



## Illinois's First Precast Deck Panel Bridge with UHPC Joints

David Liu, PhD, SE, PE, TranSystem  
Jayme Schiff, SE, PE, IL DOT

MIDAS ELITE Webinar  
October 5, 2016

# OUTLINE

► Precast Deck Panels

► 3 Approaches for Continuity

► UHPC and UHPC Joints

► Peoria Street Bridge (Circle Interchange)



# NYSDOT PROJECT



# NYSDOT PROJECT





# PANEL-TO-PANEL CONNECTION





# RIDING SURFACE





# FULL DEPTH PRECAST DECK PANEL

- Most Popular ABC (Accelerated Bridge Construction) System
- Speeds Up Construction
- Increases Quality of Concrete Members
- Increases Construction Safety
- User Convenience

# FULL DEPTH PRECAST DECK PANEL

► Precast Deck Panel in 1965

► IDOT – Precast Deck Panel in 2000 (used Post-Tensioning)

► Over 70 Projects in US - Precast Deck Panels



# WHAT ARE THE NEGATIVES?

■ Higher Construction Cost

■ Complexity of Design

■ Complexity of Construction

■ Joint Performance

# CONTINUITY AT PANEL JOINTS

▀ Internal Post-Tensioning

▀ AccelBridge system

▀ UHPC



# INTERNAL POST-TENSIONING

- Transverse Closure Pour – Abutments
- Longitudinal Closure Pour - Wider Bridge
- Cracking in Joint - PT Corrosion

# ACCELBRIDGE SYSTEM

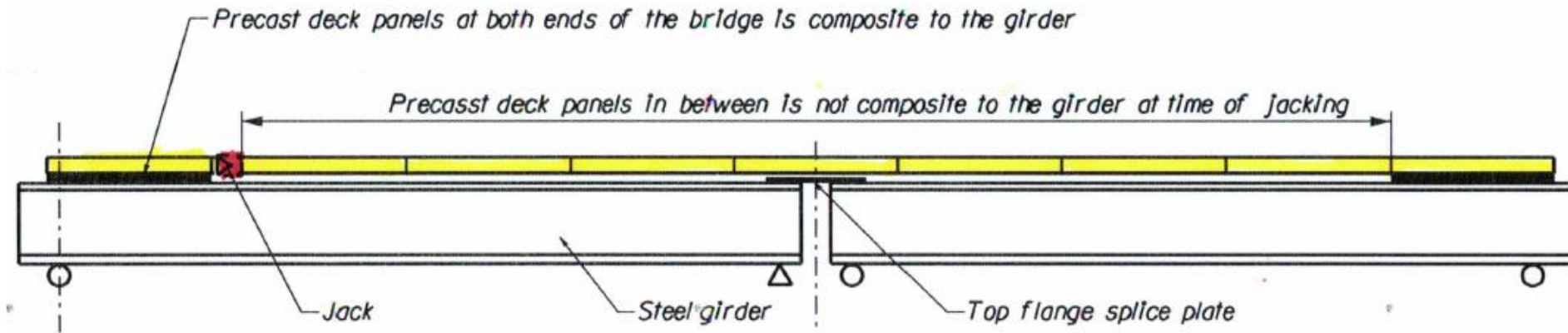
➤ Invented by Eddie He

➤ Jacking

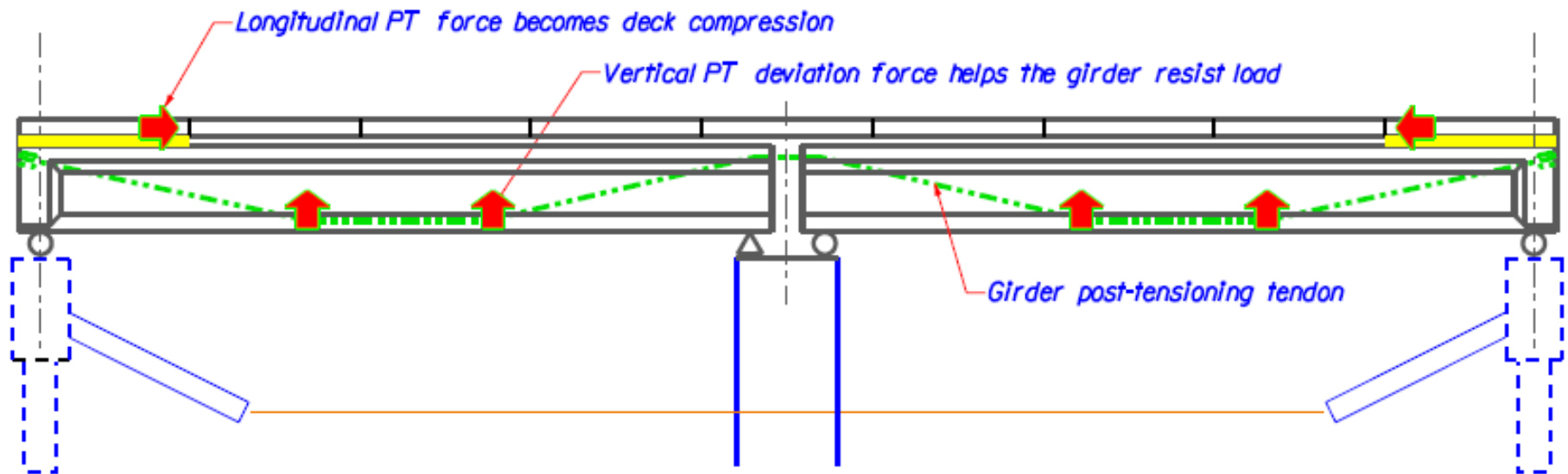
➤ External Post-Tensioning

➤ Louisiana

# ACCELBRIDGE SYSTEM JACKING



# ACCELBRIDGE SYSTEM EXTERNAL PT



*Step 4-I Install and stress girder post-tensioning*



# UHPC JOINTS

- No Post-Tensioning
- Less Construction Time
- Higher Ductility and Durability
- Higher Initial Unit Cost

- Research on UHPC – Early 1990
- 1st UHPC Bridge in Quebec – 1997
- Commercial Use in US – 2000
- PP UHPC Beam Bridge in Iowa – 2006
- Precast Deck Panel w/ UHPC Jt - 2009

