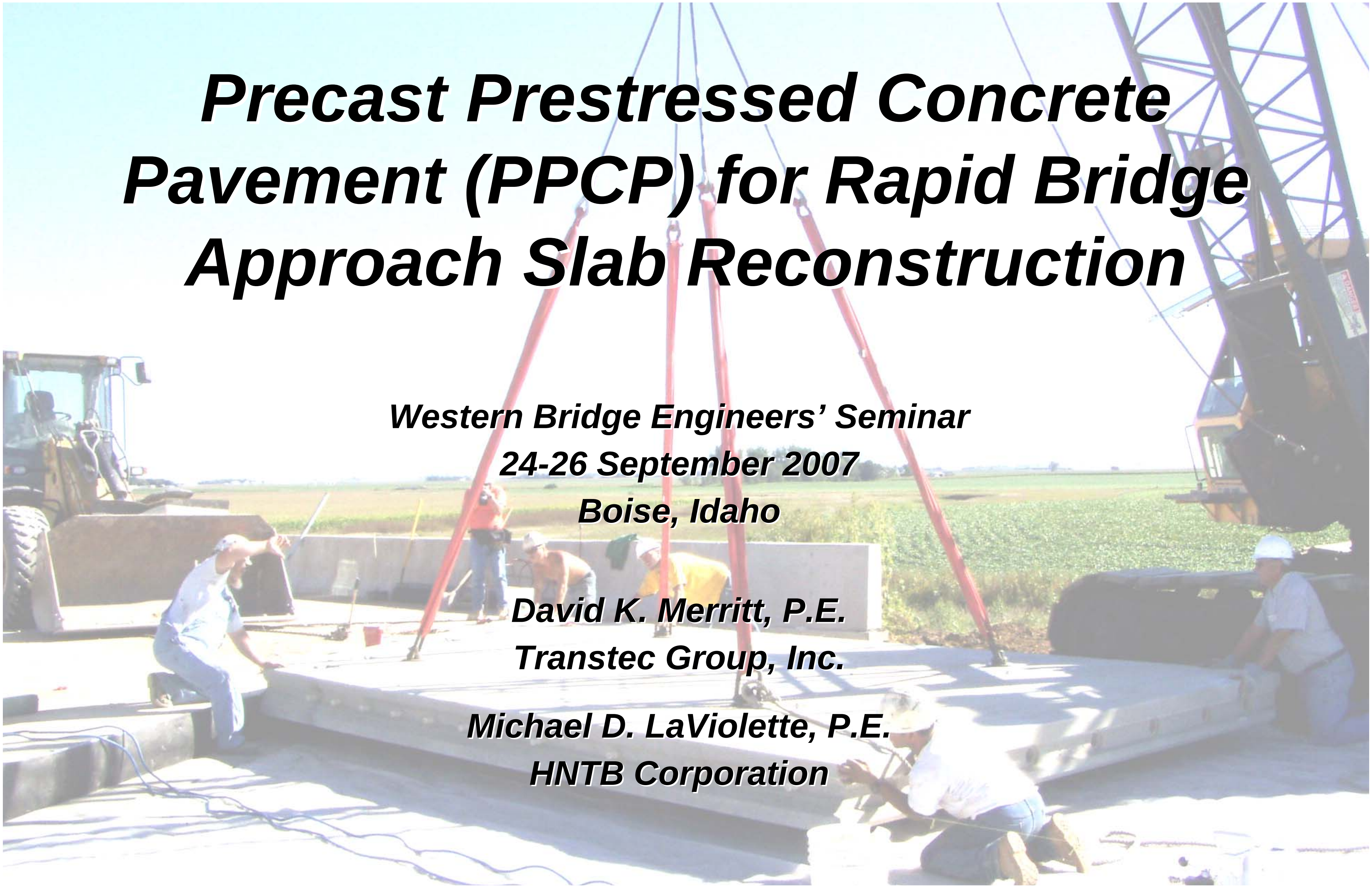
Precast Prestressed Concrete Pavement (PPCP) for Rapid Bridge Approach Slab Reconstruction



Western Bridge Engineers' Seminar
24-26 September 2007
Boise, Idaho

David K. Merritt, P.E.
Transtec Group, Inc.

