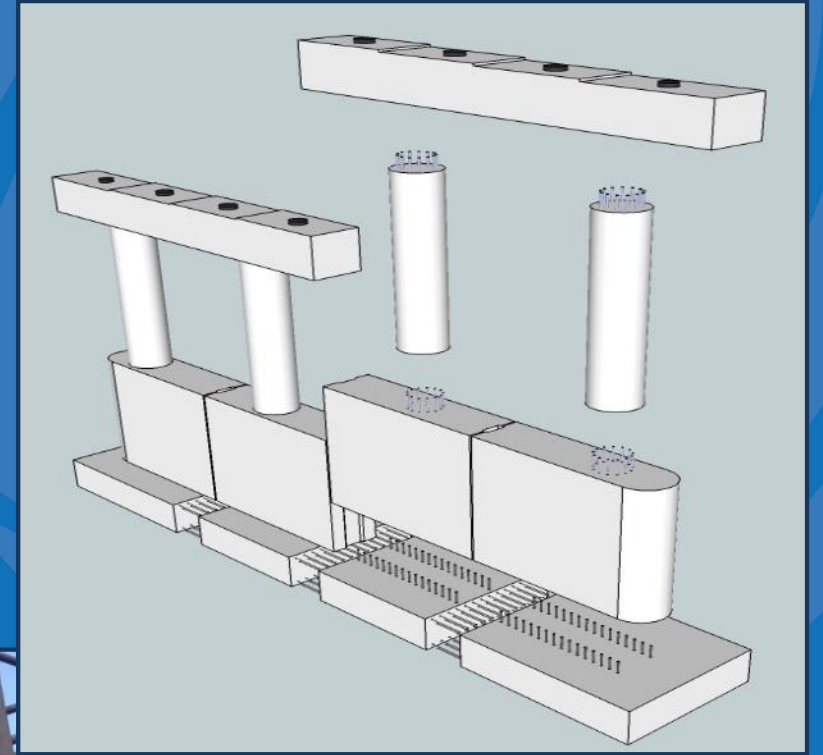
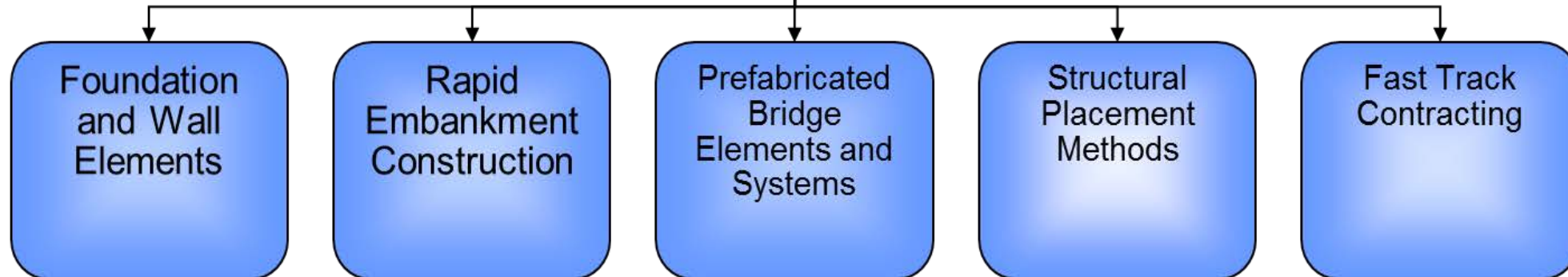


# National Perspective on Accelerated Bridge Construction

Michael P. Culmo, P.E.  
CME Associates, Inc.  
East Hartford, CT



# TECHNOLOGIES IN USE IN THE US



# STATES USING ABC



## 2014 AASHTO Bridge Owners Survey (47 responses)

- Has your state used ABC for bridge projects?
  - 43 Yes
  - 3 No
- If you answered “yes” to the above question, please provide your state’s policy for use of ABC:
  - 44 ABC is considered at the project development stage
  - 0 ABC is considered after contract execution by the contractor

## A number of states have active ABC programs

- Massachusetts, New York, Utah, Pennsylvania, Vermont, Connecticut
- Note: Some are Accelerated Programs employing ABC

# ABC and Work Zone Safety

## Work zone safety

- Construction crews
- Travelers

## Work zones are designed to be safe, but...

- We design for the minimums
- Lane width
- Shoulder widths
- Drainage

## Reality

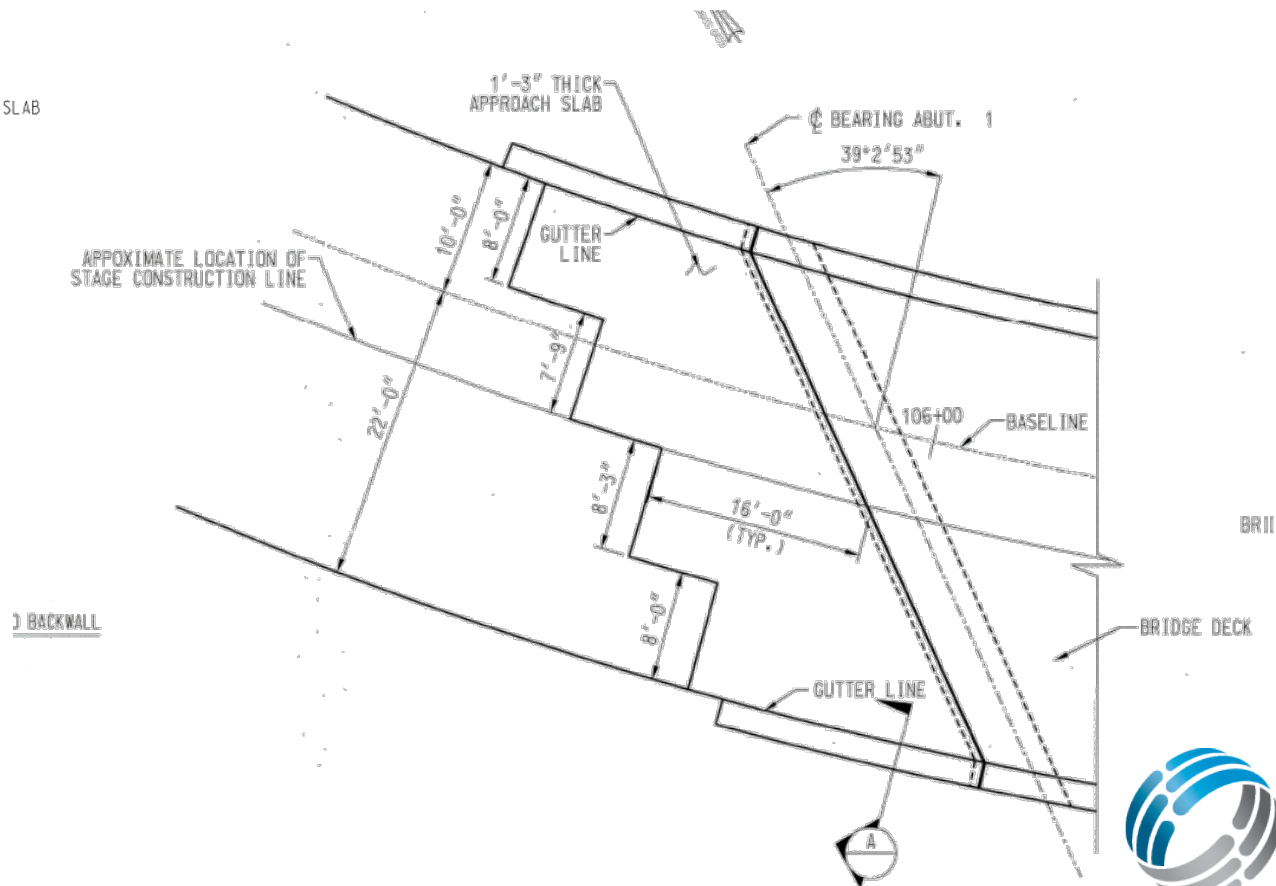
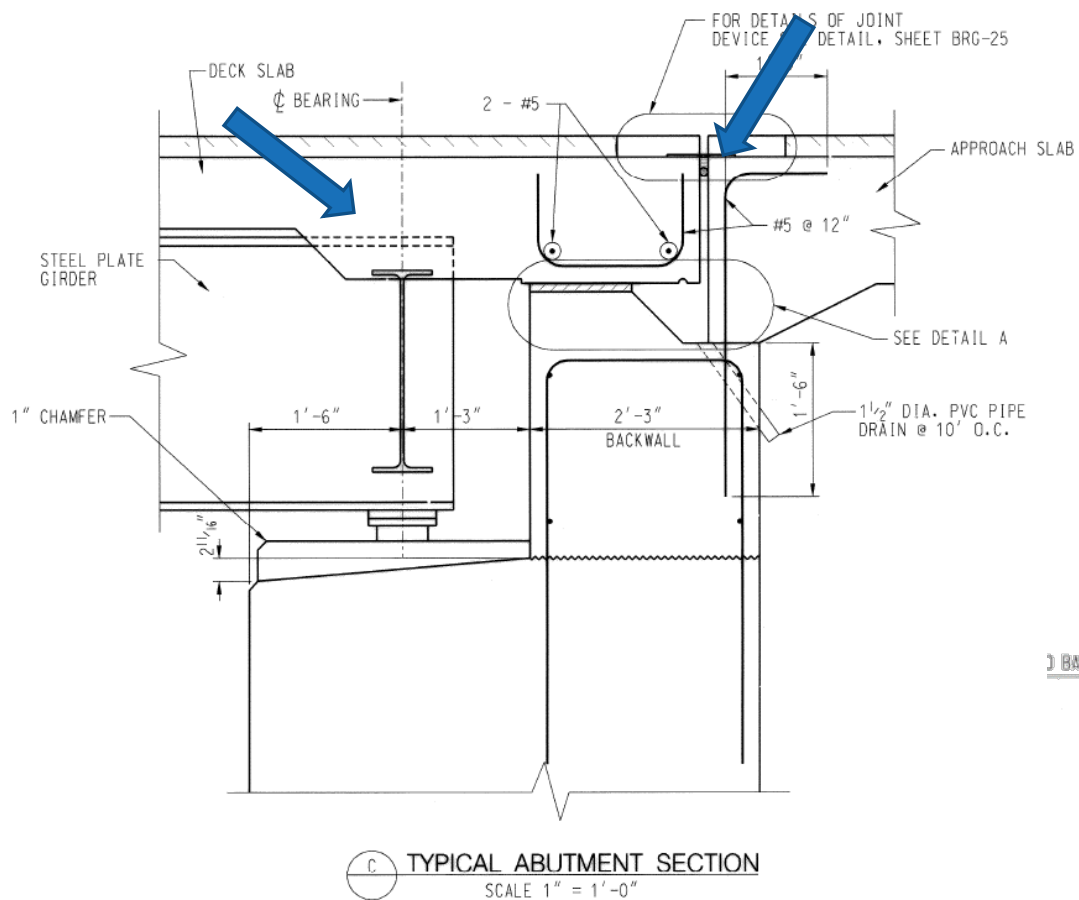
- **In 2010: 37,476 injuries, 576 fatalities**