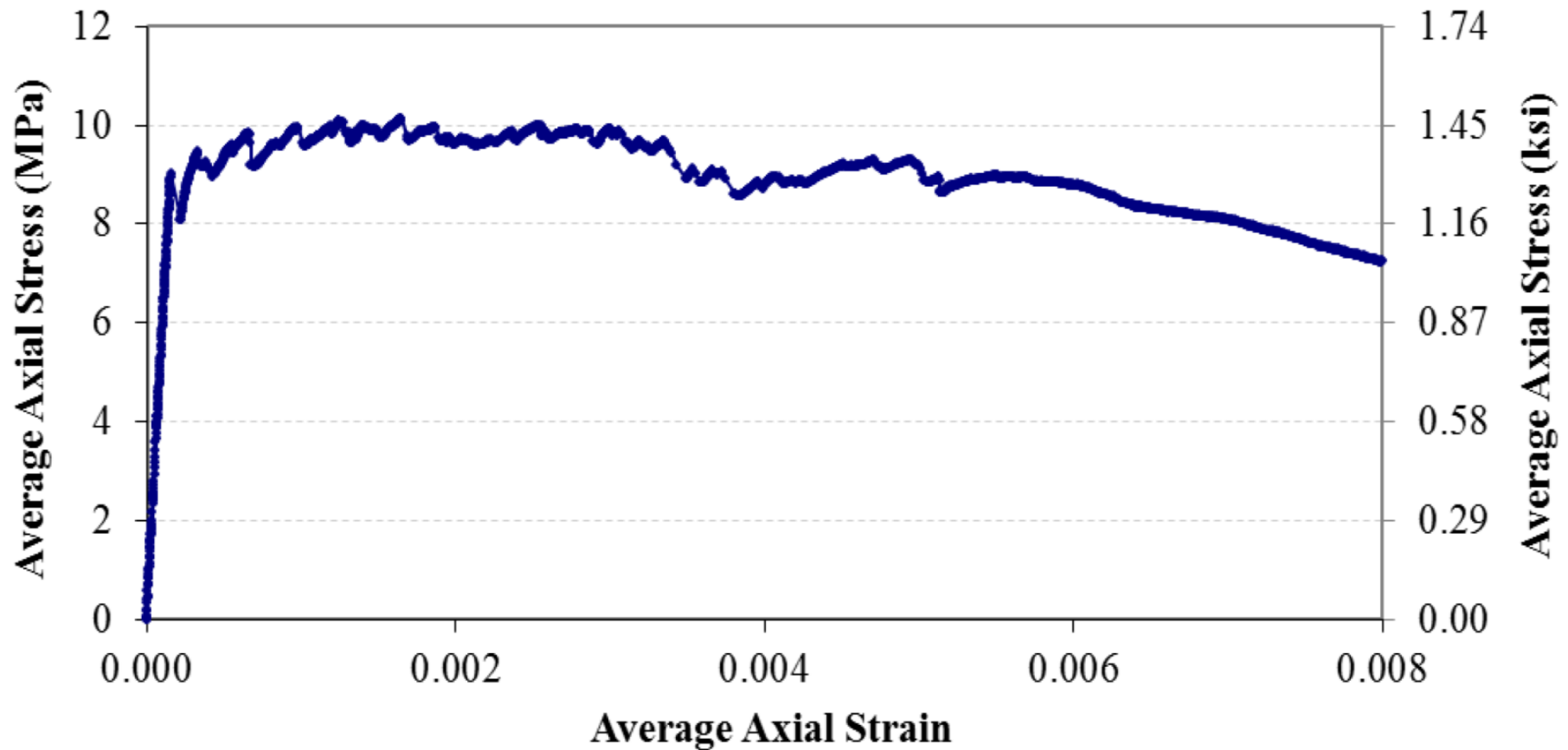
# UHPC MECHANICAL PROPERTIES

■ Cementitious Composite Material

■ 21 to 29 ksi - 28 Days

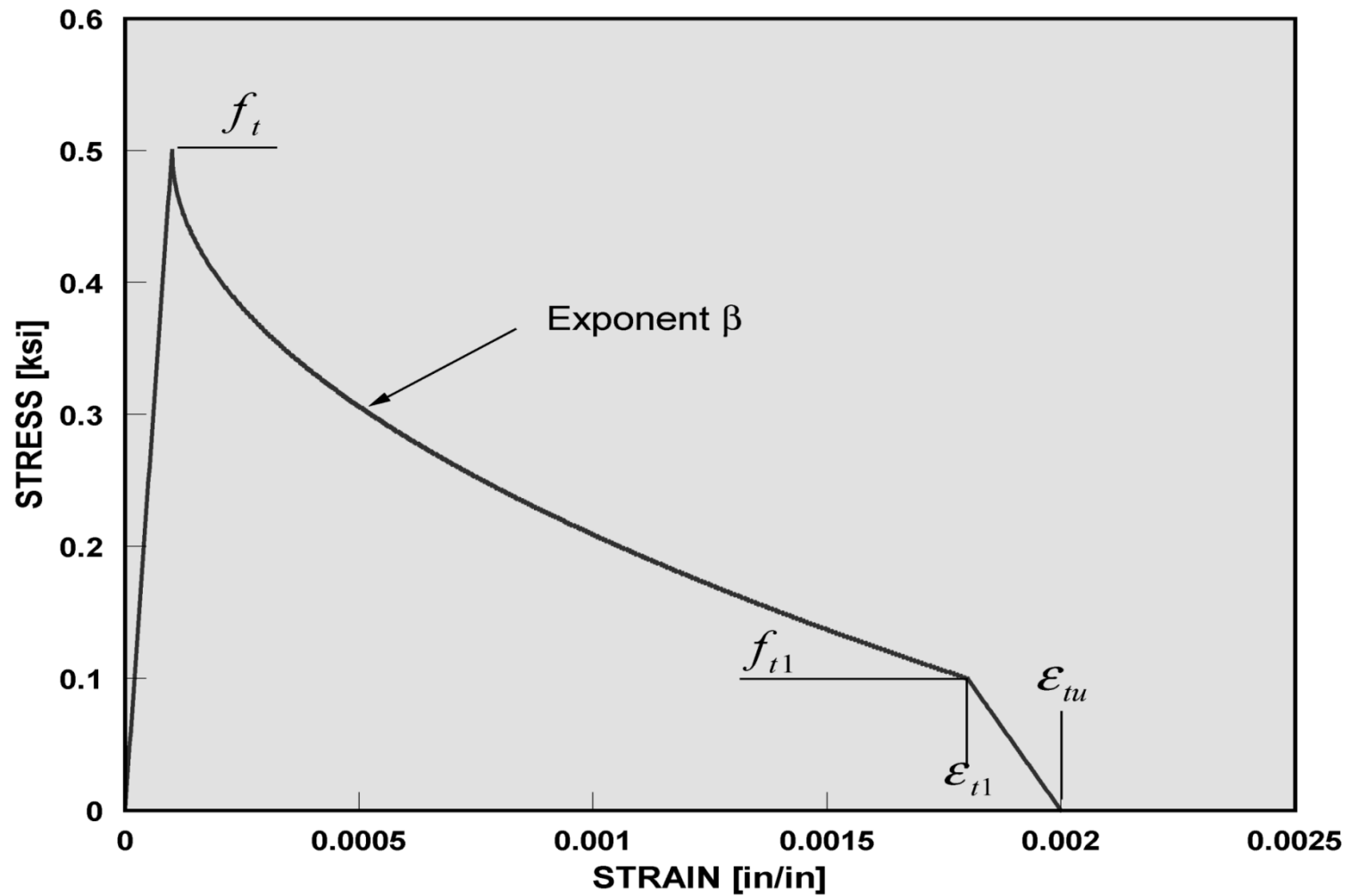
■ 12 ksi - 12 Hours

# TENSILE STRESS-STRAIN OF UHPC





# TENSILE STRESS-STRAIN - CONCRETE



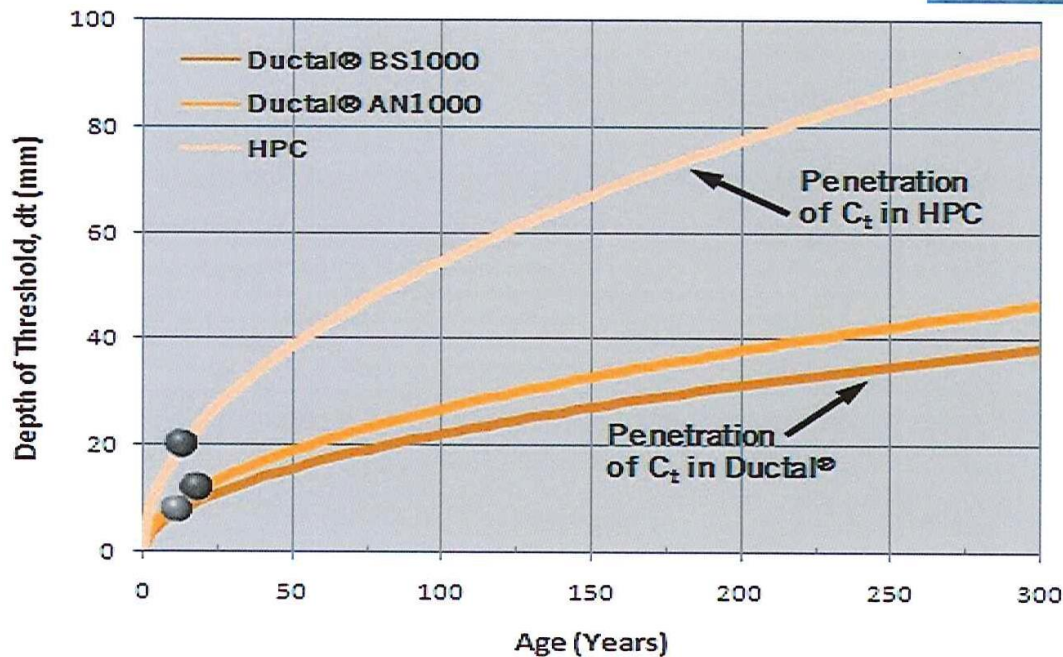
# Durability

## Impermeability & Longevity

US Army Corp, Exposure Site  
Treat Island, Maine



*August 14, 2002*



**EXPOSURE: 500**  
freeze/thaw cycles and  
4500 wet/dry cycles in  
saturated sea water

# PEORIA STREET BRIDGE

## Illinois's First Precast Deck Panel Bridge with UHPC Joints





- Cross Road Bridges

- Flyover Ramps

- Other Bridges

Morgan Street



Peoria Street

Halsted Street

Harrison Street

Van Buren Street

Jackson Blvd.