Michael D. LaViolette, P.E.
HNTB Corporation

U.S. Department of Transportation
Federal Highway Administration

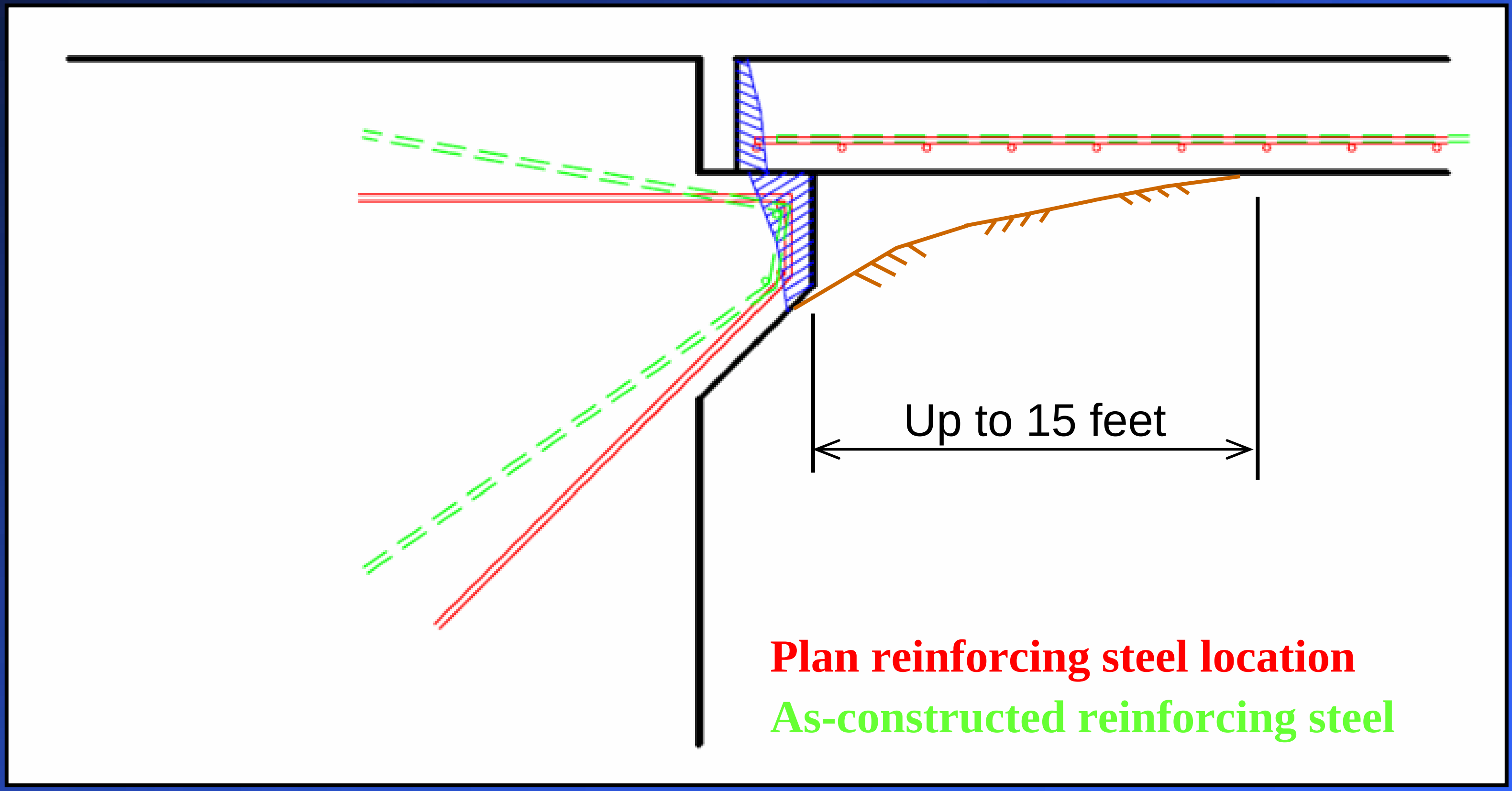
Iowa Department of Transportation

Precast Pavement

www.PrecastPavement.com

Bridge Approach Settlement Problems

Causes of Approach Settlement

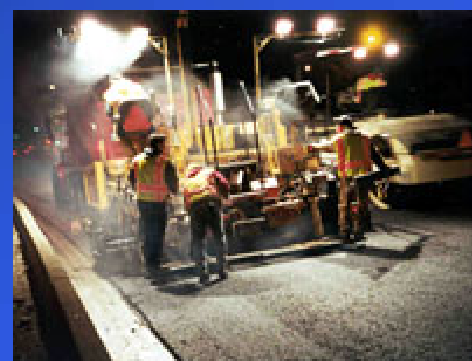


Conventional repair

Why Precast Concrete?

- How do you replace failed approach slabs under traffic?
- Night or Weekend construction?






Why Precast Concrete?