Reduced construction time = Less Exposure

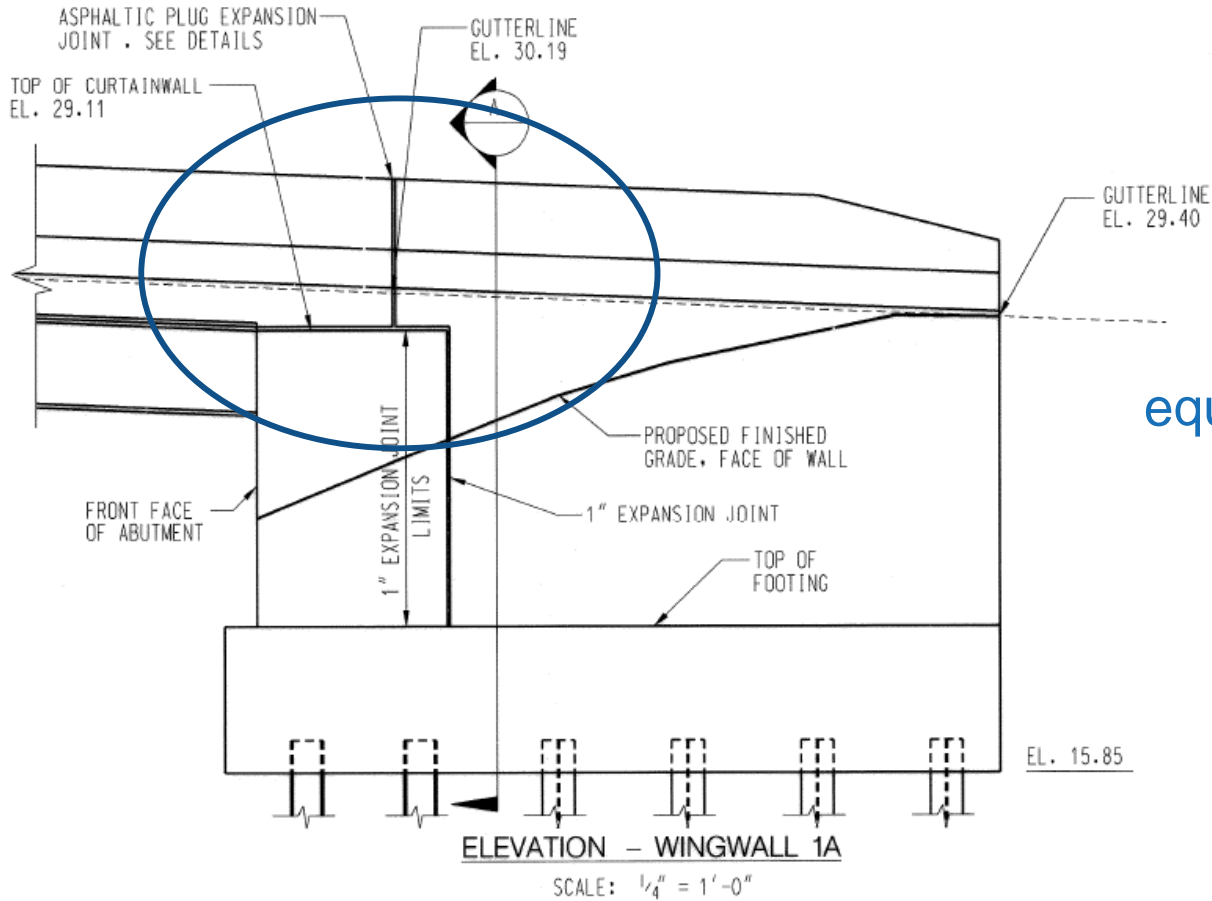
# NEED FOR SIMPLIFIED DETAILING

- Reduced risk during construction
  - Less chance of things not fitting
  - Faster construction
  - Less risk = Less cost
- Improved durability
  - Is durability a materials problem? Maybe
  - Is durability a detailing problem? Definitely
- Emulation of CIP concrete is good, but strict conversion to precast can be problematic
- Elimination of deck expansion joints should be a priority.

