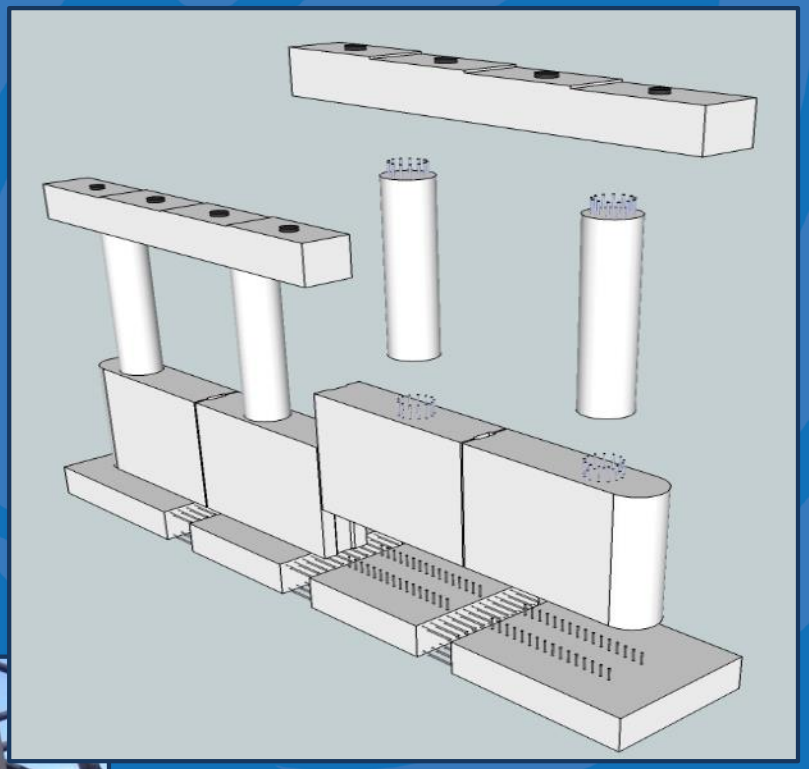
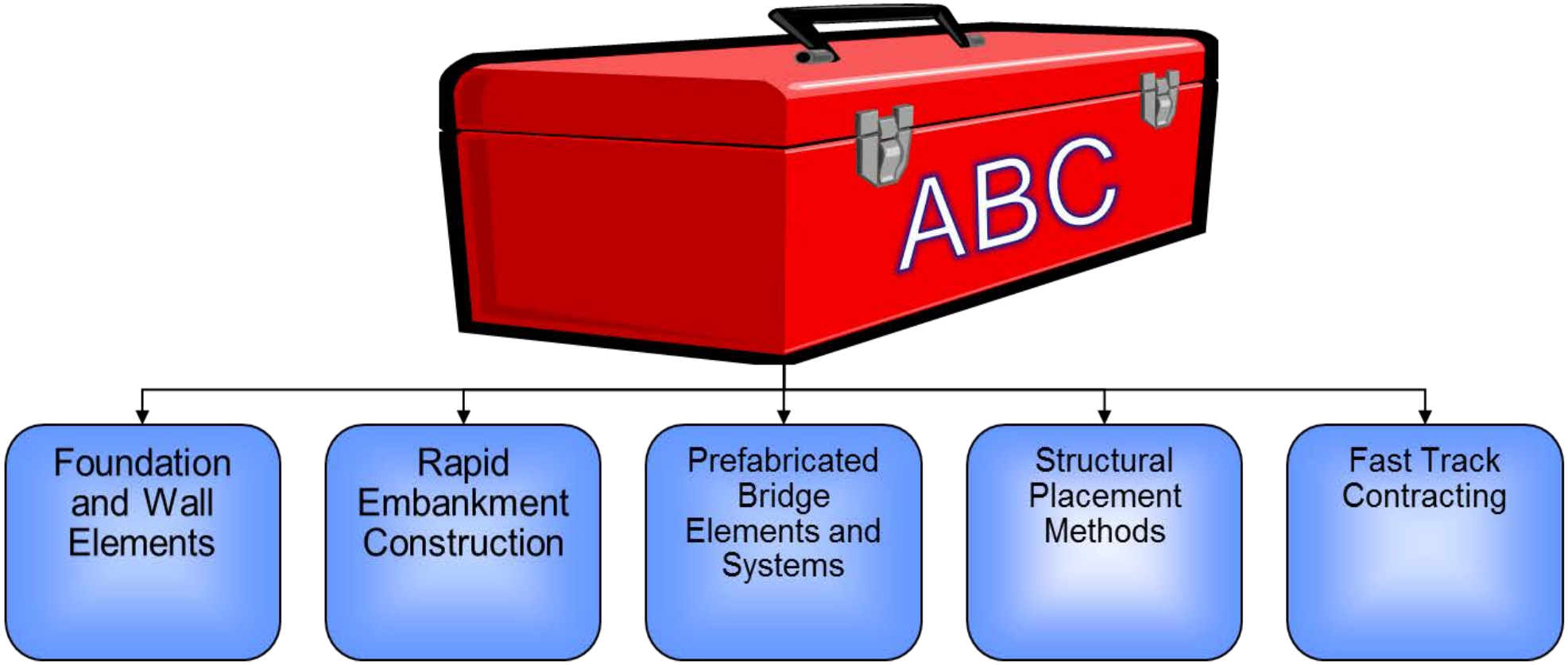
National Perspective on Accelerated Bridge Construction



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

TECHNOLOGIES IN USE IN THE US



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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

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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.