Adams Street

Monroe Street

Taylor Street





# **\$450 MILLION CIRCLE INTERCHANGE**

■ 22 Existing Bridges

■ 18 New Bridges

■ 7 Curved Steel Girder Bridges,  $R=220'$

■ 49 Retaining Walls

# CIRCLE INTERCHANGE

■ Galvanized Steel Plate Girder

■ Metalized Steel Plate Girder

■ Drilled Shaft / Micropile

**BEFORE**





**AFTER**

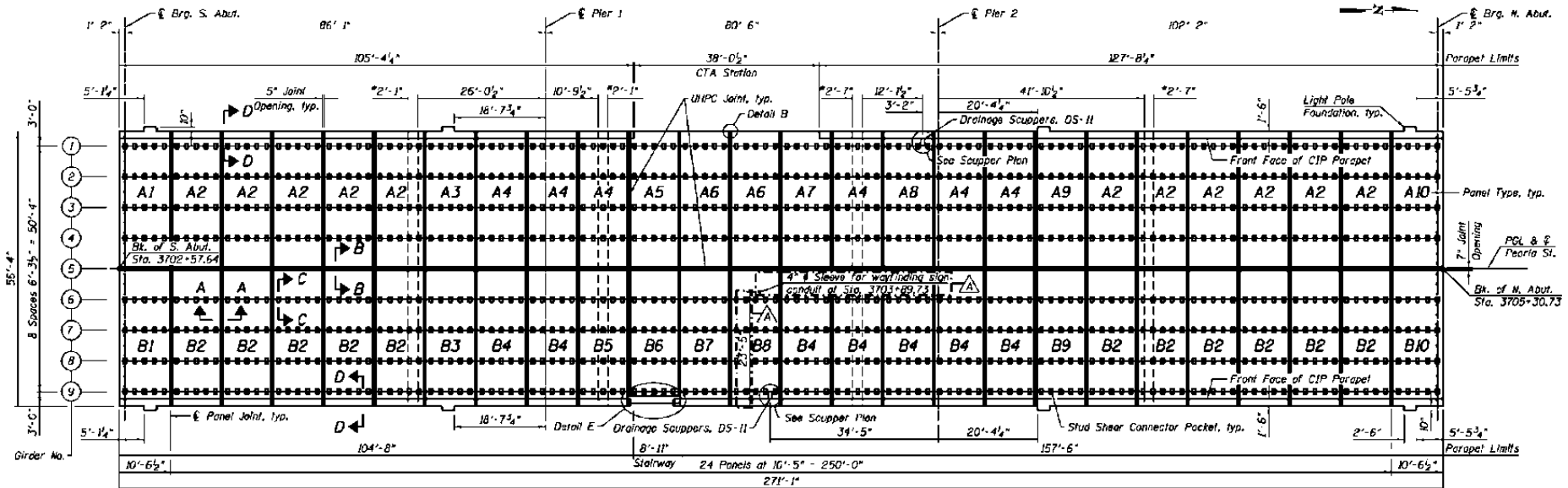


# PEORIA STREET BRIDGE

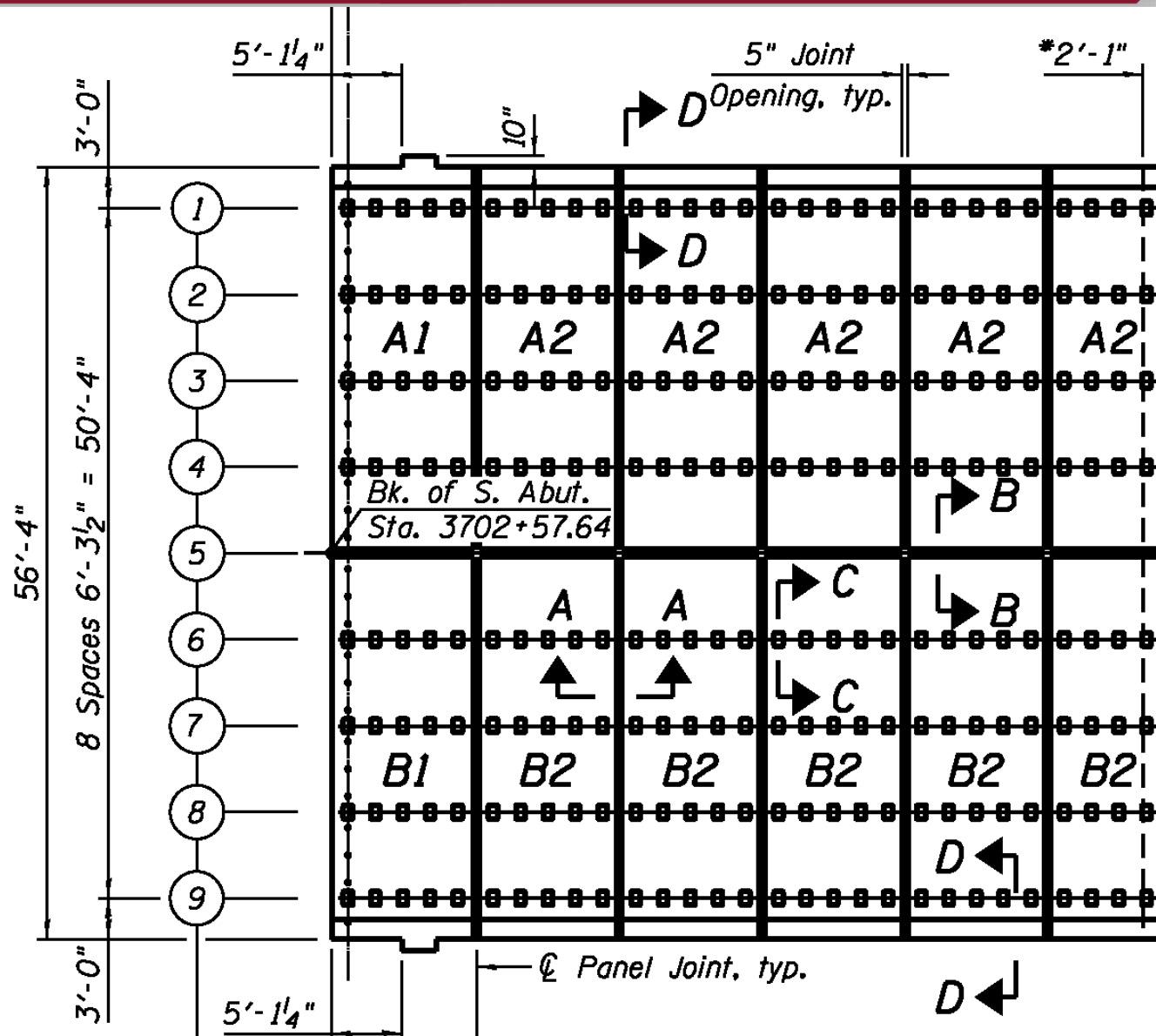
- 3-span, Galvanized Steel Plate Girder
- Total L = 273 ft, 56 ft Wide
- 52 Precast Deck Panels
- Transverse and Longitudinal UHPC joints



