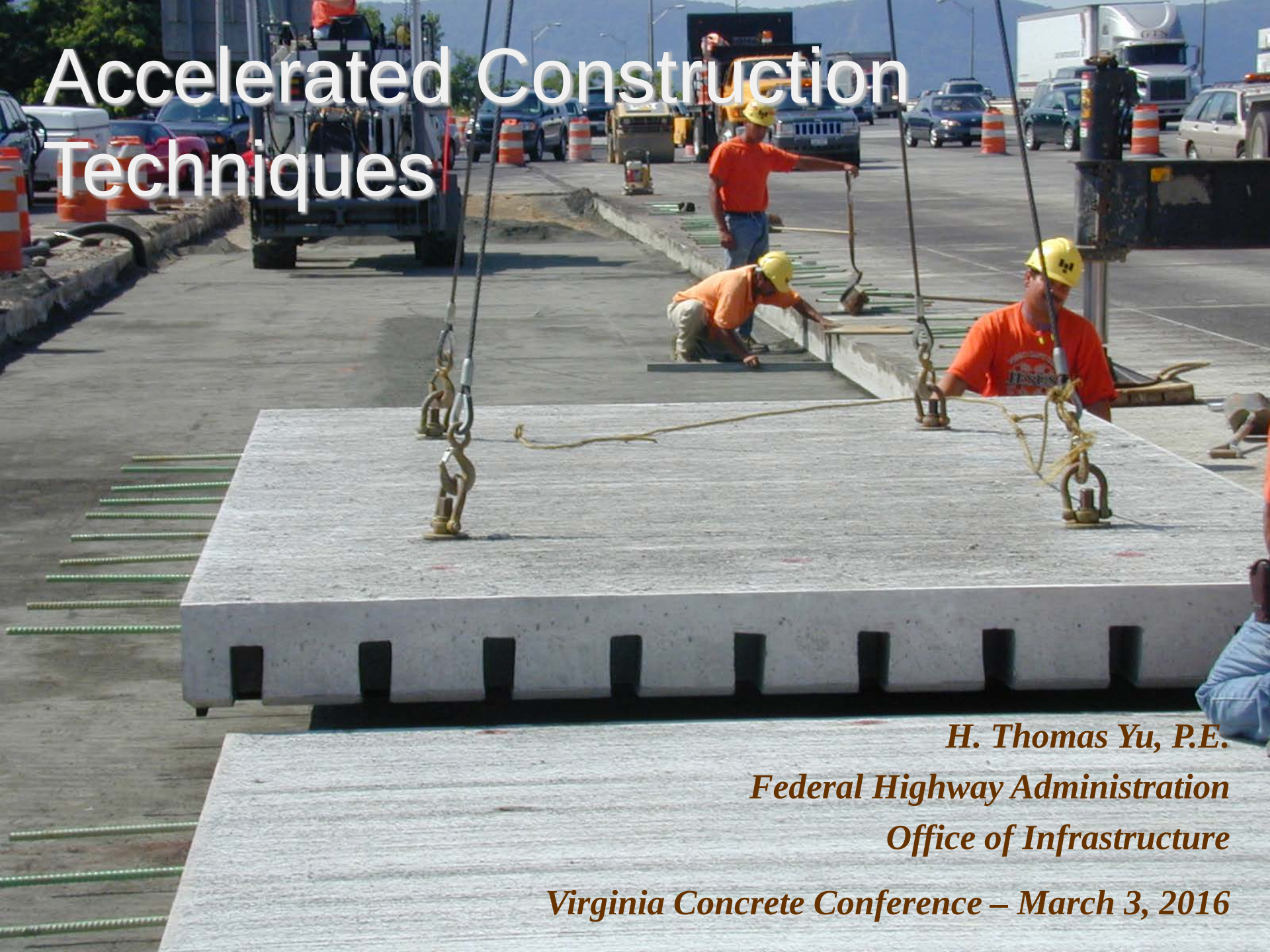
Accelerated Construction Techniques



H. Thomas Yu, P.E.

Federal Highway Administration

Office of Infrastructure

Virginia Concrete Conference – March 3, 2016

Precast Concrete Paving

- A recent technology – in use since 2001
- Developed for rapid, durable repair/construction of concrete pavements
  - Problem: concrete requires time to cure
    - ✓ *High-early-strength concrete → shorter service life*
    - ✓ *Durable concrete require longer lane closure*
  - Solution: precast paving
- Advantages of precast paving
  - **Shorter lane closures**
  - **Durable concrete → longer service life**
  - Longer construction season

Accelerated Concrete Construction Techniques

- SHRP (1987)
  - Focused on the development of fast-setting mixes
  - Construction techniques utilizing fast-setting mixes
- SHRP2 (2005)
  - Precast concrete pavements (R05)
  - Composite pavements (R21)
  - Pavement preservation (R23 & R26)

Two types of systems used in the US

- Jointed Precast Concrete Pavement (PCP)
  - Normally, reinforced concrete panels
  - Could be prestressed
- Post-Tensioned Precast Concrete Pavement (PPCP)
  - Consists of a system of specialized panels that are tied together through post-tensioning
  - 150 to 250 ft tied length

Applications

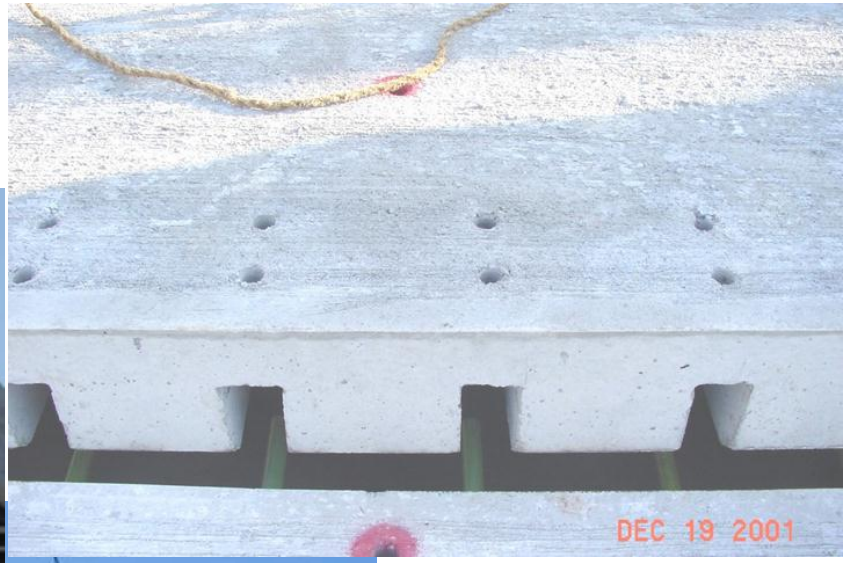
- Intermittent repairs – full-depth repair
  - Jointed PCP
  - Prestressed PCP
- Continuous paving – area replacements, reconstruction, or new construction
  - Jointed PCP
  - Post-tensioned PCP

Jointed PCP systems

SHRP2 R05
narrow-mouth surface slots

Fort Miller System
Super Slab

Super Slab

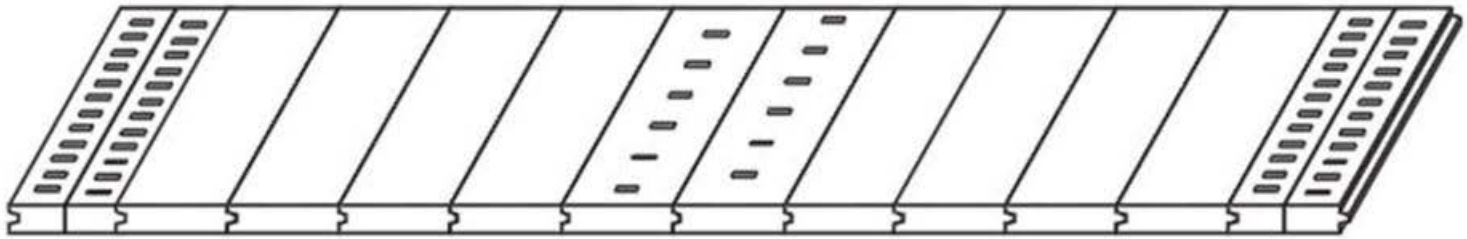


SHRP2 R05 – narrow-mouth surface slots

Other methods of installing dowel bars

PPCP system – *University of Texas (2001)*

PPCP system – *University of Texas (2001)*



- For continuous applications
- System consists of
  - Base panels – the majority of the panels
  - Central stressing panels
  - Expansion joint panels – one at each end of the section; include dowel bars and provisions for joint sealing
- Other configurations are also possible (e.g., end stressing at surface or vertical face)

