





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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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















# 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**

WSDOT 2015 ABC Workshop

7345 Linderson Way SW Tumwater WA

#### **Implementation Activities:**

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





EXPLORE























Wednesday April 1st, 2015 7:30am- 4:30pm



#### **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?	133	,	
Emergency replacement?			
Worker safety concerns?			
High daily traffic control costs?			
High traffic volume?	✓		
Emergency replacement?			✓
Evacuation route or over railroad or navigable channel?	<b>*</b>		
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?		li e	✓
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



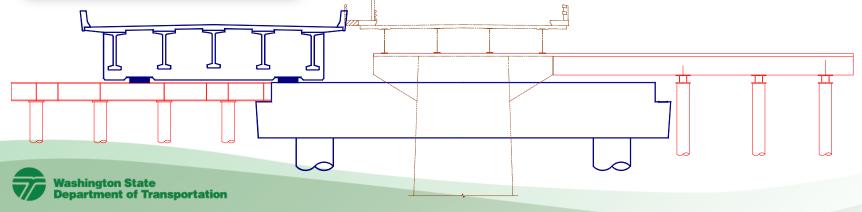


## **Accelerated Bridge Construction Project**

5 Span PS Girder
Superstructure
Replacement –
Hood Canal Bridge





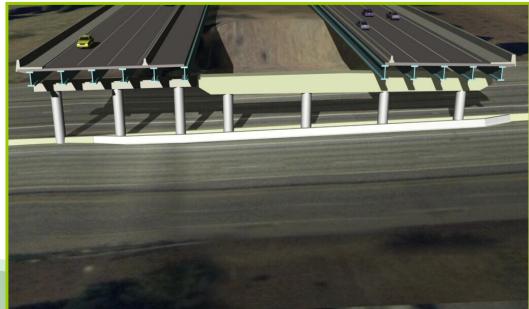


# **Innovative Bridge Construction**

SR 405 - Bellevue Access NE 8<sup>th</sup> Street ABC – Weekend Closure

Steel I-Girder
Bridges
Replacement using
Lateral Slide
Technology







# Spliced Girders:

# **Manette Bridge**









# Record-Length Precast Girders



# \*Nationry check-off funding program on Capitol Hill, p. 4 \*Baker Ready-His chief on regulatory accountability, p. 8 \*Transamerica Pyramid aims for LEEP Platinum, p. 14 \*2012 Market Forecast, p. 23 \*Software to predict compressive strength, p. 38 \*Car Wootfenal Truck update, p. 40 \*Sofar-covered psecal tumps. p. 44

# CONCRETEPRODUCTS. COM PRODUCTS \*\*Online to general p. 28 \*\*Contribution to the contribution to the contribution of the contribution to the cont

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# 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.)

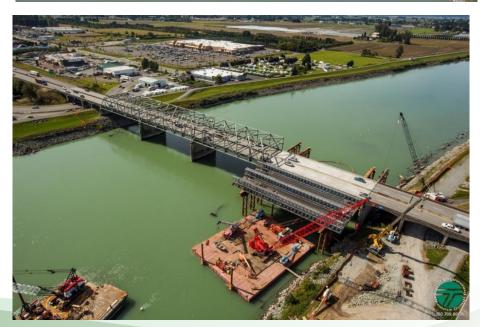


Skagit River Bridge collapse footage.mp4



Skagit River Bridge Switchover\_mpeg2video.mpg
Washington State
Department of Transportation