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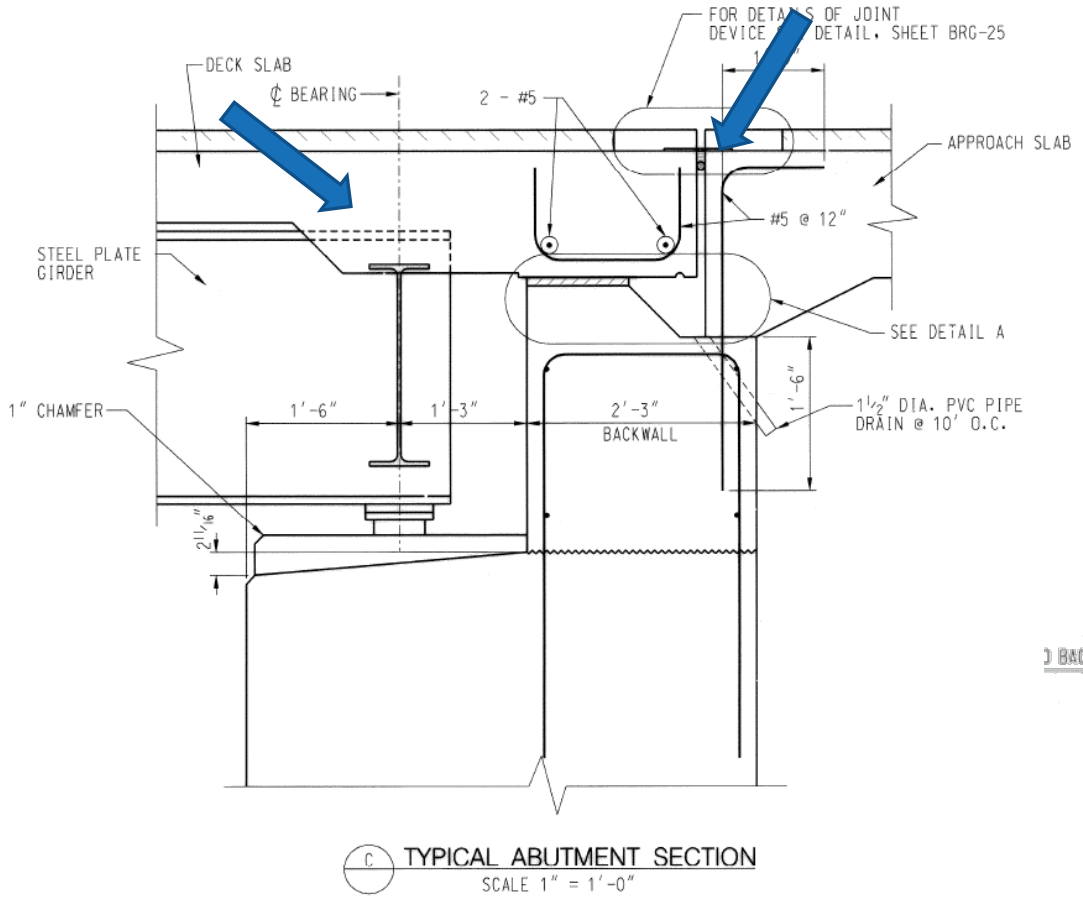
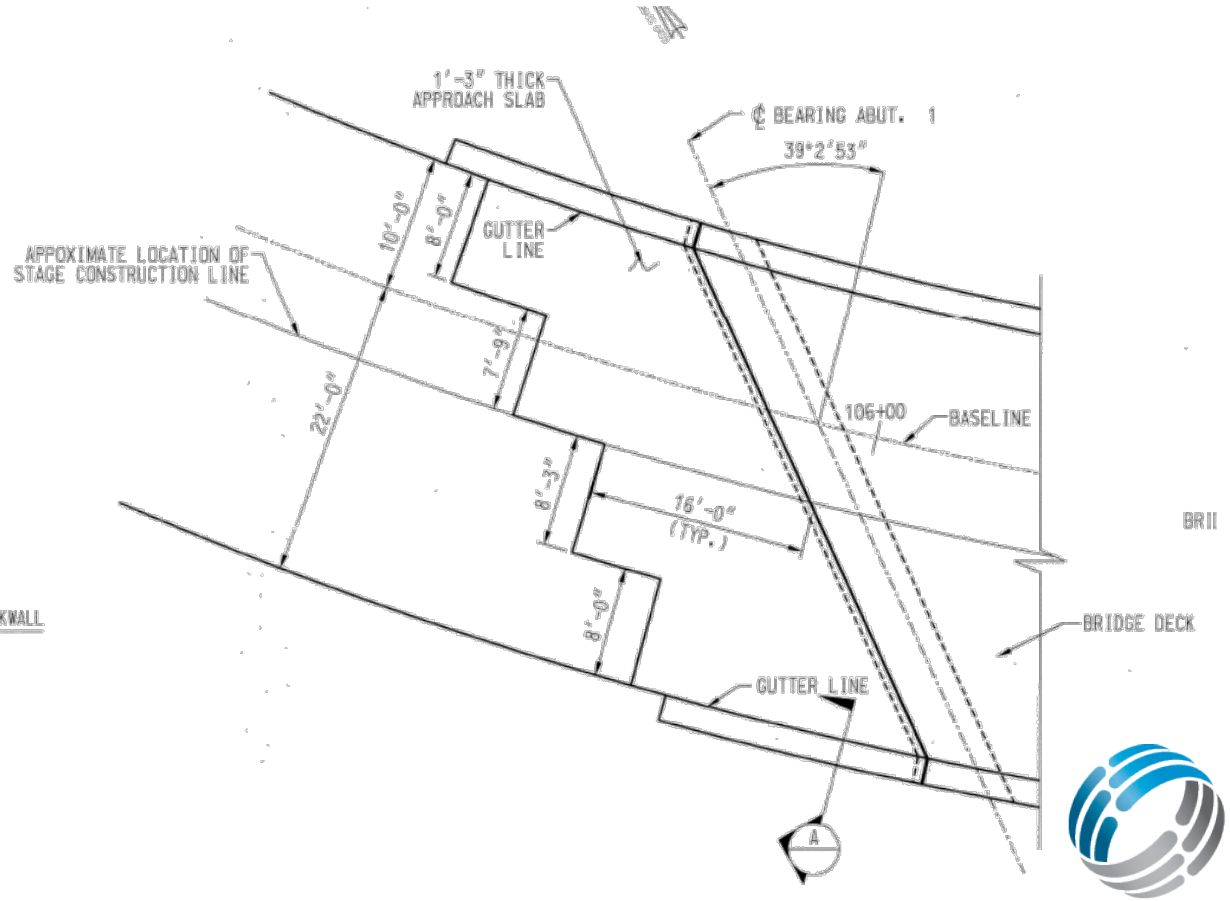
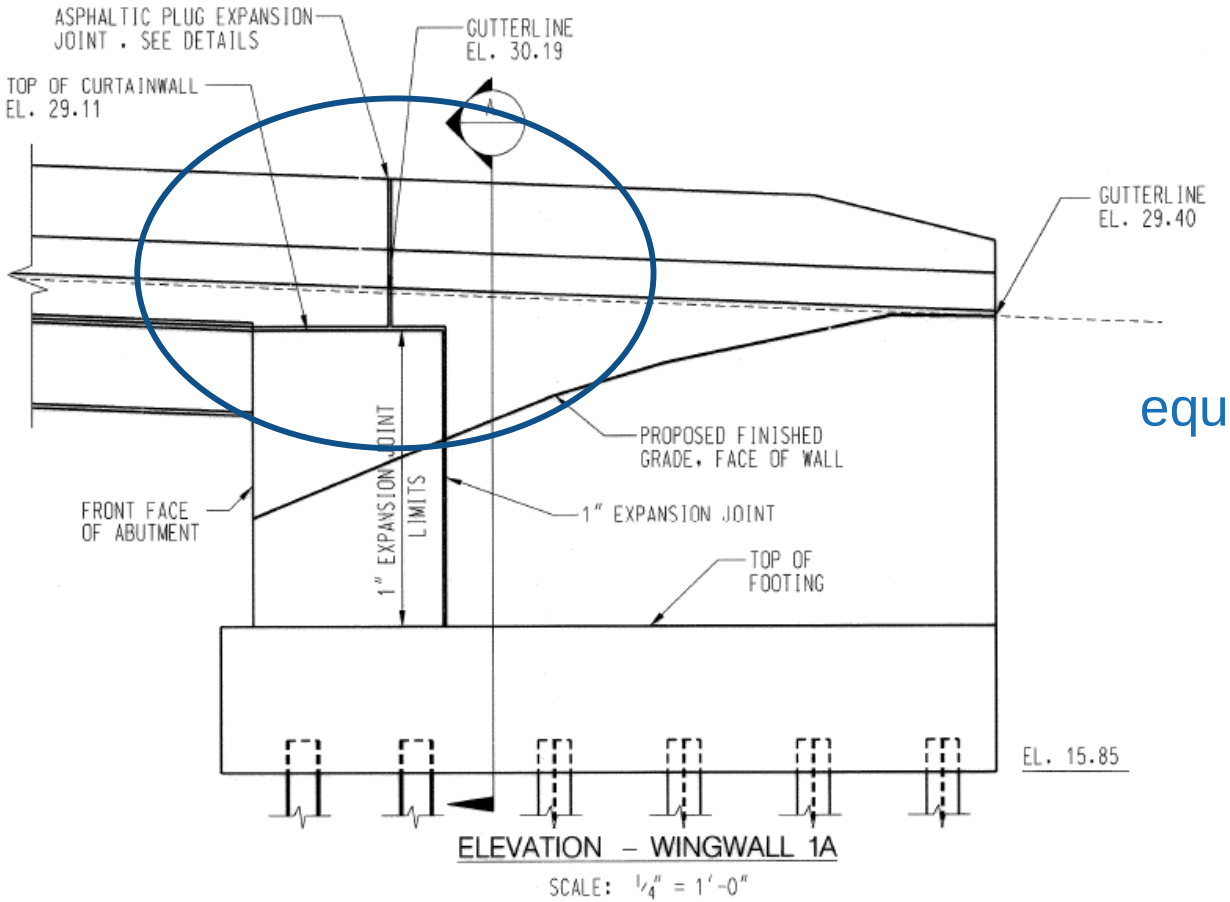
CIP DETAIL EXAMPLES