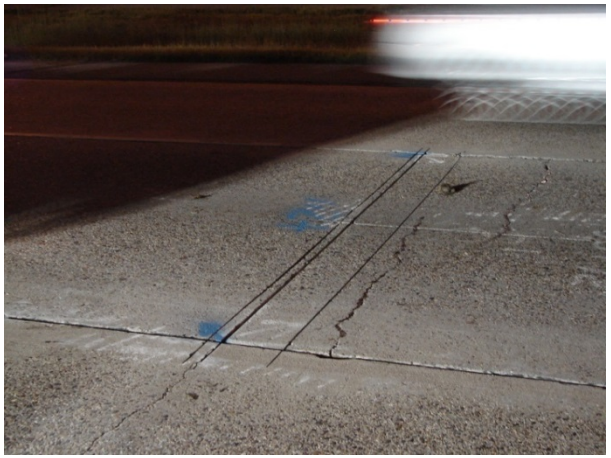
SHRP2 R05 Case Study Projects

- Intermittent Repairs
  - New Jersey – I-295 & I-280 (Fort Miller system)
  - New York – I-495 near JFK Airport (Roman Stone System)
- Continuous applications
  - Precast Prestressed Concrete Pavements (PPCP)
    - ✓ *Texas – Frontage Road – First project (2001)*
    - ✓ *Virginia – I-66*
  - Precast Jointed Concrete Pavements
    - ✓ *New York – Tappan Zee Toll Plaza – First project (2001) (Fort Miller system)*
    - ✓ *Virginia – I-66 (Fort Miller system)*

NJ I-295 (June 2008)

Intermittent Repairs using the Super Slab System

- Process:
  - Sawcut repair boundaries in advance
  - Night of repair – remove damaged panel; prepare base; drill dowel holes in existing panels; insert dowel bars; install precast panel
  - Next night – patch dowel slots; underseal panel



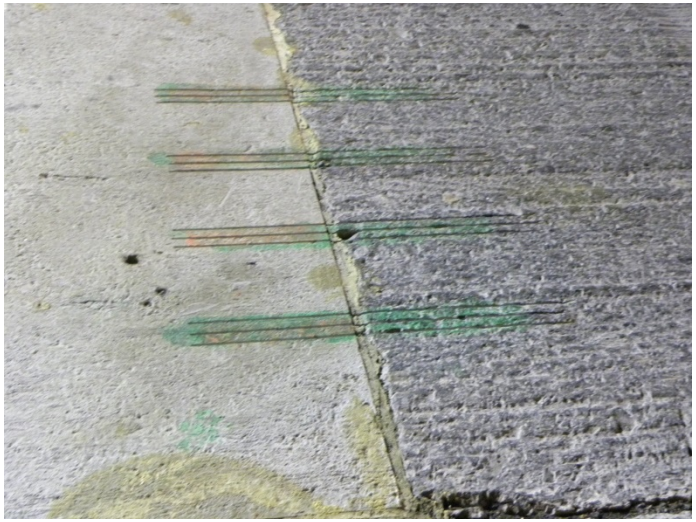
NJ I-295 (June 2008)

NEXT NIGHT ➔

Tappan Zee Jointed (Oldest - 2001)

NYS I-495, Near JFK Airport (2011)

Intermittent Repairs using the Roman Road System



Installation under Heavy Traffic – at Night

Texas PPCP (Oldest - 2001)

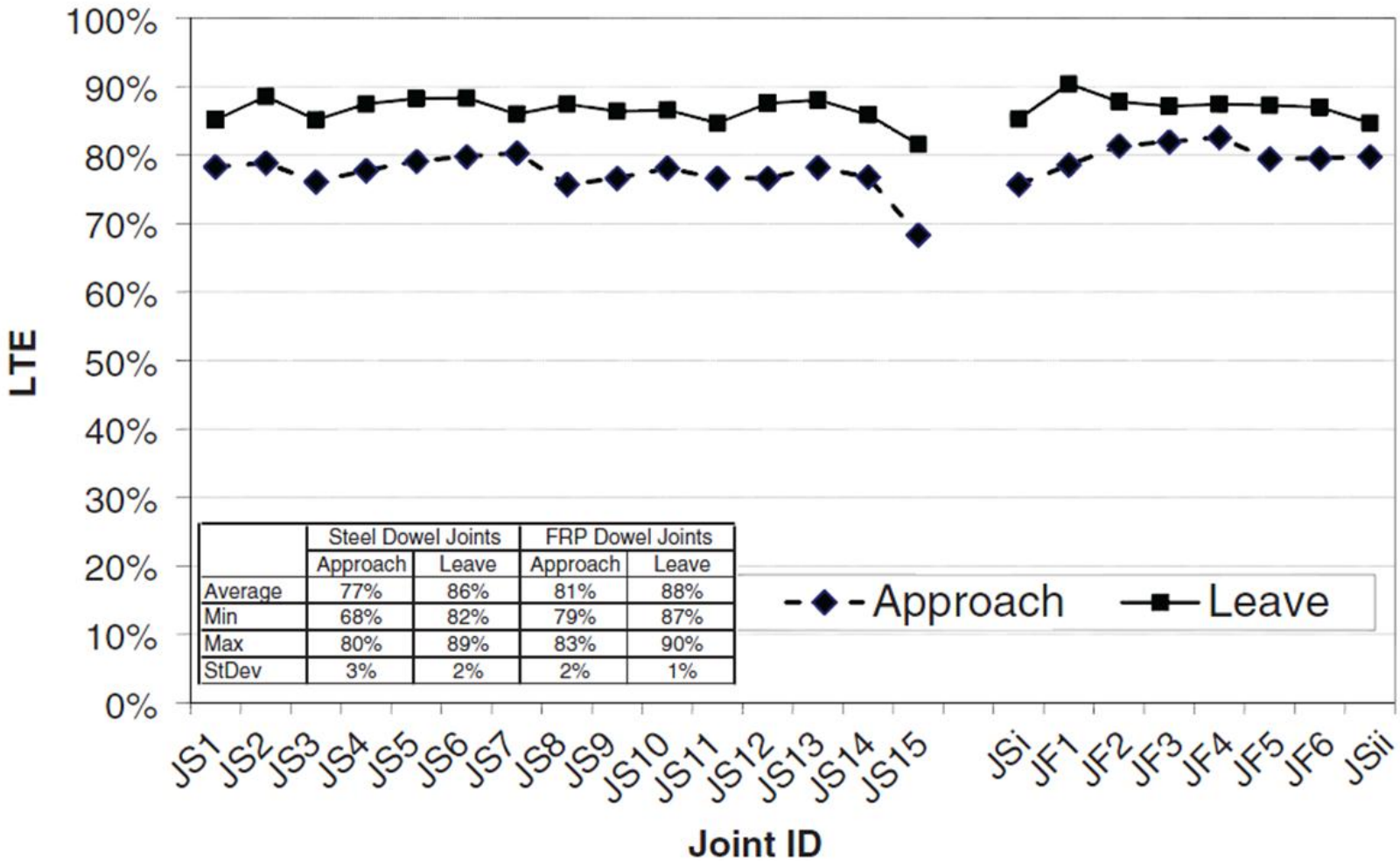
Conclusions from SHRP2 R05

- Although experience is limited (less than 11 yrs), both PCP and PPCP systems are performing well
- Currently used precast concrete paving systems are capable of performing well under traffic loading
- Precast pavement technology is ready for implementation and production use
  - For rapid pavement repair or continuous paving
  - With the expectation of good long-term performance

Potential issues (tyu)

- Unproven long-term joint performance
- Fabrication tolerance can adversely affect smoothness
  - Up to ¼ in or greater height difference at the joints
  - Wide joints (up to ½ in or wider) and no aggregate interlock – possible concern for long-term faulting performance
- Low production rate – typical production per over-night, lane closure are
  - 15 to 20 full-depth repairs for intermittent repairs
  - 30 to 40 panels for continuous placement – up to 800 ft
- High cost – $250 to $500/sy

Super-Slab LTE – NJ-130



	Steel Dowel Joints		FRP Dowel Joints	
	Approach	Leave	Approach	Leave
Average	77%	86%	81%	88%
Min	68%	82%	79%	87%
Max	80%	89%	83%	90%
StDev	3%	2%	2%	1%

LTE across the expansion joint in a PPCP

Georgetown, TX (2001), tested in 2009

Poor joint condition
Joint width ranged from 0.8 to 3.1 in (20 to 79 mm)

Joint	Nighttime LTE Testing	
	Approach Side (%)	Leave Side (%)
1	4	3
2	17	14
3	17	8
4	15	26
5	18	38
6	41	20
7	31	21
8	11	40
9	17	13
10	15	9

Conclusions

- Precast is a viable option for rapid repair/reconstruction of PCC pavements
- Inherent limitations of precast construction needs to be carefully considered
  - Fabrication tolerance
  - Long-term performance of joints
- Pavement preservation options should be fully utilized to minimize the need for reconstruction
  - Timely application of appropriate treatments
  - Use of structural enhancements to preserve the pavement structure

Thank you!

