

Precast Substructure Systems for Bridges in Seismically Active Regions

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2011 PEER Annual Meeting*

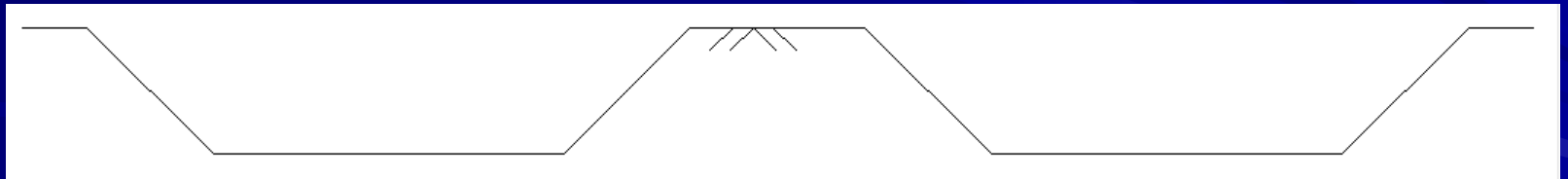
Acknowledgments

- WSDOT
- TRANSNOW
- Valle Foundation
- FHWA, Highways for Life Program
- PEER

Background

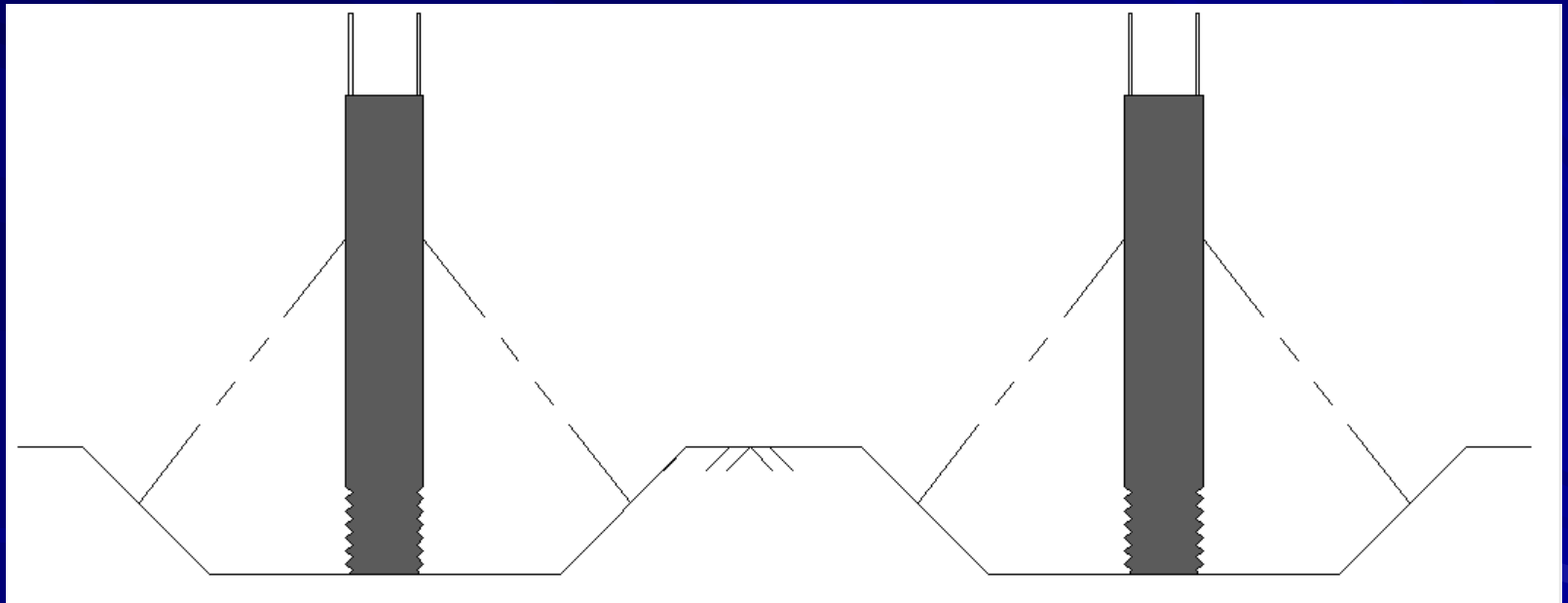
- Family of connections
- Mix and match to suit conditions
 - Large bars in grouted ducts (column to cap beam)
 - Socket connections (column to footing)