CIP DETAIL EXAMPLES

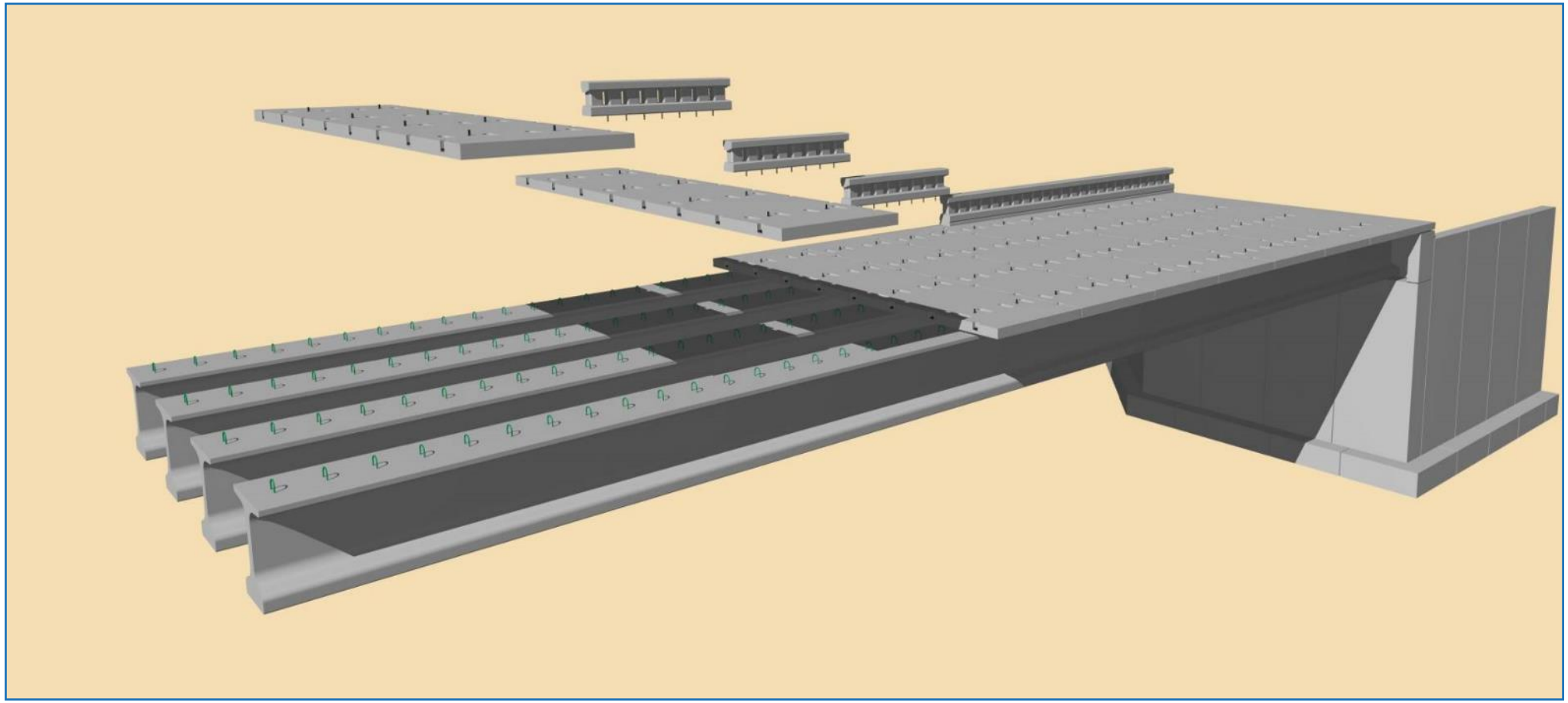


equals

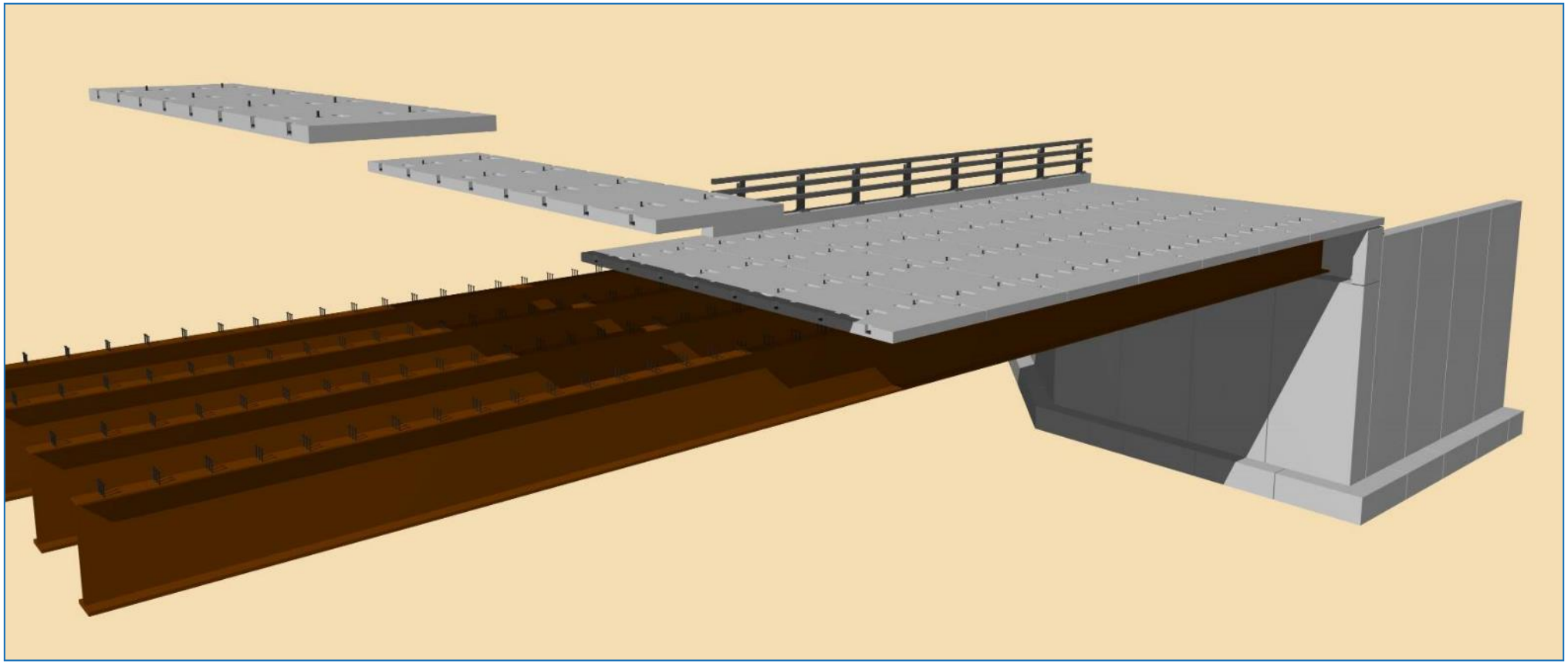
DETAILING FOR SIMPLICITY

- 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

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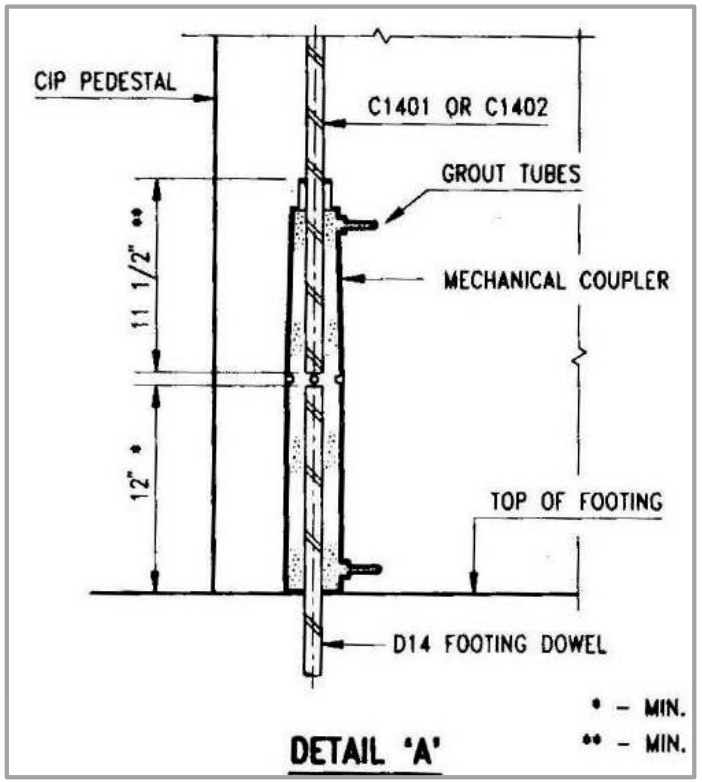
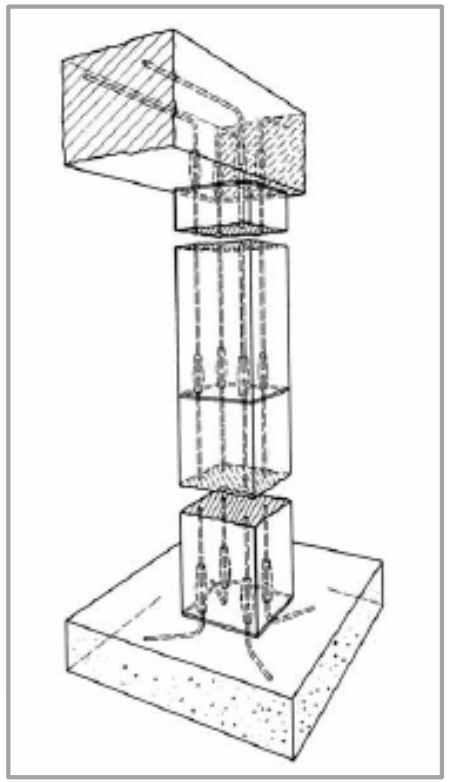
GROUTED REINFORCING SPLICE COUPLERS