# CIP DETAIL EXAMPLES



# CIP DETAIL EXAMPLES



equals



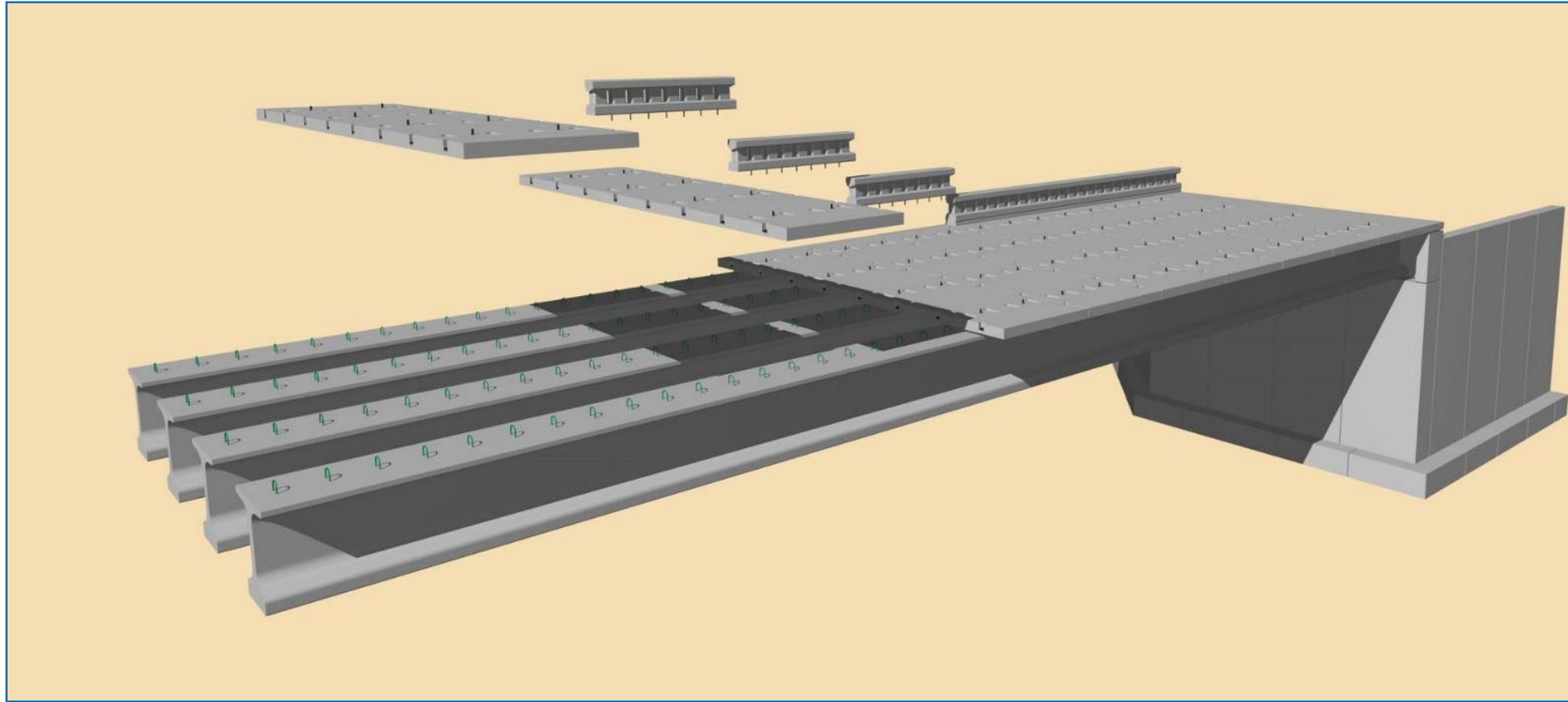
# DETAILING FOR SIMPLICITY



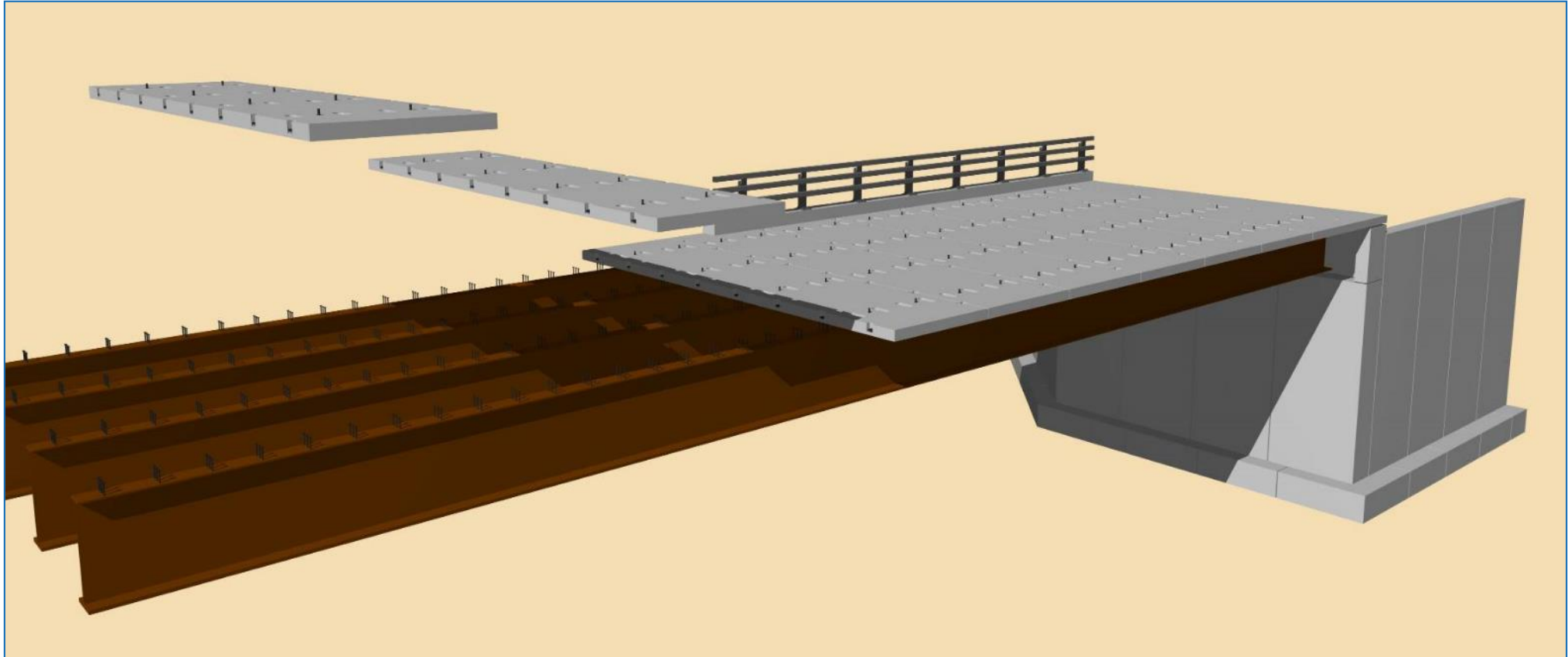
- Investigate ways to simplify details without sacrificing durability
  - Avoid complex 3D shapes
  - Avoid sloped surfaces if possible: Level is ok
  - Account for tolerances
  - If expansion joints are used, place them where they will not lead to problems
  - If joints are required in sensitive areas, choose details that are proven to be durable



# PRECAST DECKS ON PS BEAMS



# PRECAST DECKS ON STEEL FRAMING



# ISSUES WITH PRECAST DECKS

## Shear Connectors

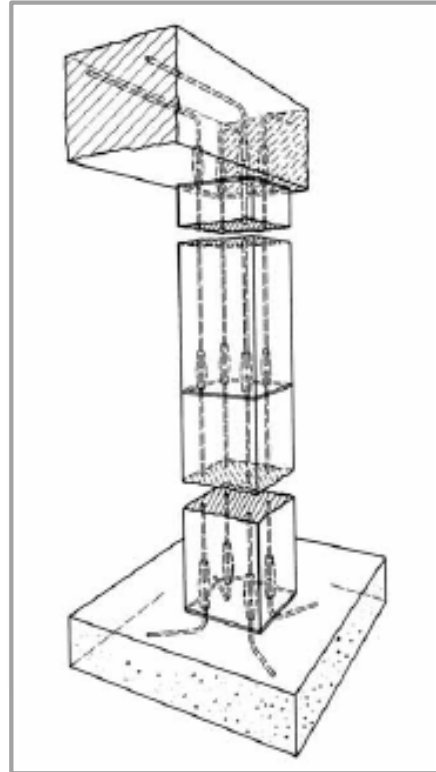
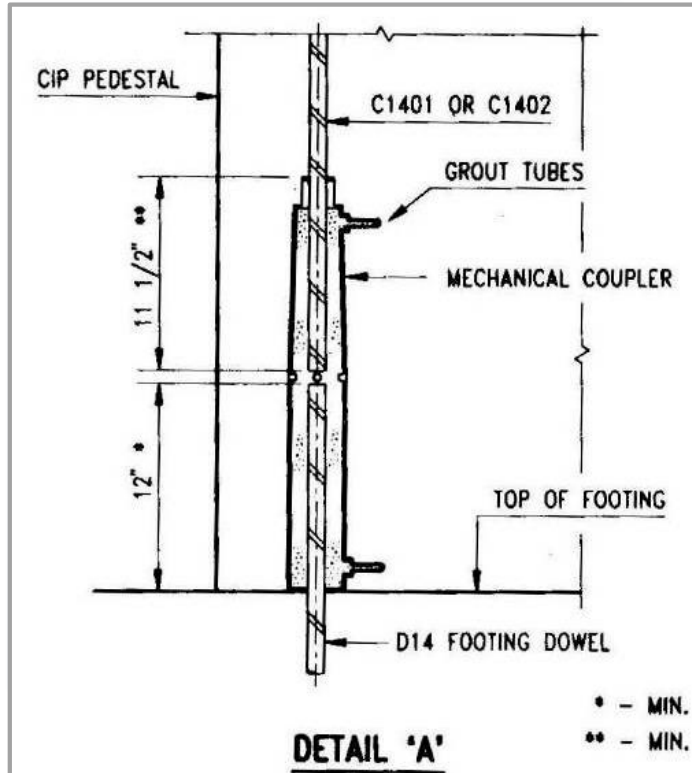
- Concrete bridges
  - Spacing of pockets can be more than 4 feet
- Steel bridges
  - Cannot fit enough studs in the pockets

## Negative moment regions

- Post-tensioned decks
  - How do we accommodate LL stresses?
  - Can get out of control
- Non-post-tensioned decks
  - Leakage issues



# GROUTED REINFORCING SPLICE COUPLERS



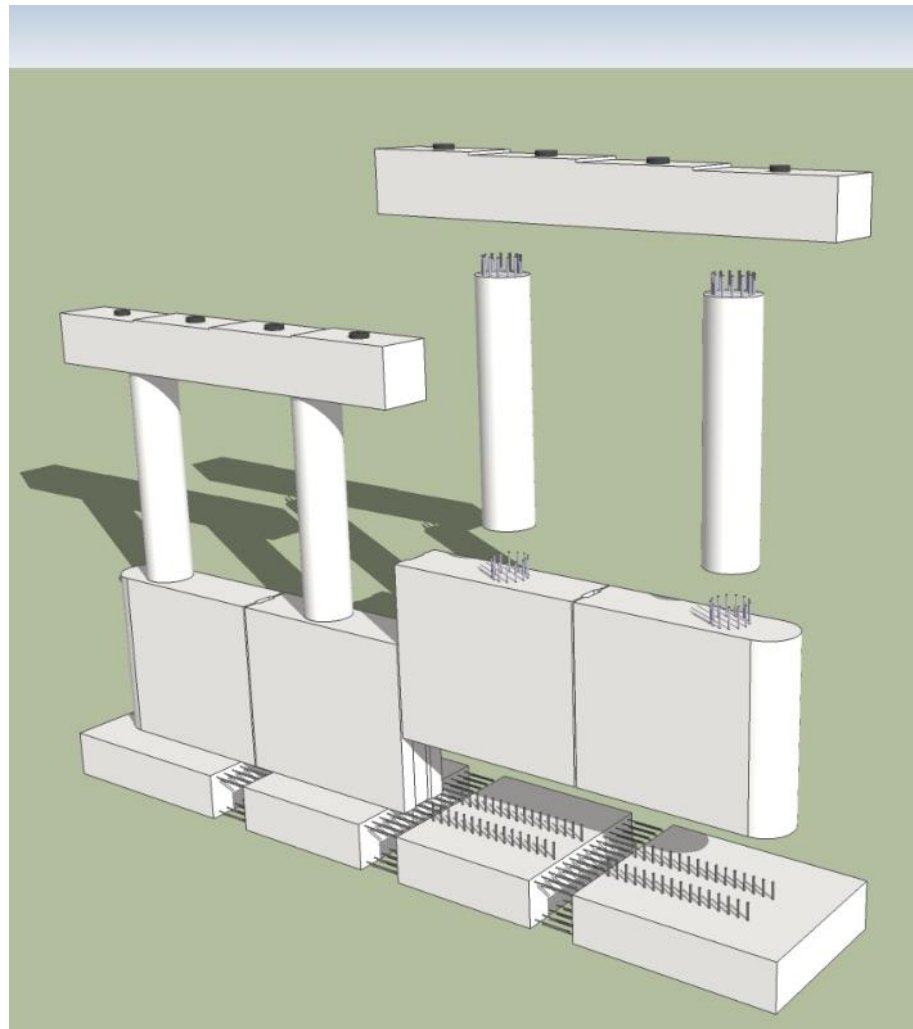
# GROUTED REINFORCING SPLICE COUPLERS



## Latest Update

- Previous research in japan showed emulative behavior
- Recent new research has proven that this is the case
  - Seismic testing at University of Nevada Reno and University of Utah
  - Slightly different ductility behavior
    - Consider placing couplers outside the columns
    - Consider debonding a small portion of the coupler outside the sleeve