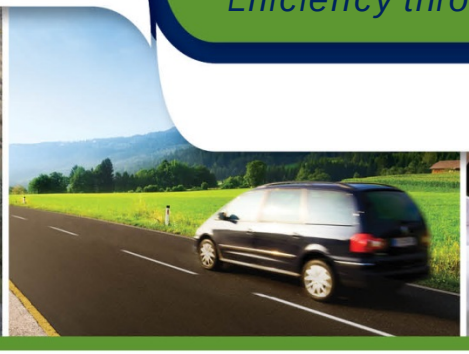
Tom Yu

tom.yu@dot.gov

202-366-1198

2016 VDOT Concrete Conference ABC Update

Efficiency through technology and collaboration



Benjamin Beerman, PE
Federal Highway
Atlanta, GA
(404) 562.3930

U.S. Department of Transportation
Federal Highway Administration

Paradigm Shift
old practices

PBES:

Pile Lagging

PBES:

Grouted Couplers

PBES:

Pile Pockets

PBES/ABC

UTDOT: Sam Wayton Parkway
2 Span Conn., 4/2011

UTDOT: White
3rd Dimension, 8/2010

8/2014
Every "S" in PBES
MNDOT: Hastings

CTDOT: I-84
2 bridges, 60 hours
7/2014

PBES/ABC

11/2014
Contractor VE, 3%
RIDOT: I-95 Barton

PBES/ABC

2015

VTrans: I-94 Hartford

ALDOT: Dothan

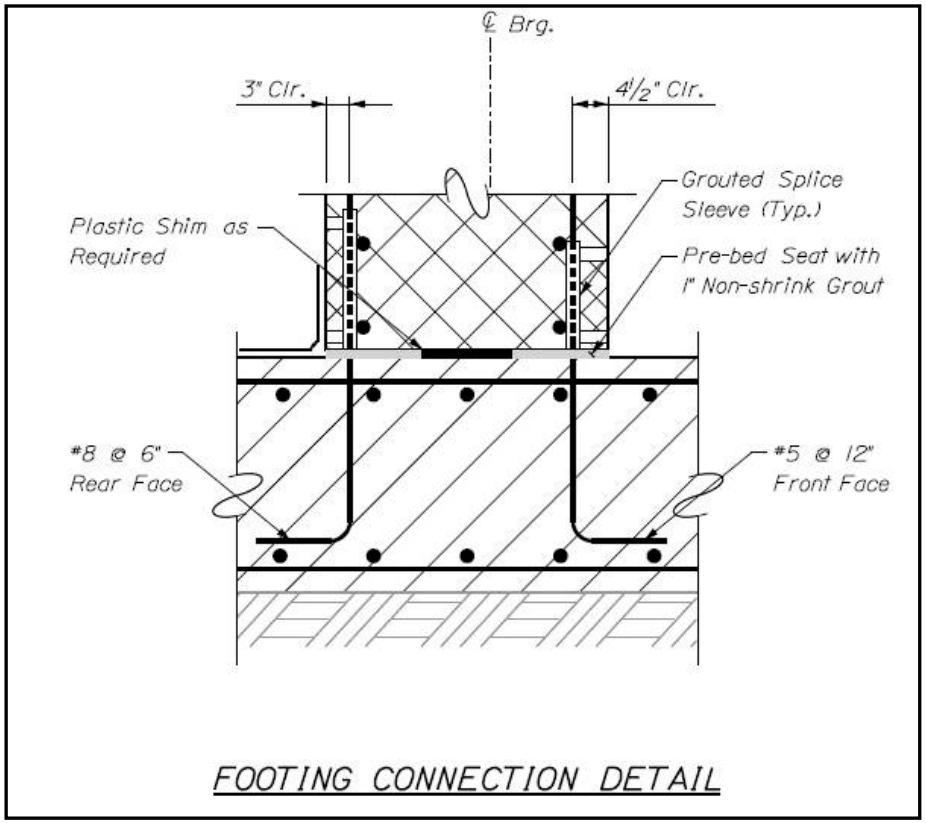
2015

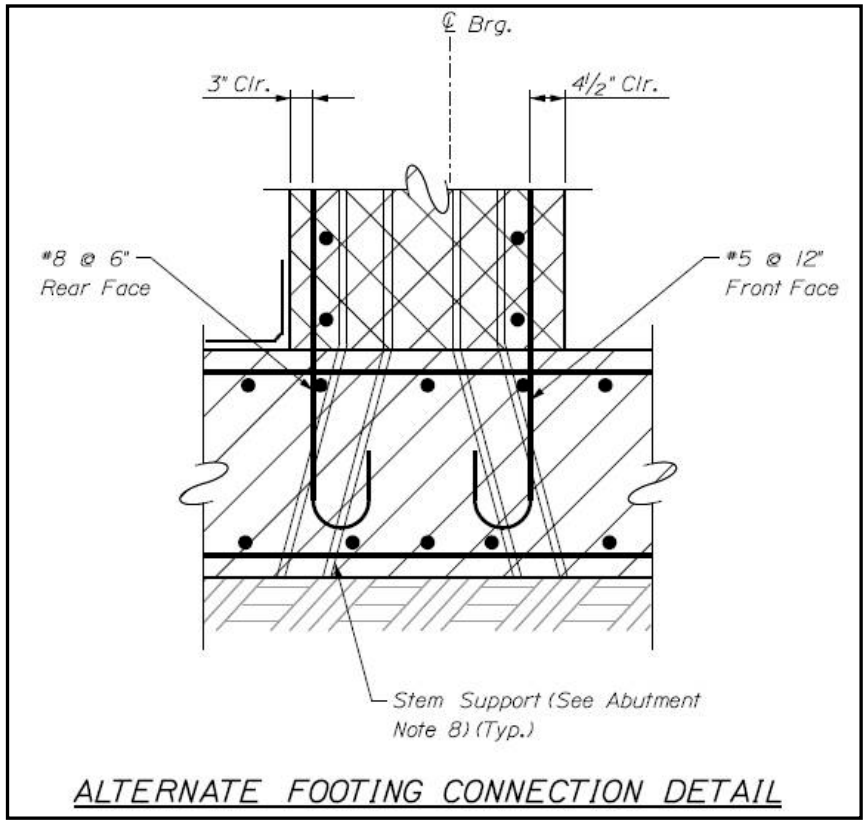
PBES/ABC

4/2015
121’ 3 Span MDB
PADOT: Rt. 581

Tappan Zee: $4Billion

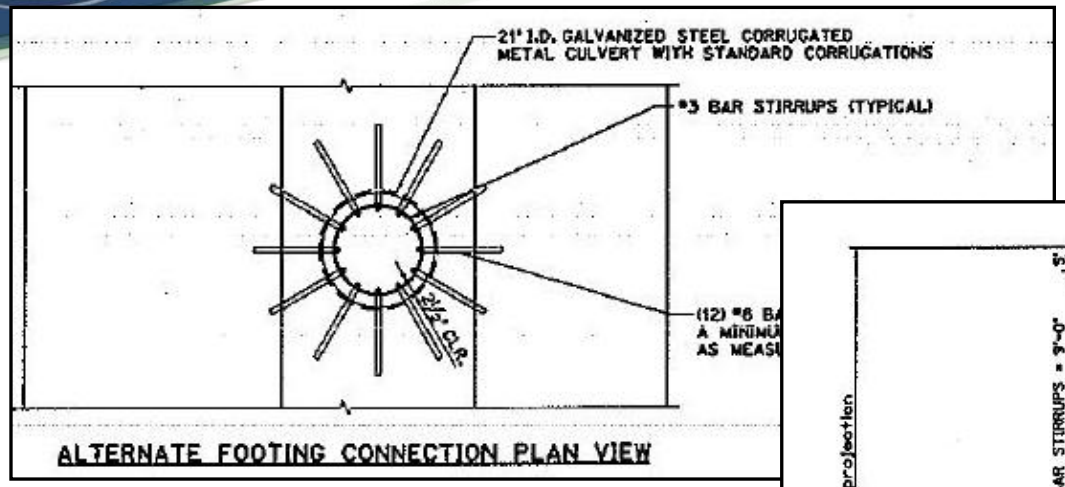
Contractor's Request

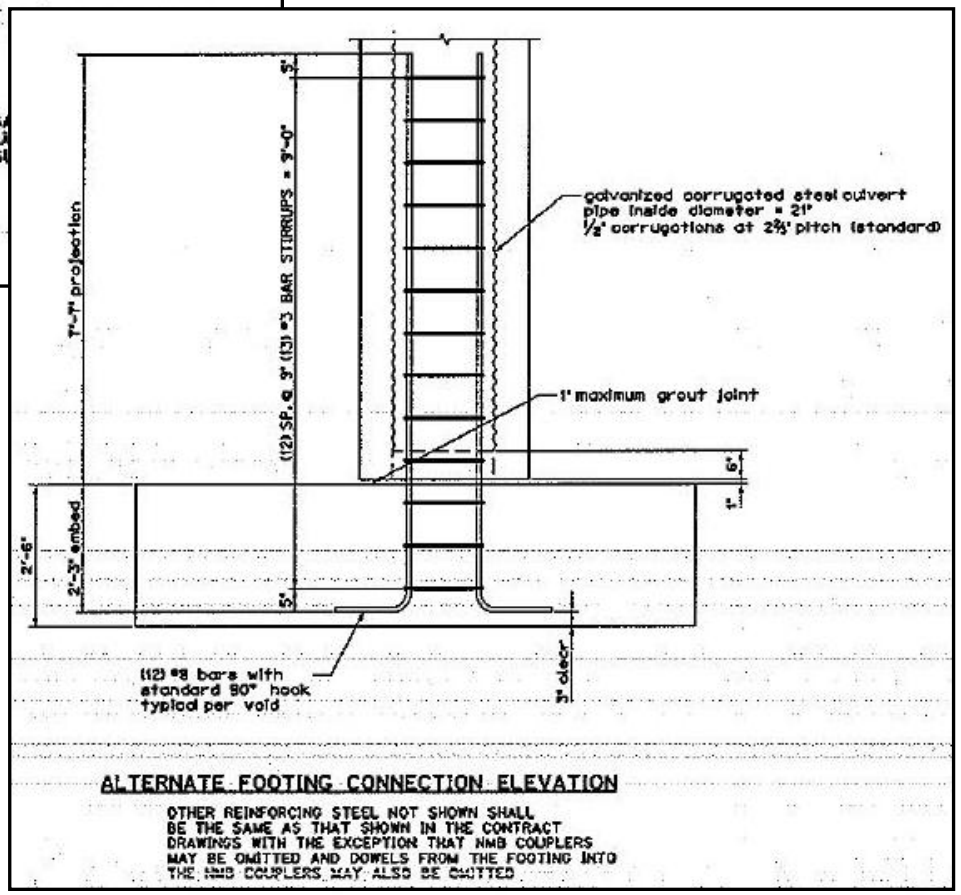




From SHRP2 ABC Toolkit
Not Used

From EDC Workshop sponsored by MassDOT
Not Used





Footing Connection Detail Proposed by Contractor and Accepted by Maine DOT