- Expedited construction technique for the commercial building and bridge industries
- Durable, High-Performance solution




Benefits

- Rapid Construction/Opening to Traffic
  - Overnight or Weekend “invisible” construction
  - Reduced User Delays/Delay Costs
  - Improved Safety for Drivers and Workers
- Controlled Fabrication Conditions
  - Improved Durability and Performance (consistent mix, adequate curing, adequate air entrainment, etc.)
- Extended Construction Season
- Construction in Remote Areas

Benefits

- *Why Prestressed Concrete?*
  - Reduces/eliminates slab cracking
  - Reduced Slab Thickness (8” vs. 12”)
  - Ability to span voids/unsound support layers

Benefits

◆ *Why Prestressed Concrete for approach slabs?*

- Ability to span voids/unsound support layers

- Move expansion joint further away from abutment

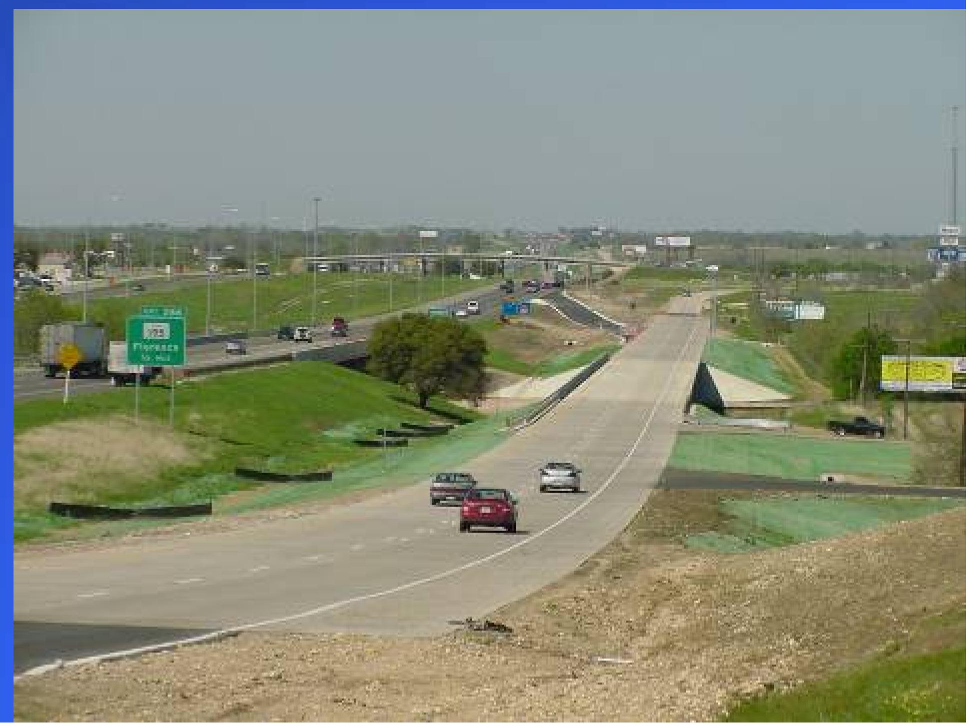
Key Features of PPCP

- Full-depth precast panels
- Keyed panel joints
  - Vertical alignment during assembly
- 2-way prestressing
  - Combination of pretensioning/post-tensioning
  - 2-way post-tensioning
- Bonded P-T System
  - Future removal of precast panels

FHWA Demonstration Projects

- 2000-present: FHWA Support of Precast Prestressed Concrete Pavement (PPCP) Demonstration Projects for state DOTs
- 2005: Iowa DOT and FHWA discuss potential applications for PPCP
  - Bridge approach slabs identified

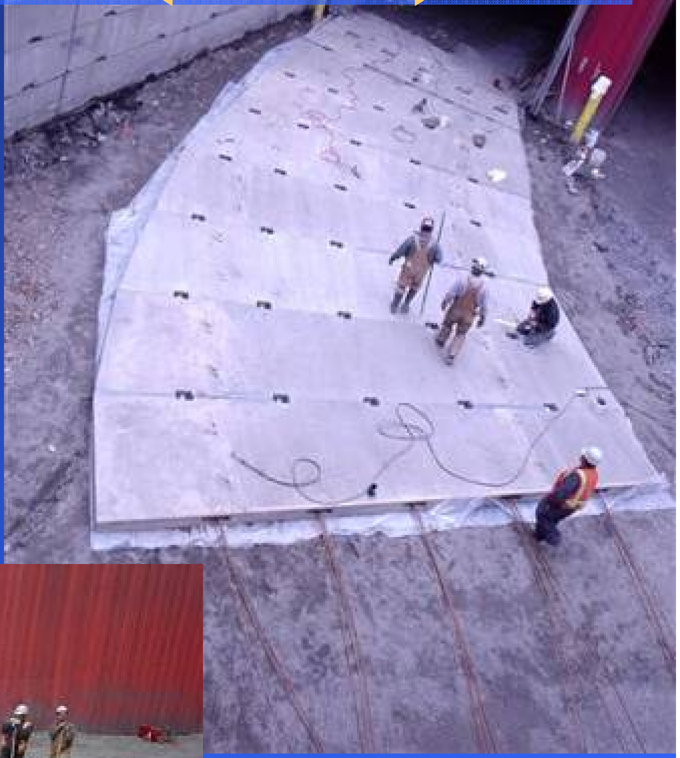
Texas Demonstration Project (2002)



California Demonstration Project (2004)

Missouri Demonstration Project (2005)