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

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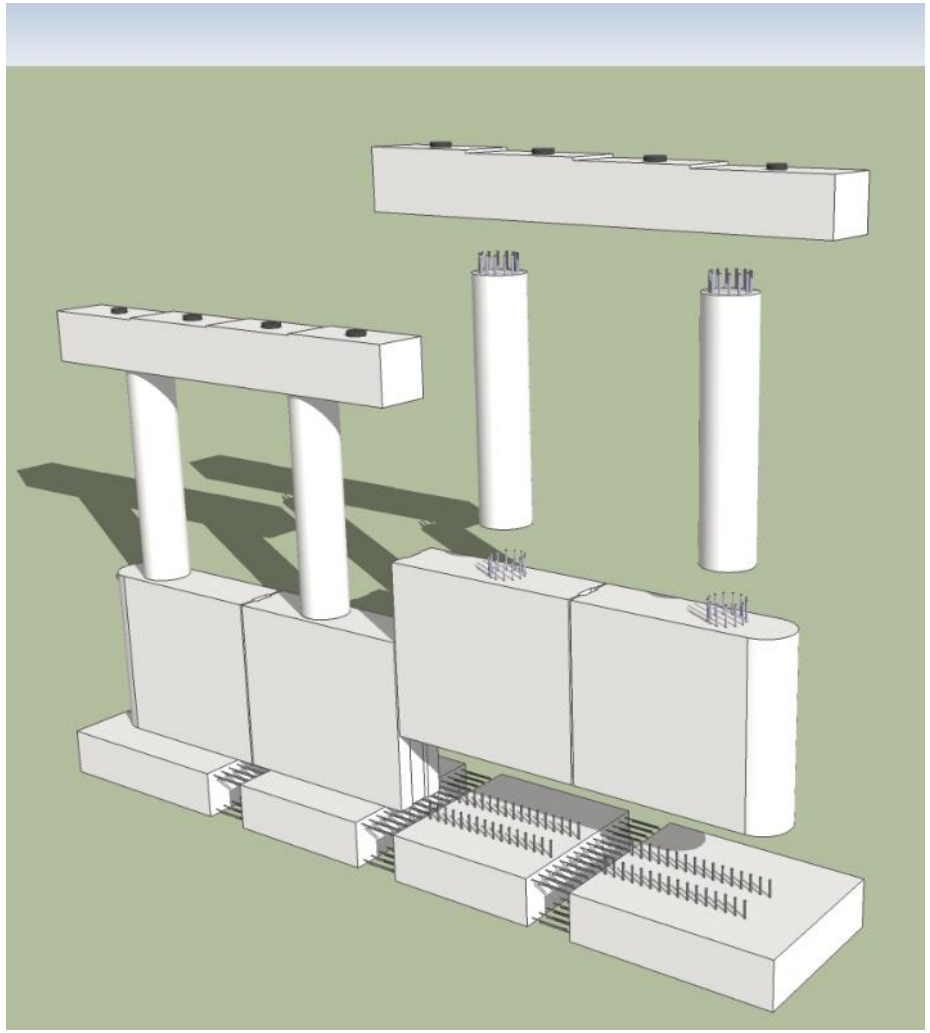
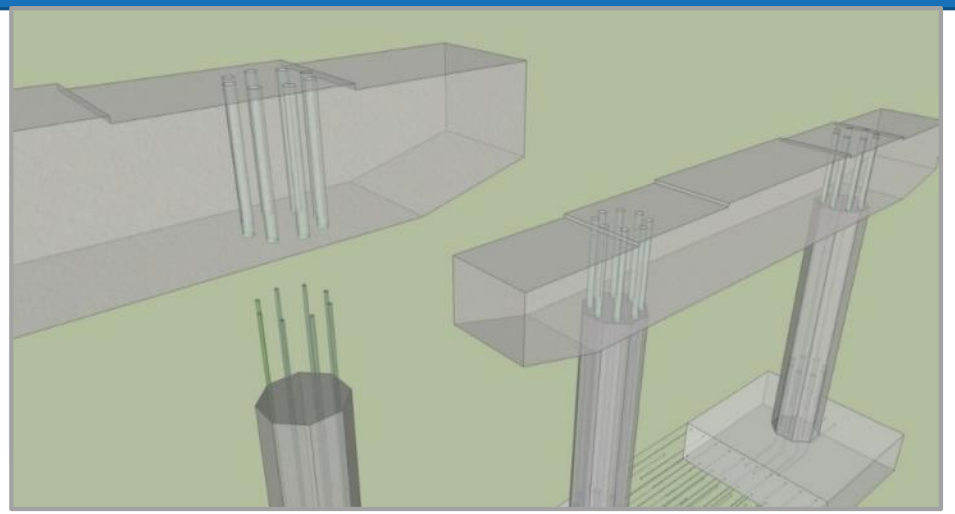
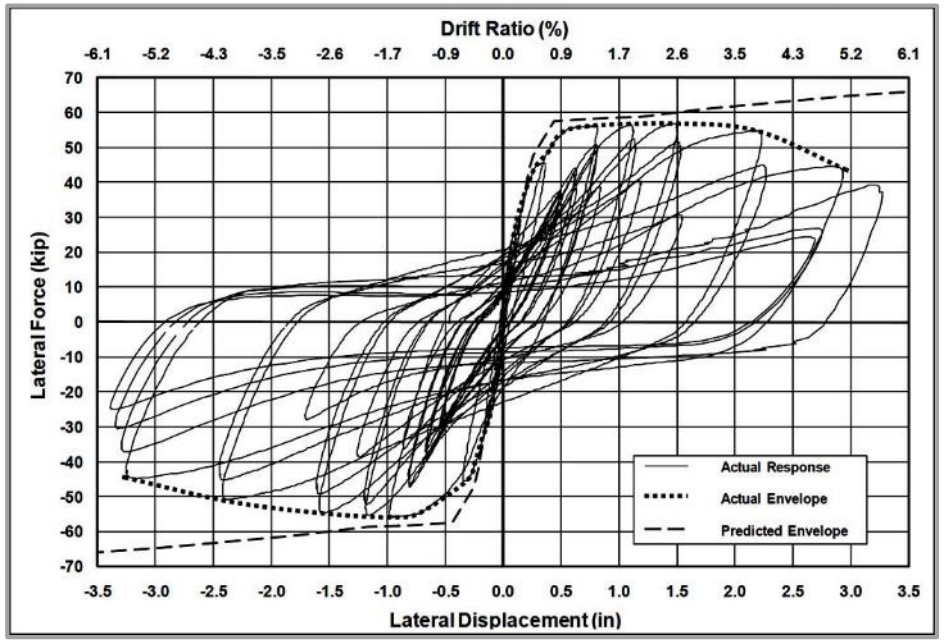
MASSACHUSETTS PROJECT



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





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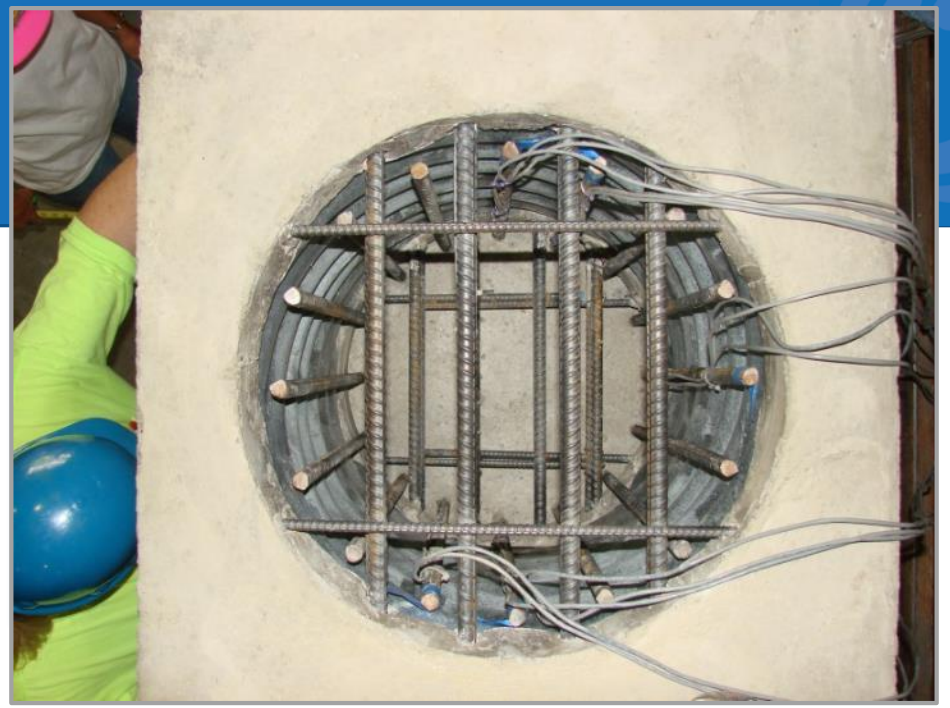
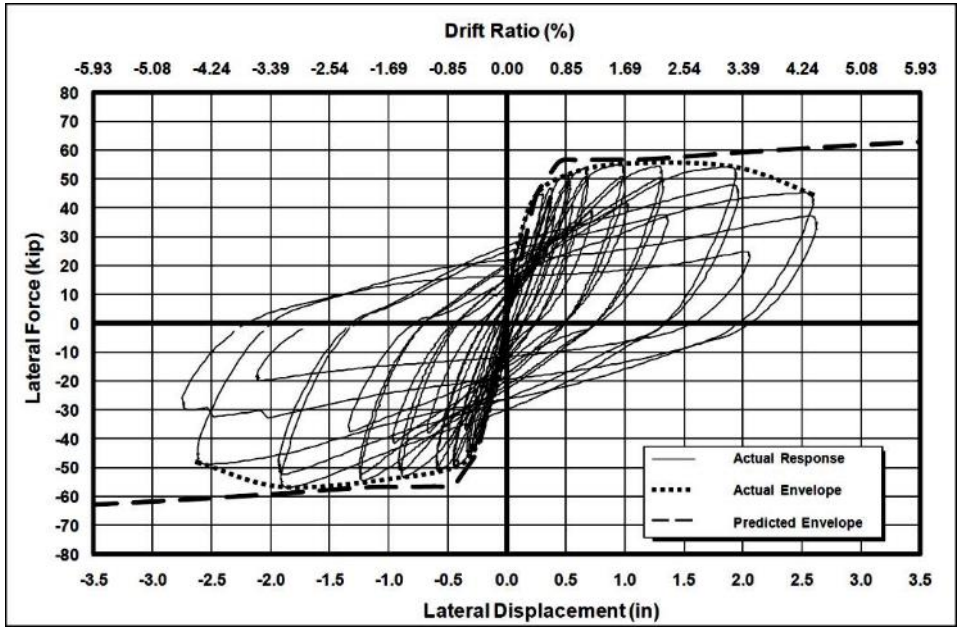
CMP VOIDS

