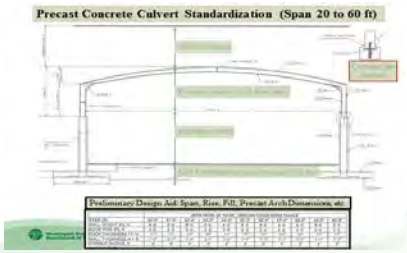
Delivery of Accelerated Bridge Construction
WSDOT Workshop
Wednesday April 1st, 2015

New Development in Accelerated Bridge Design and Construction in WA

Washington State Department of Transportation
Bridge and Structures Office
Olympia Washington

Presentation Summary

1. ABC Projects
2. ABC Related Research Projects
3. New Wide Flange Deck Bulb Tee Girders with UHPC Closure
4. Accelerated Bridge Construction – Lateral Slide
5. Geosynthetic Reinforced Soils Integrated Bridge System GRS-IBS
6. Standardization of Precast Culverts



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

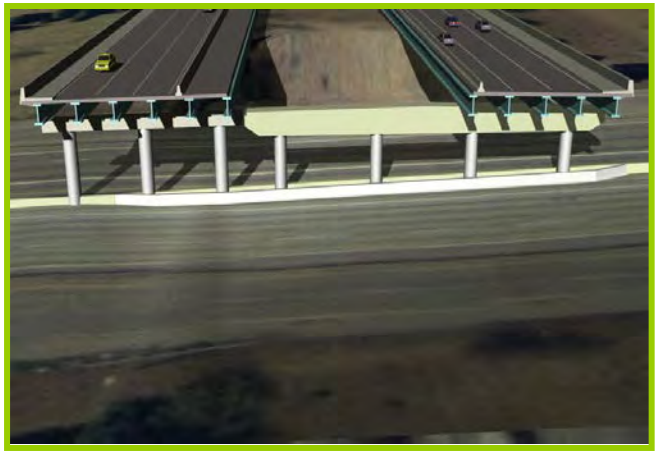
Challenges in the implementation of PBES/ABC

- ✓Lack of Education, Training, and experience
- ✓Concerns about durability and quality
- ✓Lack of defined decision process for PBES/ABC
- ✓PBES/ABC process is not integrated into practices
- ✓Lack of perceived need for speed
- ✓Lack of interest from the construction industry

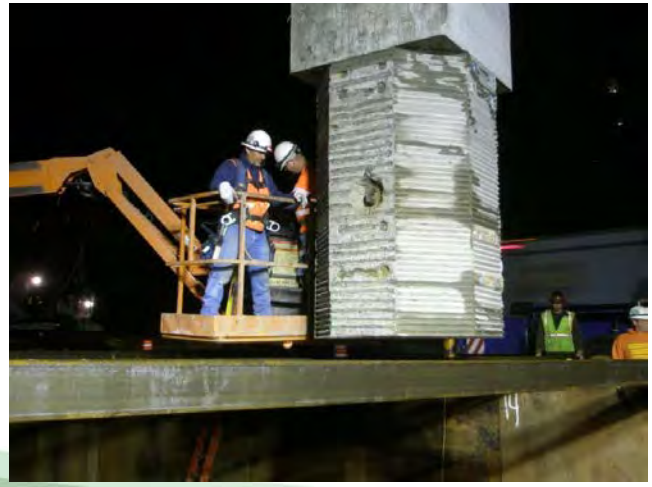
Prefabricated Bridge Elements & Systems

- ***Superstructures***
  - ✓ Deck Panels: Partial & Full-Depth
  - ✓ Prefabricated Beams: Optimized for ABC
  - ✓ Total Superstructure Systems:
- ***Substructures***
  - ✓ Pier Caps, Columns, & Footings
  - ✓ Abutment Walls, Wing Walls, & Footings
- ***Totally Prefabricated Bridges***

Example of ABC Related Bridge Projects in WA - Superstructure



Example of ABC Related Bridge Projects in WA - Substructure



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ABC Research Projects in Washington State

- **Design of Precast Concrete Piers for Rapid Bridge Construction in Seismic Regions**

  University of Washington, August 2005

- **Anchorage Of Large-diameter Reinforcing Bars Grouted Into Ducts**

  University of Washington, November 2007

- **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

  Reinforced Concrete Filled Tubes for use in Bridge Foundations

  Phase 2: **Shear capacity of CFT**

- **Seismic Performance Of Square Nickel-titanium Reinforced ECC Columns With Headed Couplers**

  University of Nevada, Reno, July 2014

- **Accelerated Bridge Construction (ABC) Decision Making and Economic Modeling Tool**

  Oregon State University, December 2011

Participation in ABC Webinars

ABC Center at Florida International University - ABC-UTC

- October 2013 - Washington State's Skagit River Bridge Emergency Slide - WSDOT
- September 2014 - SR167 Puyallup River historic bridge lateral slide – Jcobs-WSDOT

NHI Innovation Web Conference

- August 2011 - Precast Bent System for Use in High Seismic Regions – ABAM-UW-WSDOT
- August 2013 - Precast Bent System for Use in High Seismic Regions – ABAM-UW-WSDOT