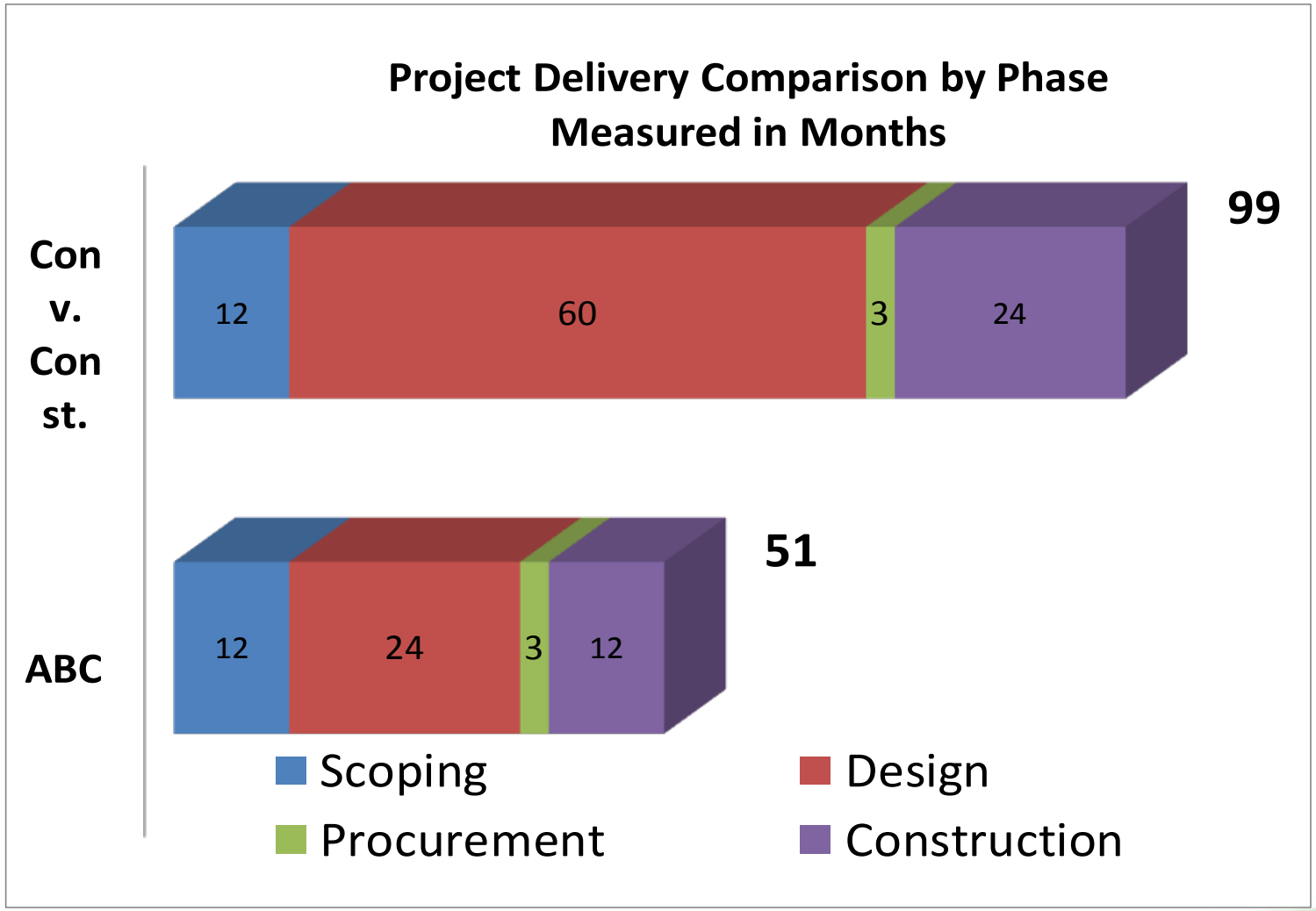
GROVE
GROVE

3/2016

1st D/B - Bridge Farm

CTDOT: I-95 Barton

Other Reasons for ABC



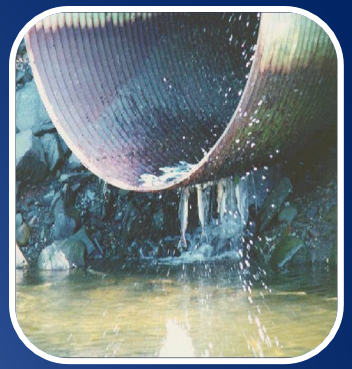
Other Reasons for ABC

30 Projects	
STIP Est. Avg.	$2,433,146
Actual ABC Avg.	$2,015,225
Total Pre. Eng.	$1,881,964
Total Const.	$9,007,805
Total Savings	$13,523,813

Savings Trends	Average:	Std dev:
Preliminary Engineering	-16	7
Total Construction Costs with CEC	-16	8
Total Project Costs	-18	7

Fish Passage Program

2013 Fish Passage Annual Report to Legislature
Coastal Anadromous Fish Passage Assessment and Remediation Progress Report



~15 Structures
$130k/bridge
~$2M/yr

Caltrans Fish Passage Barriers by District (all future program locations)		
District	**Estimated Fish Passage Barriers**	**2013 Priority Locations**
1 – Eureka	322	11
2 - Redding	56	9
3 - Marysville	6	0
4 - Oakland	72	10
5 – San Luis Obispo	87	2
6 – Fresno	0	0
7 – Los Angeles	23	2
10 – Stockton	0	0
11 – San Diego	2	2
12 - Orange	1	0
TOTAL	**569**	**36**

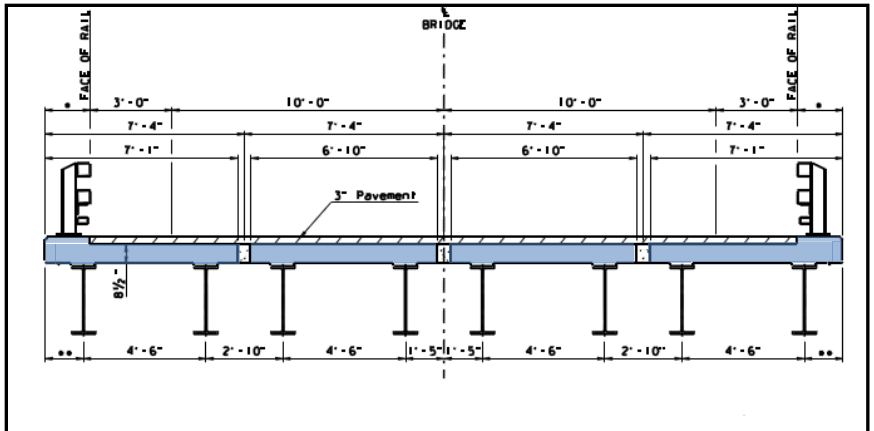
*Per the Passage Assessment Database (PAD)

520 estimated
Caltrans fish passage barriers!