NCHRP 12-74 (seismic)

Requires supplemental reinforcing

Requires temporary support





INTEGRAL ABUTMENT BRIDGES

Superstructure resists soil forces

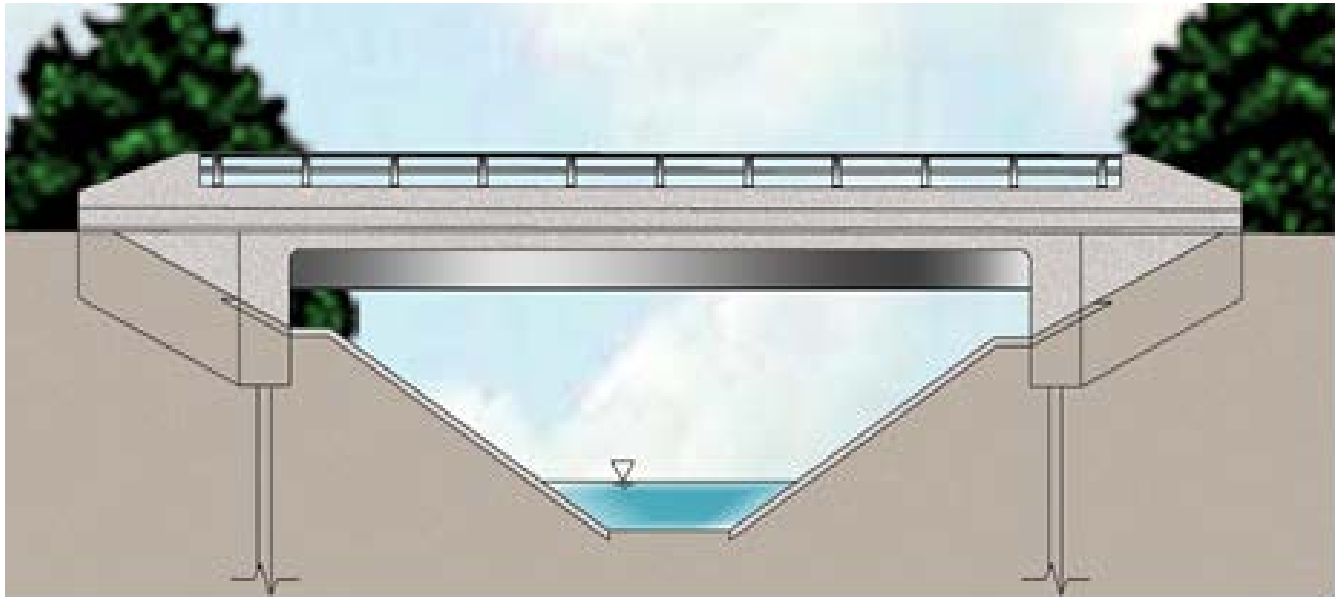
Eliminated footings

Uses fewer piles

Jointless

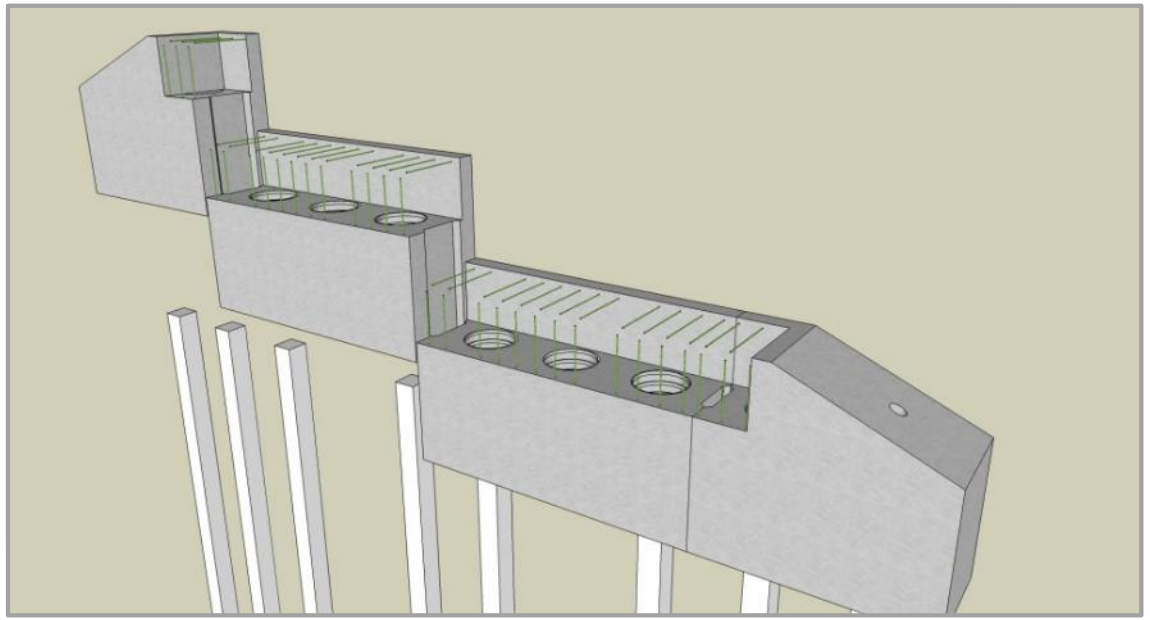
Construction in the dry

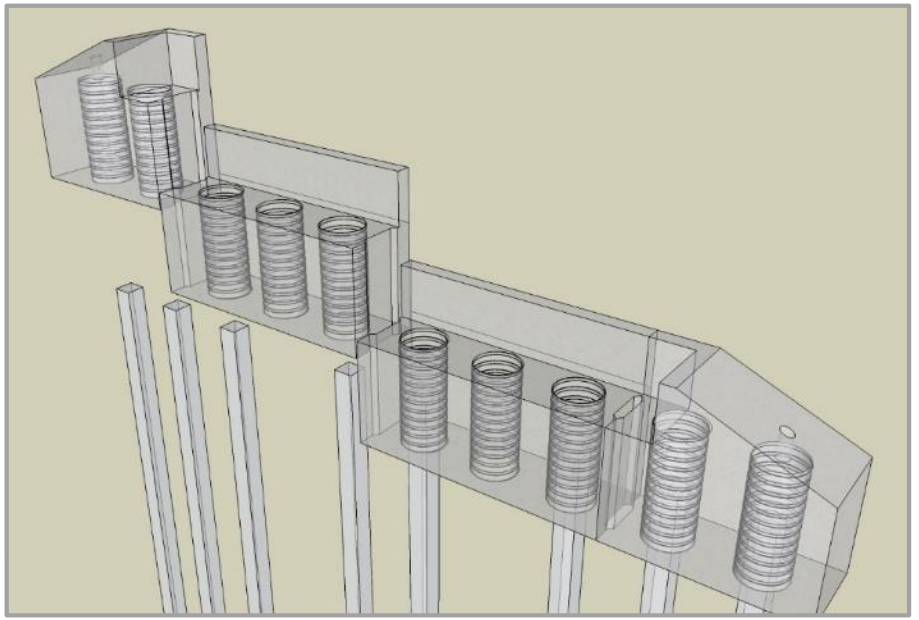
Very cost effective



PRECAST INTEGRAL ABUTMENTS