# **Skagit River Bridge Replacement**



Connection of Deck Beam Elements









# **Example of ABC Projects - Substructure**







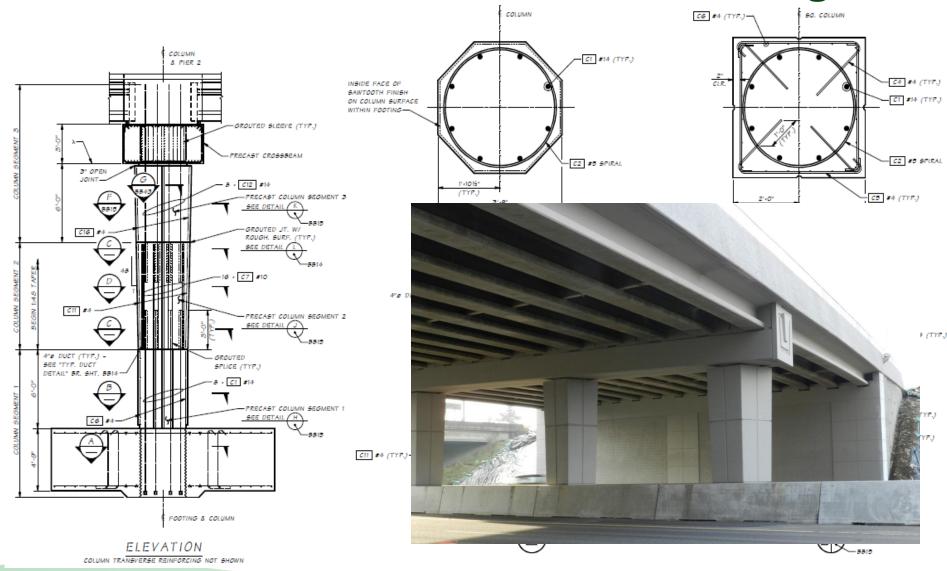






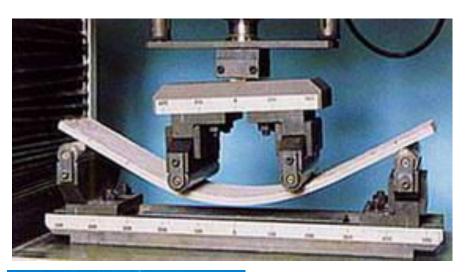


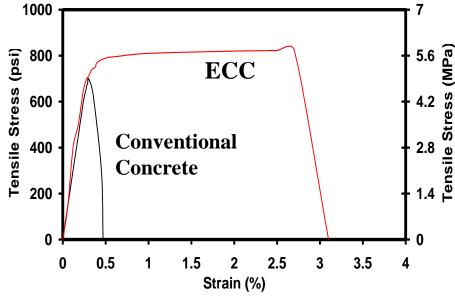
# **WSDOT - Precast Bent For Seismic Regions**



#### **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).

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%

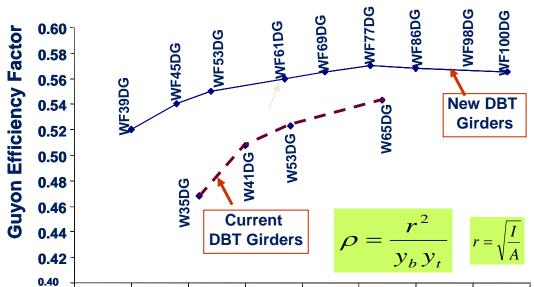
# Fish Passage Structures are Suitable For:

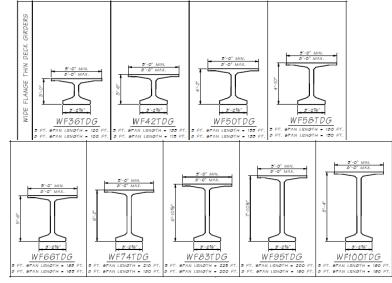
- ✓ ABC Lateral Slide
- ✓ WF Deck Girders
- ✓ GRS-IBS
- ✓ Precast Culverts



# **New Wide Flange Deck Girders**

Efficiency of DBT Girders (4 ft wide Top Flange)





Girder Depth in.

60

70

80

# Span Range of standard wide flange DBT concrete:

50

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



30

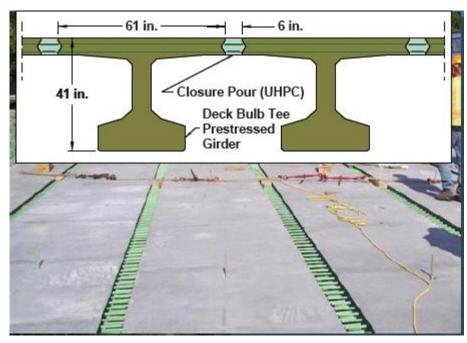
40



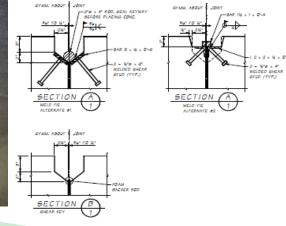
## Connection of Deck Beam Elements















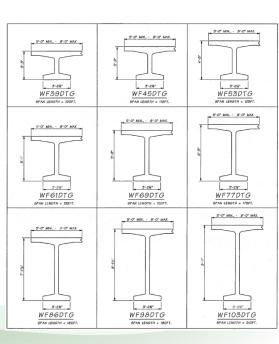
# 2015 WSDOT Research Project Use of UHPC For Decked Girder Connections