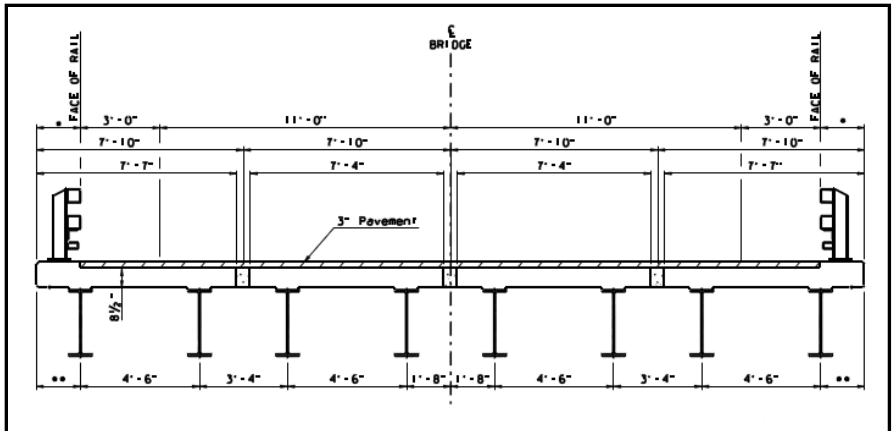
ACCELERATED BRIDGE CONSTRUCTION
Caltrans

DES PROJECT DELIVERY
DIVISION OF ENGINEERING SERVICES

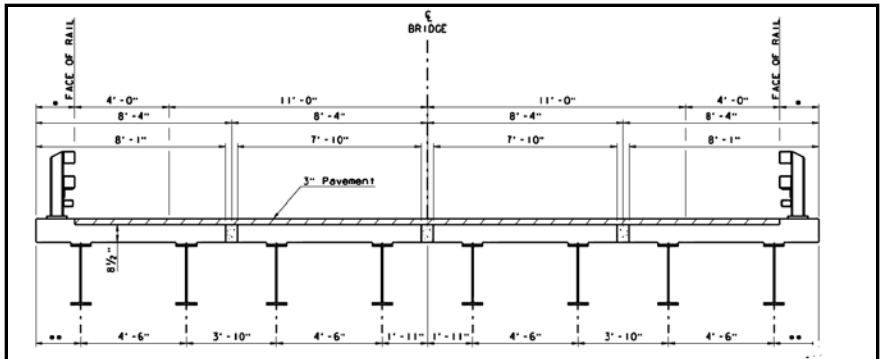
Paradigm Shift – standards



3-10-10-3 TYPICAL SECTION



3-11-11-3 TYPICAL SECTION



4-11-11-4 TYPICAL SECTION

Accelerated Bridge Program
VTRANS

Deck Level Joints w/ no Overlay

Joint Prep: important – deck level connections

MUST HAVE

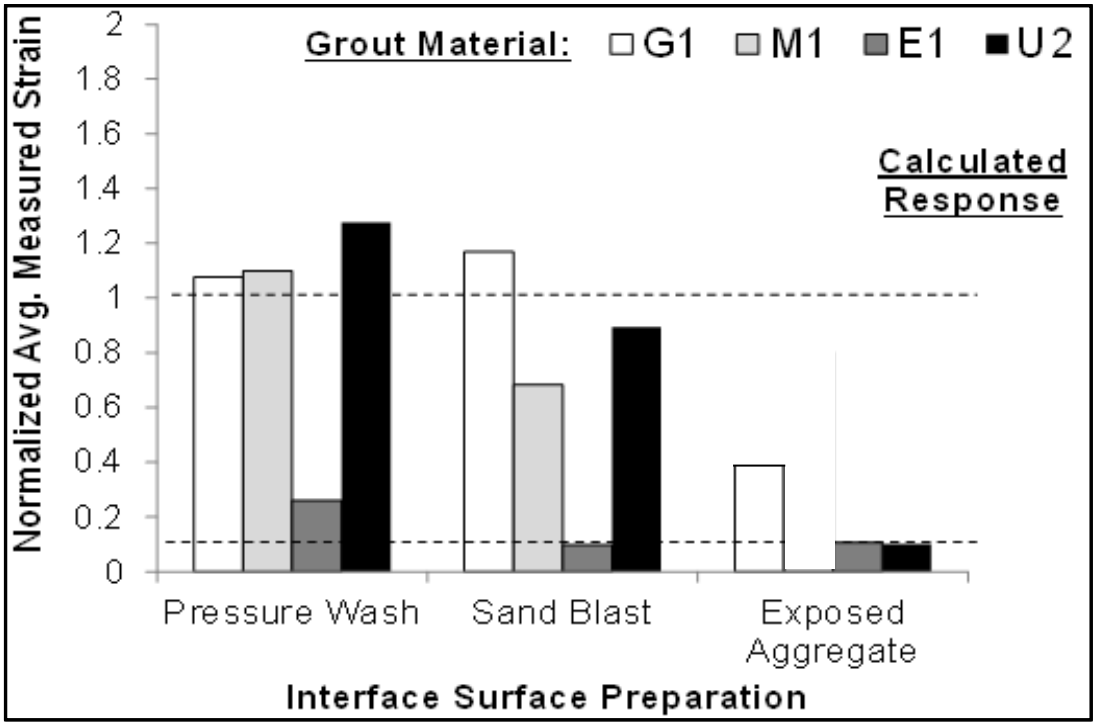
[1] Exposed Aggregate
(Form Retarder)

[2] Clean Joint

[3] Pre-wet joint
(in front of pour)