ABC Folios and Tech Notes


Bridge & Structures Office

Accelerated Bridge Construction

WSDOT ENHANCED MOBILITY


Highways for LIFE Projects

From research to practice


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Skagit River Bridge Emergency

Bridge collapse incident

View construction photos at: www.flickr.com/photos/wsdot/sets/


Tech Notes

Bridge and Structures Office

Skagit River Bridge Lightweight Concrete Girders

The Emergency Replacement

Investigation of Options

WSDOT and Bent Value Proposals


US 97 Satus Creek Bridge Replacement Project

Crossing an Environmentally Sensitive Creek

Bridge Facts Profile:


Bridge & Structures Office

Excellence & Innovation in Design

Bridge Design

Preliminary Plan Preparation

Contract Documents

Construction Specifications and Cost Estimate Preparation

NCHRP ABC Projects

- ***NCHRP 12-102:*** Recommended AASHTO Guide Specification for ABC Design and Construction
- ***NCHRP 12-105***: Proposed AASHTO Seismic Specifications for ABC Column Connections
- ***NCHRP 12-101:*** Seismic Design of Bridge Columns with Improved Energy Dissipating Mechanisms
- ***NCHRP 12-88***: Synthesis on System Performance of Accelerated Bridge Construction Connections in Moderate-to-High Seismic Regions
- Others

PBES – Implementation

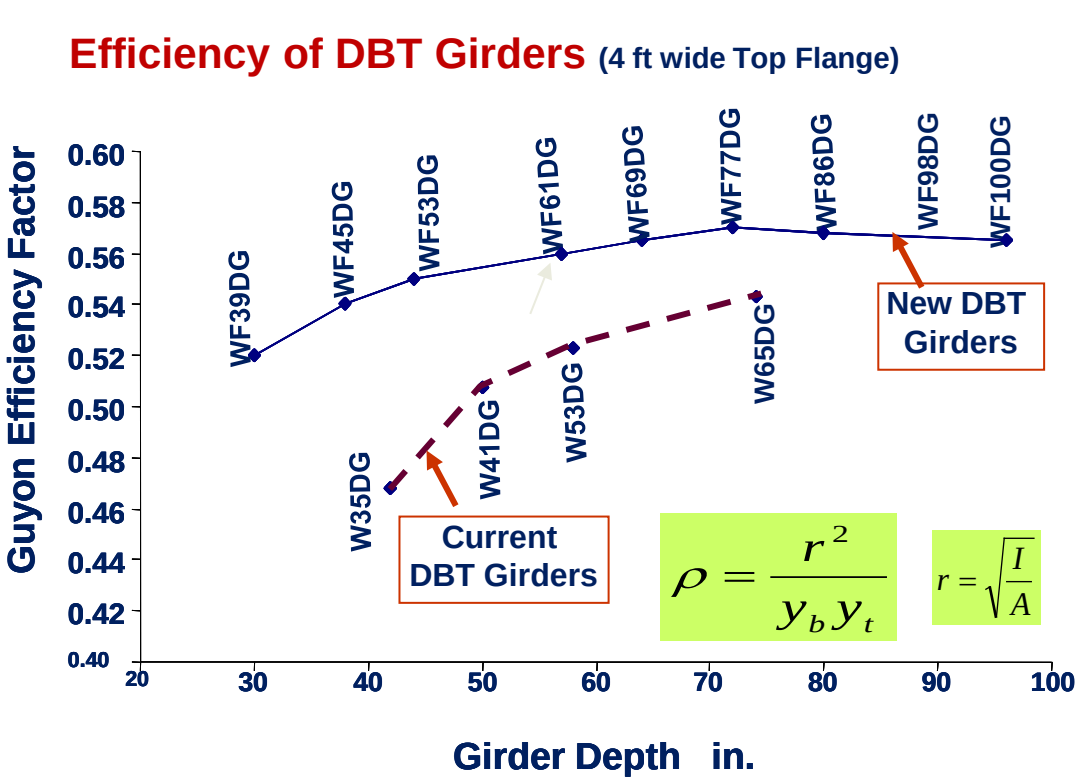
From: Summit -1: P2P Exchange - PBES

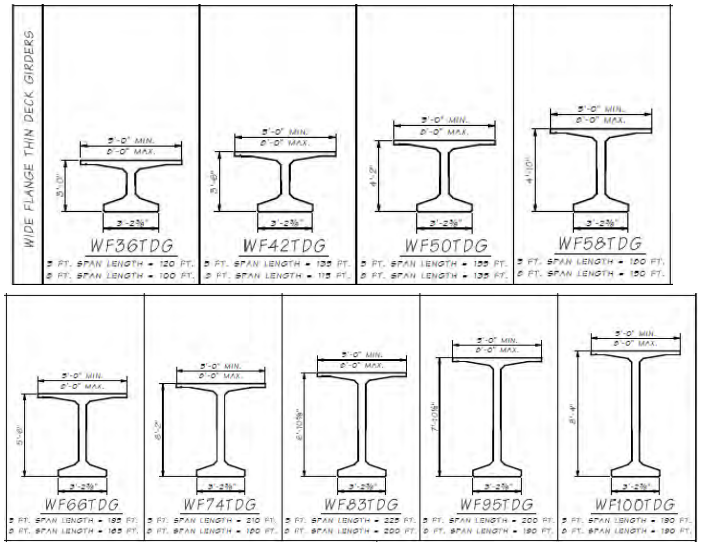
Beam Elements

Prefabricated *Deck Beam Elements include:*

- ✓ **Deck Bulb Tee Beams**
- Precast Deck Elements
- Precast Box Beams
- Precast Slabs

New Wide Flange Deck Girders





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).