#### Research Objective: WSU and UW

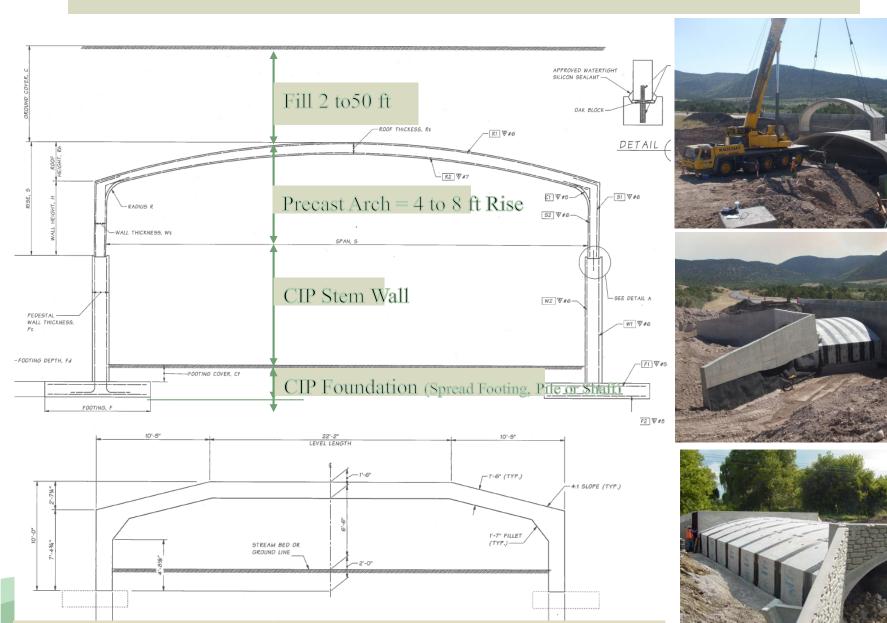
- Develop UHPC mix design
- Performance of longitudinal joints using UHPC
- Distribution of live load between adjacent units
- Continuity for live load
- Lap splice length using UHPC







#### **Precast Concrete Culvert Standardization**

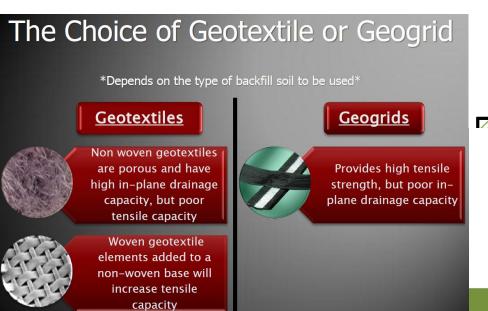


**Complete PS&E Package and Contract Plans** 

# Summit -2: Every Day Count - GRS-IBS

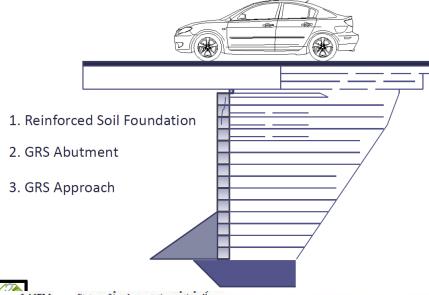
Geosynthetic Reinforced Soil Integrated Bridge System

- Eliminates approach slab
- Reduced construction time (complete in10 days)
- 25 60 % less cost depending on standard of construction





3 Main Components of a GRS-IBS:



2:15PM 2:30PM

Status of implementation nationally

Presenter:
Daniel Alzamora, P.E.
Geotechnical Engineer
Federal Highway Administration
Office of Technical Services
Resource Center
720-963-3214
daniel alzamora@dot.gov



EDC: GRS - IBS

## 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



## **ABC** Folios and Tech Notes

Bridge & Structures Office

#### Accelerated Bridge Construction



#### WSDOT ENHANCED MOBILITY

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Consisting of subject resides requests from the Binings Change Oliver, Distings Constructive, August, Prepa, Congressive, Controller, August at Program, Propositional Conference on August and Program, Propositional Conference on August and Program, Propositional Conference on August and Program of Conference on Conference on August 2015 (Program of Conference), and promises AMO practice in Managing State.





#### Skagit River Bridge Lightweight Concrete Girders

Notes

**Iecn** 



#### The Sinsergency Replacement

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#### Investigation of Options

Three collision were investigated for permanent span These obtains week investigated to parendred tipper implications or about through these for time despitement. the ongress specific is about paths grade specific ordinates. these, and is presented transmissible specific in ordinates. because the second transmissible specific paths in endight, and perspectively considered with the original bridge. any any entering to be the free consuming to finishmete and much. The project estimation of propriate with the consumption that the most finish whether space for one principles to be the cheet or consume grain options.