Red Dog Mine, Alaska (2002)



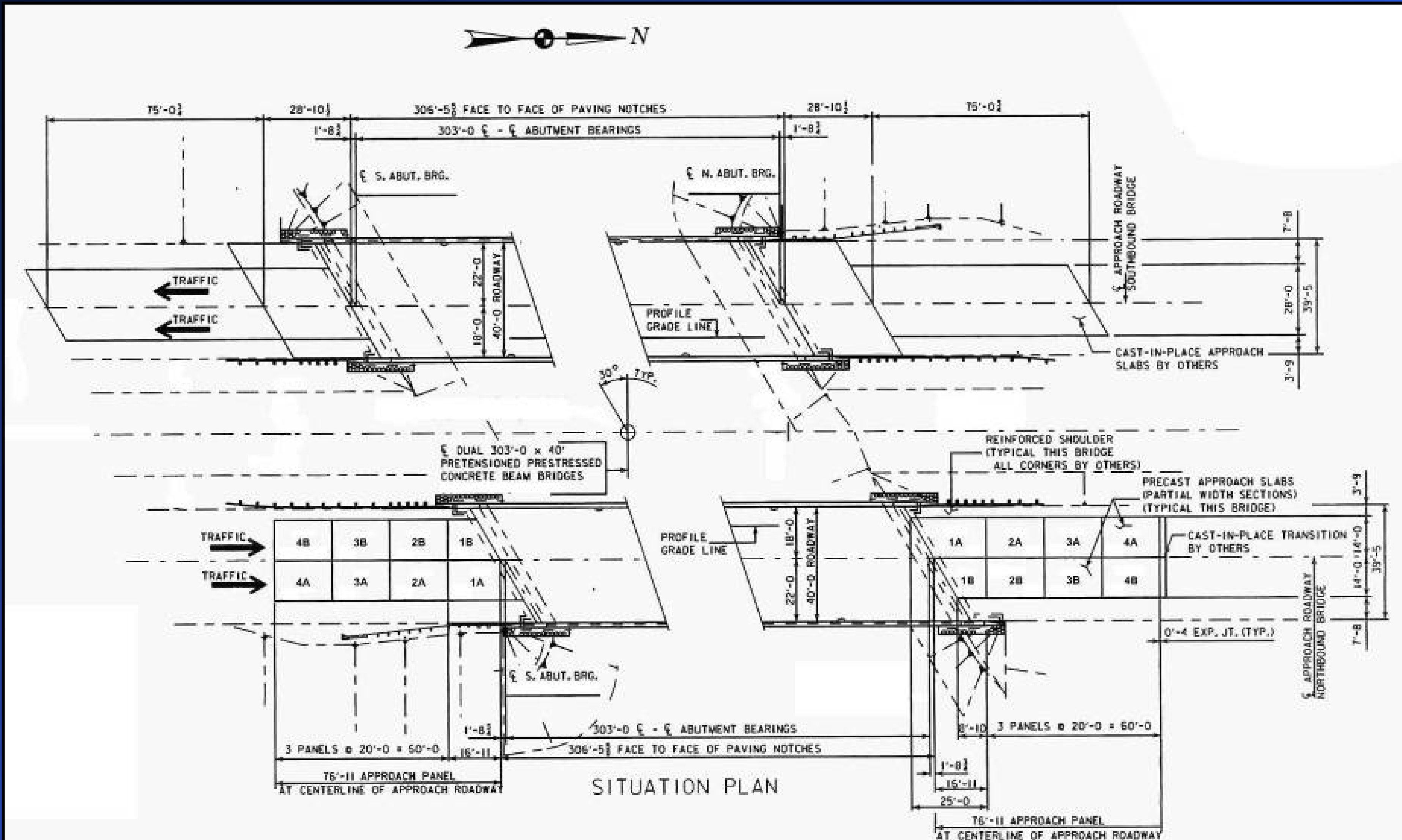
Iowa Demonstration Project

- Constructed Aug./Sept. 2006
- Precast Prestressed Bridge Approach Slabs
  - ~77 ft at either end of a skewed bridge
  - Tied to integral bridge abutment
- 2-way Post-Tensioning
- Partial-width panels (lane-by-lane construction)
- Installed over crushed aggregate base graded to crown
- Panels: 14 ft x 20 ft x 12 in.

