



U.S. Department of Transportation
Federal Highway Administration



SHRP2 Solutions: Innovative Bridge Designs for Rapid Renewal
Sacramento, CA Peer-to-Peer Exchange Workshop

Accelerated and Innovative Bridge Construction In Washington State

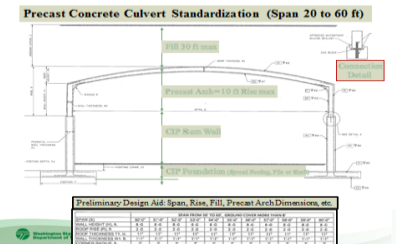
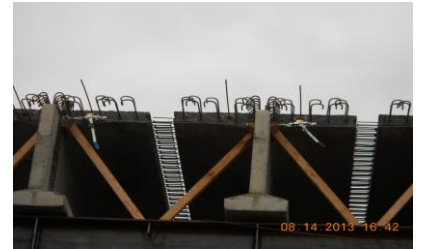
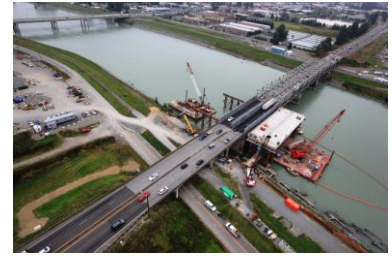
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Washington State Department of Transportation
Bridge and Structures Office
Olympia Washington

Summary

1. Recent ABC Projects
2. ABC Related Research Projects
3. New Wide Flange Deck Bulb Tee Girders with UHPC Closure
4. Geosynthetic Reinforced Soils Integrated Bridge System GRS-IBS
5. Standardization of Precast Culverts
6. R04 ABC Peer to Peer Exchange Q&A





Federal Highway Administration

Every Day Counts

Innovation Initiative



Summit -1: P2P Exchange - PBES

Prefabricated Bridge Elements & Systems

Accelerated Bridge Construction

November 13-16, 2012

Seattle, Washington

Summit -2: Every Day Count – GRS-IBS

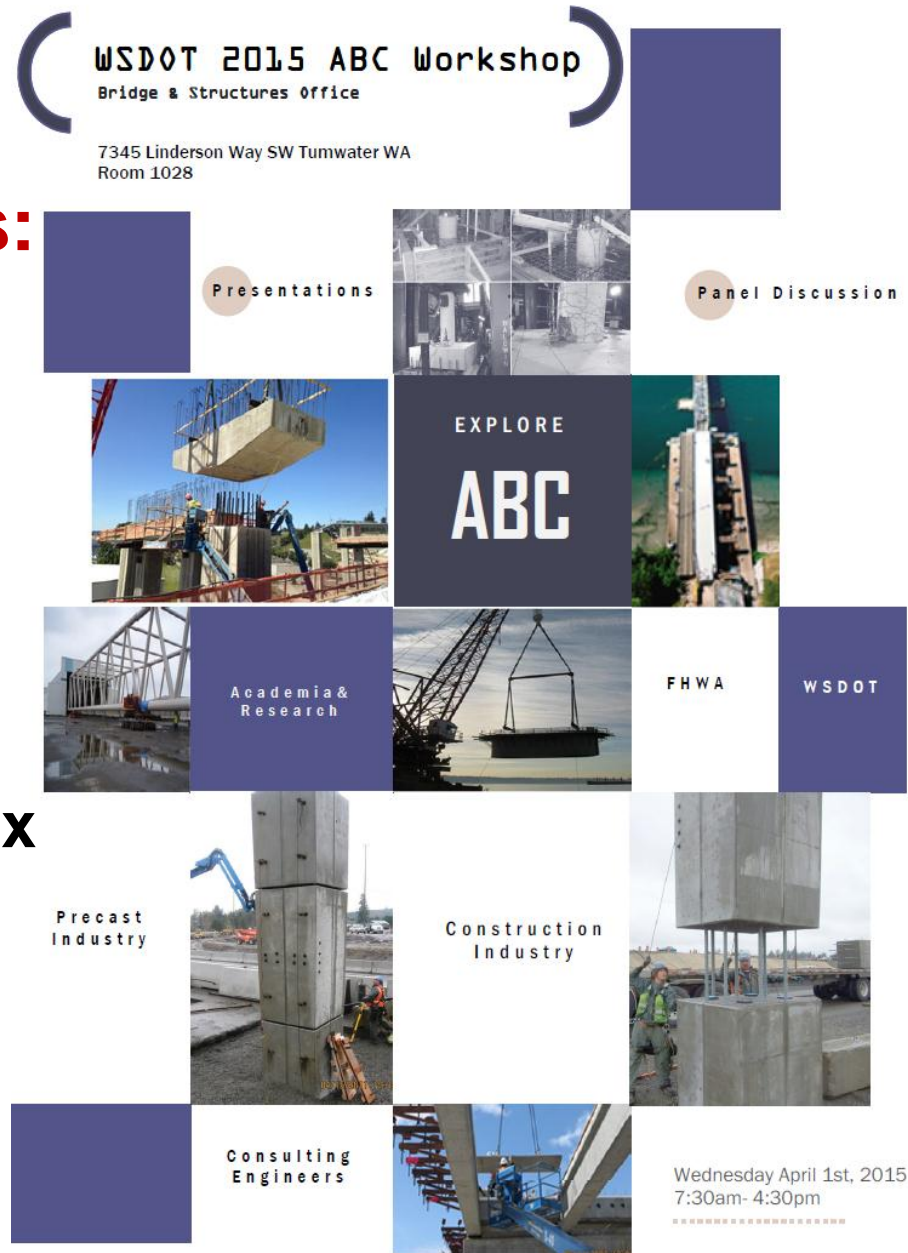
November 29-30, 2012

Portland, Oregon

WSDOT ABC

Implementation Activities:

- ABC Workshop:
 - 2008 and 2015
- Strategic Plan for ABC Implementation
- ABC Decision making Matrix
- ABC Domestic Scan
- Design and Construction Tools



ABC Decision-Making Framework Matrix

WSDOT Strategic Plan for ABC: Practice and Policy for ABC Bridge Projects

ABC Advisory committee

Construction Office:

FHWA

University:

Consultant:

Contractor:

Precast Plant:

Region:

Research

Maintenance

Question	Yes	Maybe	No
High traffic volume?			
Emergency replacement?			
Worker safety concerns?			
High daily traffic control costs?			
High traffic volume?	✓		
Emergency replacement?			✓
Evacuation route or over railroad or navigable channel?	✓		
Lane closures or detours?	✓		
Critical path of project?	✓		
Close during off-peak traffic?	✓		
Rapid recovery/repair required?	✓		
Adverse economic impact?	✓		
Weather constraints?			✓
Worker safety concerns?	✓		
Environmentally sensitive site?			✓
Natural or endangered species?			✓
Feasibility if historic bridge?	✓		
Multiple similar spans (segments) ?	✓		
Problem for ready-mix concrete?			✓
High daily traffic control costs?	✓		
Delay-related user cost concern?	✓		
Innovative contracting strategies?	✓		
Adequate owner staffing?	✓		
Group with other bridges?		✓	
Future use?	✓		
Totals:	15	1	5

Innovative Bridge Construction

SR 167 over Puyallup River - Weekend closure to move an existing 350 feet long truss bridge using the ABC sliding technology - 2014



SR 101 Dosewalips River – Detour Bridge



WSDOT SPMT BRIDGE Replacement

LEWIS & CLARK BRIDGE

120 - 8 Hrs Night Closures
200 - Single Lane Closures

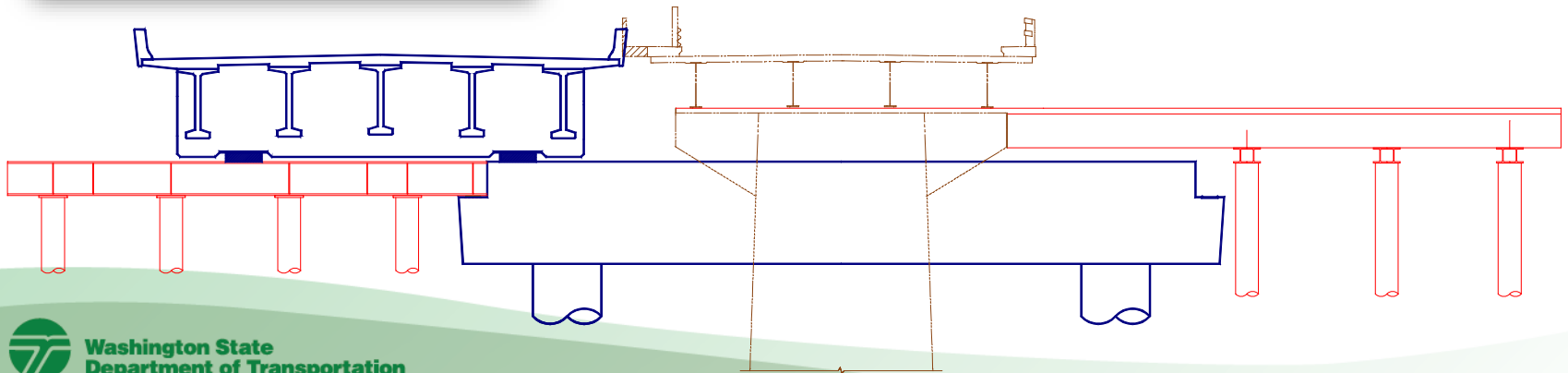


Hood Canal Bridge Transition Span – Tabular Steel Truss



Accelerated Bridge Construction Project

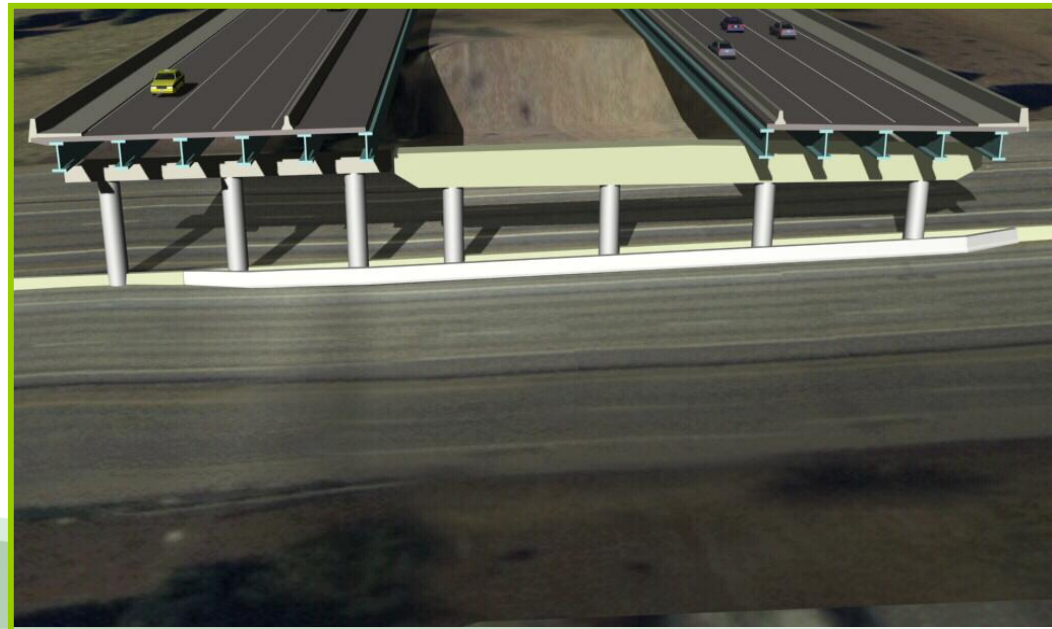
5 Span PS Girder
Superstructure
Replacement –
Hood Canal Bridge