[4] No differential movement in joint

[5] Pressure Head



70 Panel Tests

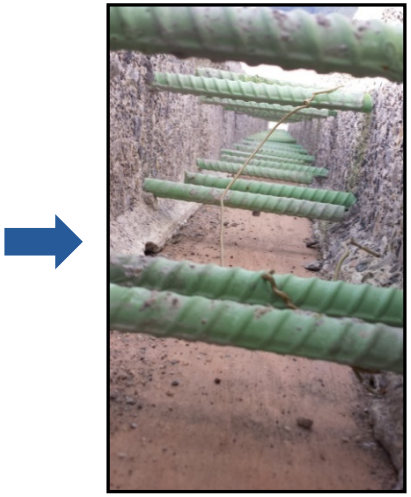
-Cyclic: 50k at .3 – 1.2M_{cr}

-Fatigue: 2M at .1M_{cr} – $M_{.37fy}$

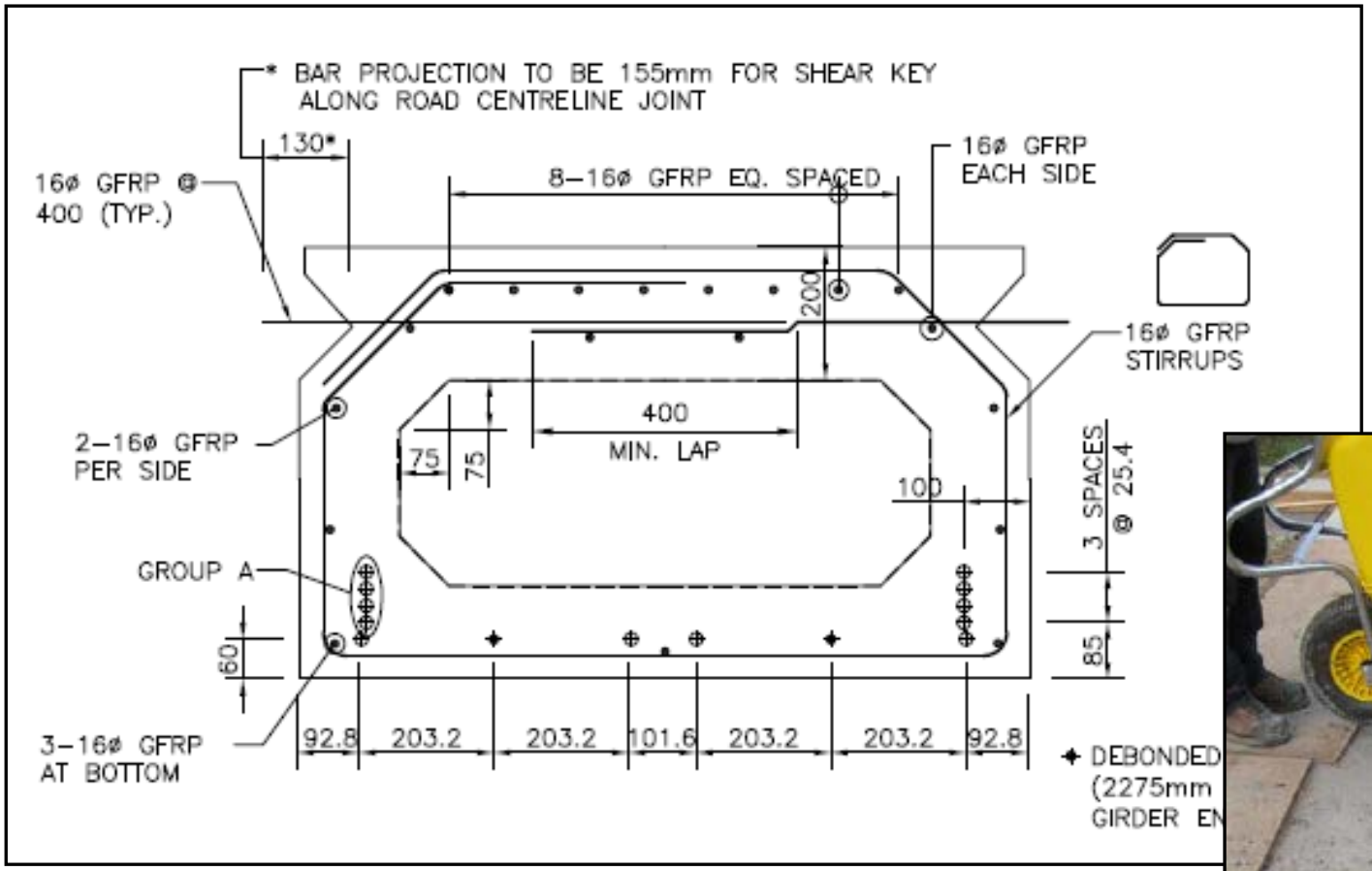
-Ultimate Load:

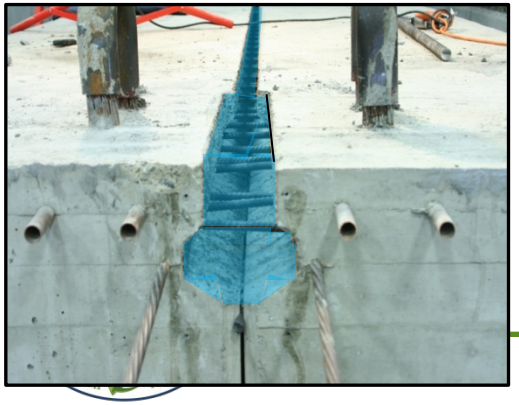
Connection Evolution!

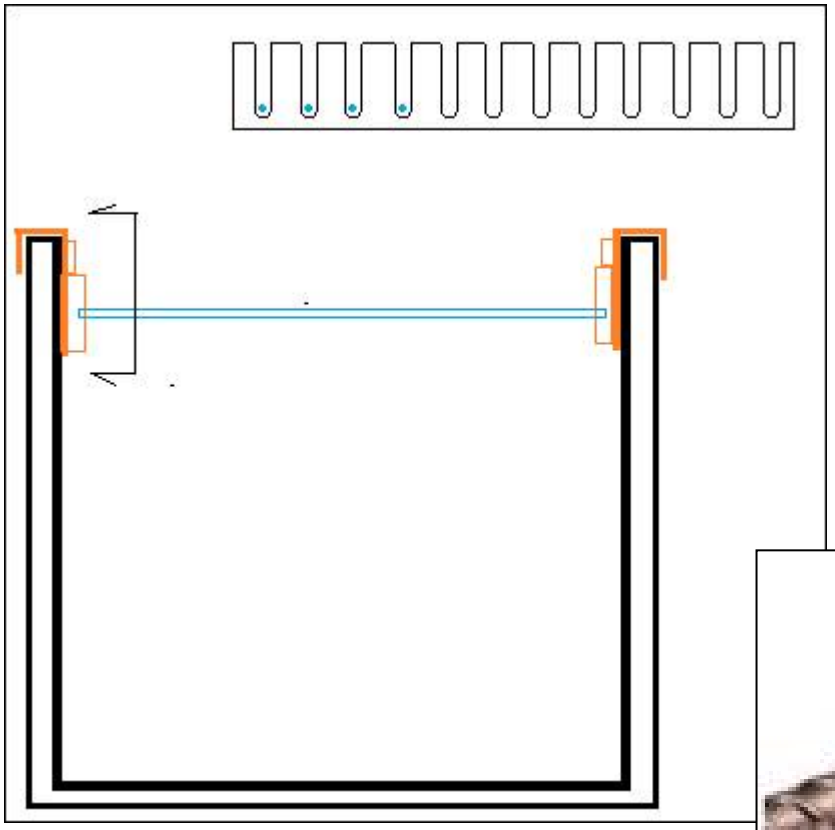
Conventional Concrete



UHPC


* BAR PROJECTION TO BE 155mm FOR SHEAR KEY
ALONG ROAD CENTRELINE JOINT
130*
16ø GFRP @
400 (TYP.)
8–16ø GFRP EQ. SPACED
16ø GFRP
EACH SIDE
200
16ø GFRP
STIRRUPS
2–16ø GFRP
PER SIDE
400
MIN. LAP
75
75
100
3 SPACES
@ 25.4
GROUP A
60
85
3–16ø GFRP
AT BOTTOM
92.8
203.2
203.2
101.6
203.2
203.2
92.8
✦ DEBONDED
(2275mm
GIRDER EN