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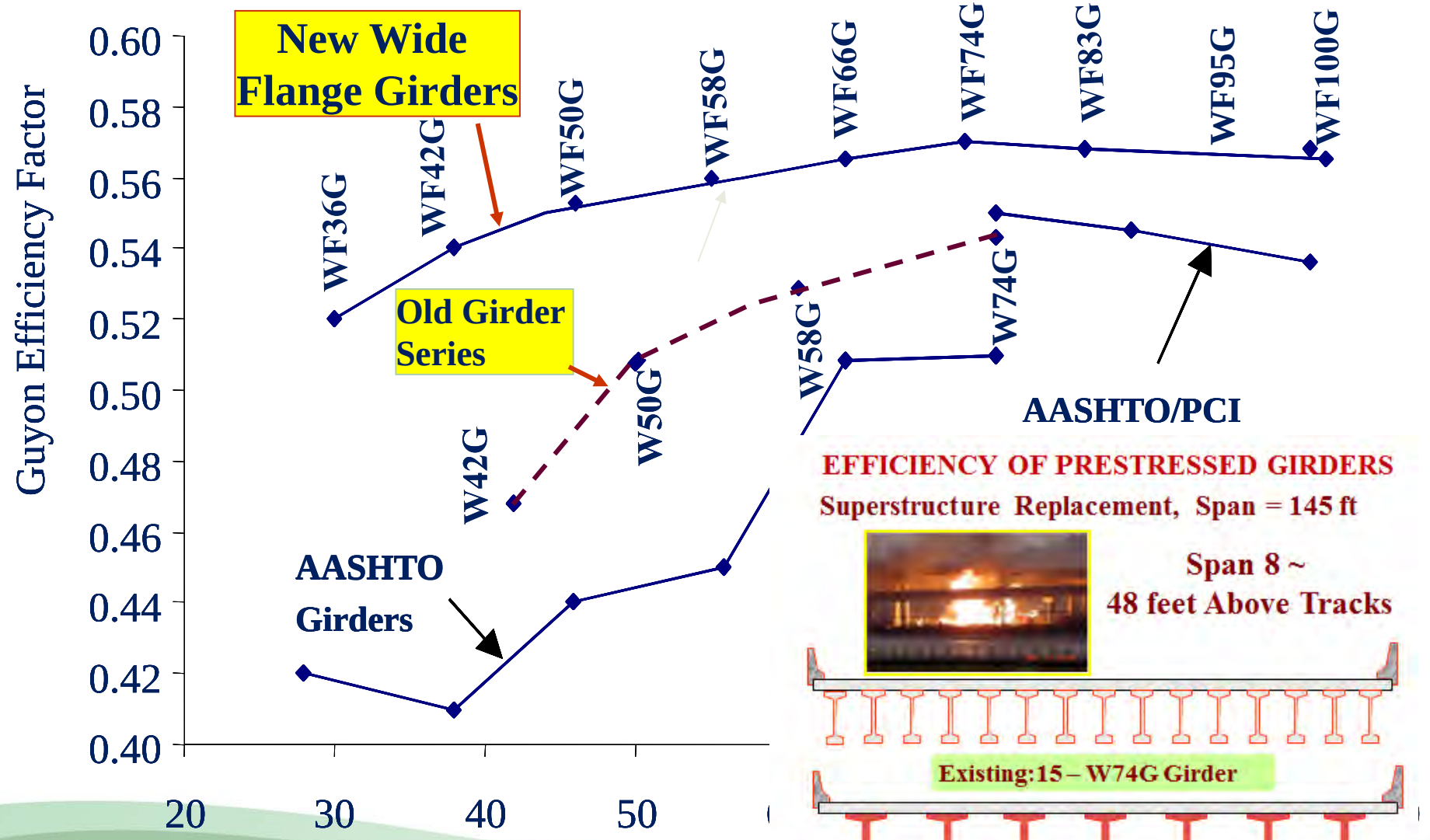
Efficiency Of Prestressed Girders



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December 2011 Concrete Products Article by Don Marsh

Wide Flange Deck Bulb Tee Girders

- **Girder Types:**
  - Type 1: CIP Slab = 5” min. for WSDOT Projects
  - Type 2: CIP concrete Overlay = 1 ½” for Low ADT
- **Concrete Types:** Normal weight, and LW
- **Top flange width:** 5.0 ft, 6.0 ft, 7.0 ft, 8.0 ft
- **Closure Types:**
  - ✓ CIP UHPC connection with lap spliced bars
  - Welded ties and grouted key connection for Low ADT Roads/Others