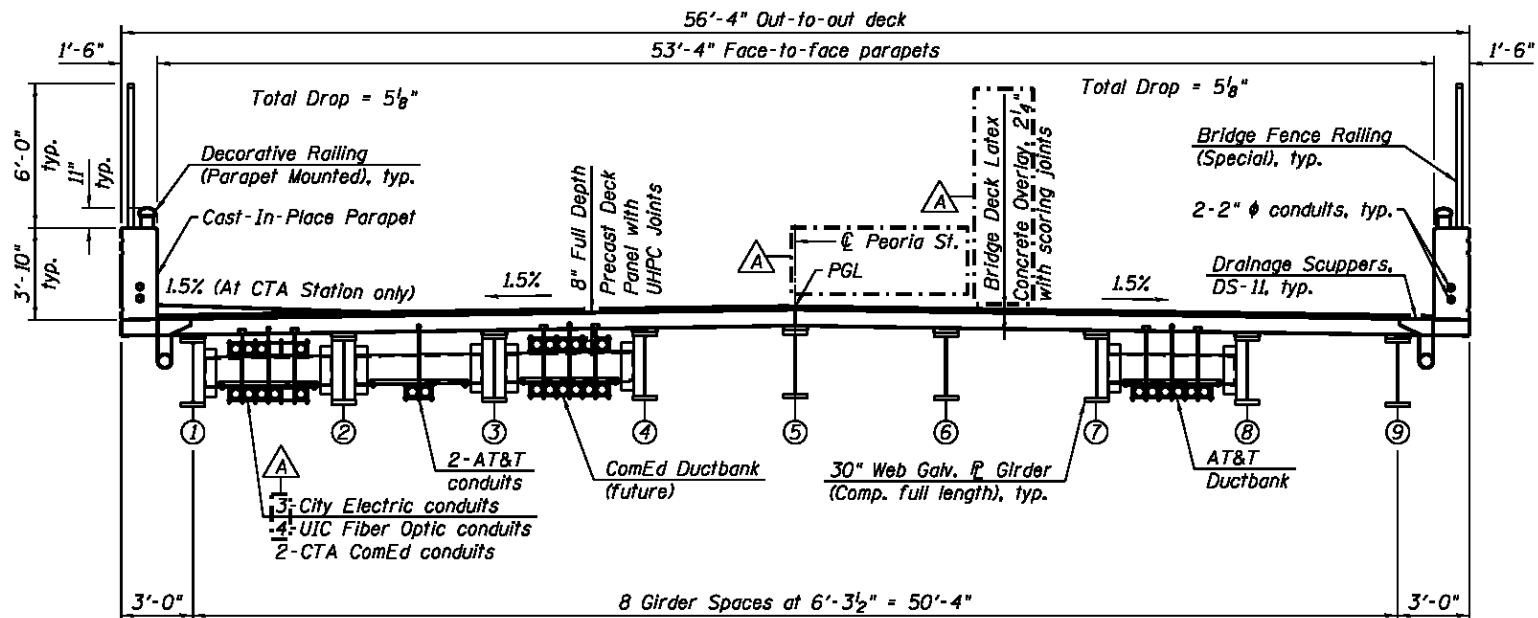
# PRECAST DECK PANEL PLAN



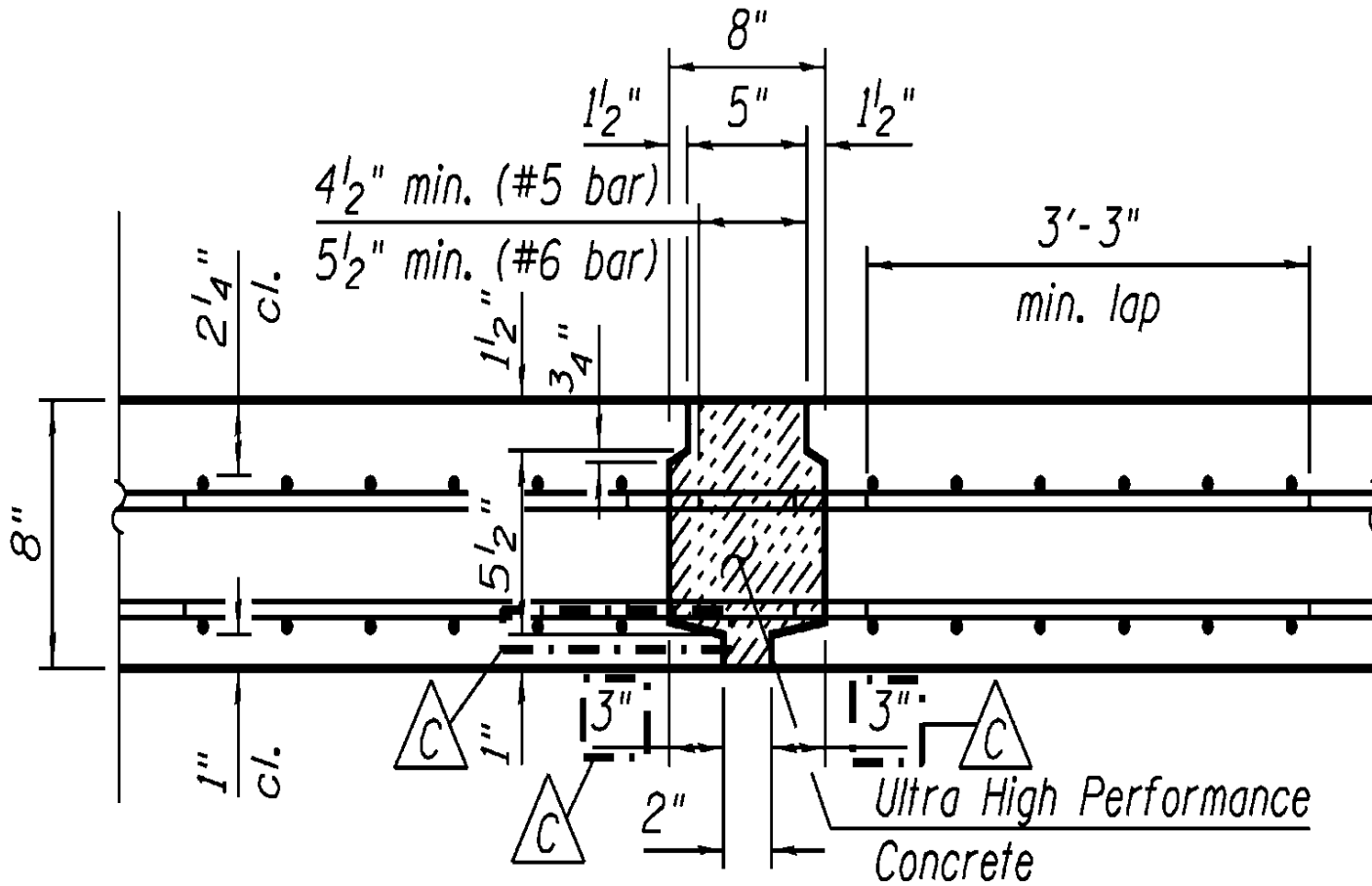
# PRECAST DECK PANEL PLAN



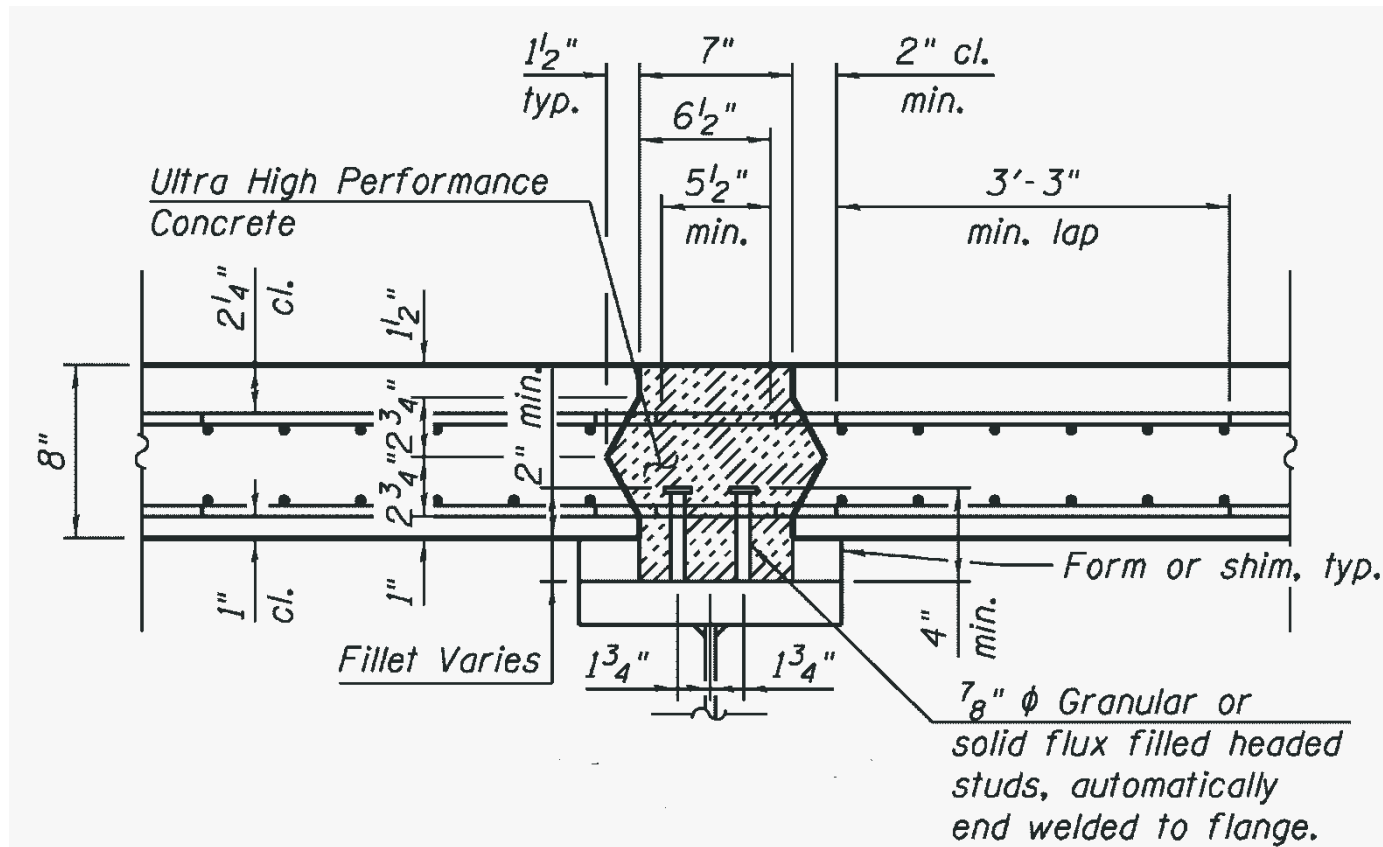
## 30



# UHPC TRANSVERSE JOINT

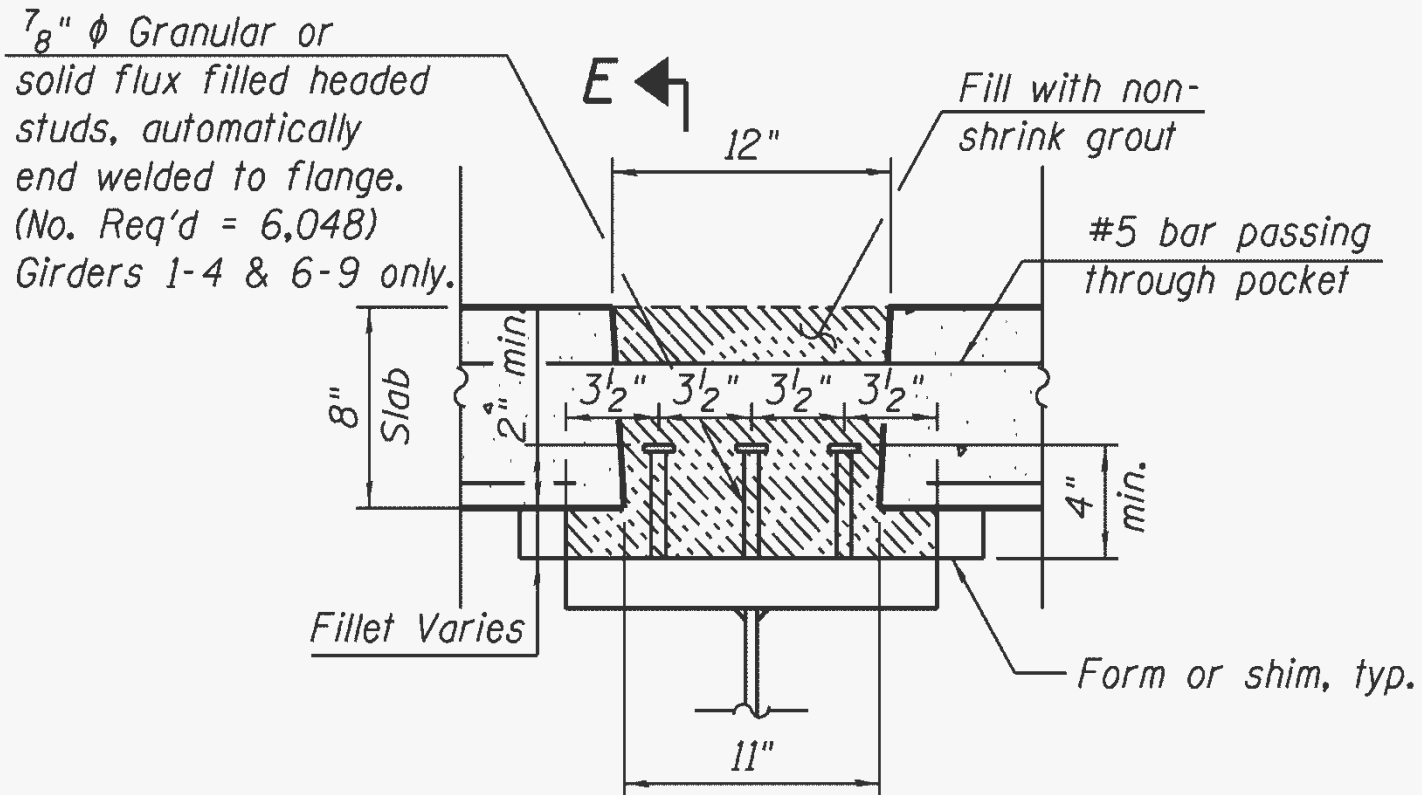


# UHPC LONGITUDINAL JOINT





# SHEAR STUD POCKET



## SEMI-INTEGRAL ON TALL WALL



# PANEL CASTING SITE



# PANEL CASTING SITE





# PANEL CASTING SITE



IDOT