ABC and PBES

EDC 1

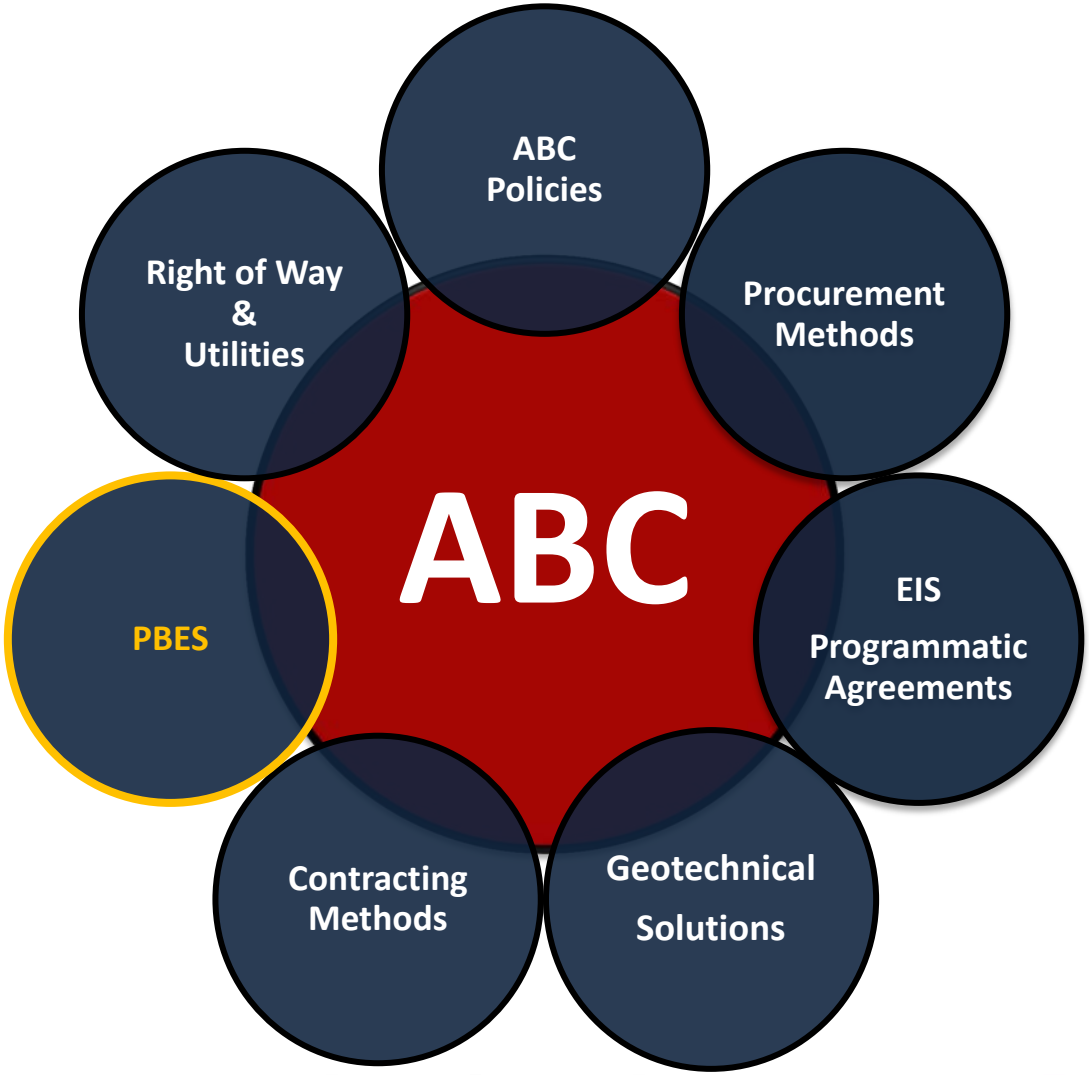
2011-2012

EDC 2

2013-2014

EDC 3

2015-2016



AASHTO
THE VOICE OF TRANSPORTATION
SUBCOMMITTEE ON BRIDGES AND STRUCTURES

2014 AASHTO HSCOBS Strategic Plan

Program Objective No. 5 of 8:

Accelerated Bridge Delivery and Construction

PBES

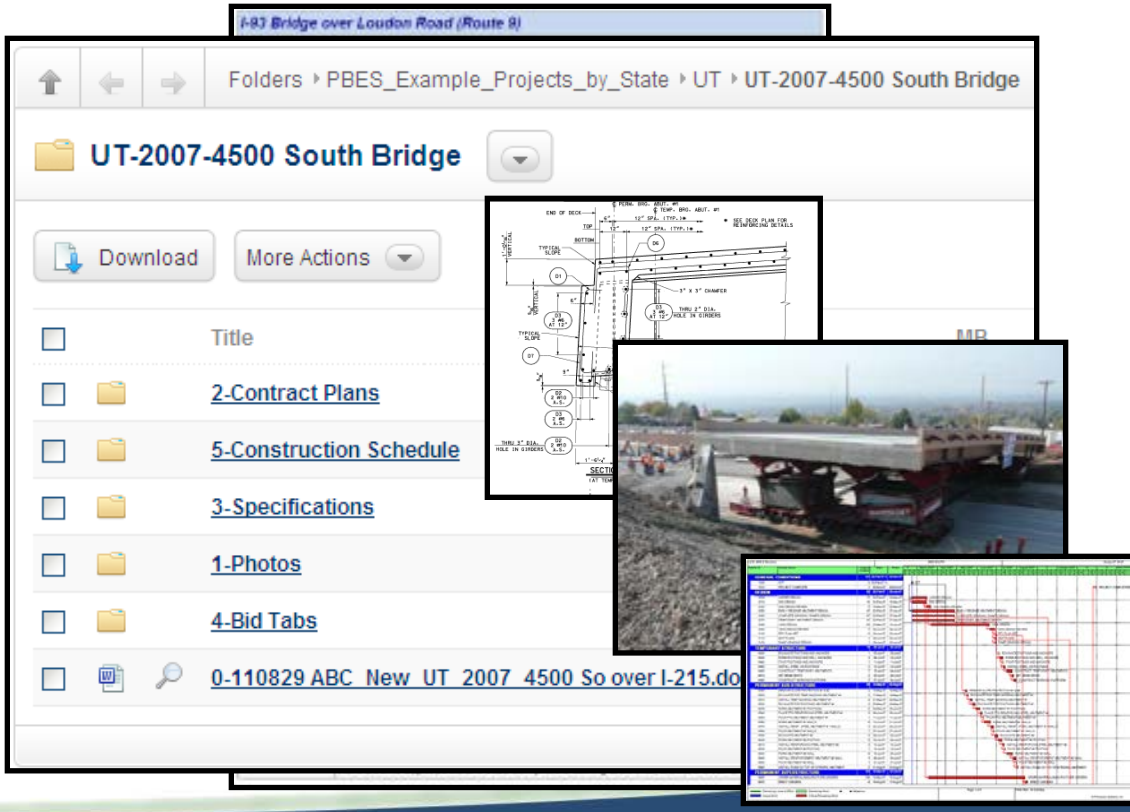
Elements

Systems

AASHTO
THE VOICE OF TRANSPORTATION
SUBCOMMITTEE ON BRIDGES AND STRUCTURES

Project Examples use PBES/ABC

- Contract Plans
- Specifications
- Bid Tabs
- Schedule
- Pictures



AASHTO
THE VOICE OF TRANSPORTATION
SUBCOMMITTEE ON BRIDGES AND STRUCTURES

Project Examples use PBES/ABC

- Contract Plans
- Specifications
- Bid Tabs
- Schedule
- Pictures

ABC UTC

List all projects

Search

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TRB Subcommittee for ABC AFF10(3)

www.trbaff103.com

WELCOME | ANNUAL MEETINGS | REGISTRATION | MEMBERS | RESEARCH PROJECTS | RTI | VIDEO OF THE YEAR | ABC-UTC | NEWS/EVENTS

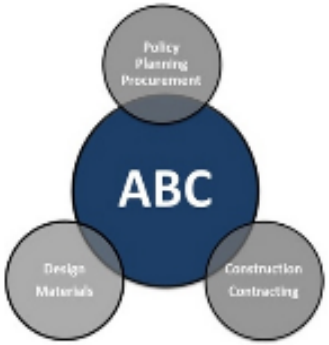
TRB
Committee on General Structures (AFF10)
Subcommittee on Accelerated Bridge Construction (AFF10-3)

Approximately one-fourth of the Nation's 600,000 bridges require rehabilitation, repair, or total replacement. The construction-related work used to address these needs can create significant impacts to the surrounding area including mobility, safety, and other social-economic related impacts. Throughout the U.S., owner agencies are realizing that the results of using ABC strategies not only helps to address onsite related constraints, but can also improve how a bridge program is delivered when used in a more routine, programmatic manner.

Scope: The TRB Accelerated Bridge Construction (ABC) Subcommittee supports research, technology transfer, and implementation to advance ABC technologies related to policy, planning, procurement, design, materials, construction and contracting. The **objective** of the subcommittee is to expand the knowledge and expertise to foster the implementation of ABC related technologies.

Road Map:
The Subcommittee will...

1. Stay informed on the current state of practice/art.
2. Identify, prioritize and prepare research needs statements.
3. Collaborate with State DOTs, FHWA, and AASHTO groups.
4. Support research projects in the areas of ABC.
5. Support technology transfer and implementation of research projects through workshops, paper, and poster sessions.



On behalf of TRB, we welcome you to join and participate with the members of this subcommittee.

