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 - Your project partner with over 100 years experience!
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

www.ContechES.com
<table>
<thead>
<tr>
<th></th>
<th>Precast</th>
<th>Plate</th>
<th>Truss</th>
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<tbody>
<tr>
<td>Life</td>
<td>50 years</td>
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<td>Installations</td>
<td>8,000</td>
<td>50,000</td>
<td>20,000</td>
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</tbody>
</table>

Comprehensive Engineering Support

Installations In Every State
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)
General Structural Plate Shapes

Shapes | Sizes — Span x Rise
--- | ---
Round | 5’ to 50’

Vertical Ellipse | 4’-8” x 5’-2” to 25’ x 27’-7”
* Other Custom Size Available

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”
* Other Custom Size Available

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

---

<table>
<thead>
<tr>
<th>GAGE</th>
<th>THICKNESS (STEEL)</th>
<th>THICKNESS (ALUMINUM)</th>
</tr>
</thead>
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</tbody>
</table>
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
Agenda

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

PRECAST FOUNDATION

PRECAST ARCH UNIT

PRECAST HEADWALL

PRECAST WINGWALL

TWIN LEAF CONSTRUCTION

CURVED ALIGNMENT

www.ContechES.com
Precast Bridge Arches

CON/SPAN® O-Series
13’ x 3.24’ to 65’ x 13.54’

CON/SPAN® B-Series
12’x3’ to 60’x14’

BEBO® E-Series
11’-6” x 4’ to 84’ x 29’

BEBO® C-Series
29’-3” x 11’ to 54’ x 26’

BEBO® T-Series
22’ x 2’-7” to 102’ x 13’-8”
8’x40’ Trailer – BEBO C54
Shape Versatility
US 93 Wildlife Crossing
Wells, NV

Engineer: NDOT
I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT

www.ContechES.com
I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT

www.ContechES.com
I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT
www.ContechES.com
I80 Wildlife Crossing Oasis to Pilot Peak
Wells, NV

Engineer: NDOT
www.ContechES.com
Photo Credit: Jeff Burrell
Northern Rockies Program Coordinator, Wildlife Conservation Society

Trappers Point
Wyoming
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

www.ContechES.com
Deer Park – Hwy 101
Port Angeles, WA

Engineer: David Evans & Associates

www.ContechES.com
US 101 / DEER PARK ROAD
CLALLAM COUNTY
PORT ANGELES, WA
Deer Park – Hwy 101
Port Angeles, WA

(2) 12’ Lanes
(2) 8’ Shoulders
Total = 40’ x 16’-6”
Clearance Box
SR 14 Tunnel
Washougal, WA

Engineer: Wallace Engineering

www.ContechES.com
Glenn Highway and Muldoon Road
Anchorage, AK
Agenda

• Intro to Contech
• Precast Arch Bridges Around the Country
• Buried Structures Design Philosophy
  • Precast Design
  • Production
  • Installation
• Questions
# Bridge Type Selection Chart

<table>
<thead>
<tr>
<th>PRODUCTS</th>
<th>SPAN</th>
</tr>
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<tbody>
<tr>
<td>Steel Plate Girder</td>
<td>80-300 ft</td>
</tr>
<tr>
<td>Pedestrian Truss</td>
<td>20-300 ft</td>
</tr>
<tr>
<td>Vehicular Truss</td>
<td>50-300 ft</td>
</tr>
<tr>
<td>Rolled Beam Bridge</td>
<td>20-120 ft</td>
</tr>
<tr>
<td>Precast I/T Beams</td>
<td>40-175 ft</td>
</tr>
<tr>
<td>Precast Box Beam</td>
<td>20-90 ft</td>
</tr>
</tbody>
</table>

## CONVENTIONAL BRIDGE
### STEEL
- Precast Bridge
- Steel Plate Girder
- Pedestrian Truss
- Vehicular Truss
- Rolled Beam Bridge

### CONCRETE
- BEBO®
- CON/SPAN®
- 3-Sided Flat Top

### BURIED BRIDGE
### METAL
- MP & ALS Pipe Arch
- 4-Sided Concrete Box
- Aluminum Structural Plate
- BridgeCor®
- Multi-Plate® SUPER-SPAN™

### CULVERT
### METAL
- Corrugated Metal Pipe
- CMP
- Round & Pipe Arch
- 4-Sided Conc. Box
- ALS Pipe
- MP

## COLOR LEGEND
- Precast Bridge
- Plate Bridge
- Truss Bridge
- Drainage
- No CONTECH Offering

[Chart Image]
Buried Bridge vs. Conventional Bridge

- Buried Bridge:
  - 32’ x 16’-6” Clearance Box
  - 10’ x 20’
  - 6’ x 10’

- Conventional Bridge:
  - 10’ x 20’
  - 6’ x 10’

www.ContechES.com
A. Buried Bridges vs. Conventional 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

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>During</strong></td>
<td></td>
<td></td>
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</table>