Corrugated Pipe Void Pockets

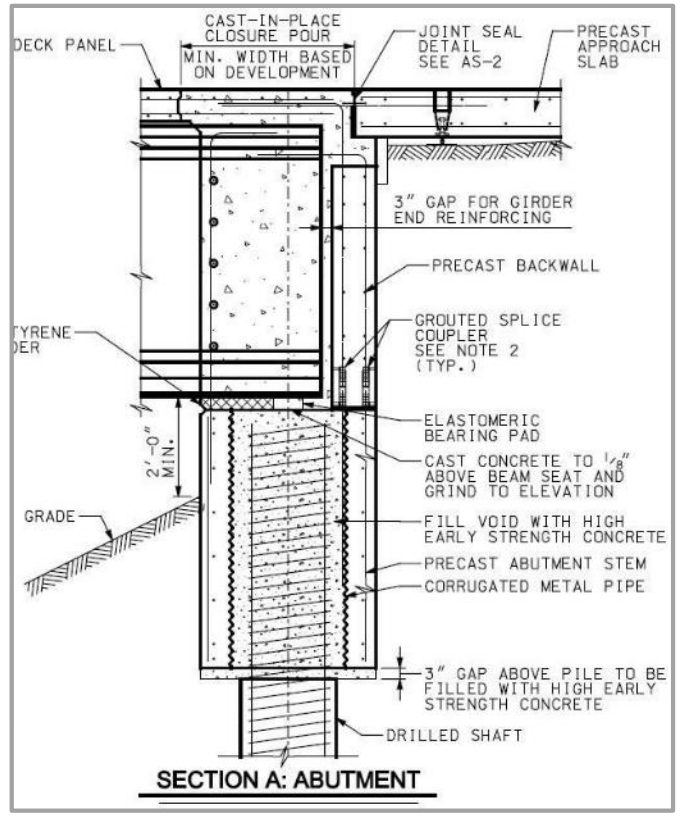




CMP VOIDS

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



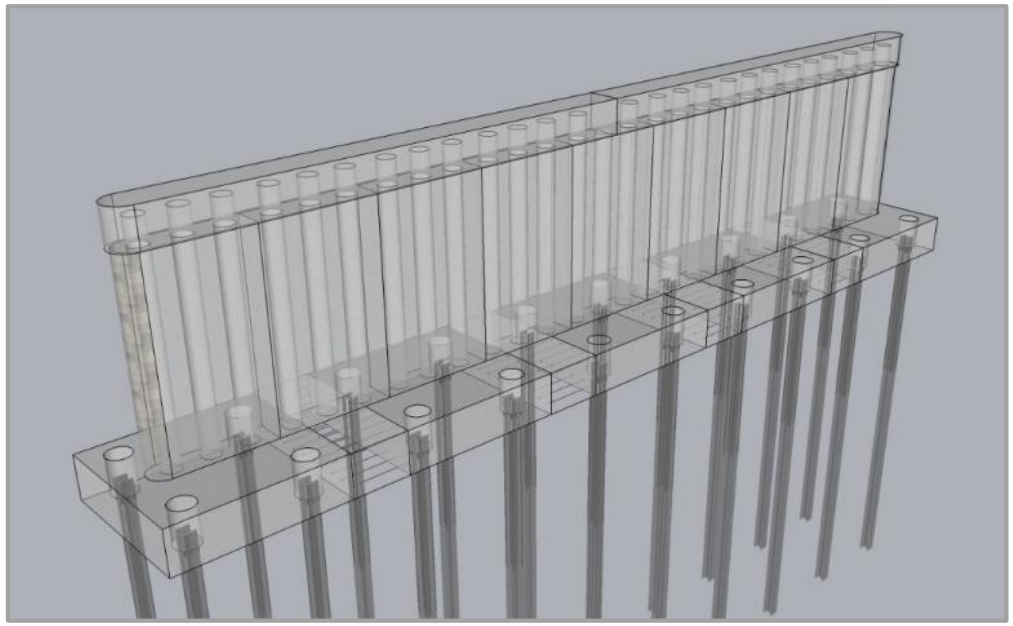
Integral Abutment Project

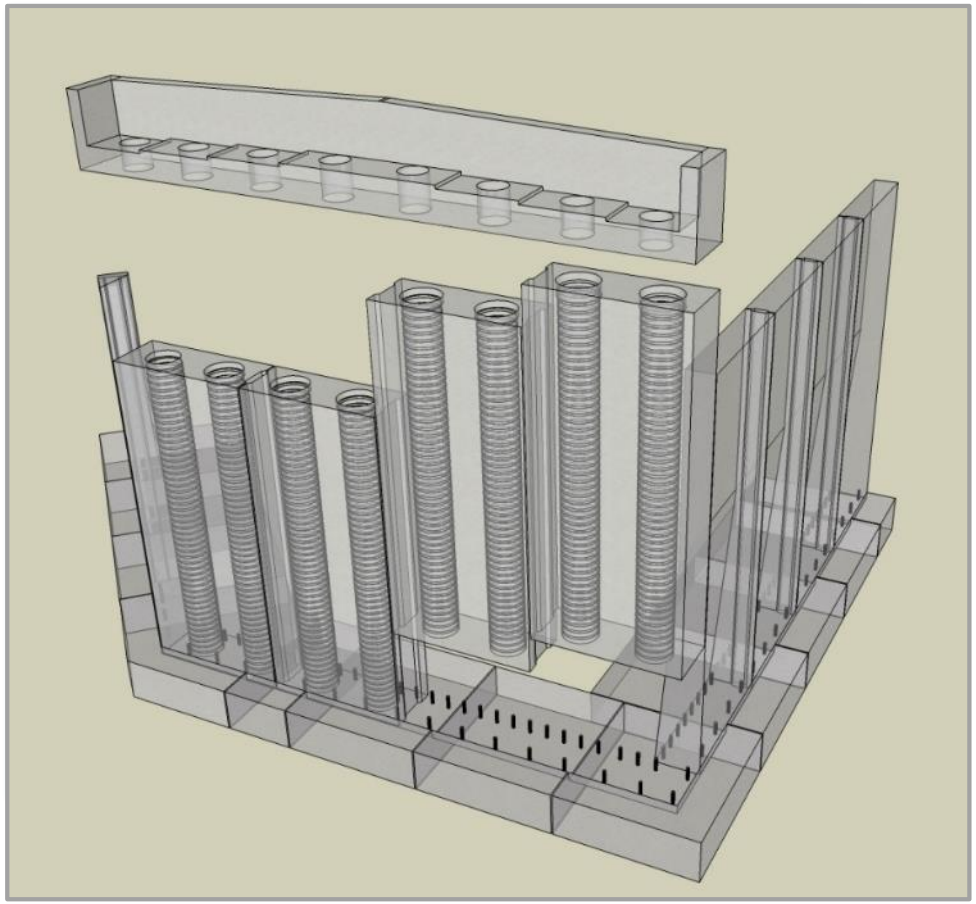
Charlemont, MA

CANTILEVER WALLS

CMP Voids Used to:

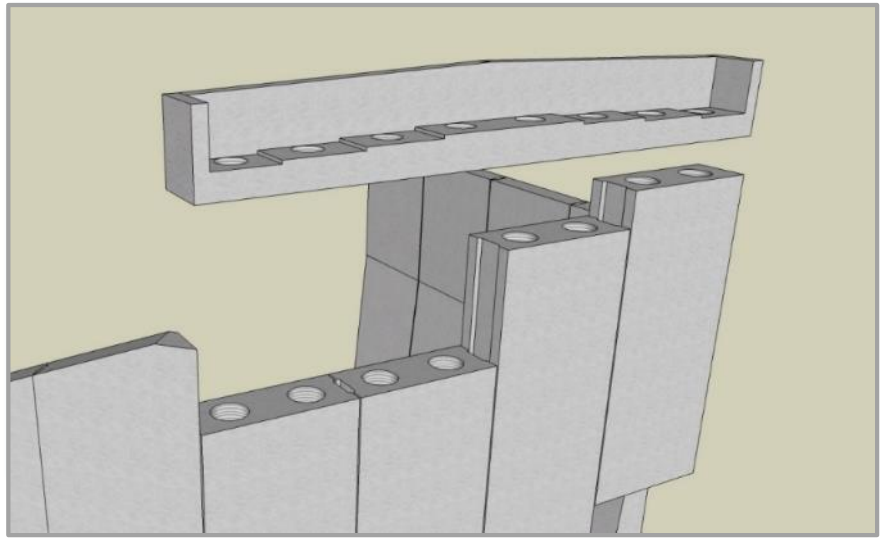
- Reduce weight
- Connect cap to wall stems
- Connect Stub Abutments to Footings