Innovative Bridge Construction

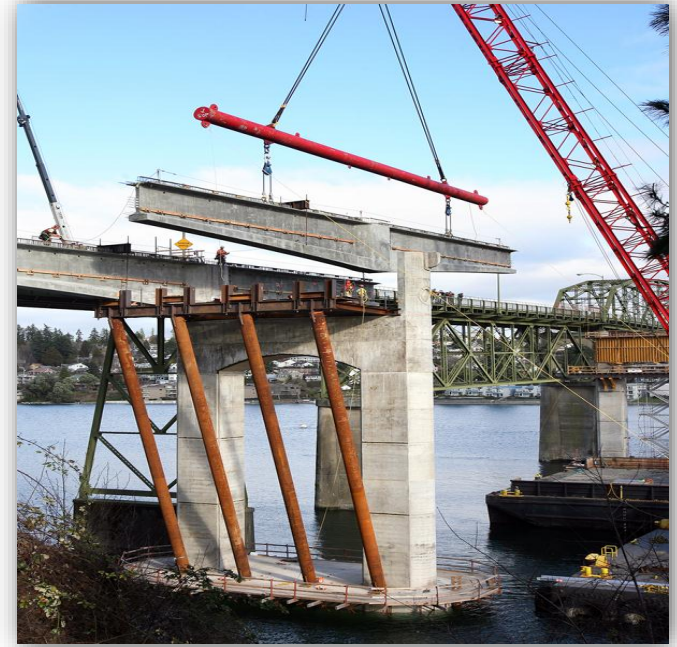
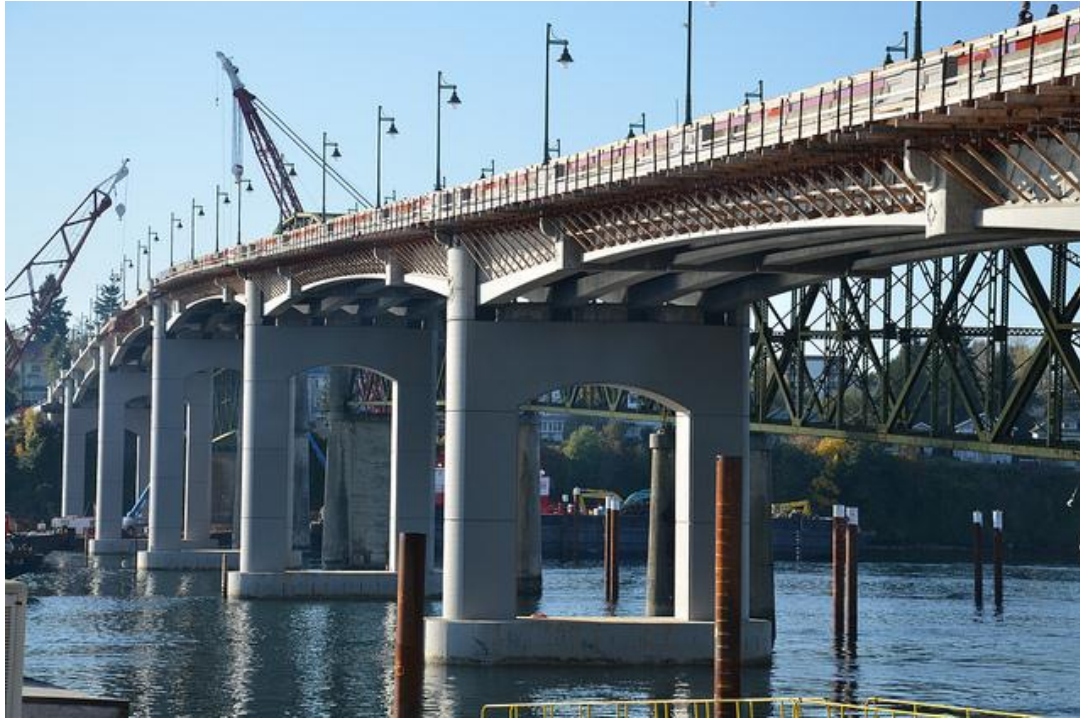
SR 405 - Bellevue
Access NE 8th
Street ABC –
Weekend Closure

Steel I-Girder
Bridges
Replacement using
Lateral Slide
Technology



Spliced Girders:

Manette Bridge



Record-Length Precast Girders



DECEMBER 2011

- Masonry check-off funding program on Capitol Hill, p. 4
- Baker Ready-Mix chief on regulatory accountability, p. 8
- Transamerica Pyramid aims for LEED Platinum, p. 14
- 2012 Market Forecast, p. 23
- Software to predict compressive strength, p. 38
- Cat Vocational Truck update, p. 40
- Solar-powered precast home, p. 48

TAKE IT TO THE LIMIT

Value engineering, design-build methods steer states' record-length girder specs



Alaskan Way Viaduct - 205 ft WF100G



I-5 - Skagit Bridge Collapse & Replacement

- Truss Collapse, I-5 near Mount Vernon on May 23
- Over height load struck critical steel supports.
- I-5 carries ADT = 71,000



Bridge Move Summary:

1. Temporary Span out (25 min.)
2. Permanent Span in (45 min.)
3. Deck Lowering (30 min.)



Skagit River Bridge collapse footage.mp4



Skagit River Bridge Switchover_mpeg2video.mpg



Skagit River Bridge Replacement



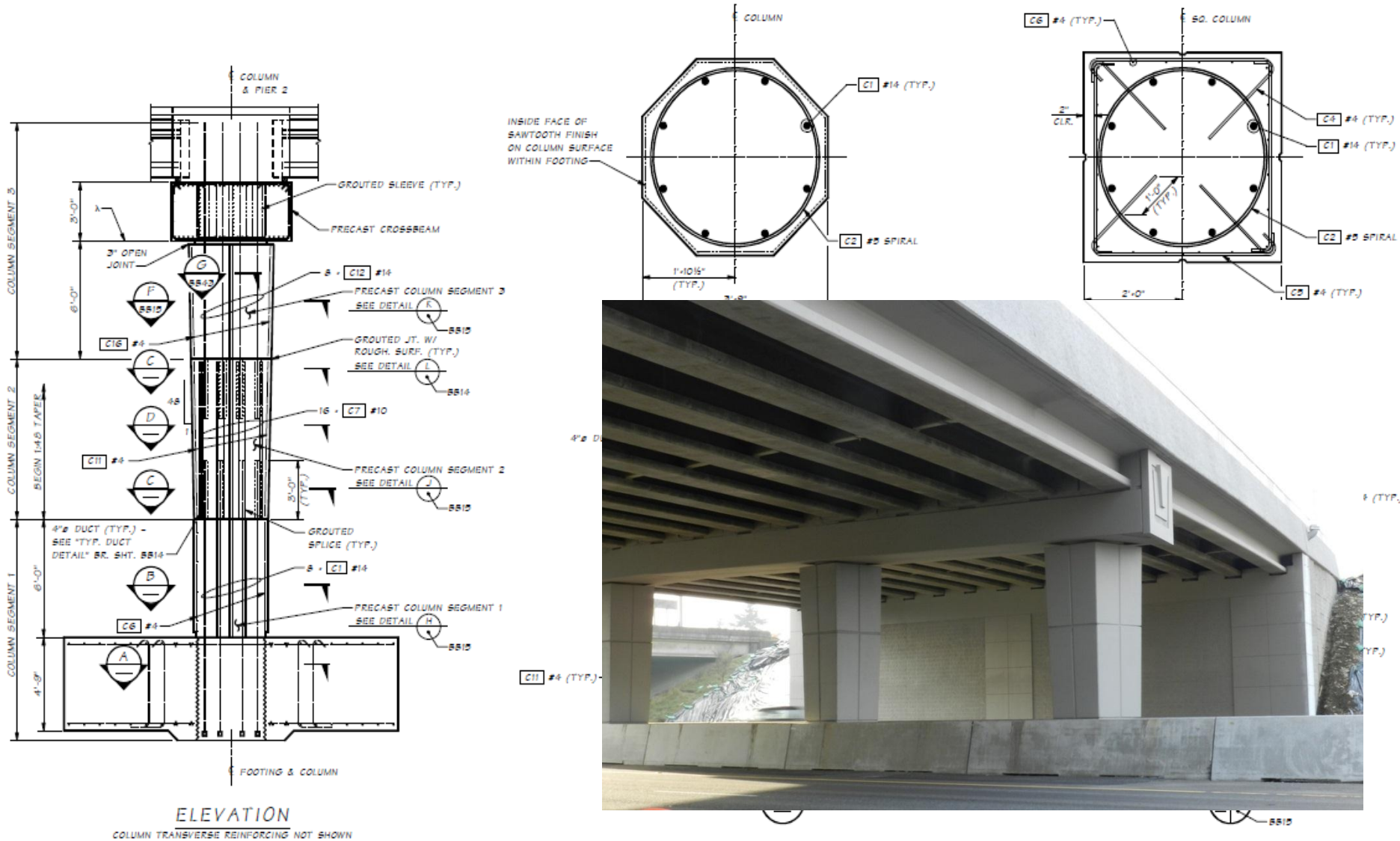
Connection of Deck Beam Elements



Example of ABC Projects - Substructure



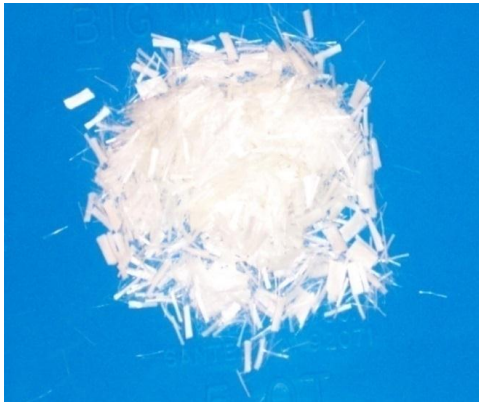
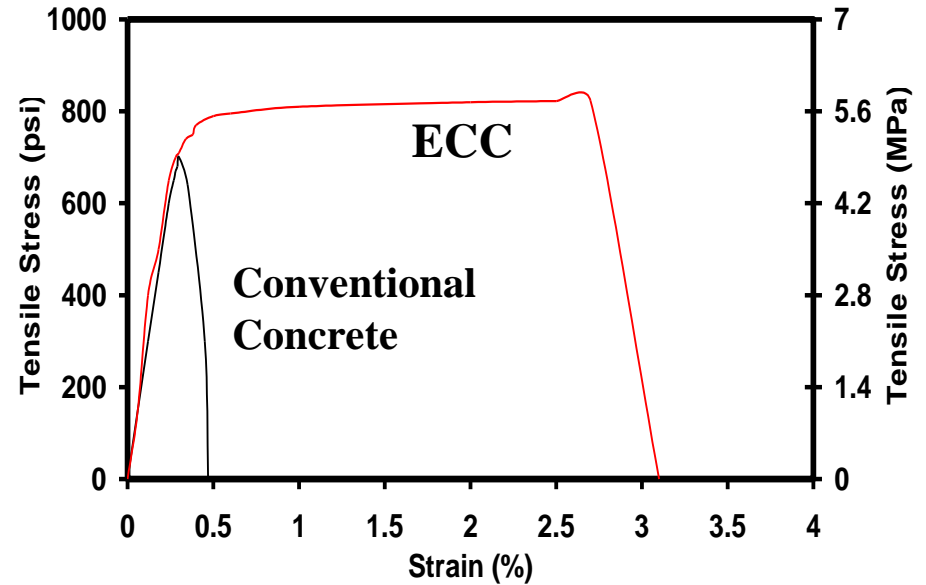
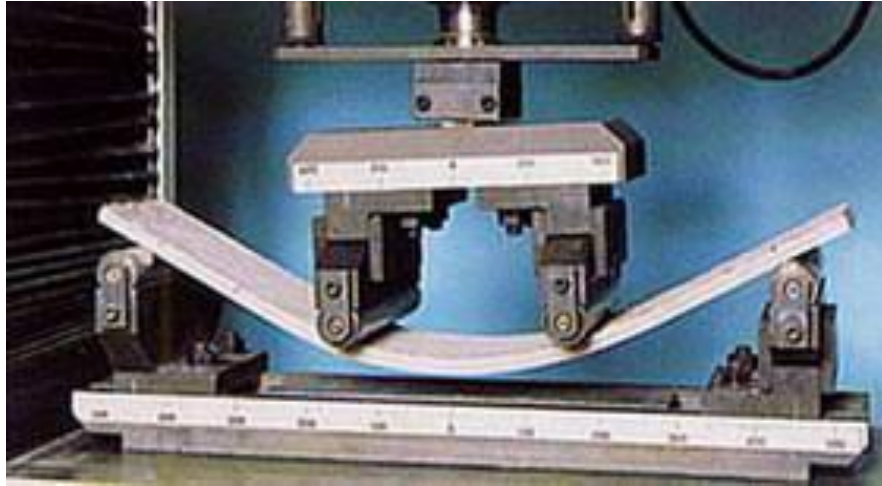
WSDOT - Precast Bent For Seismic Regions