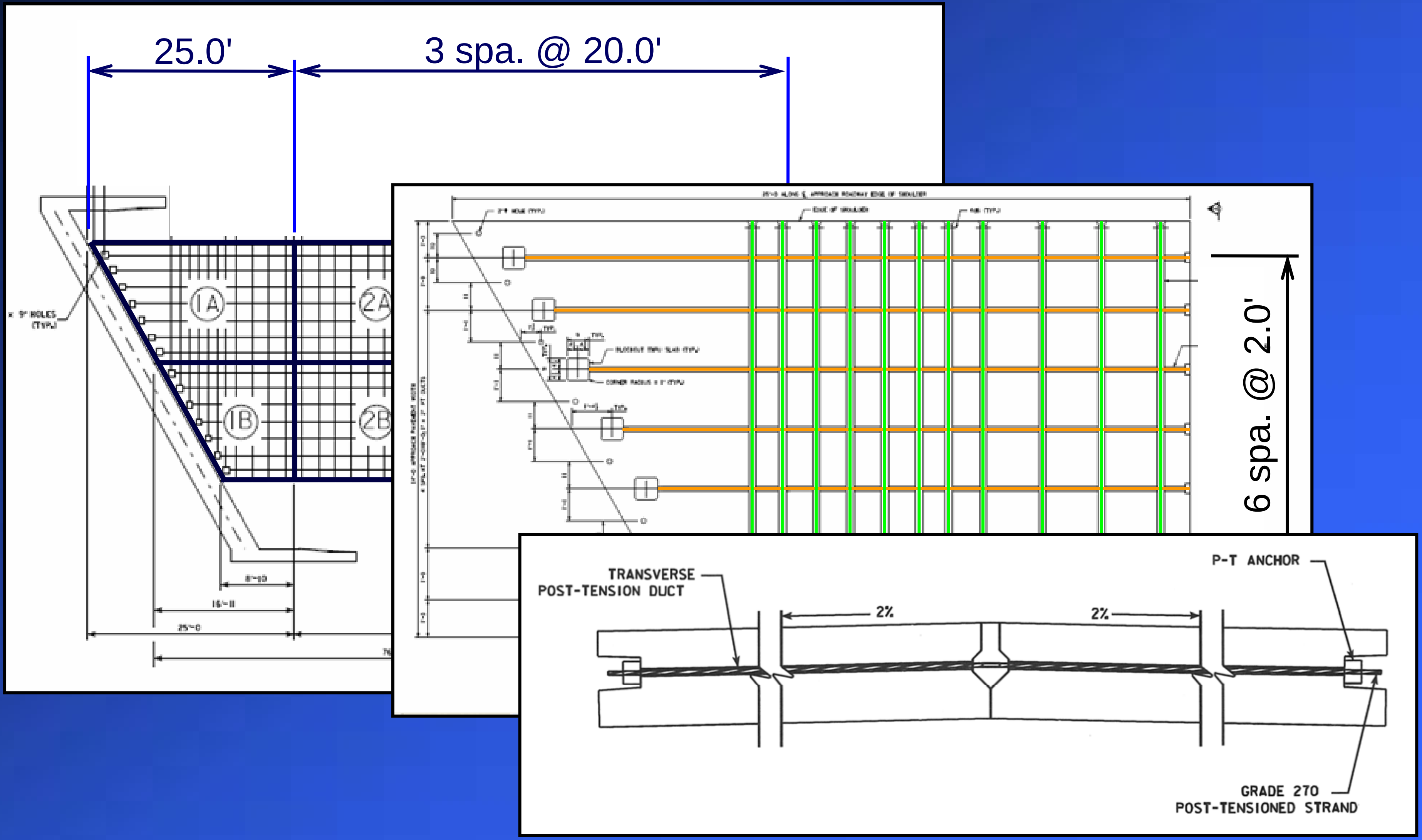
Selected Iowa project

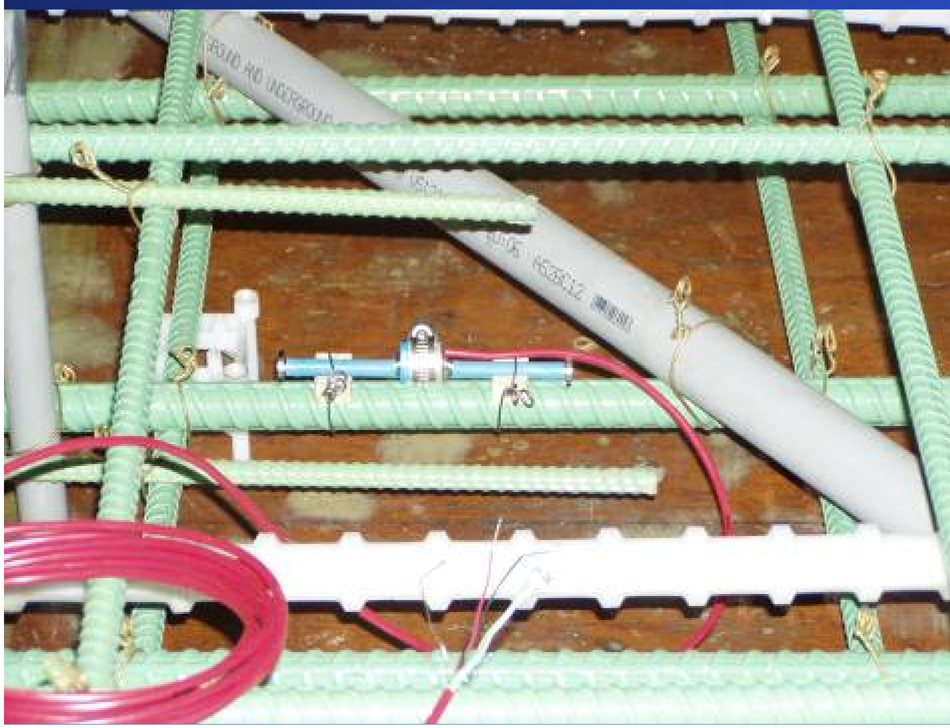
- Project Location:
  - IA Highway 60 over Floyd River (O'Brien County)
- Dual bridges
  - 30° skew
  - Integral Abutments
  - Northbound - PPCP
  - Southbound – CIP
  - Tied to abutment