Deck Girders: Skagit River Bridge Replacement - ABC and A+B+C

Connection of Deck Beam Elements

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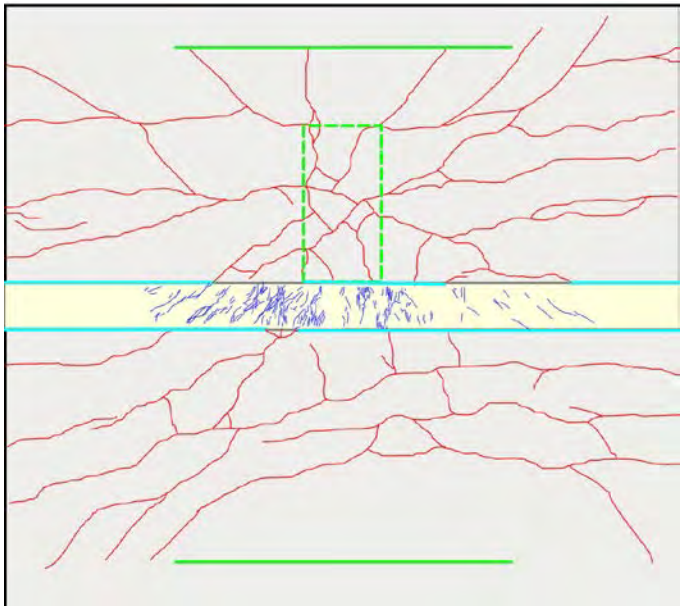
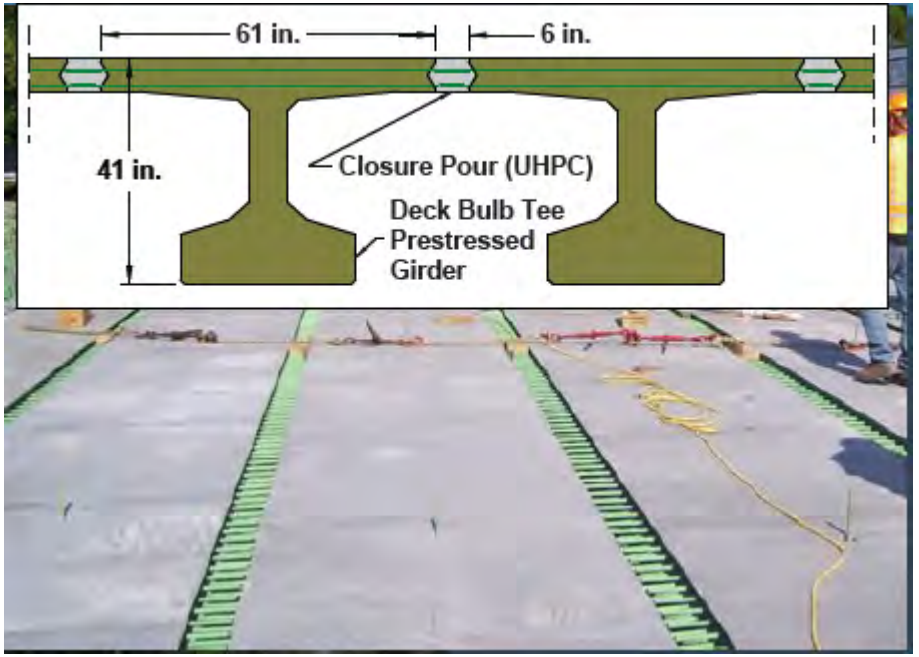
Research Pays off: New NCHRP Publication

- NCHRP 18-15 High-Performance/High-Strength Lightweight Concrete for Bridge Girders and Decks
- FHWA HRDI-40- Lightweight Concrete for Bridge Girders: Contact: Ben Graybeal
- FHWA-HRT-13-060 - Ultra-High Performance Concrete for Bridges, Ben Graybeal
- Nchrp 12-69 - Guidelines for Design and Construction Of Decked Precast, Prestressed Concrete Girders
- NCHRP 173 - Cast-in-Place Concrete Connections for Precast Deck Systems

Connection of Deck Beam Elements





SR 31 over Canandaigua Outlet Lyons, New York Ultra-High Performance Concrete (UHPC)