# UNLOADING PANELS



**Utility Concrete Products, LLC**

# ERECTING PANEL





# FIBERGLASS FORMS AT TRANS JOINT



# PANEL LAYOUT



Utility Concrete Products, LLC



# UHPC TRANSVERSE & LONG JOINT





# SHEAR STUD POCKET



# CAST NON-SHRINK GROUT





# MIXING UHPC



# CAST UHPC



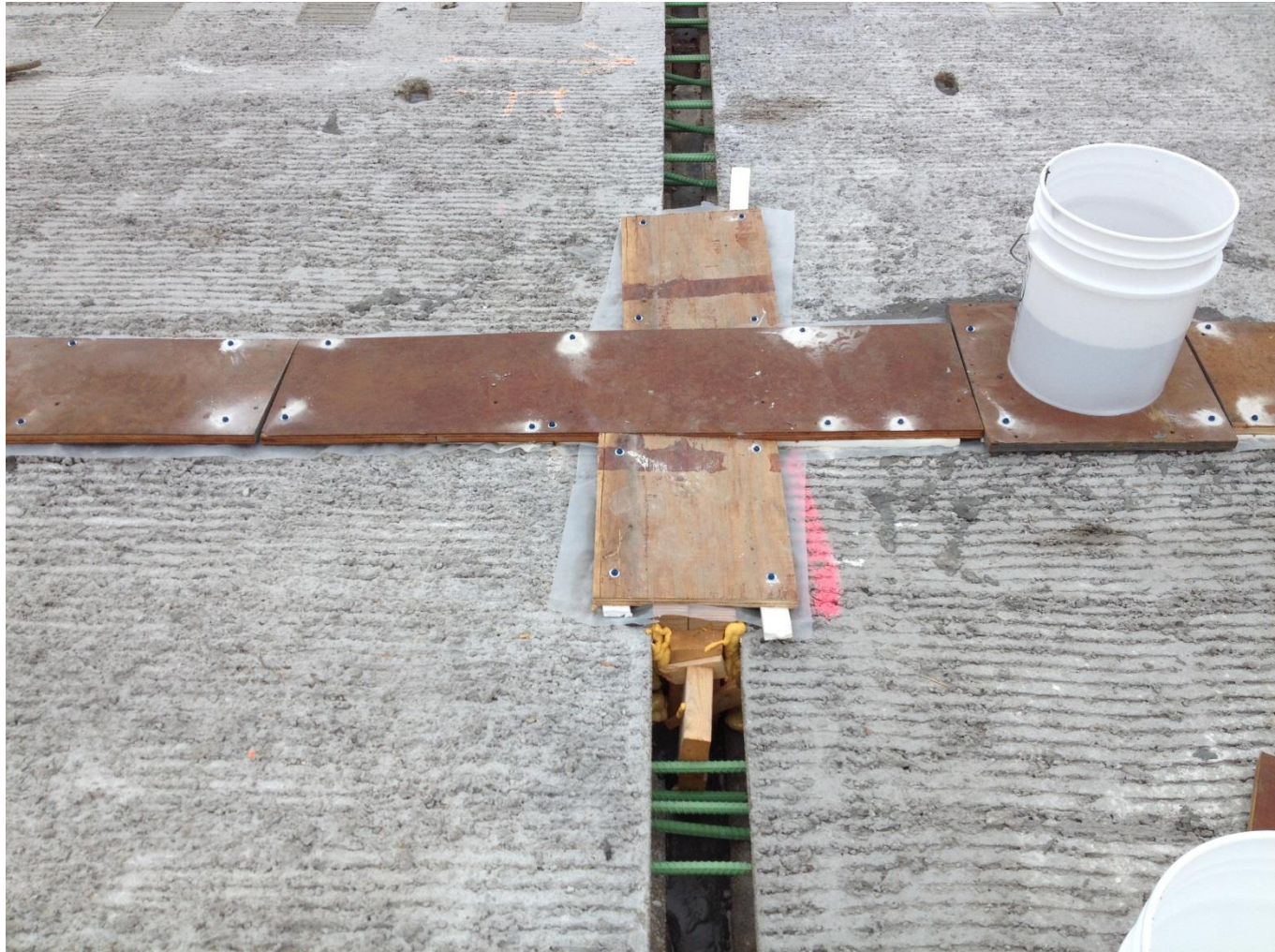


# CAST UHPC





# FORM AT TOP OF UHPC





# TOP OF UHPC JOINT



# BEFORE OVERLAY



**Utility Concrete Products, LLC**