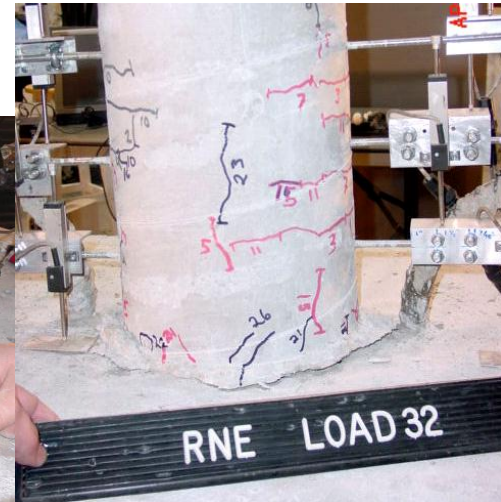
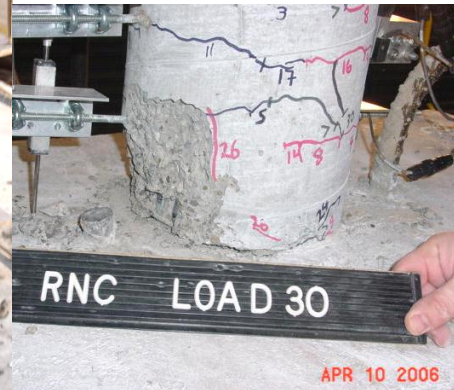
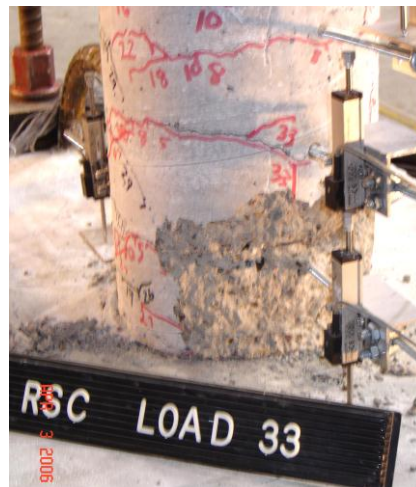
Pier Elevation - Segmental Columns and Precast Bent Cap

Innovative Materials SMA-ECC for Bridge Bents

AWV South Approach - Innovative Materials UNR



Polyvinyl Alcohol
Fiber



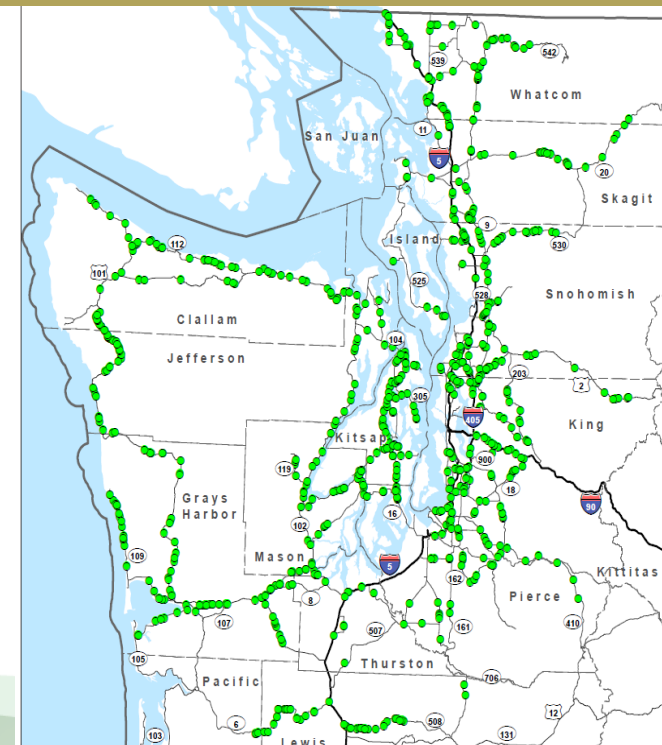
WSDOT Fish Passage Culverts Replacement

- WSDOT to correct 825 fish barriers by 2030.
- 30 to 40 culverts each year between 2015 – 2030.
- \$310 million per biennium (\$2.4+ billion Total).

Fish Passage Structures are Suitable For:

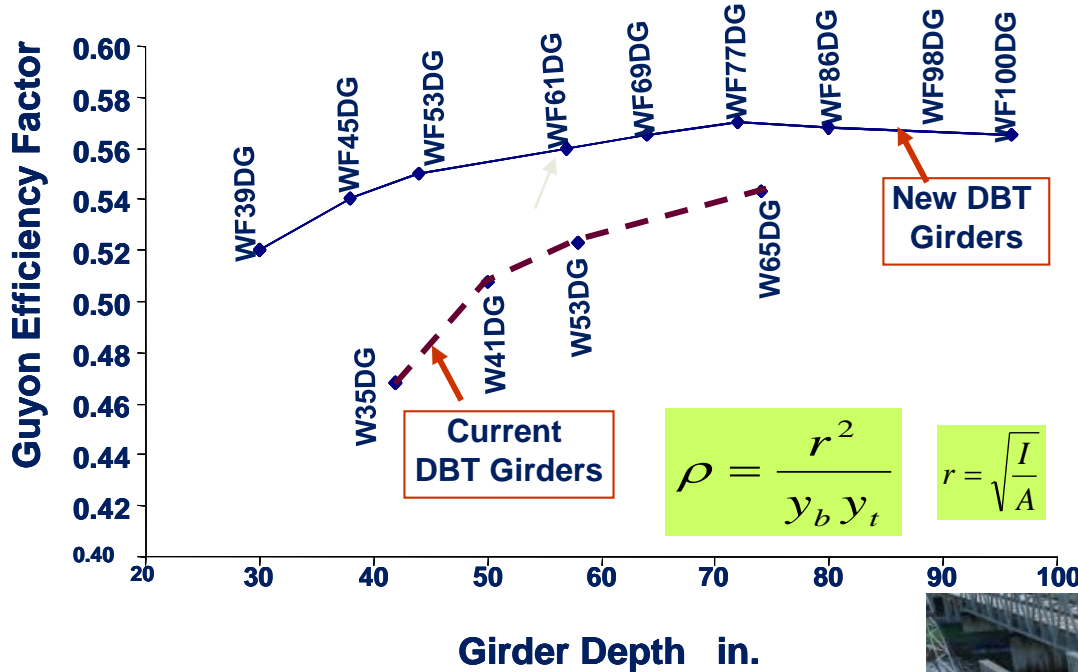
- ✓ ABC – Lateral Slide
- ✓ WF Deck Girders
- ✓ GRS-IBS
- ✓ **Precast Culverts**

Total Fish Passages	825
% Bridge	40%
Total Bridge	330
Remaining Culverts and Stream Realignment	495
Culverts with span over 20 ft	50%
Total Culverts	248
Added to WSDOT Bridge Inventory by No of Structures	578
Added to WSDOT Bridge Inventory by %	16%