Bridge Situation Plan



Precast Approach Slab Layout




GROUND AND UNDERGROUND












Future Projects

- Iowa DOT – approach slab reconstruction under traffic
  - Single precast panel
  - P-T approach slab to abutment
- FHWA is currently providing support to state DOTs interested in constructing a demonstration project.
  - Bridge approach slabs
  - WIM Installations
  - Unbonded Overlays
  - Others?

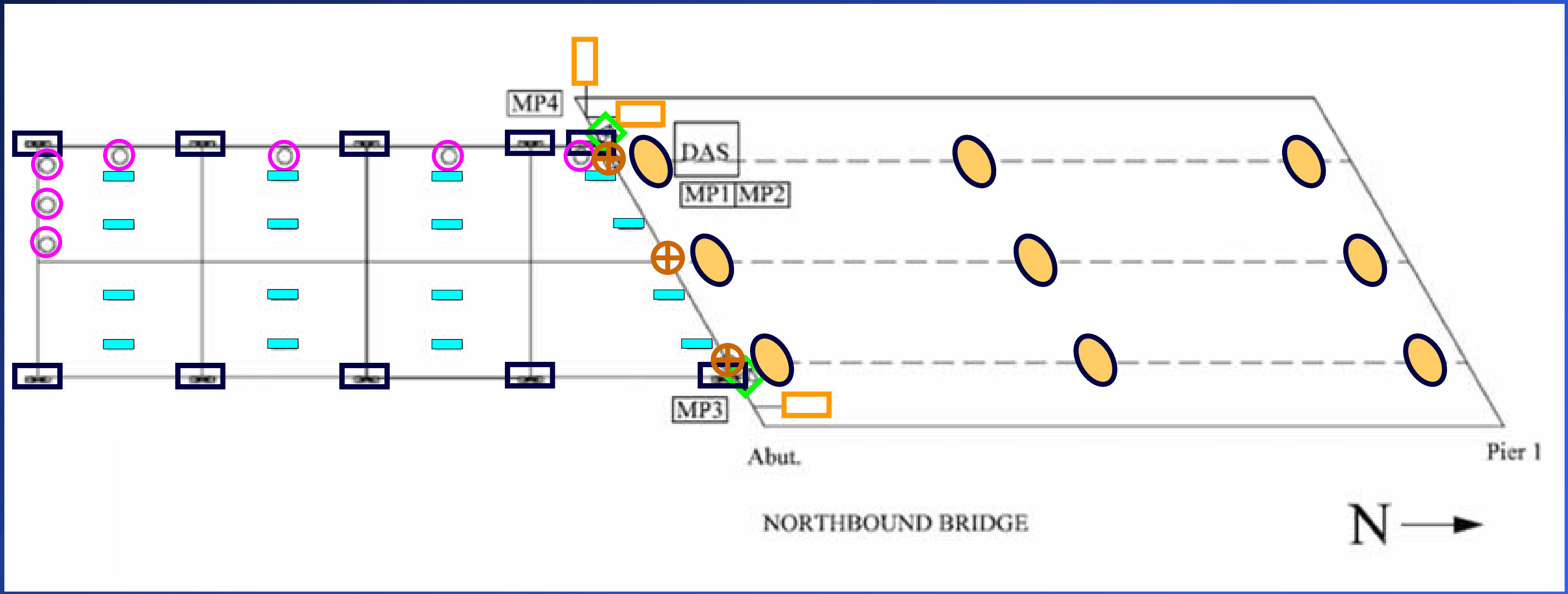
Goals of Instrumentation Program

Iowa State University

Bridge Engineering Center

- Verify structural performance of PPCP as bridge approach pavement
  - Joint openings
  - Bridge movements
  - Girder flexural behavior
  - Pile axial/flexural behavior
- Provide useful comparison with adjacent CIP bridge approach pavement