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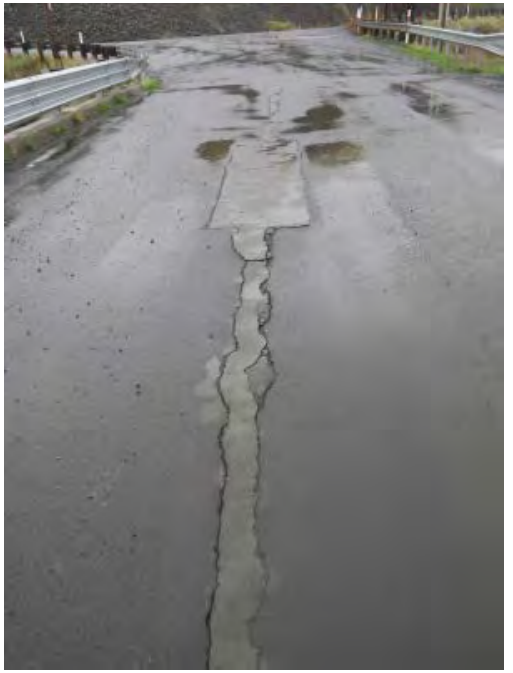
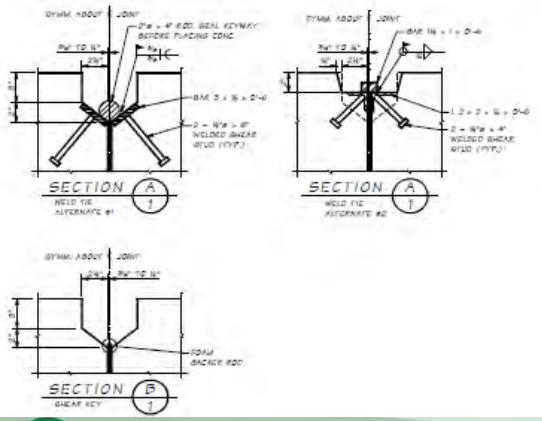
Past Performance of Deck Girder Bridges





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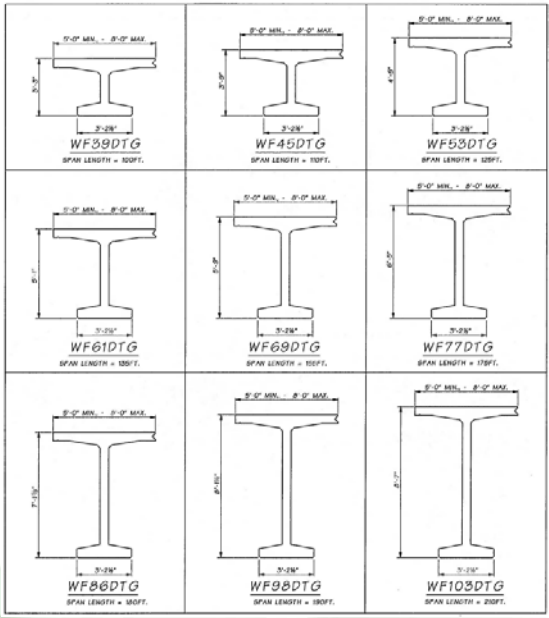
2015 WSDOT Research Project

Use of UHPC For Decked Girder Connections Between Adjacent Units

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



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
- Flexible design – easily modified for unforeseen site conditions
- Built with common equipment and materials

U.S. Department of Transportation
Federal Highway Administration

Every Day Counts

Geosynthetic Reinforced Soil Integrated Bridge System
May 9th, 2013

Location
Washington State Department of Department of Transportation
Bridge and Structures Office
7345 Linderson Way Southwest
Tumwater, Washington 98501
Conference Room 1028

Geosynthetic Reinforced Soil Integrated Bridge System
Instead of conventional bridge support technology, Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) technology uses alternating layers of compacted granular fill material and geosynthetic reinforcement to provide support for the bridge. GRS provides a smooth transition from the bridge onto the roadway, and alleviates the "bump at the bridge" problem caused by uneven settlement between the bridge and approaching roadway. To learn more about EDC, please refer to the following web site:

http://www.fhwa.dot.gov/everydaycounts/technology/grs_ibs/index.cfm

Agenda:

9:30AM	Introduction
9:40AM	GRS Fundamentals
10:00AM	Performance tests and monitoring
10:30AM	Construction of GRS-IBS and Video
11:30AM	Lunch
12:30PM	Design of GRS-IBS
1:30PM	User Perspective and example project
2:15PM	Status of implementation nationally
2:30PM	Adjourn