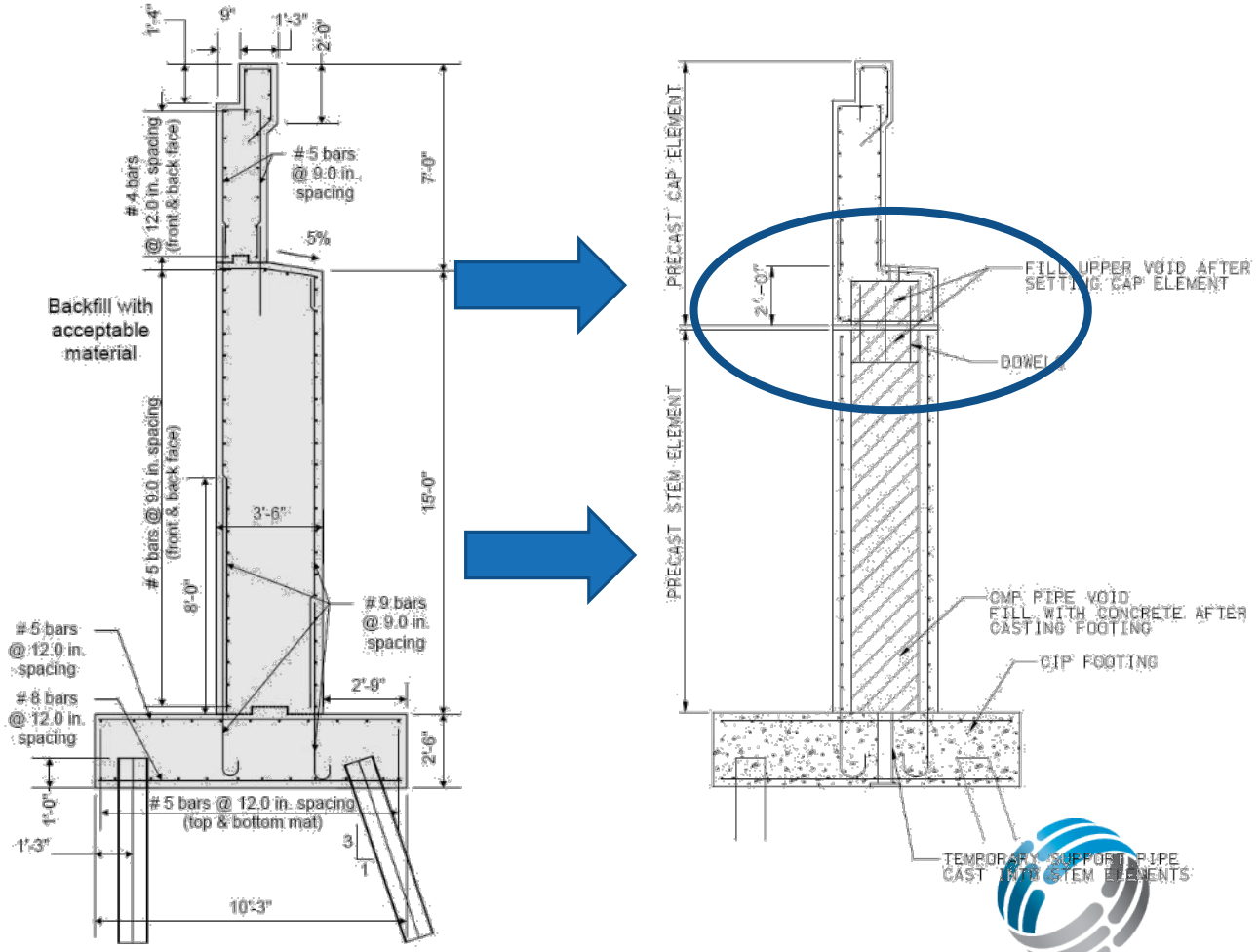




CANTILEVER ABUTMENTS

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





CANTILEVER ABUTMENTS

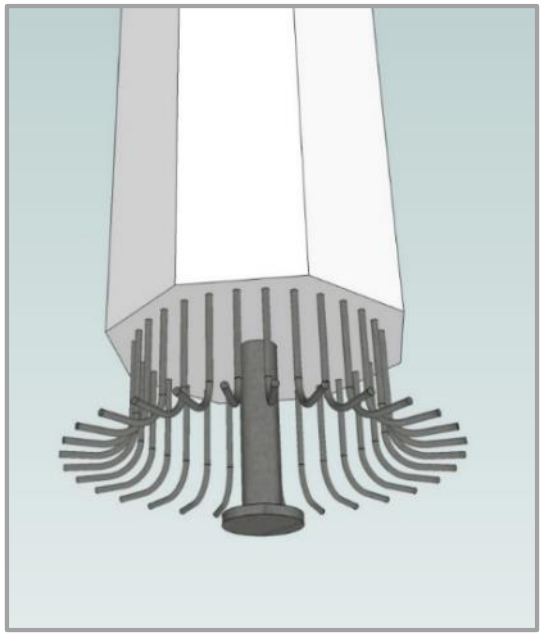
Worthington, MA

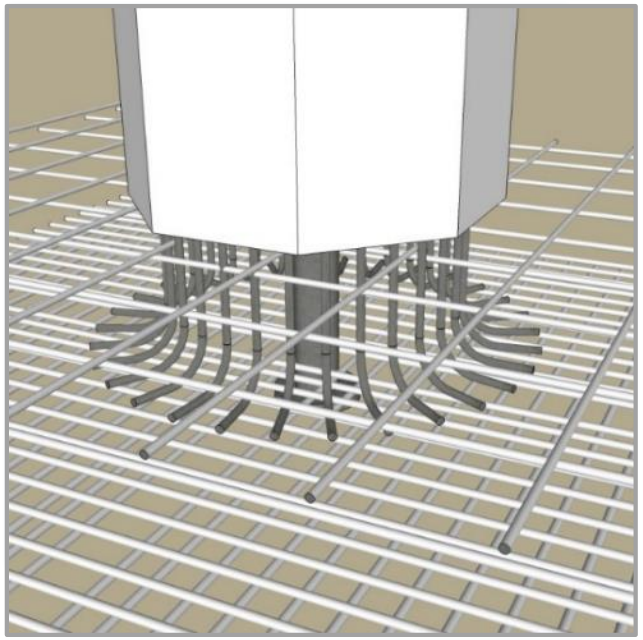
CANTILEVER ABUTMENTS

- Maine DOT Bridge

Pile Supported Footings

CIP Footing with Precast Column

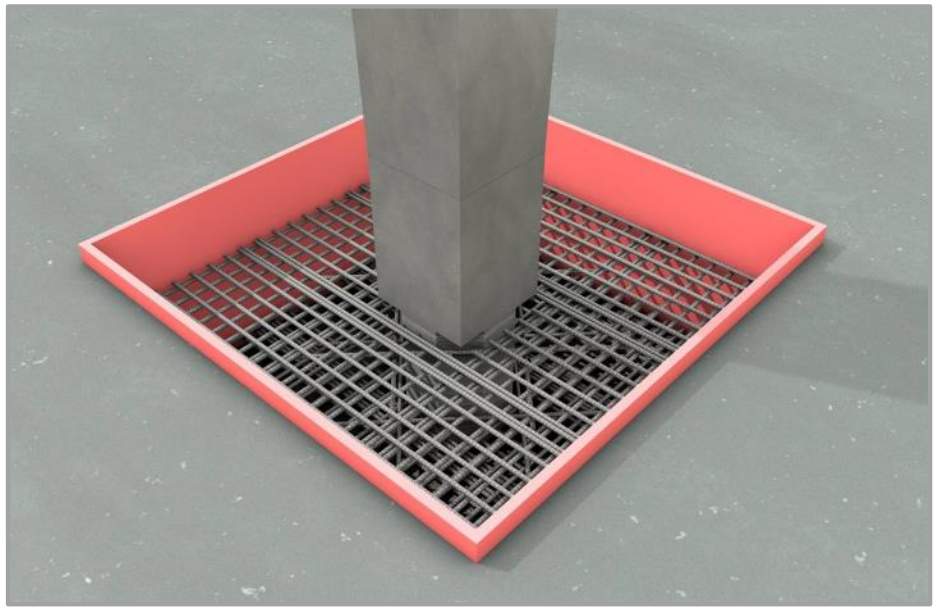




Pile Supported Footings

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