# MASSACHUSETTS PROJECT



# GROUTED PT DUCTS

Good for seismic connections

Based on Research in Texas,  
California and Washington

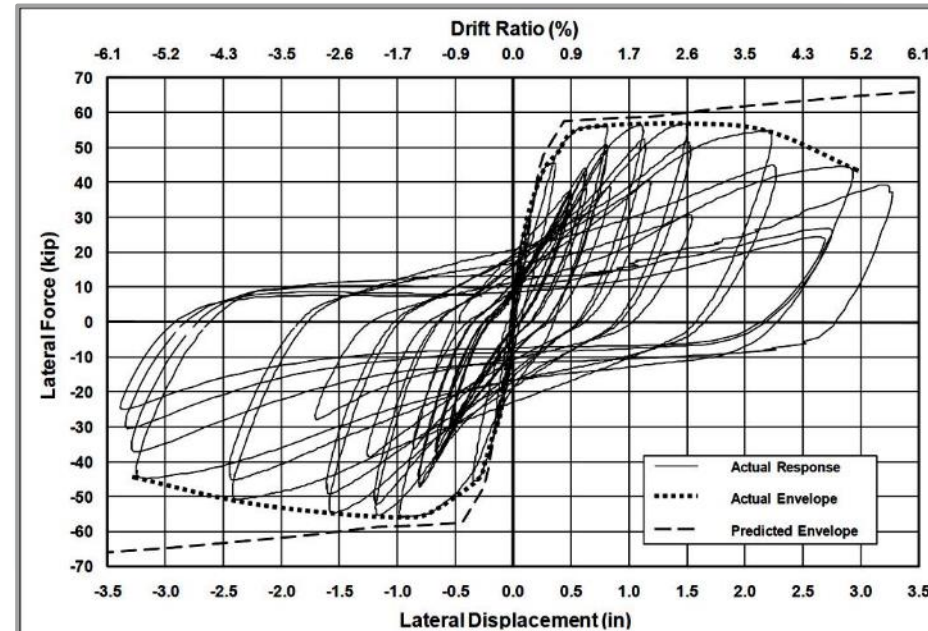
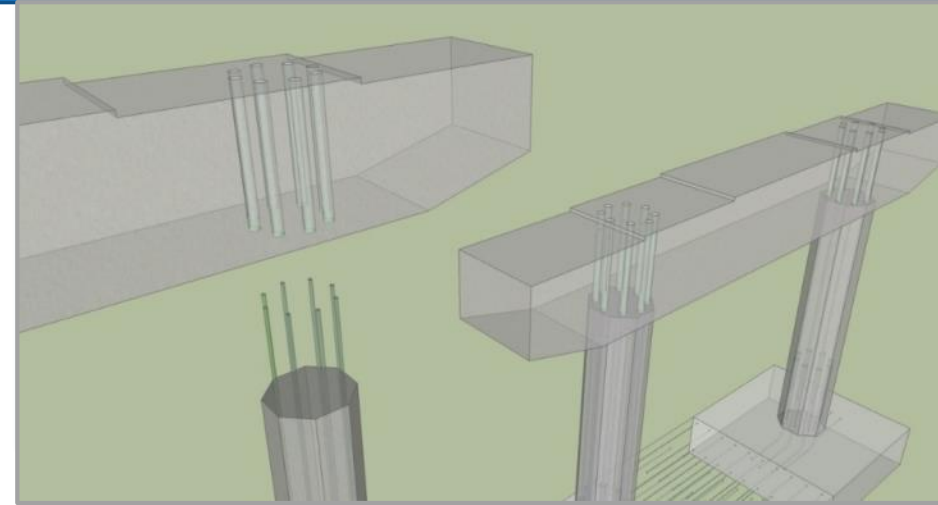
NCHRP 12-74 (seismic)

Similar to grouted couplers

Good for development into mass  
concrete

Lap splices?

Check conflicts with transverse  
bars



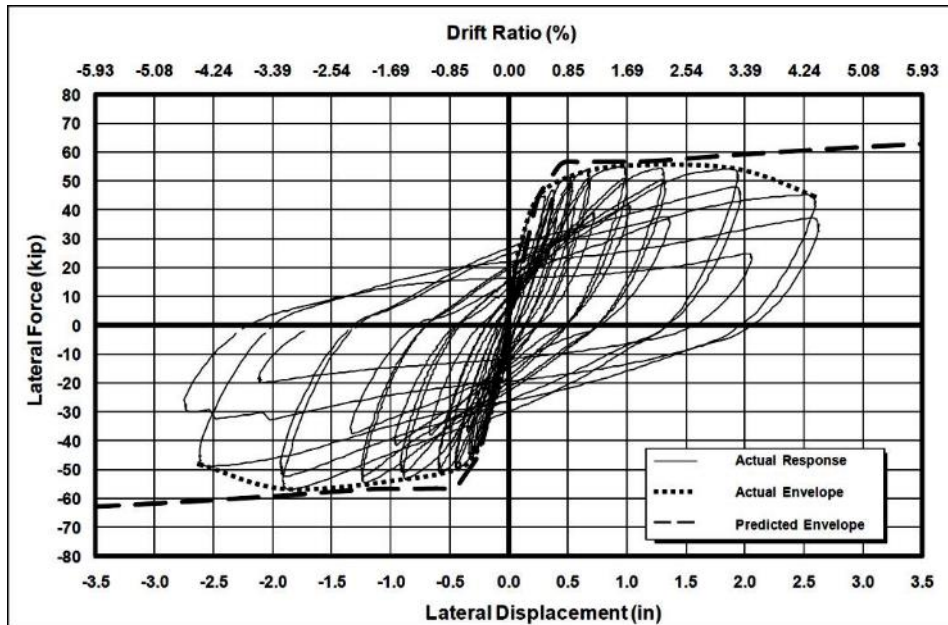
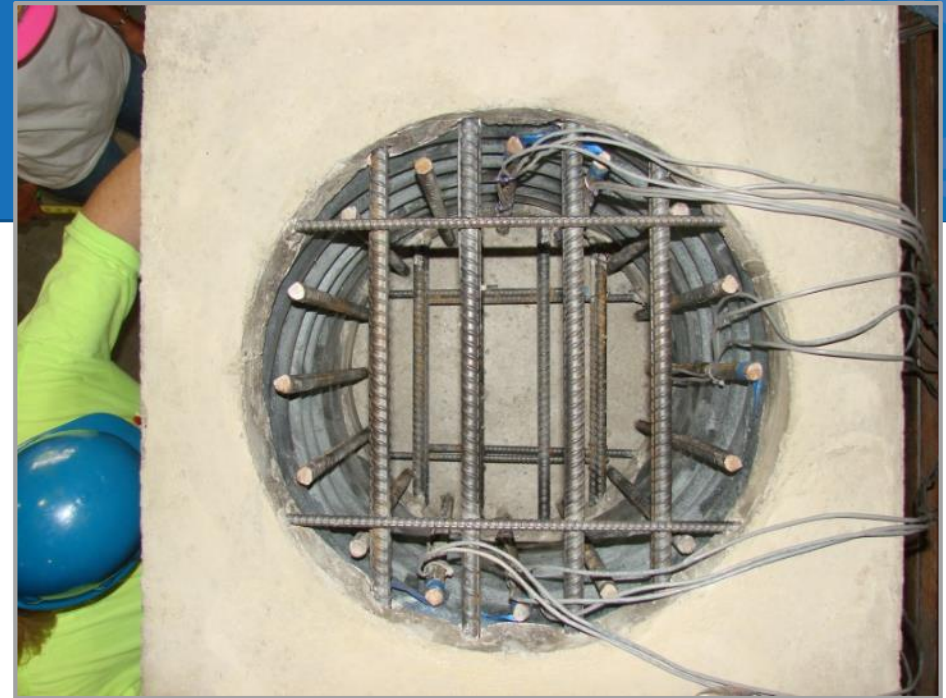


# CMP VOIDS

NCHRP 12-74 (seismic)