Presenter:
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EDC: GRS - IBS

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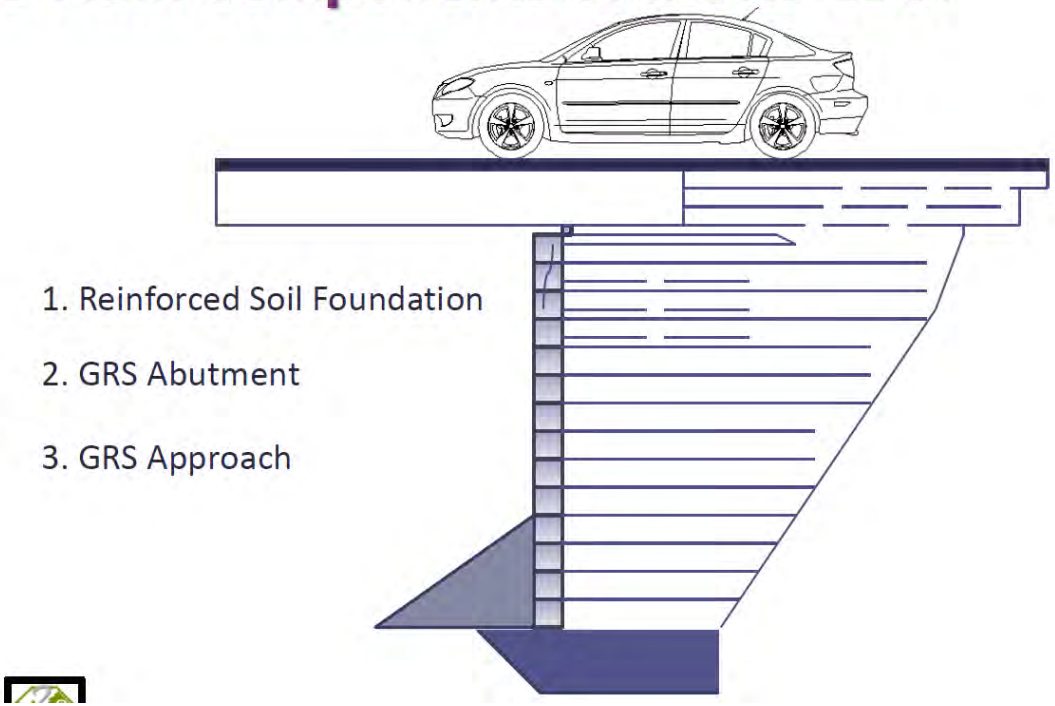
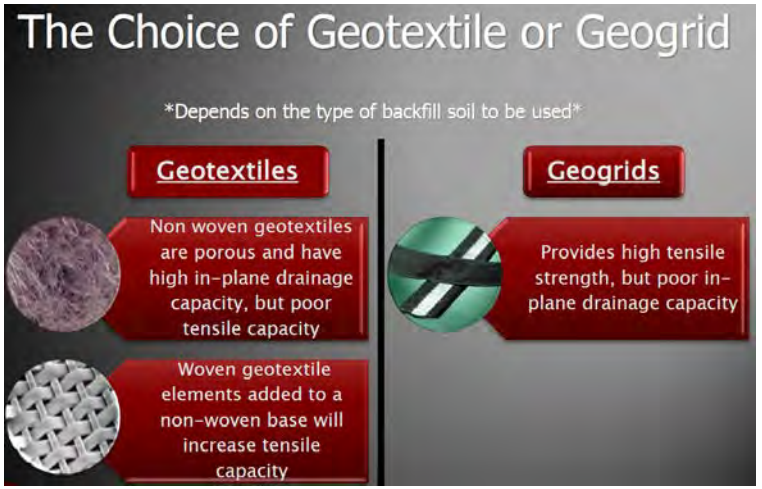
Date, time and details of last edit

Geosynthetic Reinforced Soil-Integrated Bridge Systems (GRS-IBS)

3 Main Components of a GRS-IBS:



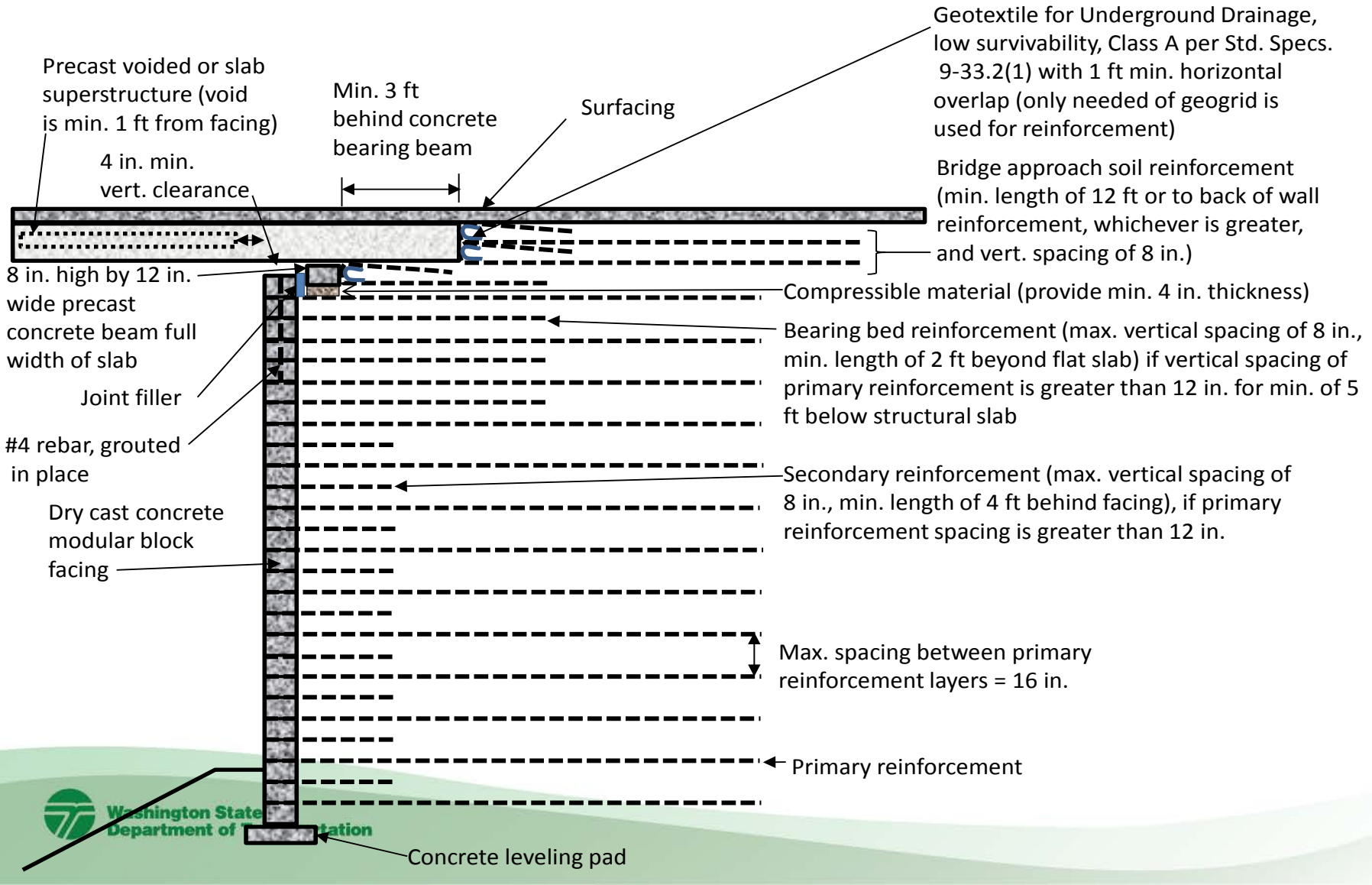
1. Reinforced Soil Foundation
2. GRS Abutment
3. GRS Approach