# AFTER OVERLAY





# LESSONS LEARNED

■ SP to Prevent VE for CIP Deck

■ A+B Bidding

■ Non-Shrink Grout – Shear Pocket

# LESSONS LEARNED

▀ Forms for UHPC

▀ Special Provision

▀ Mock up – Precast Deck Panel

# CONCLUSION

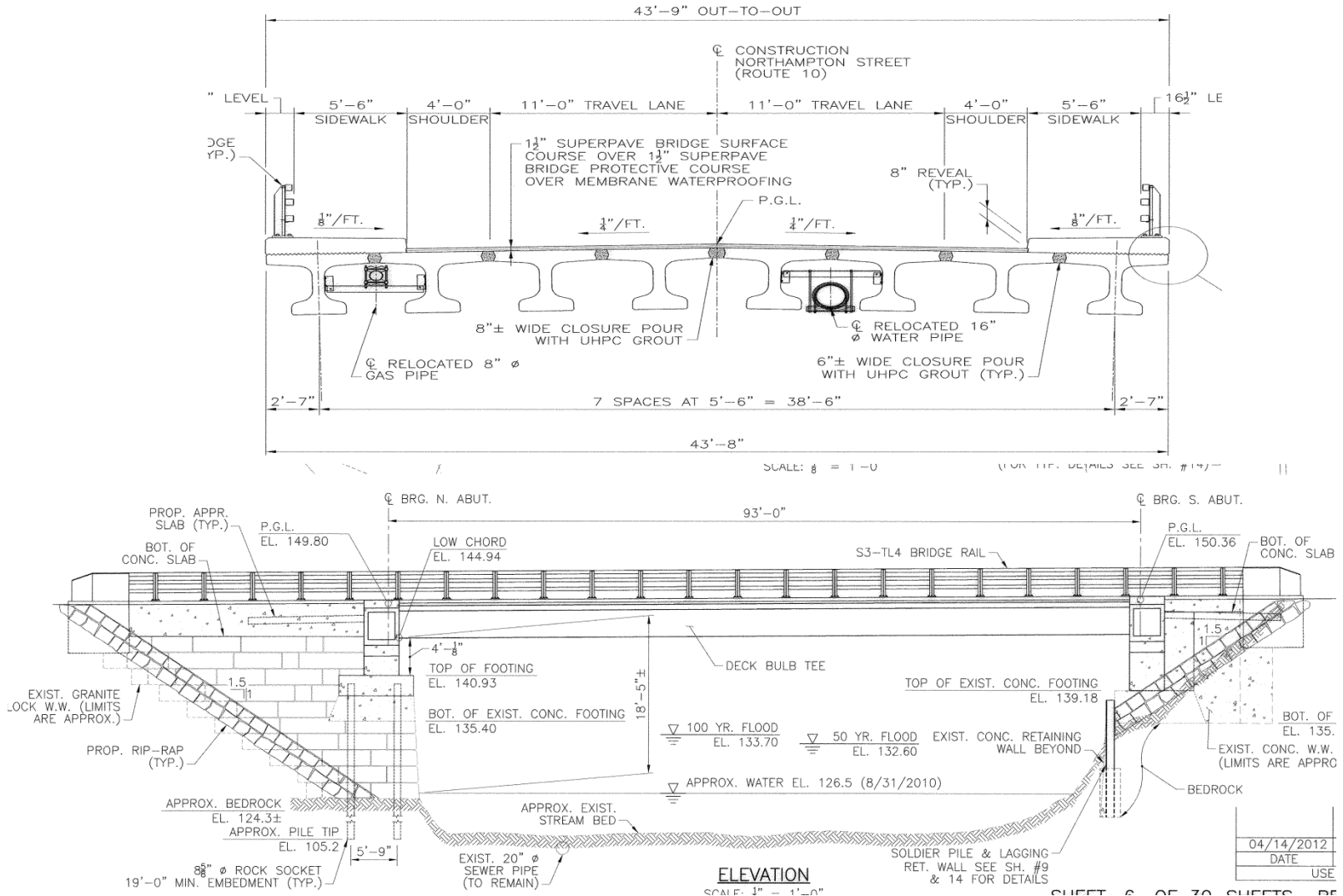
- Higher Compressive Strength ( $\geq 21$  ksi)
- Higher Tensile Strength with Ductility
- Increased Durability
- Less Construction Time
- Higher Initial Unit Cost