Requires supplemental reinforcing

Requires temporary support



# INTEGRAL ABUTMENT BRIDGES

Superstructure resists soil forces

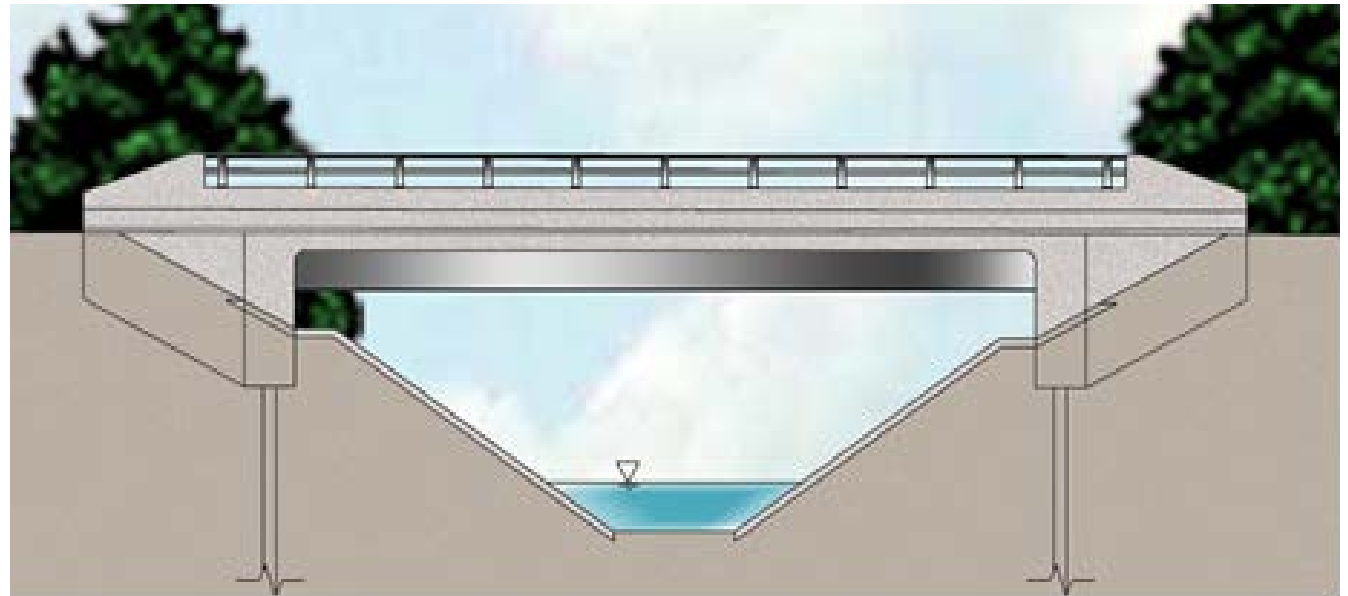
Eliminated footings

Uses fewer piles

Jointless

Construction in the dry

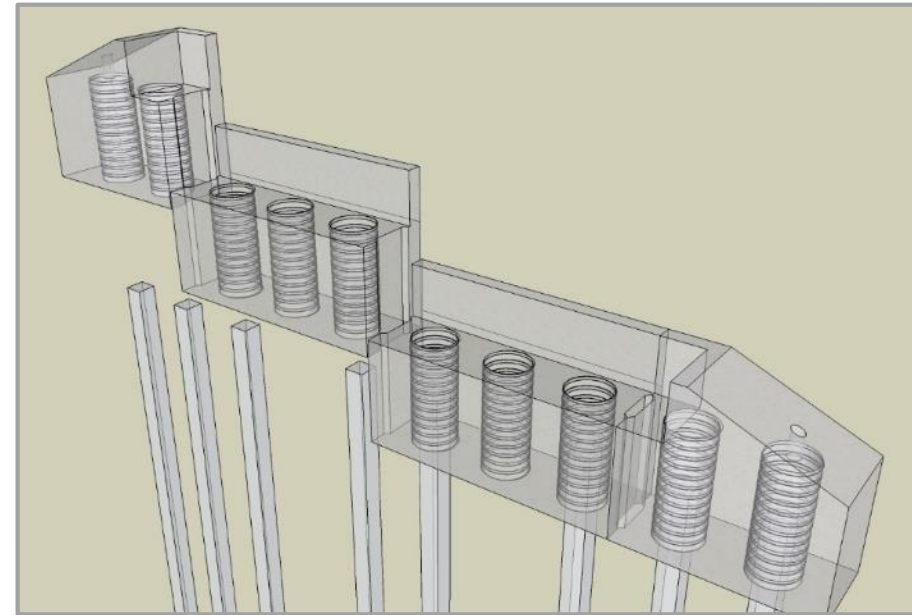
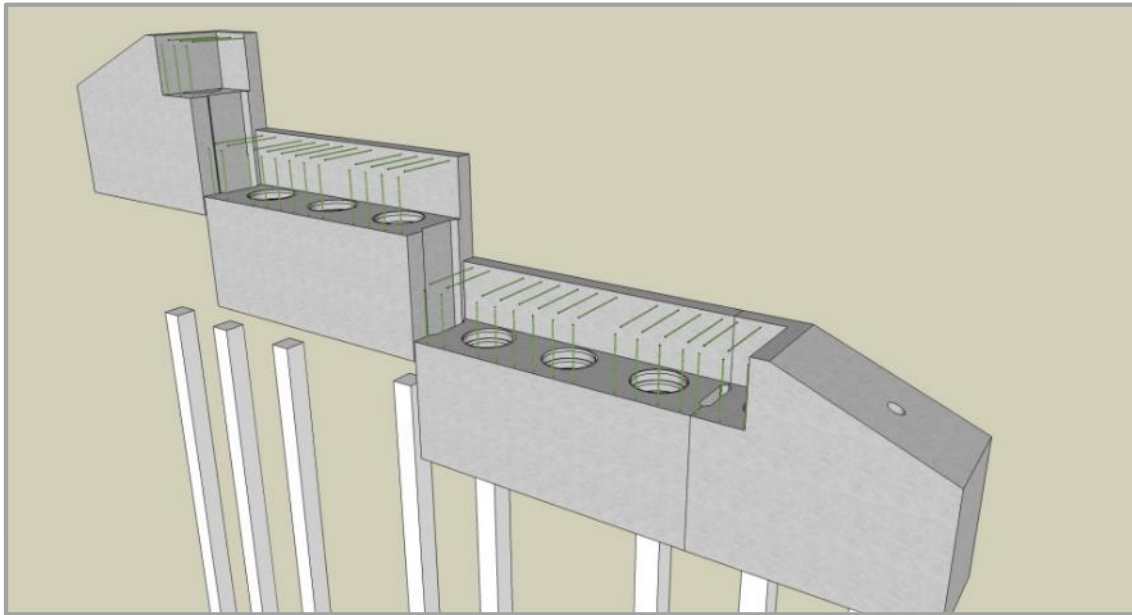
Very cost effective



# PRECAST INTEGRAL ABUTMENTS



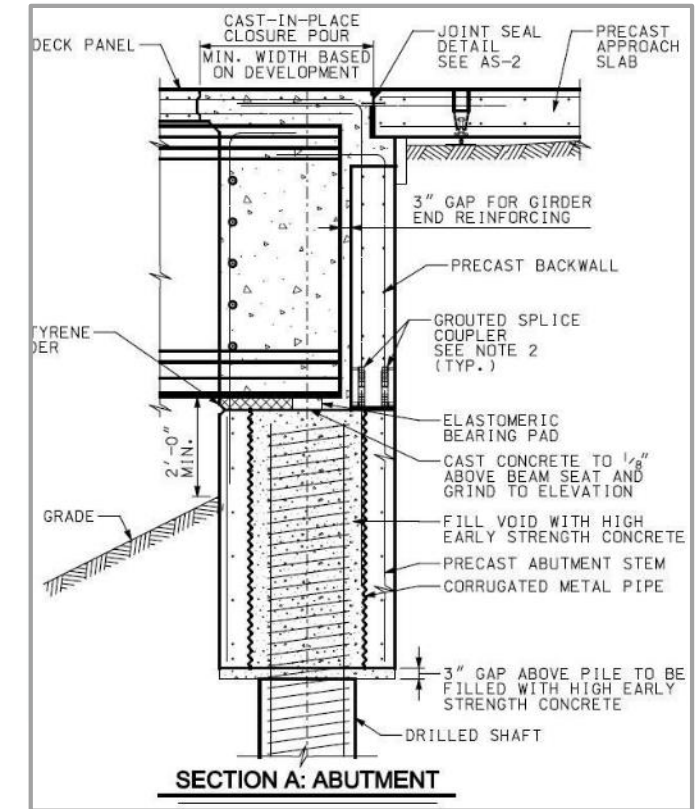
## Corrugated Pipe Void Pockets



# CMP VOIDS

## Corrugated Void Pockets

- Developed in Iowa
- Tested for seismic connection
- Very good shear capacity
  - Footings
  - Integral abutments
  - Pier caps
- Easy to form
- Reduces shipping weight



