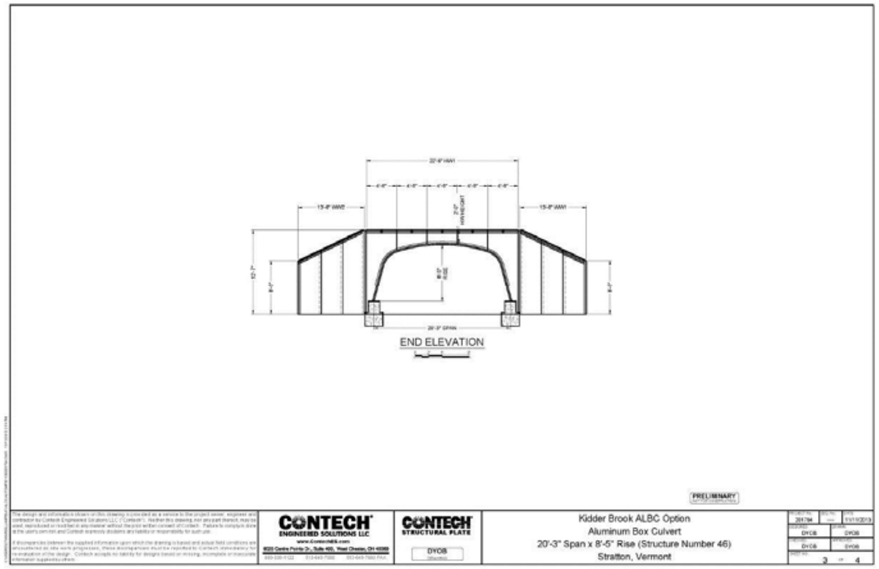


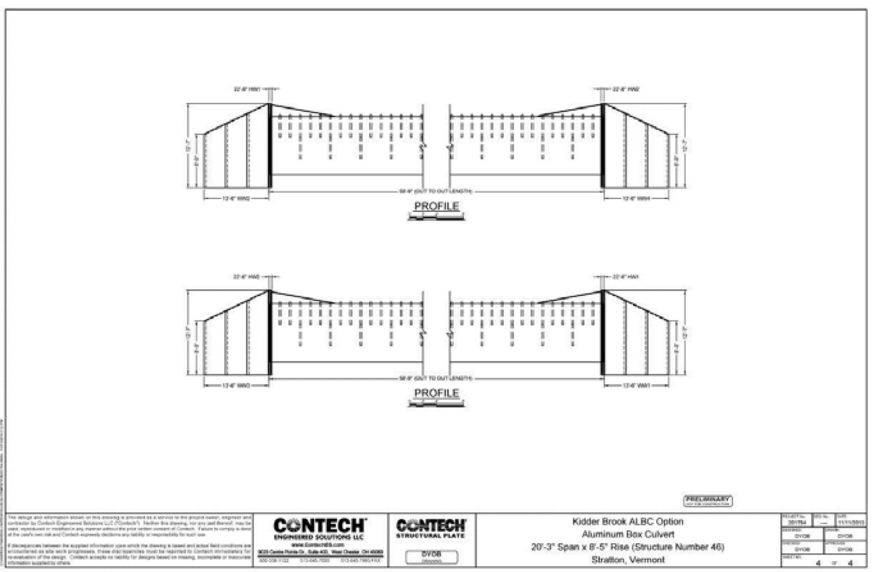


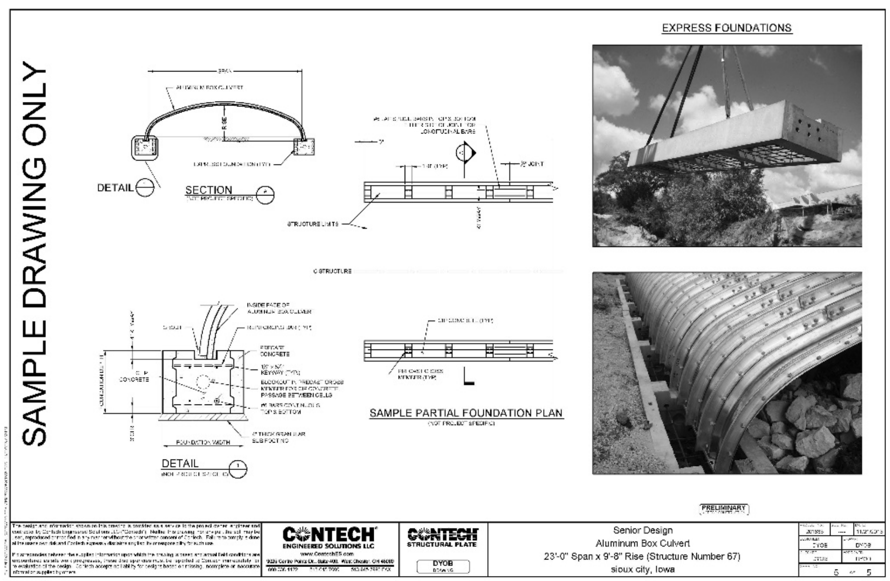


CONTECH
ENGINEERED SOLUTIONS





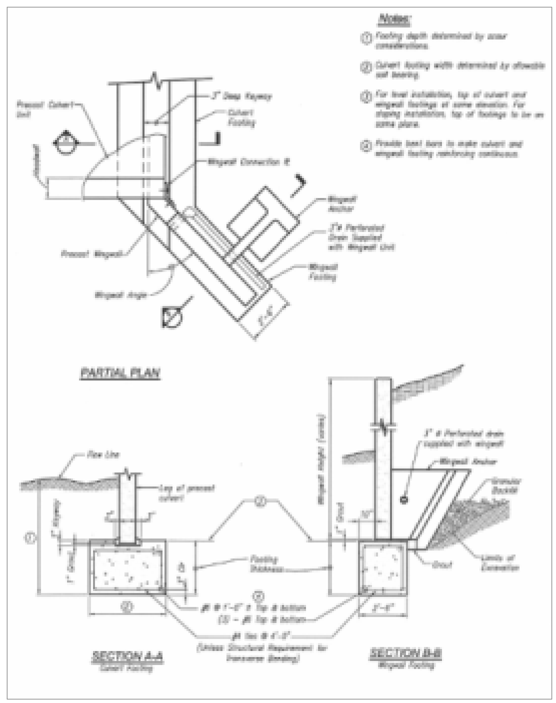


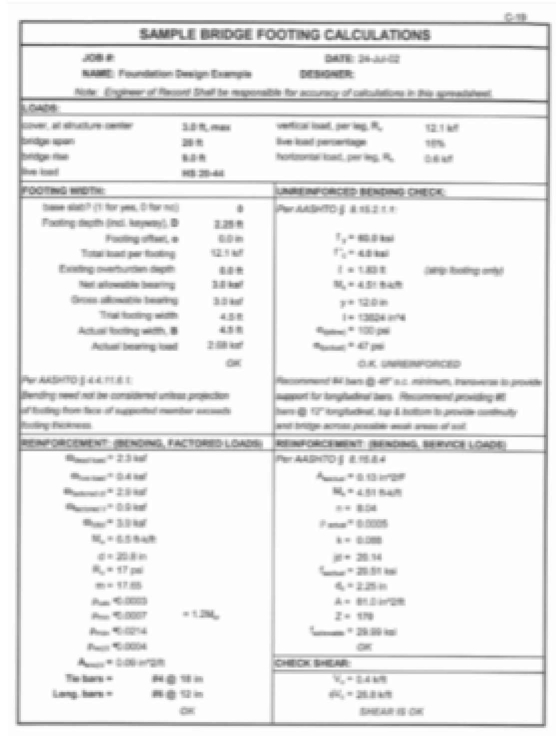


Building Blocks to a Successful Project

Solution Development | **Design Support** | Installation

- Horizontal and vertical reactions
- Foundation sizing
- Foundation design calculations
- Foundation drawings




SAMPLE BRIDGE FOOTING CALCULATIONS

JOB #: DATE: 24-Jul-02

NAME: Foundation Design Example DESIGNER:

LOADS:

FOOTING WIDTH:

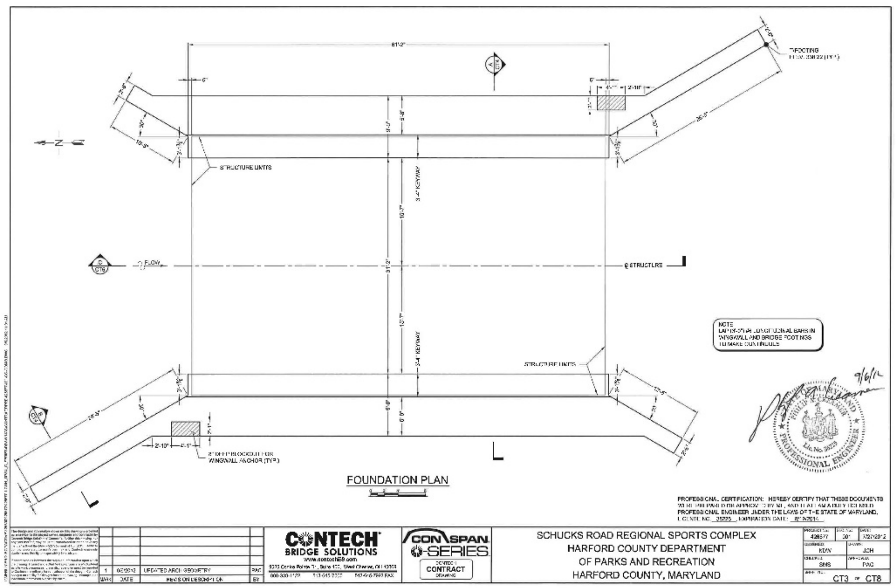
UNREINFORCED BENDING CHECK:

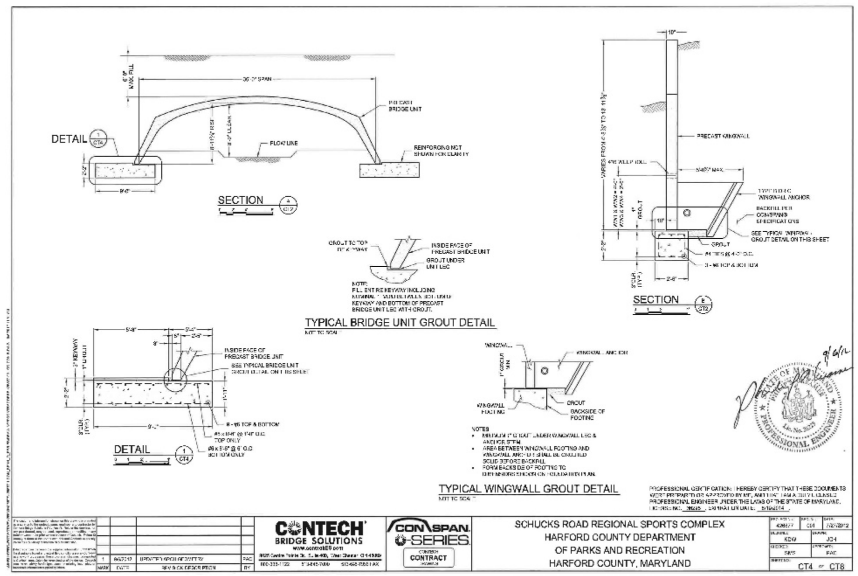
REINFORCEMENT (BENDING, FACTORED LOADS)

REINFORCEMENT (BENDING, SERVICE LOADS)

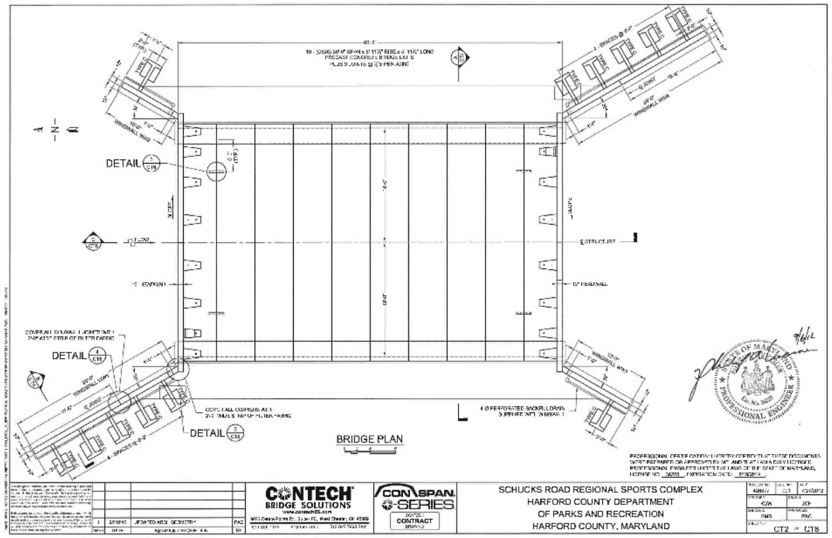
CHECK SHEAR:

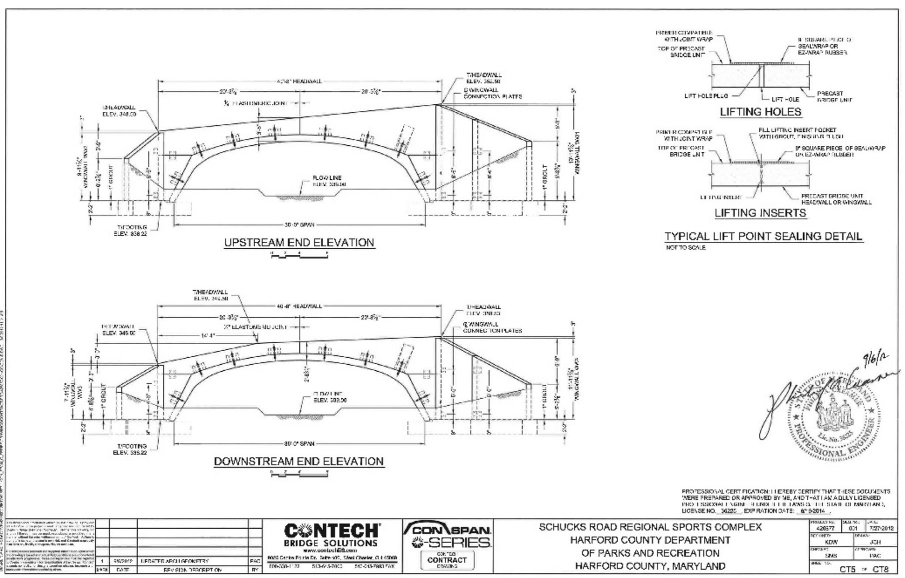
Foundation Design

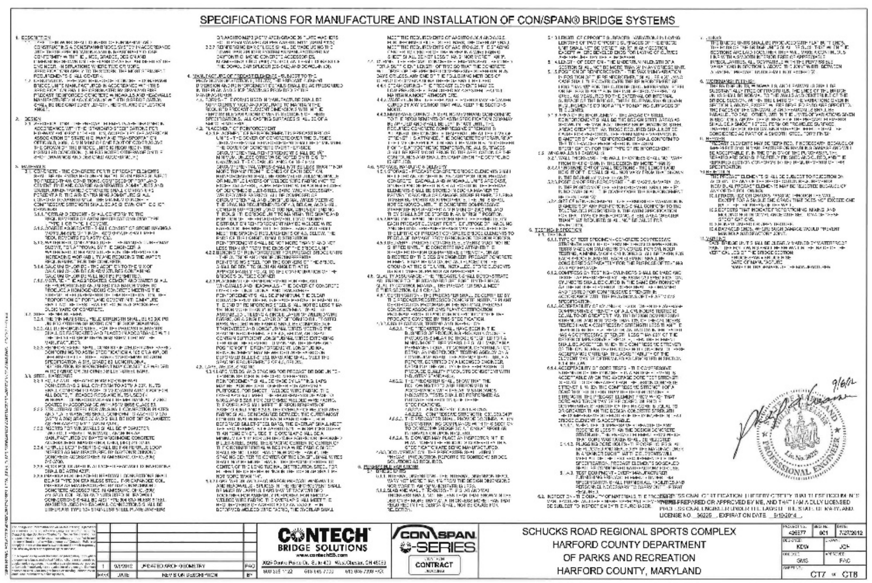




Contract Drawings







Questions?

CROSSINGS. CULVERTS. BRIDGES. CONTECH.