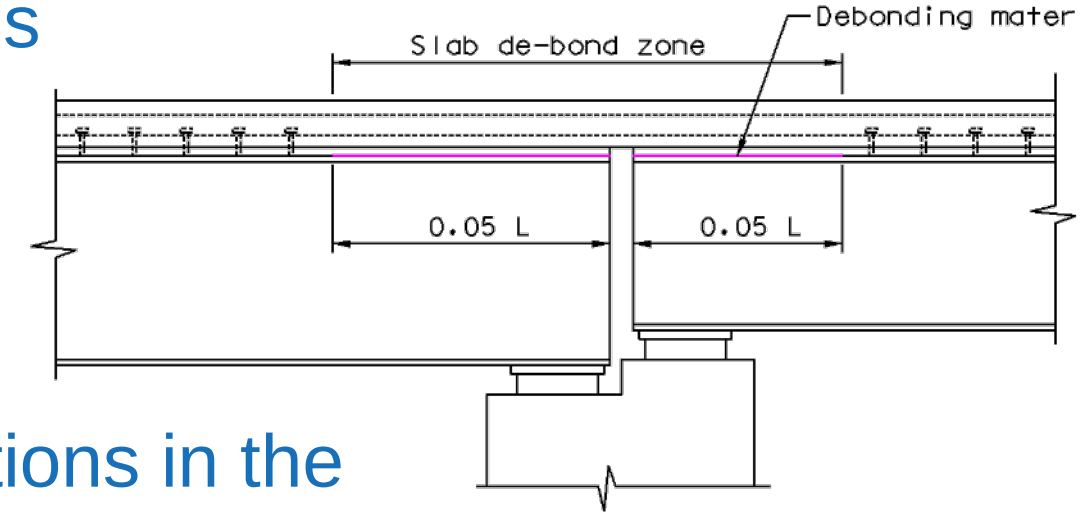
MODULAR DECK BEAMS

- 2 Beams with Precast Deck

MODULAR DECK BEAMS

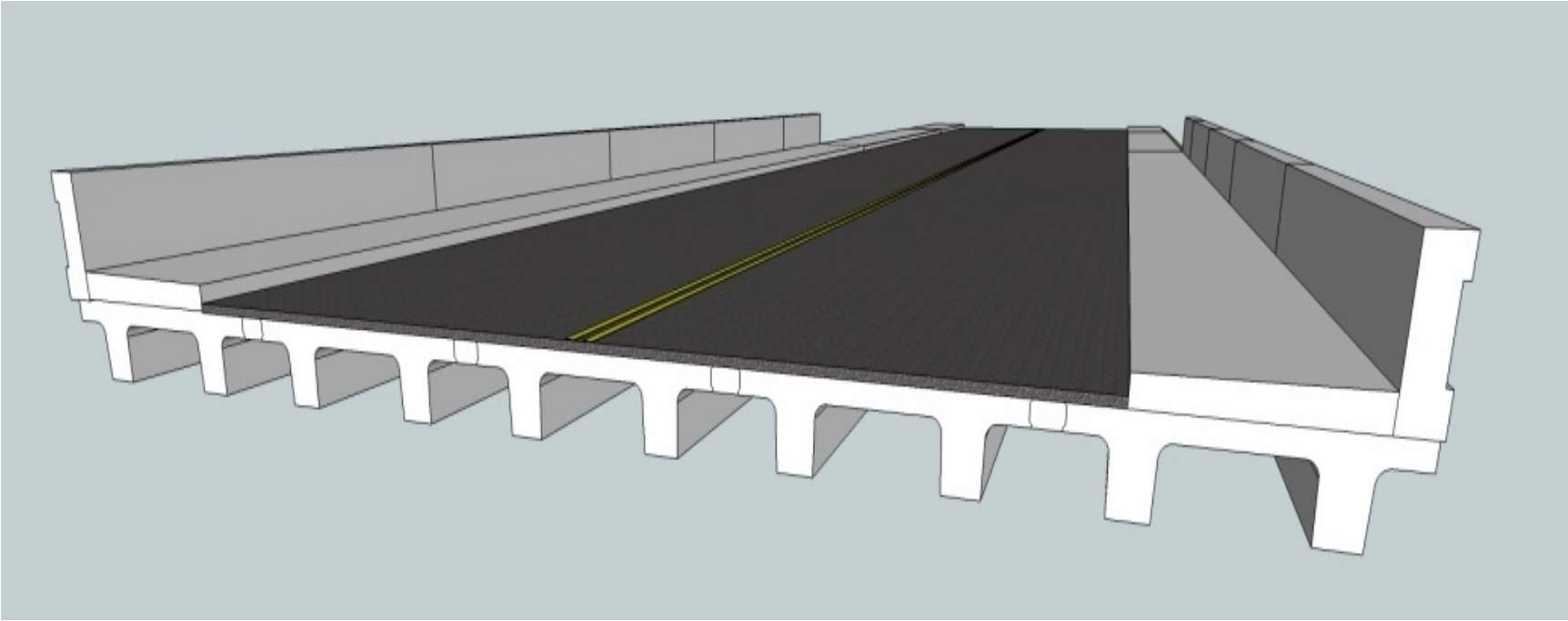
LINK SLABS

- 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

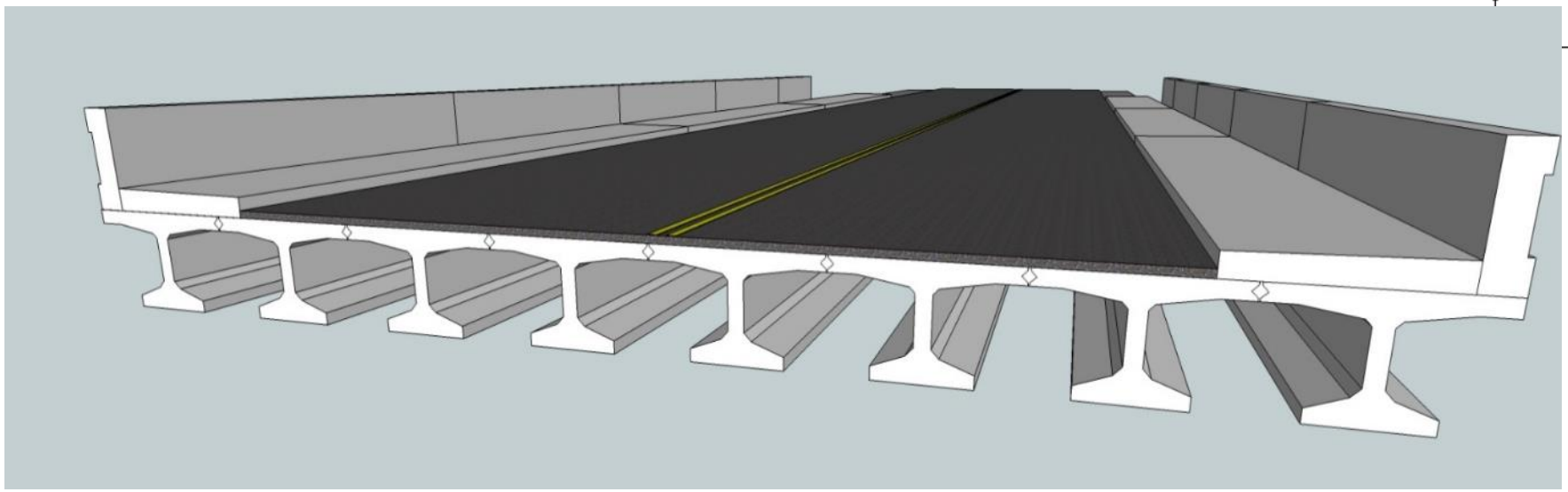
- Precast Double Tee for Bridges
- Developed by the PCI NE Bridge Tech Committee

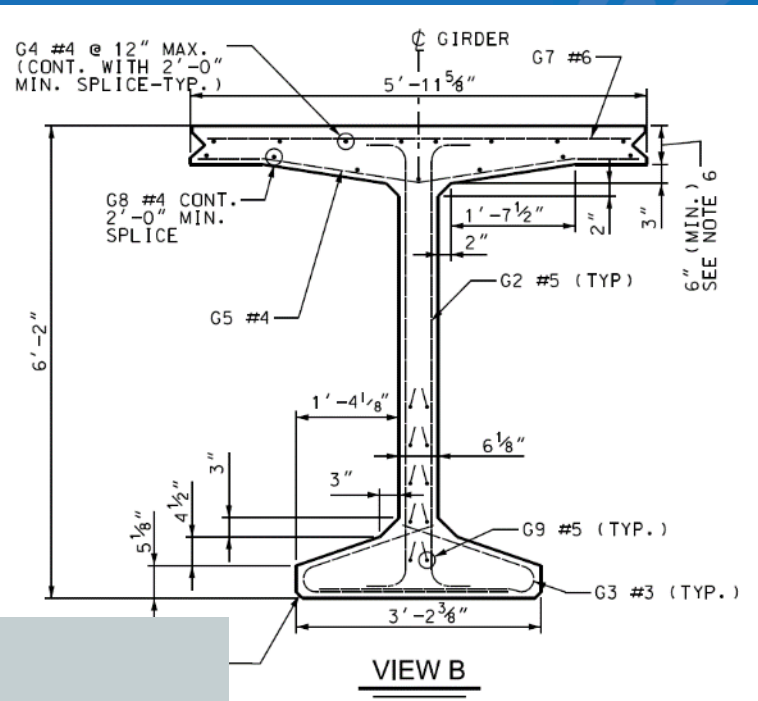


Details at: www.pcine.org

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

culmo@cmeengineering.com