# Integral Abutment Project

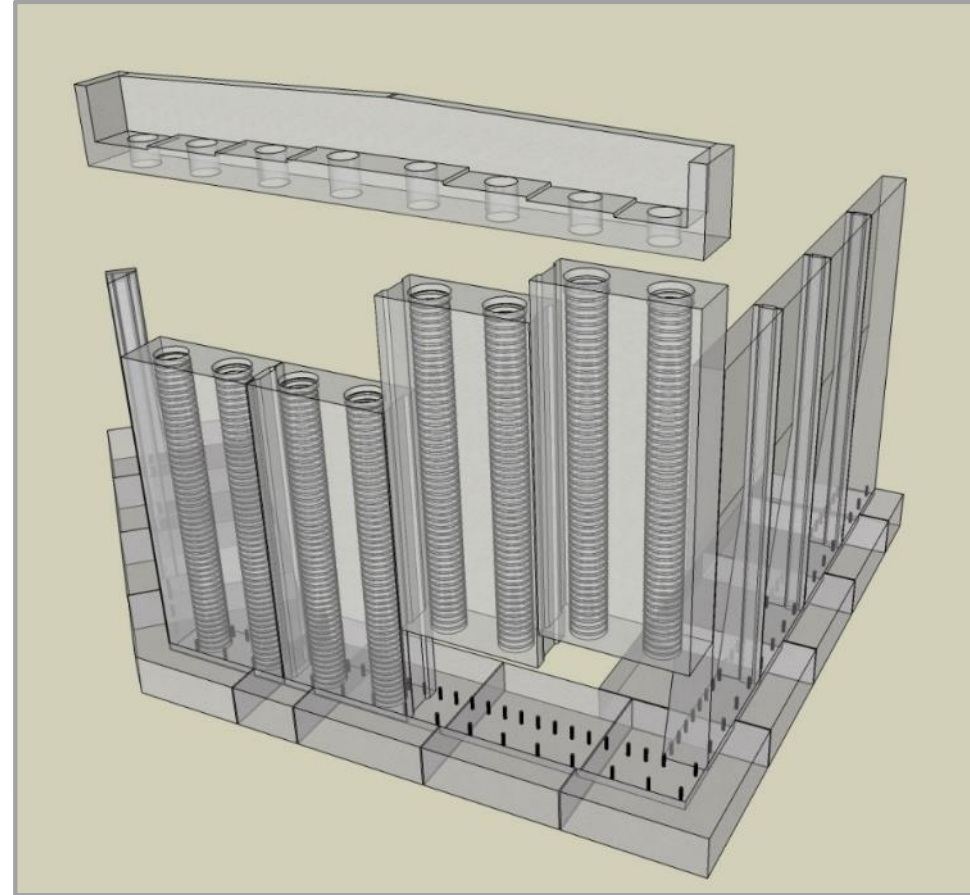
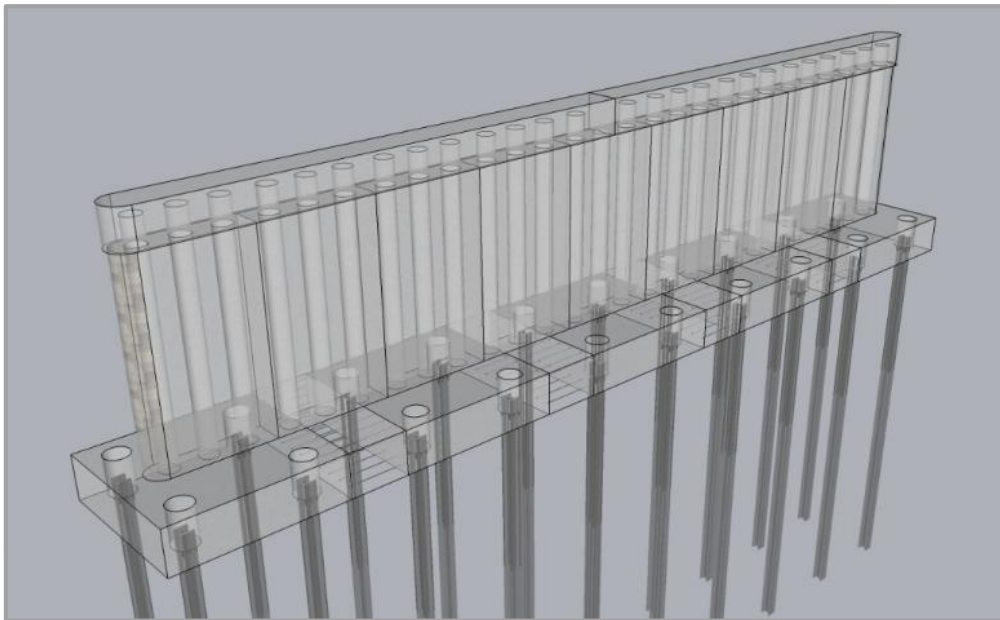
Charlemont, MA



# CANTILEVER WALLS

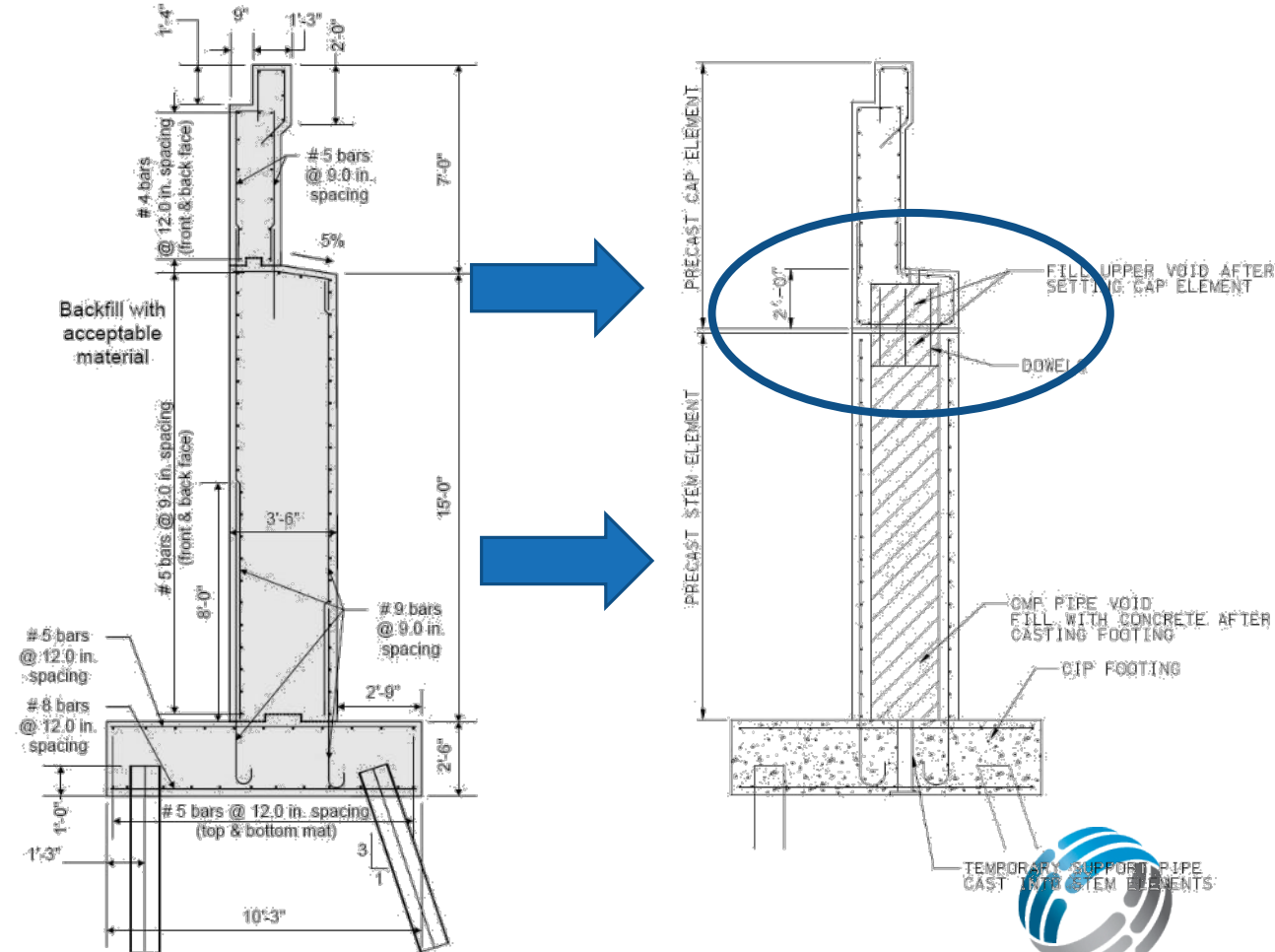
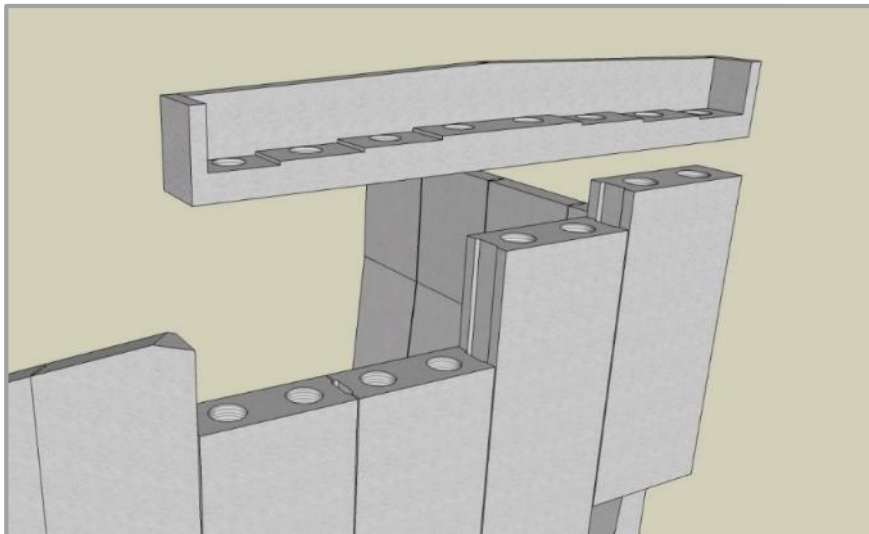
## CMP Voids Used to:

- Reduce weight
- Connect cap to wall stems
- Connect Stub Abutments to Footings



# CANTILEVER ABUTMENTS

- Connect cap piece with CMP Void Connection
  - Complex details left to one piece
  - Simplifies wall panels
  - Low moment demand connection
  - Easy construction



# CANTILEVER ABUTMENTS

Worthington, MA





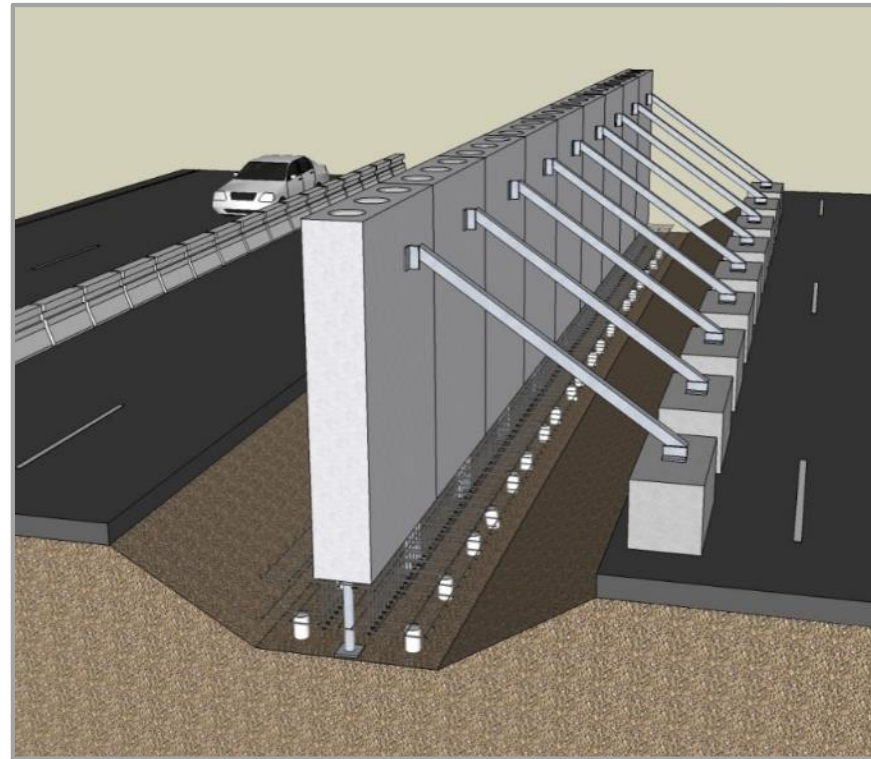
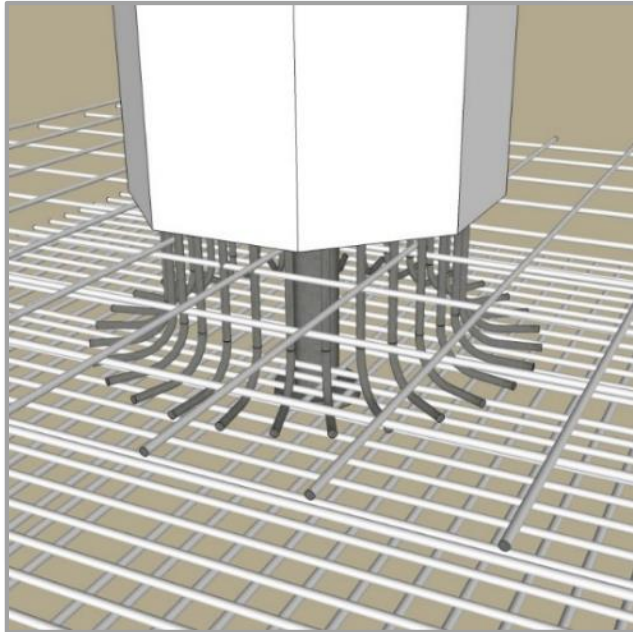
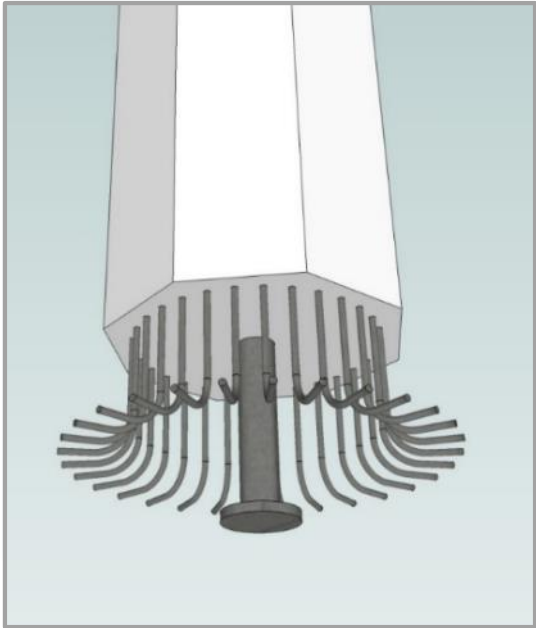
# CANTILEVER ABUTMENTS

- Maine DOT Bridge



# Pile Supported Footings

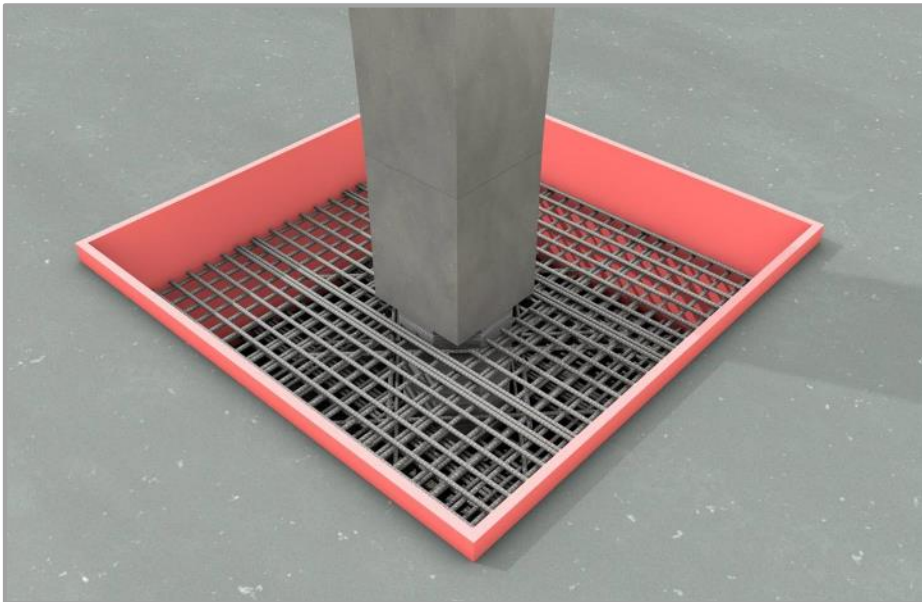
## CIP Footing with Precast Column



# Pile Supported Footings

## Corrugated Column End

- Based on FHWA Highways for LIFE Research in Washington
- No reinforcing passing from column into footing
- Good for pile supported foundations