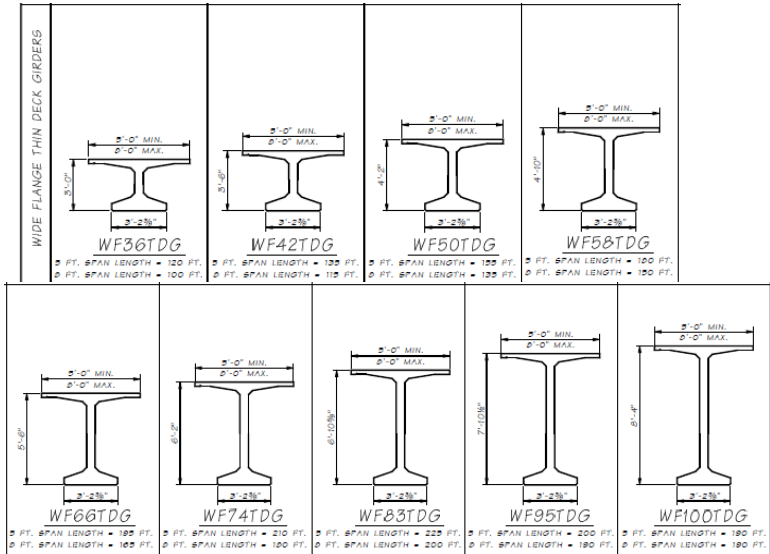
New Wide Flange Deck Girders

Efficiency of DBT Girders (4 ft wide Top Flange)



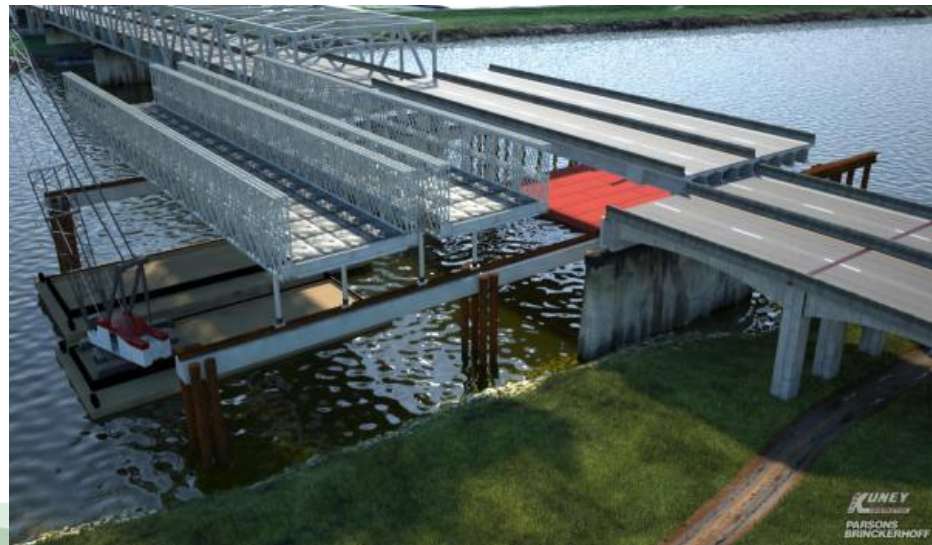
$$\rho = \frac{r^2}{y_b y_t}$$

$$r = \sqrt{\frac{I}{A}}$$

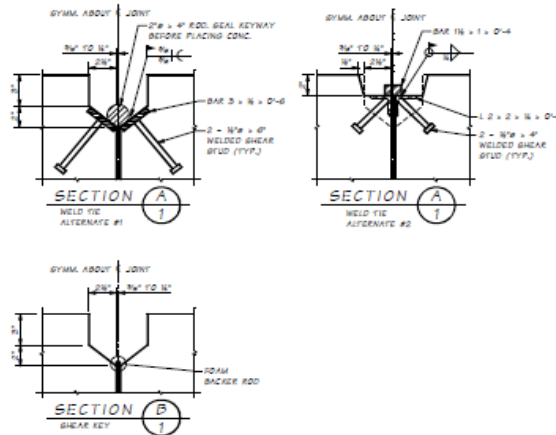
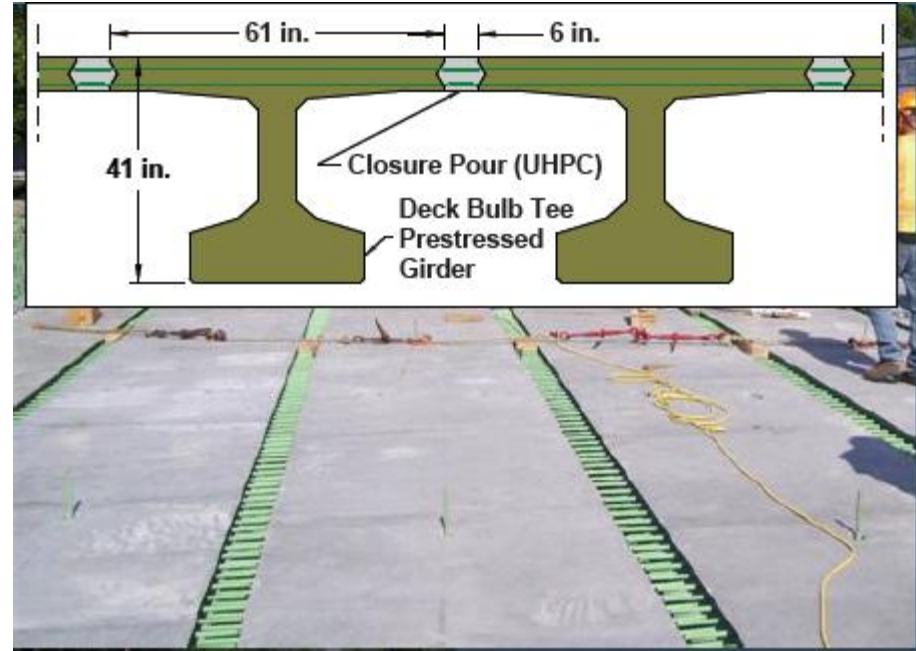


Span Range of standard wide flange DBT concrete:

- Thin deck span up to 225 ft (250 ft LW Girders)
- Deck girders span up to 195 ft (230 ft LW Girders).