#### WSDOT and Bast Wake Proposals.

Four George Build (SR) leave autoritied proposals for the pertiament again replacement. Two of the proposals Falkalad steel girder replacement space, and the denacing two proposets mutualist collections so concrete order sour revision. NSDCT selected the bank ratios programs spart golonis. Prof.N.1. Selected the best value proposes, virtially difficult a presidenced concrete givine Best built feet replacement spart. Lightweight concerns was apportise for the ginders, Replacement and Sentrals, is sayly within the influenced point described trinsports. The concrete ginder present the-course costs. The observed groter programmed ey many wife the permanent man







#### **Highways for LIFE Projects**



#### Frem research to practice

Highways for LIFE Projects are catabonations between the Washinston State Department of Transportation and the Federal Highway Administration, Quickly adopting innovations

Final Report with resign specifications and



#### US 97 Satus Creek Bridge Replacement Project



#### Crossing an Environmentally Sensitive Creek

The Satus Creak findge represents an entirely sex investion in tridge design. It is a curved preliabilisated concerte landge. It was built by segments and then delivered to a remote also. The impressively long 100 foot single span was recessary to selfely environmental constraints at the highway greening of Babin Dreek.

The totalise is bounted 25 value would send of Topperion Washington along US ST. If you powersucted as part of a \$15.4 million project. completed in the first part of 2013. It replaced are stirl, boast resalvished director belongs book to 1942; This new and modern resident structure corrects: steeligh deficiencies with the sid timber bridge including vehicular impact and selemic resistance. Reserved untrigue faceborers are implemented in the prefabilicated girder segments.

#### Bridge Pacific Profiler

Bridge Grountaine Cost \$2.40 million Owner: Washington State Department

Bridge Designer Engineer's Michael

Corposesso, Taccosa, NA

State Bridge Arendant Part D. State Bridge Regimen: Ego Phings, FE, SE, PhO

General Commercian Pranklin Pacific Construction Company, Swittle, WA Past-Yestening Santractor: Schwage

#### Bridge & Structures Office Skagit River Bridge Emergency





#### Bridge collepse incident

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#### **Bridge & Structures Office**

#### Excellence & Innovation in Design









Special Structures: Pleasing Broiges and Movestile Straiges

Type Bite and Localize Reports

The office prepares loridge continuous states redisting the tree ligate and intertializes. Posteriously

coage anginees lead the process that establishes the structure type, slepth and span arrangement. This contamentur with standholders is the

back for completing the final chappe

**Contract Documents** 

Direign designers and detailers use state of the art computer settings.

in their engineering computation

Bridge Pleasers.

Yorker Engineering 4: Emergency Deby?

Proliminary Plan

Preparation



#### **Bridge Design**

The INSECT Bridge and Shrinkers Office provides safe-processes for the status, nanoportalises organization from status, nanoportalises organization from sea in 150 value of the status traver and concerns bridges in highly complete, and producing ing projects.

The office has one of the highest oncodesture of registered smortural engineers in the United tistos. Structural engineers study for many years, undergo rigious a reliand feeling and are the most ette geop in the bridge delige field. He also have PRO angresses. Tell guide the office in restone and

#### We have needs a century of expertise

Reservate Place

4 - Sectioning Strafe-

- Contract Documents
- Construction Sysothophora and
- Constitutible Registri Signs and Surrivative Structures
- Structural separts with with the specifications and cost expects to preside construction. This activity consumed of the line and skell for a typinal bridge project.
  - The office has many decades of Providige to Brain upon

#### Construction Specifications and Cost Estimate Preparation

Proposition of the on goth from and details following columns by the MSDOT Mannbard specifications for Modol, Bridge and Manhapat Construction, and Machigai Combanitos, and appointung gentlesi garcial productors in supplement live geochiotores for auto laures and obtain. 10 c. bin-coal detimates and prepared laures on the spendides consultated for sect bod laur. Of this behavior and a replace of fees which project files that the content feesing contraction advantage of feesing contractions advantage. Complex contractions advantage on the contraction of advantage of feesing the project files that the content feesing contraction advantage of advantage of the content of project files advantage of contractions of advantage of advantage of project files and advantage of project advantage of project advantage of project advantage of project and advantage of project advantage project proje



# 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.





#### **WSDOT ABC Website**

#### 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)

#### 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