#### Bridge Type Comparison Chart

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Buried</th>
</tr>
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<tbody>
<tr>
<td>Traffic Disruption*</td>
<td>2 YEARS</td>
<td>5 MONTHS</td>
</tr>
<tr>
<td>Construction Time*</td>
<td>2 YEARS</td>
<td>1 YEAR</td>
</tr>
<tr>
<td>Initial Cost*</td>
<td>$8 M</td>
<td>$5.5 M</td>
</tr>
</tbody>
</table>

*Estimated
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
Accelerated Bridge Program (Staged Construction/Prefabrication)

- Reduces onsite construction time
- Reduces Mobility Impacts
- Reduces Environmental impact time
- Reduces user costs
- Improves Safety
- Improves Quality
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.
“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
- Buried Structures Design Philosophy
- Precast Design (Structural Design)
- Production
- Installation
- 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)
Construction Increments

<table>
<thead>
<tr>
<th>Line Colors</th>
<th>Increment</th>
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</thead>
<tbody>
<tr>
<td>Red</td>
<td>1</td>
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<tr>
<td>Green</td>
<td>2</td>
</tr>
<tr>
<td>Cyan</td>
<td>3</td>
</tr>
<tr>
<td>Blue</td>
<td>4</td>
</tr>
<tr>
<td>Magenta</td>
<td>5</td>
</tr>
<tr>
<td>Live Load</td>
<td>6</td>
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</table>

<table>
<thead>
<tr>
<th>Text Colors</th>
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<tbody>
<tr>
<td>Red</td>
<td>In-situ</td>
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<tr>
<td>Cyan</td>
<td>Concrete</td>
</tr>
<tr>
<td>Green</td>
<td>Backfill (ML95)</td>
</tr>
<tr>
<td>Blue</td>
<td>Cover (SM90)</td>
</tr>
</tbody>
</table>

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

Line Colors
Red  1
Green  2
Cyan  3
Blue  4
Magenta  5
Live Load  6

Text Colors
Material Type
Red  In-situ
Cyan  Concrete
Green  Backfill (ML95)
Blue  Cover (SM90)

BEBO C54T/6 (2'-0" C, HL93)
Max Negative Moment M (ft*K/ft)

BEBO C54T/6 (5'-0"C, HL93)
Max Positive Moment M (ft*K/ft)

BEBO C54T/6 (2'-0" C, HL93)
NOTES:
1. MINIMUM C Gordon concrete compressive strength shall be 7000 PSI.
2. OVERTURE LENGTH SHALL BE MEASURED FROM LAST CHECKING.
3. DIMENSIONS SHOWN ARE FOR FORM SYSTEM "COTI."
4. MINIMUM TENSION STRENGTH FOR WELDED WIRE FABRIC SHALL BE 65,000 PSI.
5. REINFORCING SHALL BE LIMITED TO A MAXIMUM OF THREE LAYERS OF REINFORCING WIRE OR BARD PER AREA (AT OR A3).
6. ALL SHEETS OF PRECAST TO HAVE 900 CHAMFER.
7. SPACES OF CONSTRUCTED REINFORCING MUST BE A MAXIMUM OF 10' 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 ASMT N306.
9. ALL WELDED WIRE FABRIC SHALL BE GALLANIZED.
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.
SEISMIC DESIGN AND ANALYSIS OF BURIED STRUCTURES USING CANDE-2007

Report Prepared
for
CONTECH Construction Products, Inc.

by
Dr. Michael G. Katona

March 2009

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

NCHRP REPORT 611
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMY OF ENGINEERING

www.ContechES.com
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,

\[ \gamma_{\text{max}} = \frac{\tau_{\text{max}}}{G} \]  

Equation 2.3.2

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

\( \text{PGA/g} \) = non-dimensional peak ground acceleration of design earthquake

\( \sigma_v = z \omega_{\text{soil}} \) = overburden stress at base of culvert

\( z = (H + \text{rise}) \) = depth from surface to base of culvert (\( H \) = cover height)

\( \omega_{\text{soil}} \) = weight density of soil

\[ R_d = \begin{cases} 
1 - 0.00233z, & \text{for } z < 30 \text{ feet} \\
1.174 - 0.00814z, & \text{for } 30 \text{ feet} < z < 75 \text{ feet} 
\end{cases} \] = 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 \( \tau_{\text{max}} \), which is discussed in the following paragraph and illustrated in Figure 2.3.1.
Figure 3.1-1 Illustration of typical load steps for static loading.