Connection of Deck Beam Elements

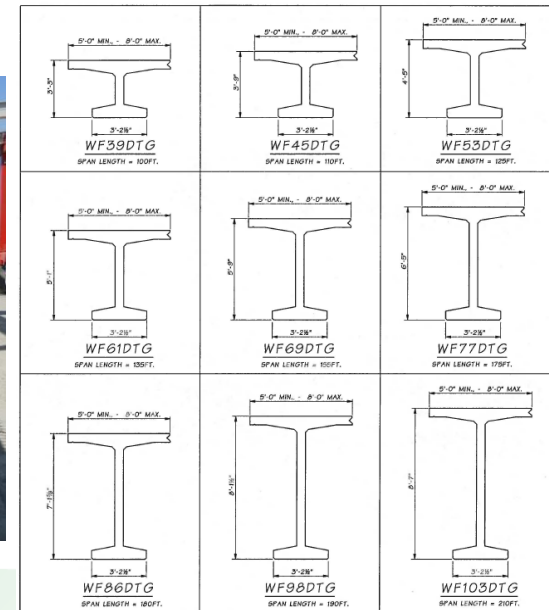


2015 WSDOT Research Project

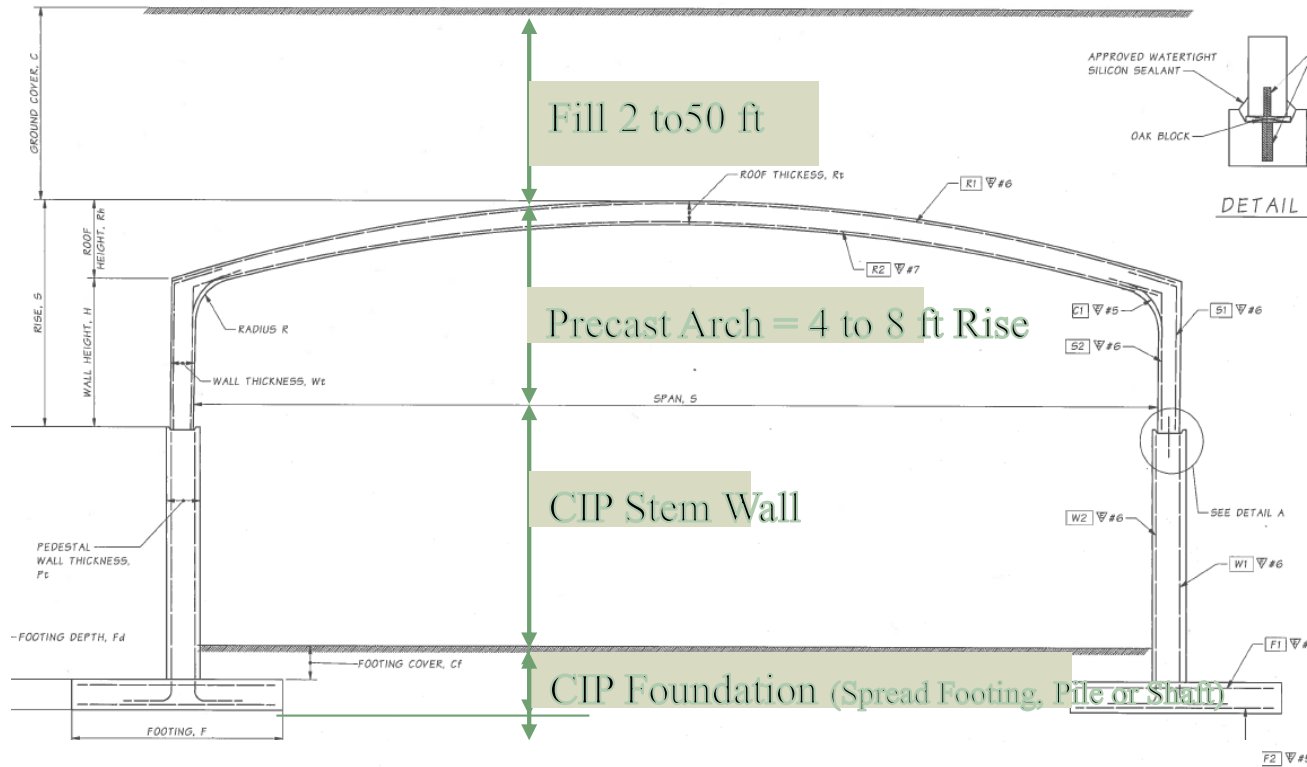
Use of UHPC For Decked Girder Connections

Research Objective: WSU and UW

- Develop UHPC mix design
- Performance of longitudinal joints using UHPC
- Distribution of live load between adjacent units
- Continuity for live load
- Lap splice length using UHPC



Precast Concrete Culvert Standardization

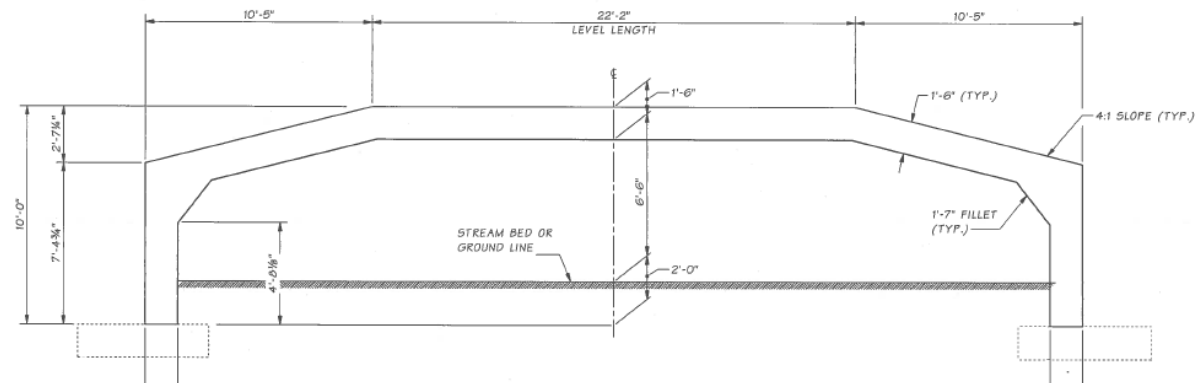


Fill 2 to 50 ft

Precast Arch = 4 to 8 ft Rise

CIP Stem Wall

CIP Foundation (Spread Footing, Pile or Shaft)