- **12-98**: Guidelines for PBES Tolerances and Dynamic Effects of Bridge Moves
- **12-102**: Development of an ABC Design and Construction Specification
- **12-105**: System Performance of ABC Connection in Moderate-to-High Seismic Regions

Monthly ABC Webinar

ABC Risk

A Contractor's Perspective

Walter Eggers

Tom Mousel

Paul Giroux

Kiewit

March 17, 2015

1:00 – 2:00 EST

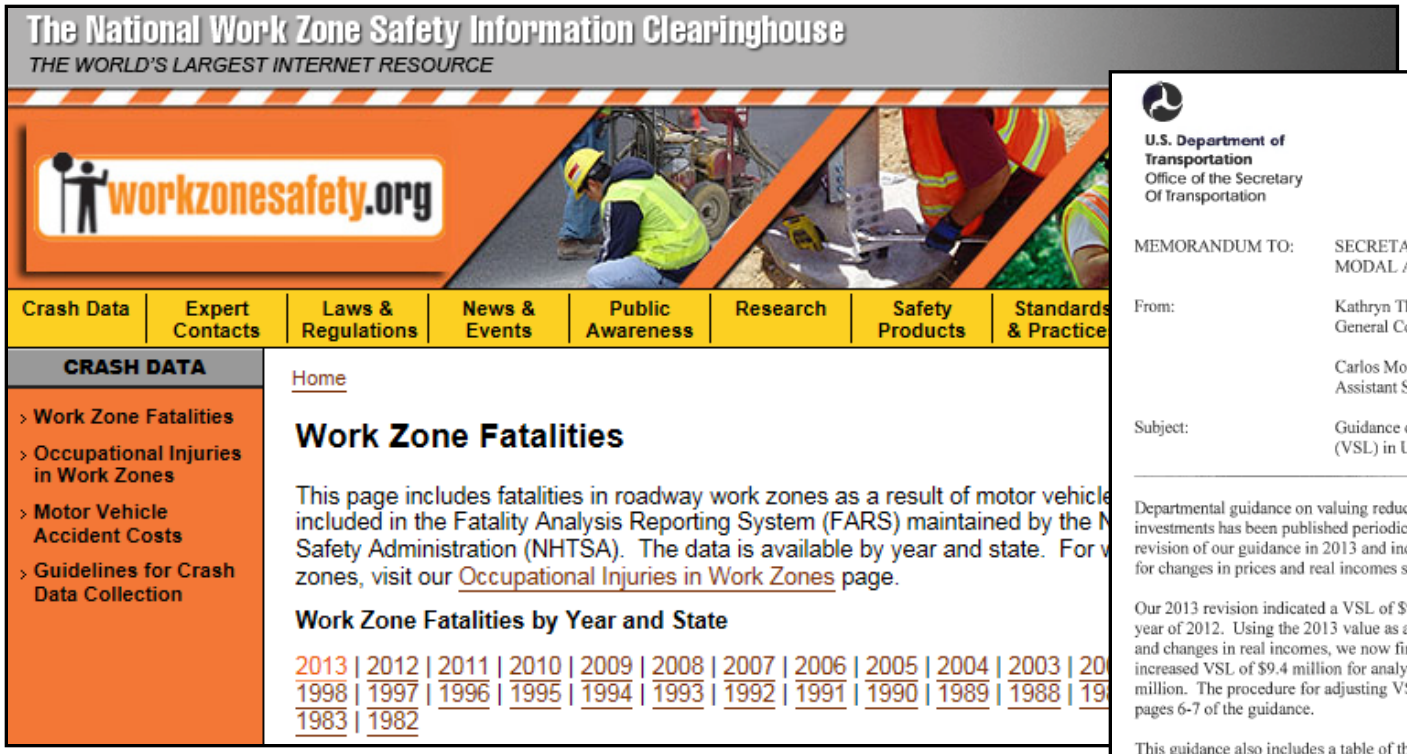
No. 61

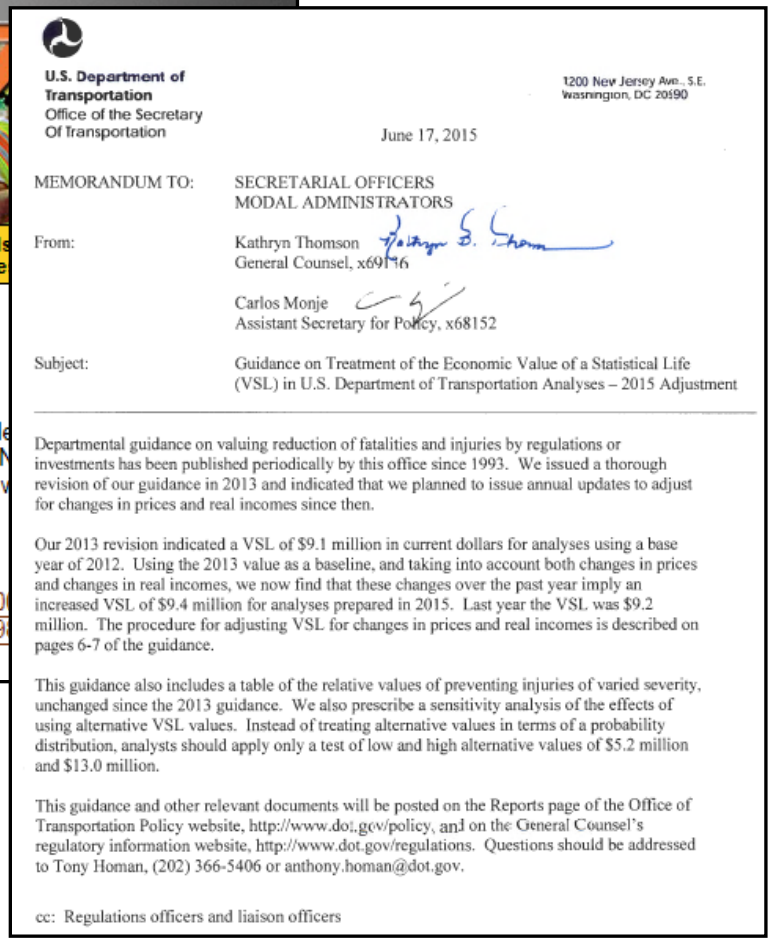
Quantifying Safety from an ABC Perspective

Work Zone Fatalities

+

Value of a Statistical Life





U.S. Department of Transportation
Office of the Secretary Of Transportation

1200 New Jersey Ave., S.E.
Washington, DC 20590

June 17, 2015

MEMORANDUM TO: SECRETARIAL OFFICERS
MODAL ADMINISTRATORS

From: Kathryn Thomson
General Counsel, x69146

Carlos Monje
Assistant Secretary for Policy, x68152

Subject: Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in U.S. Department of Transportation Analyses – 2015 Adjustment

Departmental guidance on valuing reduction of fatalities and injuries by regulations or investments has been published periodically by this office since 1993. We issued a thorough revision of our guidance in 2013 and indicated that we planned to issue annual updates to adjust for changes in prices and real incomes since then.

Our 2013 revision indicated a VSL of $9.1 million in current dollars for analyses using a base year of 2012. Using the 2013 value as a baseline, and taking into account both changes in prices and changes in real incomes, we now find that these changes over the past year imply an increased VSL of $9.4 million for analyses prepared in 2015. Last year the VSL was $9.2 million. The procedure for adjusting VSL for changes in prices and real incomes is described on pages 6-7 of the guidance.

This guidance also includes a table of the relative values of preventing injuries of varied severity, unchanged since the 2013 guidance. We also prescribe a sensitivity analysis of the effects of using alternative VSL values. Instead of treating alternative values in terms of a probability distribution, analysts should apply only a test of low and high alternative values of $5.2 million and $13.0 million.

This guidance and other relevant documents will be posted on the Reports page of the Office of Transportation Policy website, http://www.dot.gov/policy, and on the General Counsel's regulatory information website, http://www.dot.gov/regulations. Questions should be addressed to Tony Homan, (202) 366-5406 or anthony.homan@dot.gov.

cc: Regulations officers and liaison officers

Economic Value of a Statistical Life (VSL)

The additional cost that individuals would be willing to bear for improvements in safety that, in aggregate, reduce the number of expected fatalities by one.

It's

the economic benefit gained from preventing a fatality

It's not

the value of a life

Economic Value of a Statistical Life (VSL)

Per Executive Orders 12866 & 12893, OMB Circular A-4, and DOT Order 2100.5….

Evaluate, in monetary terms, the cost and benefits of regulatory investments and administrative actions in order to demonstrate the faithful execution of their responsibilities to the public.

Value of Safety

Virginia		
Work zone Crashes	Injuries	Fatality
4,068	1,857	15

Fatality VSL				
	LEAP			Min. VSL
Fatality rate/month	1 % Fatality rate/month	9 months conventional	3 weeks ABC	$5.2M
1.25	0.0125	0.1125	0.00938	**$536,250**

VDOT

VIRGINIA Give 'em a BRAKE HIGHWAY WORKERS

Value of Safety

~92% Safety Improvement

Virginia		
Work zone Crashes	**Injuries**	**Fatality**
4,068	1,857	15

Disutility Factors			
Minor	0.003	0.025	**$1,659,694**
Moderate	0.047		
Serious	0.105		
Severe	0.266		
Critical	0.593		
Fatal	1		

$54k+ $1.66m
*~**$2.2M/year***

- ***Non fatal accidents/Injury***
- ***Property damage***
- ***On-site worker injury/reportables***

VDOT

VIRGINIA Give 'em a BRAKE HIGHWAY WORKERS

The U.S. is the global leader in ABC!
No other country has completed more ABC projects in terms of
Volume
Complexity
Effectiveness

Thank You!

FHWA

Benjamin Beerman, P.E.