Instrumentation Plan
NB Bridge

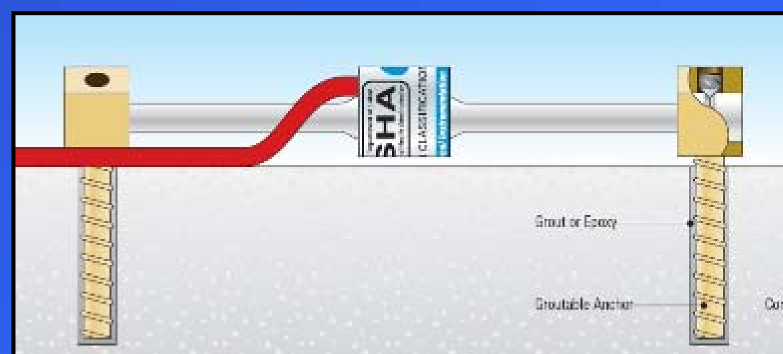


- Joint movement crackmeters (10)
- PT strandmeters (7)
- Embedded strain sensors (16)
- Displacement transducers (3)
- Tiltmeters (2)
- Girder strain sensors (18)
- Pile strain sensors (12)

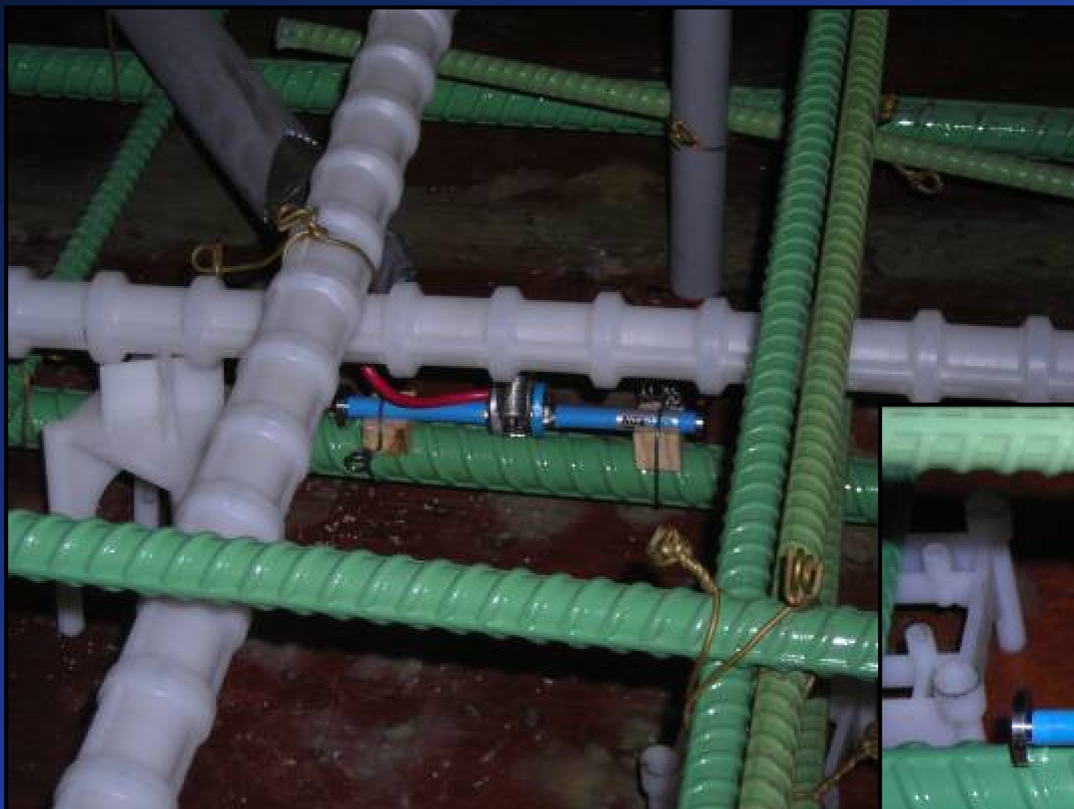
Installation of pile strain sensors

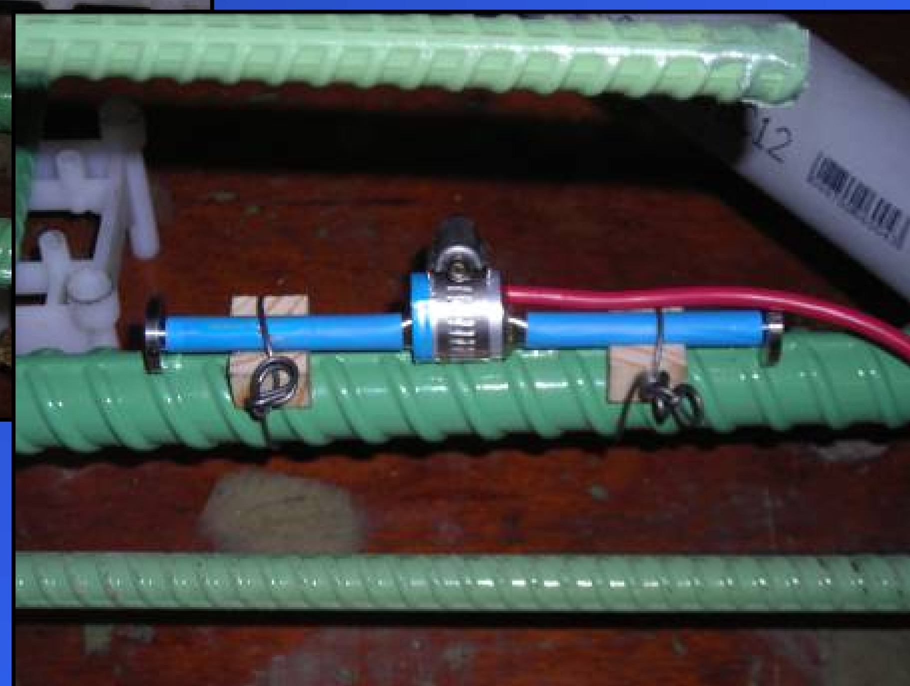
Installation of pile strain sensors

Surface-mounted strain sensors



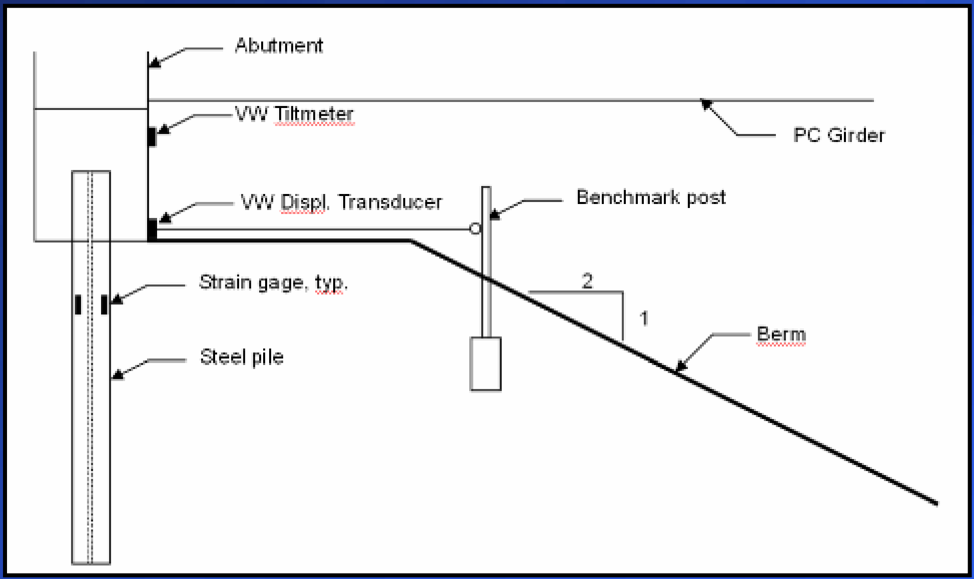
Embedded strain sensors - panels





Displacement transducers

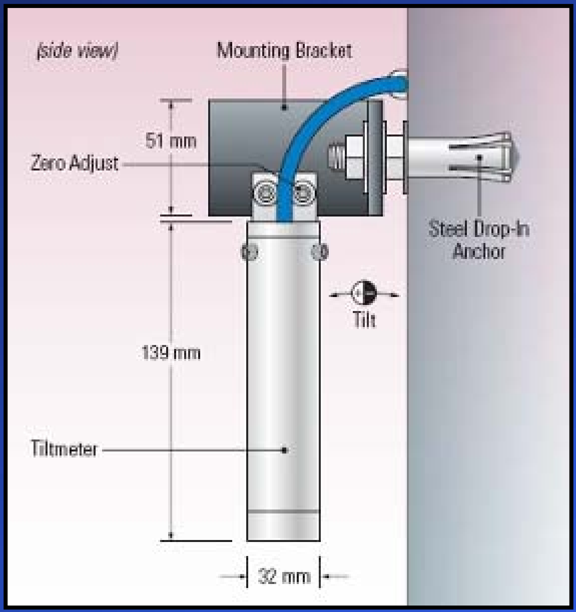
- Geokon Model 4427
- Measure longitudinal and transverse movement of bridge abutment
- Skewed abutment – bridge "rotates" in plan view



Displacement transducers installation

Tiltmeters

- Geokon Model 6350
- Measure longitudinal rotation of abutment due to thermal movements of bridge



P-T Strandmeters

- Geokon Model 4410
- Used to monitor long-term PT losses


Crackmeters

- Geokon Model 4420
- Monitors joint openings between panels
- Blockouts cast in each panel

Crackmeter installation

Data acquisition system

- Total of 113 sensors (both bridges)
- 7 multiplexers to simplify onsite wiring
- Collect data once/hour for approx. 16 months