Complete PS&E Package and Contract Plans

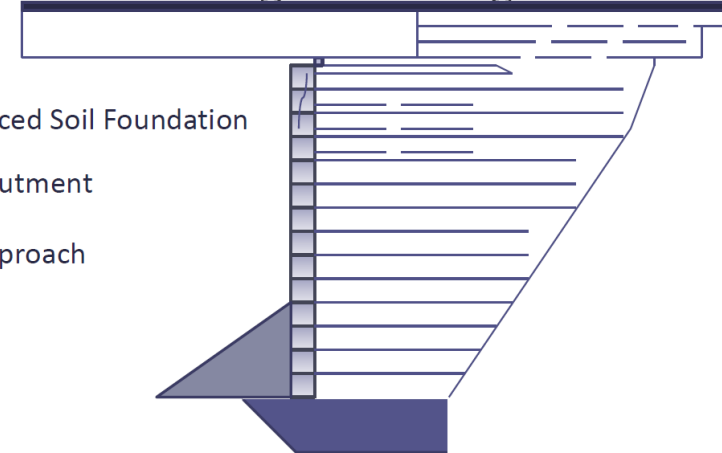
Summit -2: Every Day Count – **GRS-IBS**

Geosynthetic Reinforced Soil Integrated Bridge System

- Eliminates approach slab
- Reduced construction time (complete in 10 days)
- 25 - 60 % less cost depending on standard of construction



3 Main Components of a GRS-IBS:

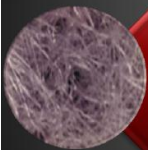


1. Reinforced Soil Foundation
2. GRS Abutment
3. GRS Approach

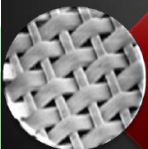
The Choice of Geotextile or Geogrid

Depends on the type of backfill soil to be used

Geotextiles

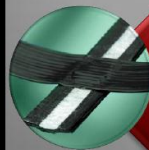


Non woven geotextiles are porous and have high in-plane drainage capacity, but poor tensile capacity



Woven geotextile elements added to a non-woven base will increase tensile capacity

Geogrids



Provides high tensile strength, but poor in-plane drainage capacity



2:15PM
2:30PM

Status of implementation nationally
Adjourn

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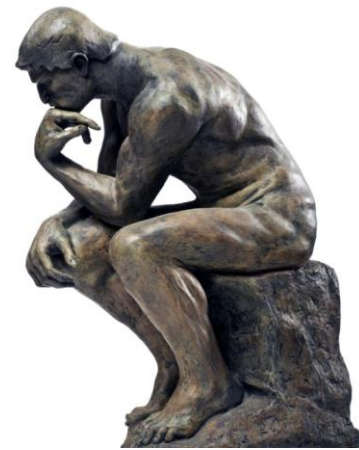


ABC Research Projects in Washington State

- **Use of UHPC for Wide Flange Decked Girder Connections**
University of Washington and Washington State University - 2015
- **Seismic Performance Of Nickel-titanium Reinforced ECC Columns With Headed Couplers**
University of Nevada, Reno, July 2014
- **Highways for LIFE Precast Bent System for High Seismic Regions**
BergerABAM and **University of Washington**, March 2013
- **Reinforced Concrete Filled Tubes for use in Bridge Foundations**
University of Washington, June 2012 & 2014
- **Accelerated Bridge Construction (ABC) Decision Making and Economic Modeling Tool**
Oregon State University, December 2011
- **Anchorage Of Large-diameter Reinforcing Bars Grouted Into Ducts**
University of Washington, November 2007
- **Design of Precast Concrete Piers for Rapid Bridge Construction in Seismic Regions**
University of Washington, August 2005

BDM Chapter for Accelerated and Innovative Bridge Design & Construction

- The Audience
 - WSDOT Engineers
 - Consultant Engineers
 - Contractors
- Provide a broad perspective.
- Provide technical guidance on Precast Bents.
 - DBB and DB.
- Be a resource for Regions and Bridge Engineers.



R04 ABC Peer to Peer Exchange Q&A

- Who kicked off the ABC discussion in your agency? (Or is holding it back potentially?)
 - ABC is not officially acknowledged. It is considered on a case-by-case basis per project
- From an ABC standpoint, what has worked well and what has been more of a struggle?
 - Superstructure: Lateral Sliding, SPMT worked well
 - Substructure: Slowly but positively
- Have your local consultants and/or contractors bought into ABC? Why or why not?
 - Same as above

R04 ABC Peer to Peer Exchange Q&A

- Have you let the public know about your ABC projects and what they can expect?
 - Public involvement is not generally considered except for some joint replacement projects High ADT
- Is your agency working on a program wide implementation plan for ABC?
 - Not yet but it may change with the Fish passage program
- Has cost estimating been an issue? For let jobs did the estimate reflect the bid?
 - Yes - Cost estimating is usually based on direct cost

R04 ABC Peer to Peer Exchange Q&A

- Lessons learned from past projects? Things you would do again? Not?
 - Yes: All past ABC experiences were positive in WA.
- Were ABC designs/specifications problematic for your agency?
 - No – Design Specs were provided
- What issues came up during acquisitions and construction?
 - Potential for construction risks
- Would you do ABC construction again?
 - Yes – ABC has been successful in WA.

Accelerated Bridge Construction Resources (ABC)

Reports

- WSDOT ABC Strategic Plan (pdf, 161kb)
- FHWA Seismic ABC Workshop Report (pdf, 998kb)
- ABC Seismic Connections - TRB Research Proposal (pdf, 5.2mb)
- Design of Precast Concrete Piers for Rapid Bridge Construction in Seismic Regions (pdf, 2.78mb)
- A Precast Concrete Bridge Bent Designed to Re-center after an Earthquake (pdf, 2.82mb)
- Rapidly Constructible Large-Bar Precast Bridge-Bent Seismic Connection (pdf, 8.4mb)
- Anchorage of Large-Diameter Reinforcing Bars Grouted into Ducts (pdf, 1.9mb)
- Fully Precast Bridge Bents for Use in Seismic Regions (pdf, 356kb)

Thank You!

Presentations



- 2015 ABC Workshop (pdf, 16mb)
- Presentations from WSDOT ABC Workshop (September 30, 2008) (500mb)
- Presentations from WSDOT-CalTrans TRB 2009 Seismic ABC Collaboration (612mb)
- Lewis and Clark Bridge Deck Replacement (pdf, 11mb)
- Rapid Replacement of the Hood Canal Bridge Approach Spans (pdf, 9.07mb)
- ABC Pooled Fund Meeting (pdf, 960kb)
- HFL Testing Briefing (pdf, 5.3mb)
- A precast Concrete Bridge Bent for Seismic Regions: Achieving both Performance and Constructability (pdf, 9.6mb)
- Unbonded pre-stressed connections (pdf, 1.1mb)
- Concrete Filled Steel Tubes for Bridge Foundations and Substructures (pdf, 9.4mb)

Links

- Highways for Life