Geosynthetic Integrated Bridge System

MSE wall supported abutments

GRS supported abutment – flat slab superstructure with no footing and dry-cast modular block wall facing



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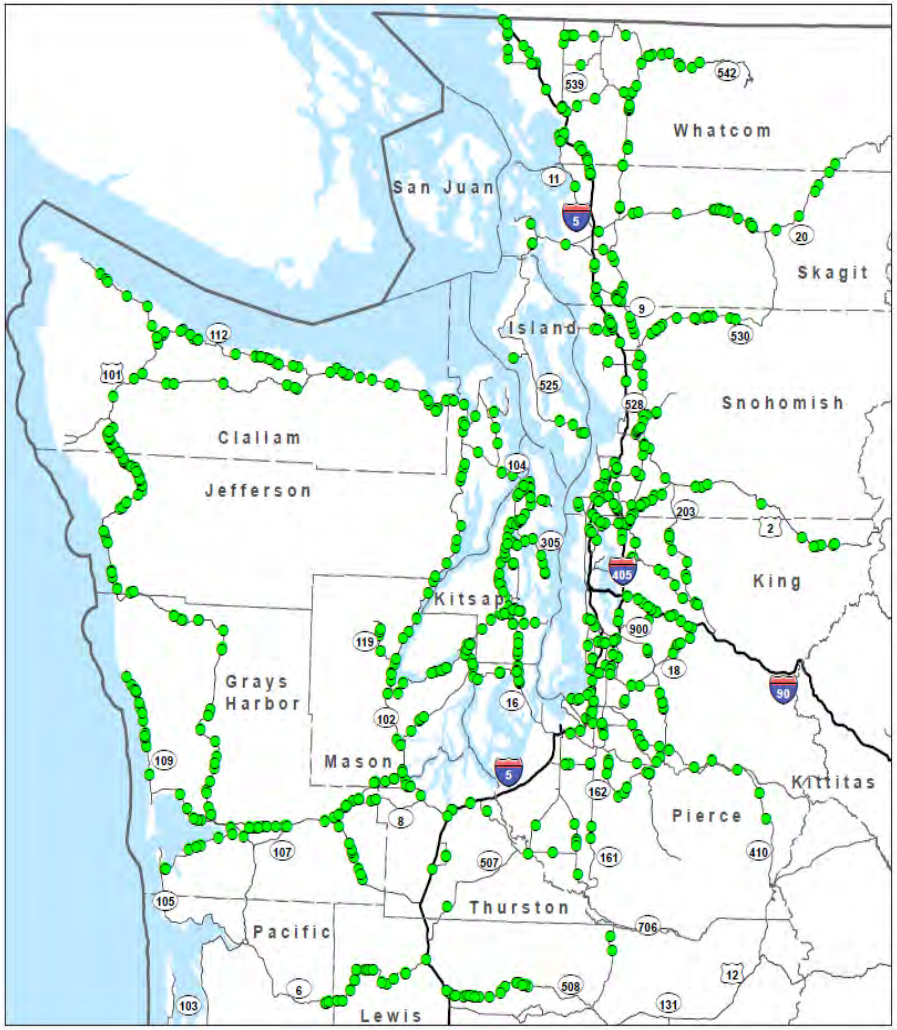
WSDOT Fish Passage Culverts Replacement

- 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:

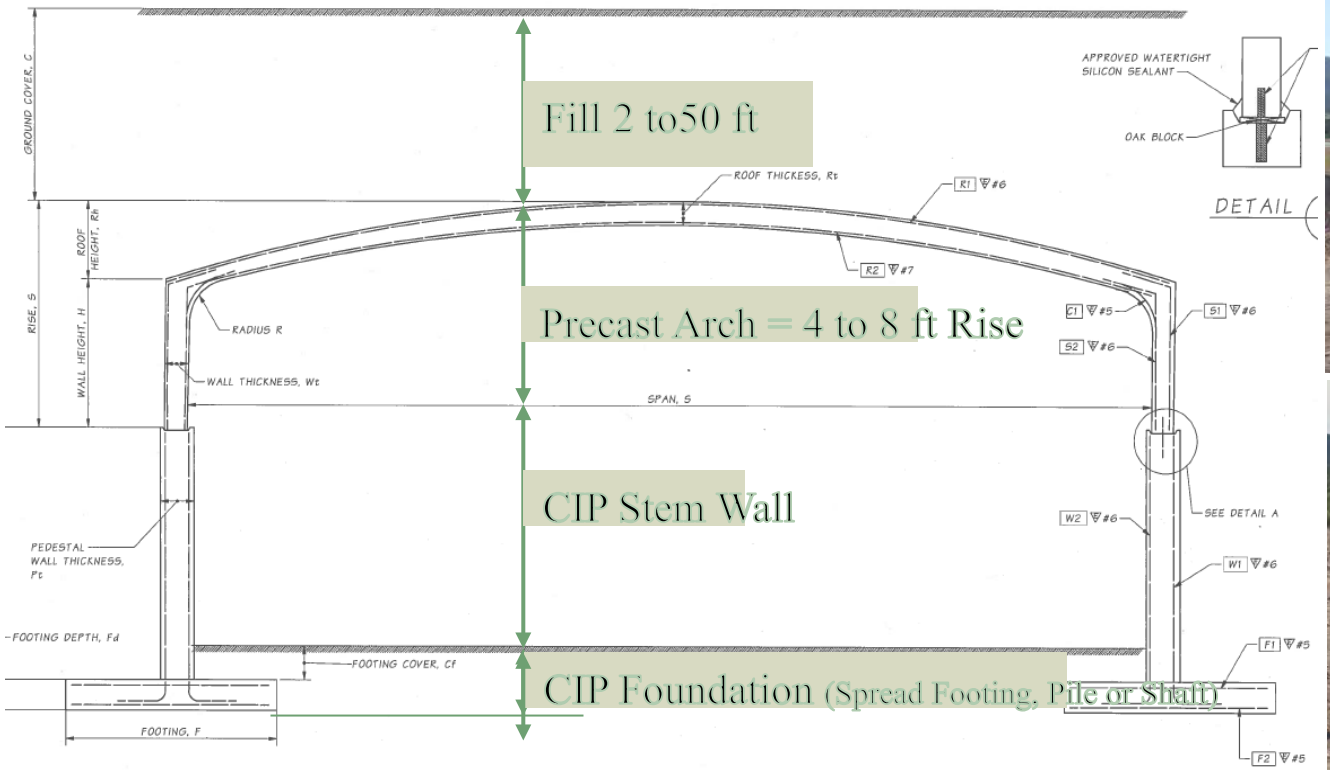
- ✓ ABC – Lateral Slide
- ✓ Deck Girders
- ✓ GRS-IBS
- ✓ Precast Culverts

Scope of Work: Fish Passage Projects

Bridges and 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%**

Precast Concrete Culvert Standardization



Preliminary Design Aid: Span, Rise, Fill, Precast Arch Dimensions, etc.

	SPAN FROM 50' TO 60', GROUND COVER MORE THAN 8'										
SPAN (S)	50'-0"	51'-0"	52'-0"	53'-0"	54'-0"	55'-0"	56'-0"	57'-0"	58'-0"	59'-0"	60'-0"
WALL HEIGHT (H), ft.	8 -0	8 -0	8 -0	8 -0	8 -0	8 -0	8 -0	8 -0	8 -0	8 -0	8 -0
ROOP RISE (R), ft.	2 -0	2 -0	2 -0	2 -0	2 -0	2 -0	2 -0	2 -0	2 -0	2 -0	2 -0
ROOF THICKNESS T1, in.	11"	11"	11"	11"	11"	11"	11"	11"	11"	11"	11"
WALL THICKNESS W1, ft.	1'-1"	1'-1"	1'-1"	1'-1"	1'-1"	1'-1"	1'-1"	1'-1"	1'-1"	1'-1"	1'-1"
CORNER RADIUS, ft.	2'	2'	2'	2'	2'	2'	2'	2'	2'	2'	2'

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Standard Precast Concrete Culvert

- Design Criteria & Design Specifications
- Preliminary Design Aids
- Span Capability Charts
- Design Tools and Software
- Bridge Design Manual & Standard Details
- Standard Drawings for Arch Structures
- Improved Joint Details between Segments
- Complete PS&E Package and Contract Plans

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WSDOT ABC Website

Accelerated Bridge Construction Resources (ABC)

Thank You!

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

- 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, 1.1m
- Concrete Filled Steel Tubes for Bridge Foundat

Links

- Highways for Life

- ✓ **ABC Website** – Rick Brice
- ✓ **ABC BDM Chapter** – Patrick Gallagher
- ✓ **Folios and Tech Memos** – Paul Kinderman
- ✓ **New Deck Girders** - Rick Brice –Scott Sargent – Brian Aldrich
- ✓ **Culverts** – Lou Tran – Mark Szewcik

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