Load Step 7 – Vehicle load

Load Step 6 – Soil layer
Load Step 5 – Soil layer
Load Step 4 – Soil Layer
Load Step 3 – Soil Layer
Load Step 2 – Soil Layer
Load Step 1 – In situ soil and structure

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

Load Step 8 – Impose racking displacements

\[ \Delta_x = z \gamma \]  
\[ \Delta_y = z \gamma \]  

SEISMIC CALCULATIONS

1) Identify design earthquake for site in question
2) Calculate the maximum free field shear strain (\( \gamma_{max} \)) at the culvert location
3) Create a finite element model using incremental construction to simulate vertical loads
4) Use model to analyze a seismic event by specifying displacement boundary conditions (\( \Delta \)) using free field shear strain

ILLUSTRATION OF SEISMIC "RACKING" DISPLACEMENTS ON CULVERT STRUCTURE
Construction Increments for both load Cases

Soil Materials for both load Cases
Agenda

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• Installation
• Working with Contech
• Questions
Production

• Products typically produced by a Certified Plant

• Quality Control
  o Wood form vs Steel form
  o Constructability Tolerance
  o Longevity of structure

• Contech QA/QC Reports

• Contech Field Rep

• Buy America
- Outer mesh being lifted
• QC checking reinforcement before closing form
• Setting inside form
• Top of closed form
PRODUCTION DAILY QUALITY CONTROL CHECKLIST

SETUP & CASTING ARCH UNITS
(Tolerances ± 1/8” maximum)

Job Name: 
Job Number: 
Item Produced: 
Date Produced: 

Producer: 

All form surfaces cleaned, including castwall and base frame:

- Check if Soffit is square
- Check area of steel with gauge and print
- Soffit thoroughly cleaned
- Check PVC pipes
- Check hole size:
  - Lift Hoist
  - Weep Hoist
  - Cable Holes
- Check tops of mesh (1/2” minimum)
- Check all clear spacers (2” or 1.5”)
- Check if cage cleaned from soffit:
- Check leg lengths
- Check if inside form is centered
- Check top ties on form:
- Check bottom bolts on form
- Check for gage inside and outside of soffit
- Check reinforcing after form is closed, ensure proper spacing
- Check Special items (skew, blockout, etc.)

Before 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

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

Top of Leg
Bottom of Leg
Top of Form
Bottom of Form

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.

Authorized by: 
Date: 

All items addressed by: 
Date: 

Best Practices for Manufacturing Quality CONSPAN® Structures
© 2014-2020 CONTECH Bridge Solutions, Inc.
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.
Headwall
Wingwalls
Agenda

• Intro to Contech
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• Production
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• Questions
Back & Beyond
Snohomish Co, WA

Engineer: LDC
www.ContechES.com
Indianola
Kitsap Co, WA

Engineer: GeoEngineers
Indianola
Kitsap Co, WA

Engineer: GeoEngineers
U.S. 395 Over BNSF Railroad
Spokane, WA

Engineer: HDR Inc./WSDOT
U.S. 395 Over BNSF Railroad
Spokane, WA

Engineer: HDR Inc./WSDOT

www.ContechES.com
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
Aluminum Box Culvert on EXPRESS Foundations
200 East Minor Arterial - UDOT
Logan, Utah
Madigan Bypass Realignment – Murray Creek Culvert Replacement
JBLM, WA
Madigan Bypass Realignment – Murray Creek Culvert Replacement
JBLM, WA
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

Revegetation – Before & After

Speed of Installation
Armortec – Articulated Concrete Blocks

SCOUR PROTECTION  CHANNEL LINING  DAM OVERTOPPING  OUTLET PROTECTION
Keystone Retaining Walls

Keystone
with Geogrid Reinforcement

Keysteel™

EXTENSIBLE.

INEXTENSIBLE.
Keystone Retaining Walls

END TREATMENTS

ABUTMENTS

RETAINING WALLS
Agenda

- Intro to Contech
- Precast Arch Bridges Around the Country
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- Precast Design
- Production
- Installation

- Working with Contech
- Questions
### 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
- Project Design Worksheet
- Structure Selection
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- Preconstruction Meeting
- On-Site Installation Assistance
- Logistics Coordination

www.ContechES.com
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

Chico Creek – Mason County
Rendering
Building Blocks to a successful Project

Solution Development

Design Support

Installation

Photo Site Simulation

Tryon Creek, Portland

Tryon Creek, Portland
Building Blocks to a successful Project

Solution Development

Design Support

Installation

To get started, choose a structure type:

- Aluminum Box Culvert
- MULTI-PLATE SUPER-SPAN
- CON/SPAN BEBO
- U.S Bridge Continental

DYO ALBC
DYO Plate
DYO Precast
DYO Truss
Design Your Own Bridge

Contact Information
- First Name
- Last Name
- Title
- Role in Project
- Company
- Address
- City
- Zip
- E-mail
- Fax
- How did you hear about CONTECH®, CON/SPAN® and/or BEBO® bridges?**

Project Information
- Project Title
- Project Location - City
- Project Location - County
- Project Location - State
- End Market
- End Sub-Market
- Funding

Bridge Design Parameters
- Series
- Shape
- Rise
- Length

Headwall Parameters
- Upstream Height
- Downstream Height

Wingwall Parameters
- Length - Range is 8 to 50 ft.
Building Blocks to a Successful Project

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

Solution Development
Design Support
Installation

www.ContechES.com
Foundation Design
Questions?

CROSSINGS. CULVERTS. BRIDGES. CONTECH.