# Bridge Superstructure Installations

## PREFABRICATED SUPERSTRUCTURE - SPMT



# Bridge Superstructure Installations



2 Superstructures replaced in 16 hours  
(including demolition of old bridges)

# ISSUES WITH SPMTS

Rental costs are still significant

- \$50,000 to \$1,000,000 depending on several factors

Availability is good, but not great

- This can affect the construction schedule

Risk is higher with SPMTs

Still a viable option for high profile projects

- Bridges over high ADT Roadways

# Slide-in Bridge Construction (SIBC)

## SLIDING/SKIDDING



# Slide-in Bridge Construction (SIBC)

## Superstructure – Sliding





# BENEFITS OF SIBC

Costs are lower when compared to SPMTs

Several ways to design the equipment

Risk is low

Great for

- River Crossings
- Interstate bridges over local roads

# MODULAR DECK BEAMS

- 2 Beams with Precast Deck

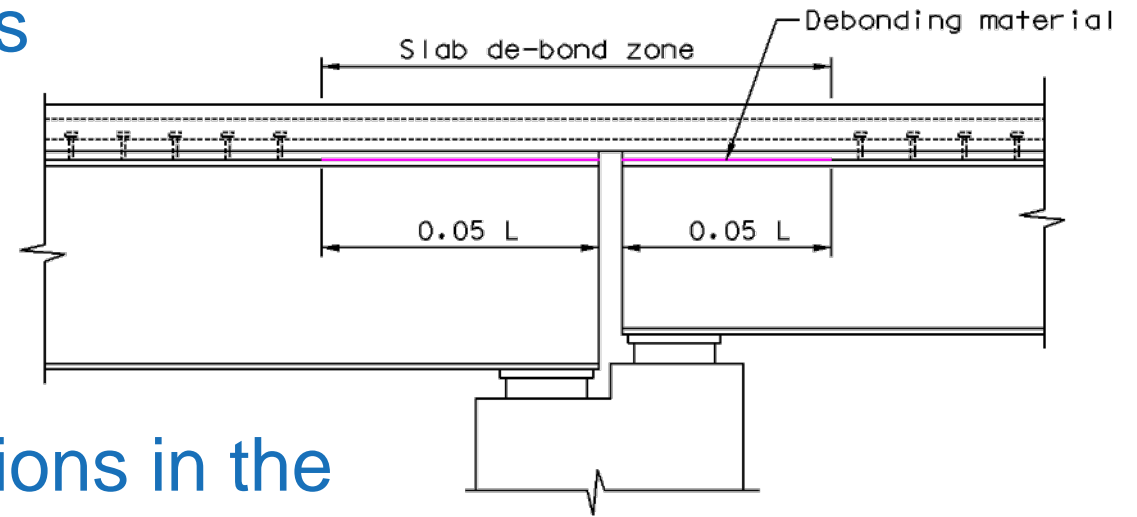


# MODULAR DECK BEAMS



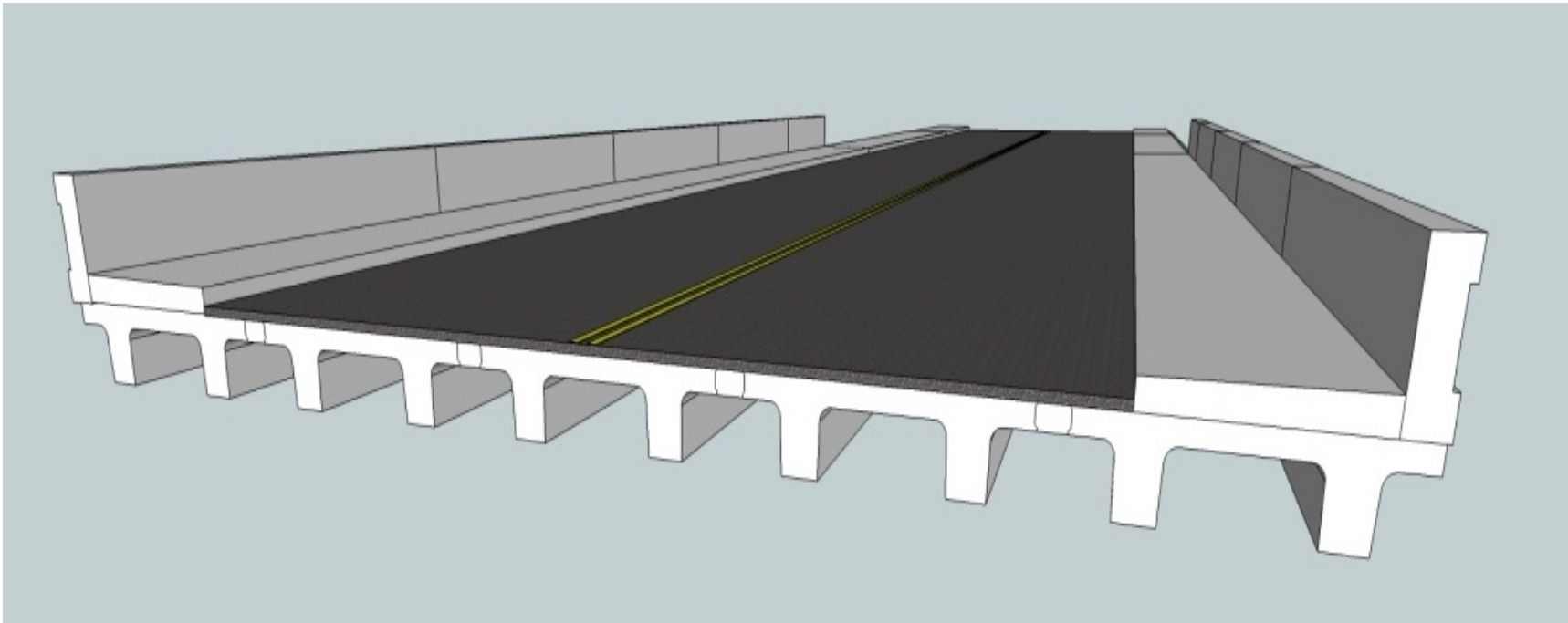
# LINK SLABS

- Another option for multi-span bridges
- Jointless, not continuous
  - Less complicated
  - Less Expensive
  - Great for prefabricated beam elements
- Used to accommodate the end rotations in the beams



# NEXT BEAM

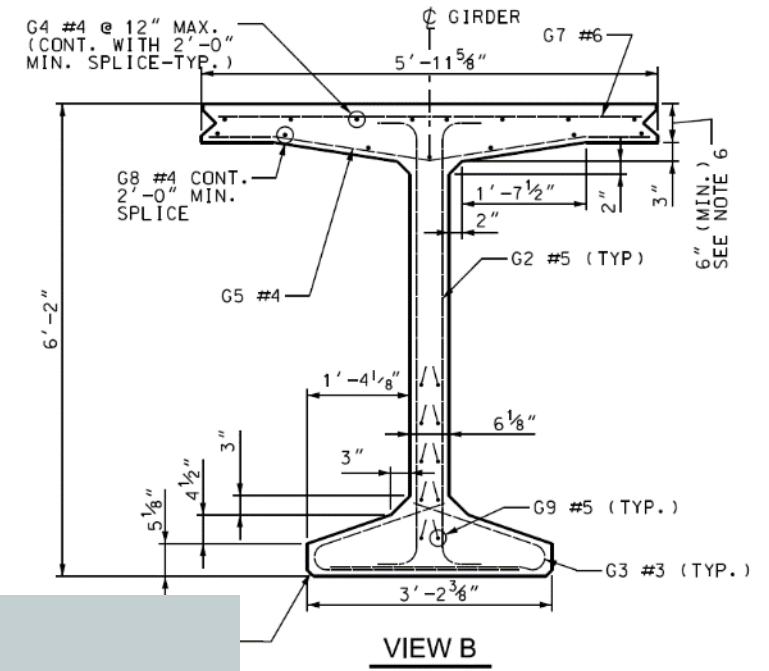
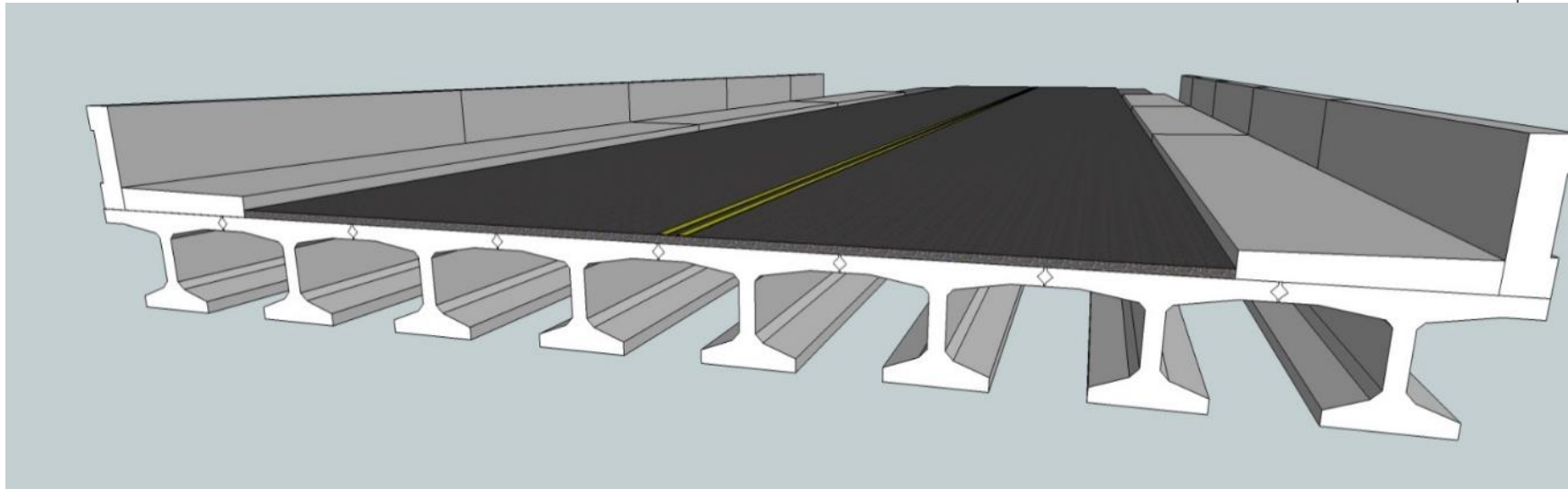
- Precast Double Tee for Bridges
- Developed by the PCI NE Bridge Tech Committee



Details at: [www.pcine.org](http://www.pcine.org)

# DECK BULB TEES

- Bulb Tee Beam with thicker top flange
- Butted system



# DURABILITY OF PREFABRICATED ELEMENTS

- Utah DOT has studied performance of ABC projects
- Projects built with latest details are performing very well
- Connecticut DOT - Precast Decks (2)
  - Built in 1990
  - In excellent condition today
- Florida DOT – Precast Piers
  - Built in extreme corrosive environment in 1995
  - In excellent condition today

# CONCLUSIONS

- The US is adopting the use of ABC on a wide scale
- ABC is becoming standard practice
- Improved safety is an added benefit
- More states are implementing programs
- Durability is not an issue
- The technology is here and market ready
- SHRP2 Products can be used for a wide variety of ABC projects



# QUESTIONS



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