# **UHPC - Other Applications**



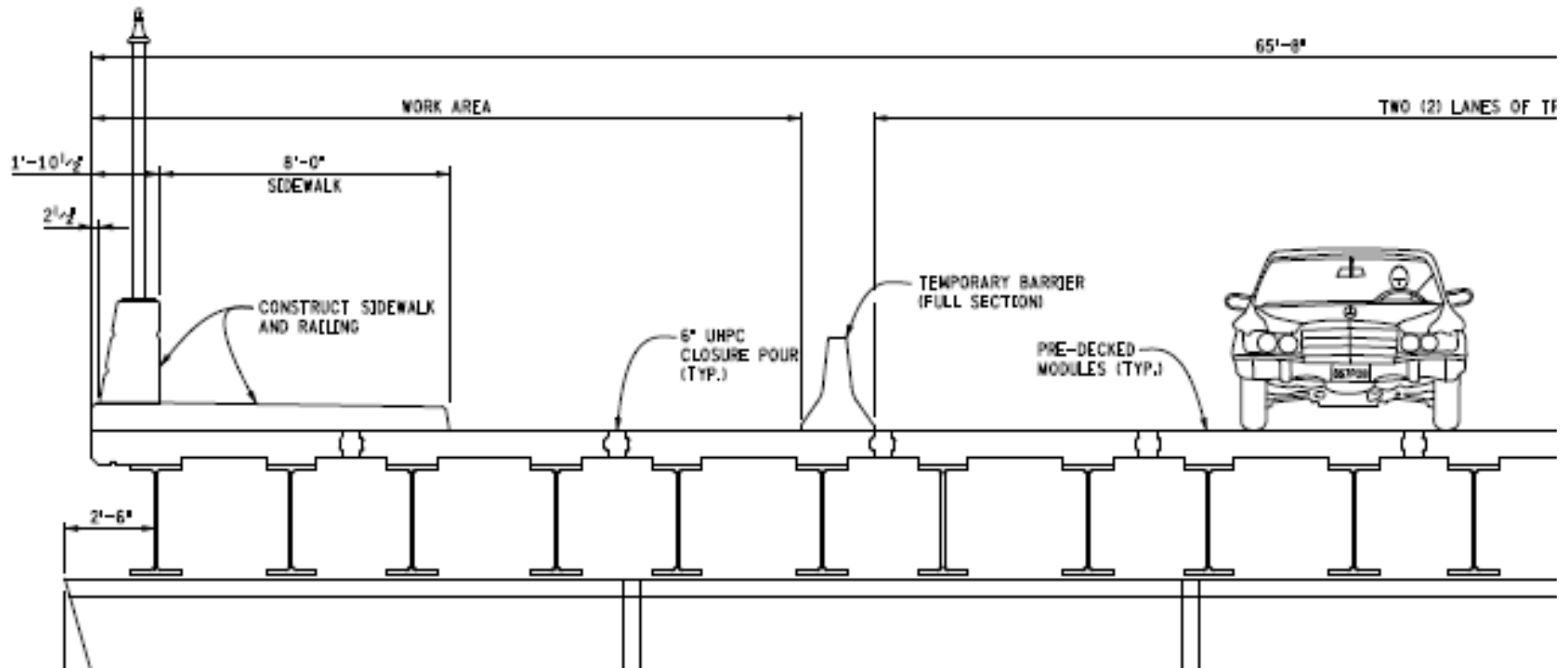
# Deck Bulb T-Beam w/ UHPC Joints



# Double T-Beam w/ UHPC Joints



# Steel Beam Module w/ UHPC Joints

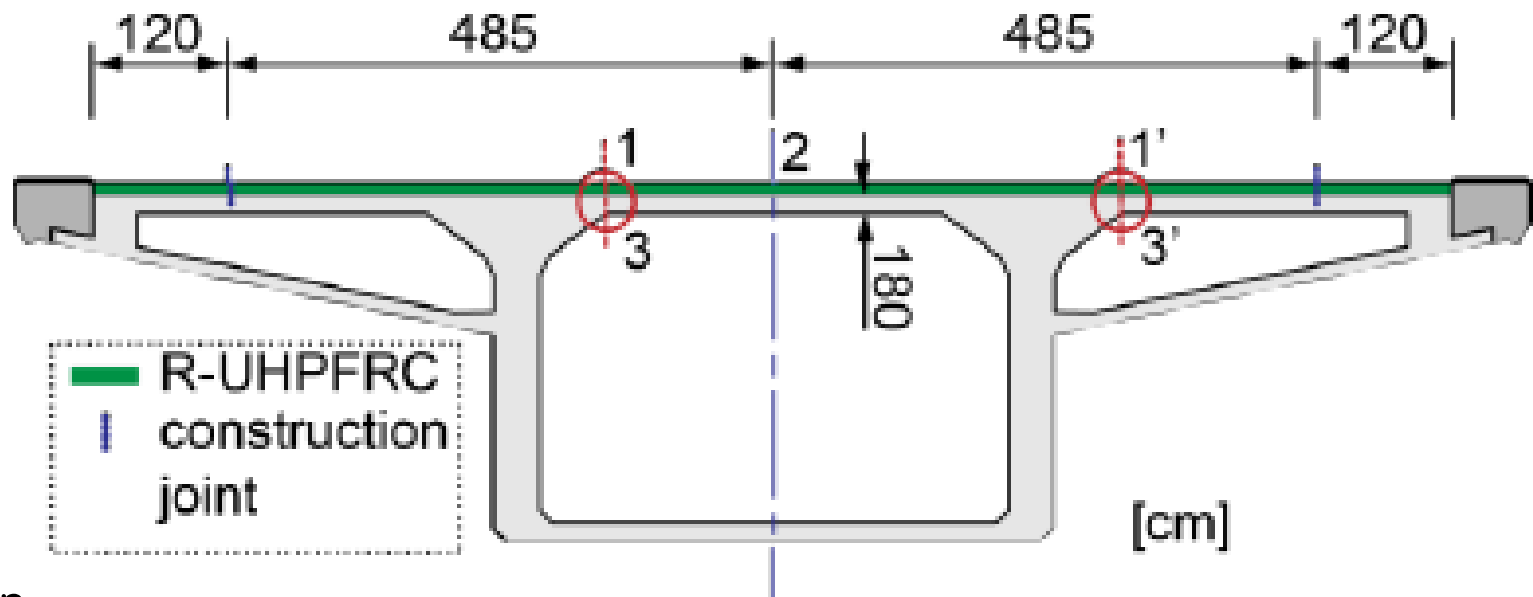


# UHPC Overlay (Iowa)





# UHPC Overlay (Switzerland)



# UHPC link slab (NYSDOT)

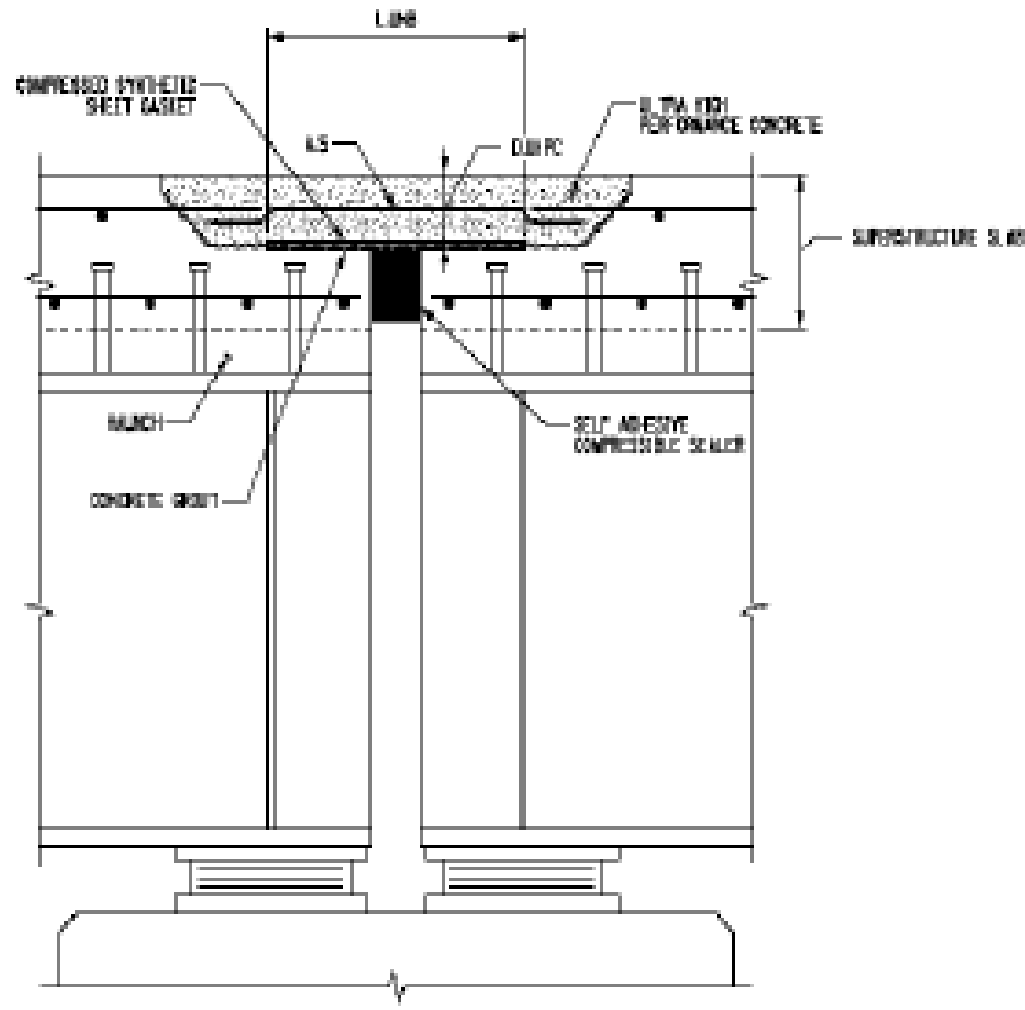


Figure 5-Link Slab Cross Section

NYSDOT, Mathew Royce

# PIER REPAIR/RETROFIT



**Lafarge Ductal, Gaston Doiron**

# Questions?



**EXPERIENCE** | Transportation