Construction Procedure



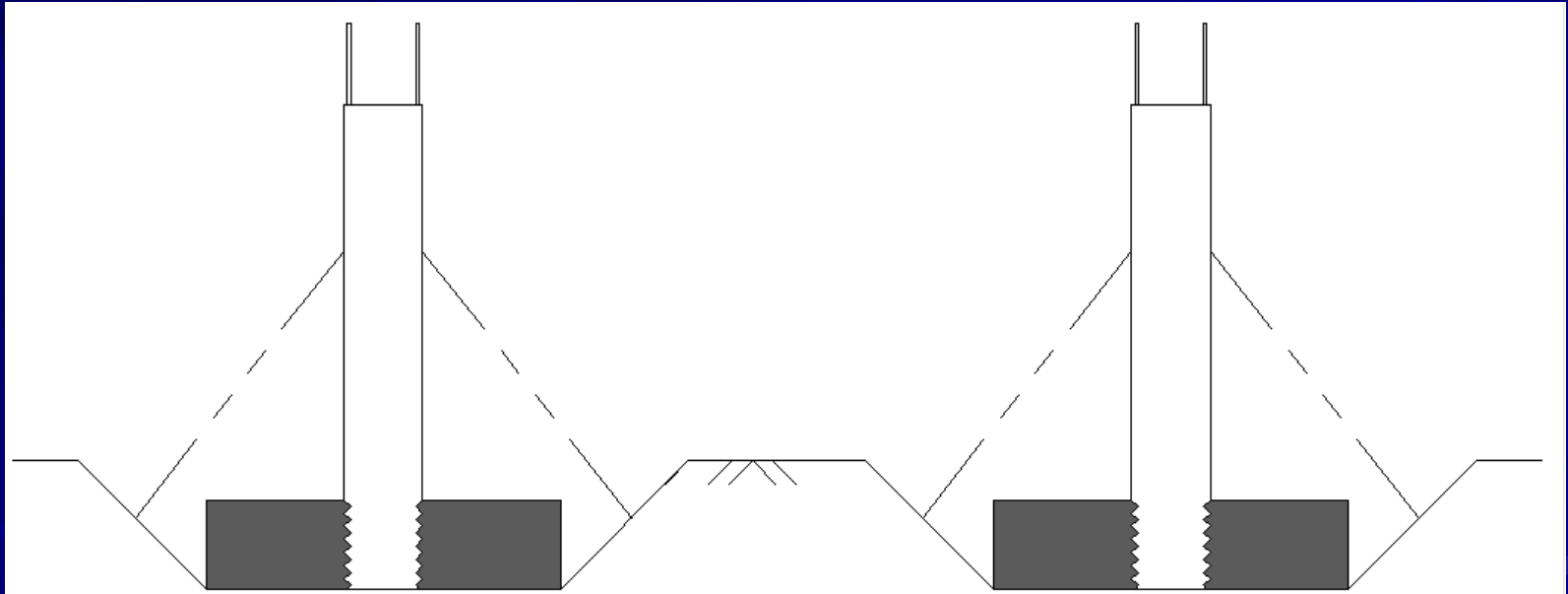
1) Excavate footing.

Construction Procedure



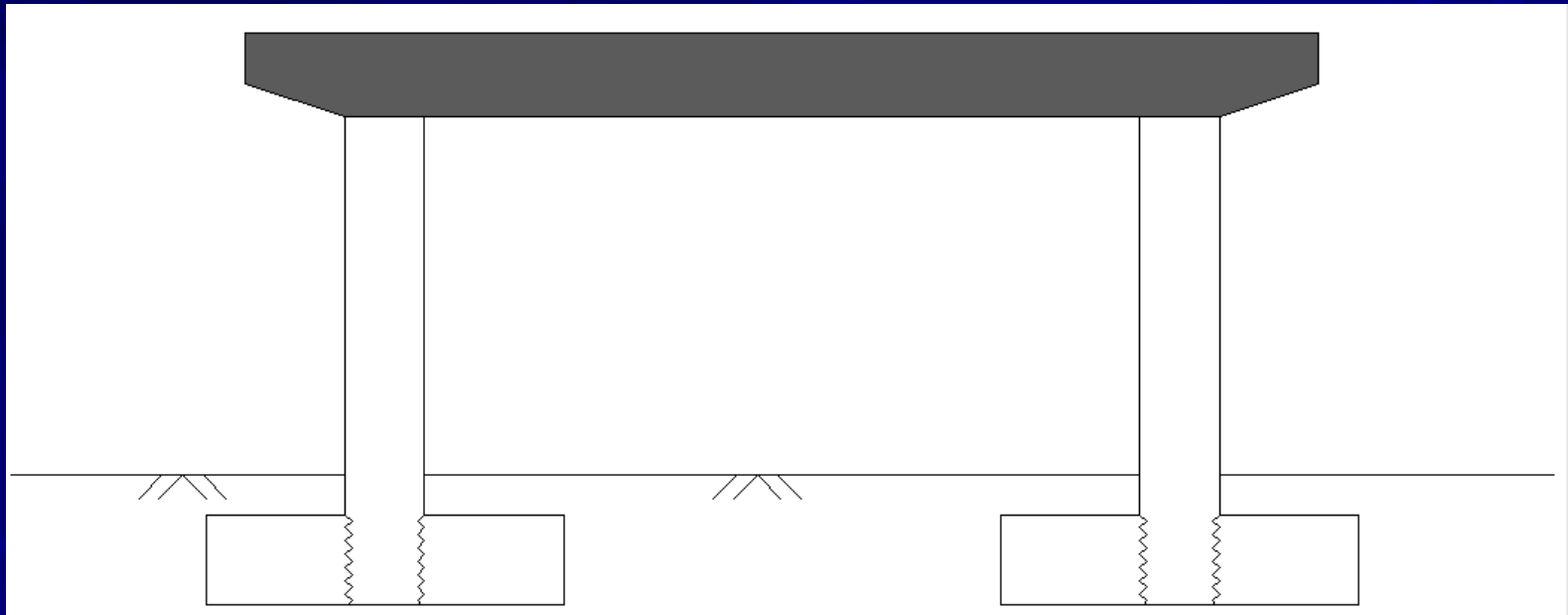
2) Position and brace precast column.

Construction Procedure



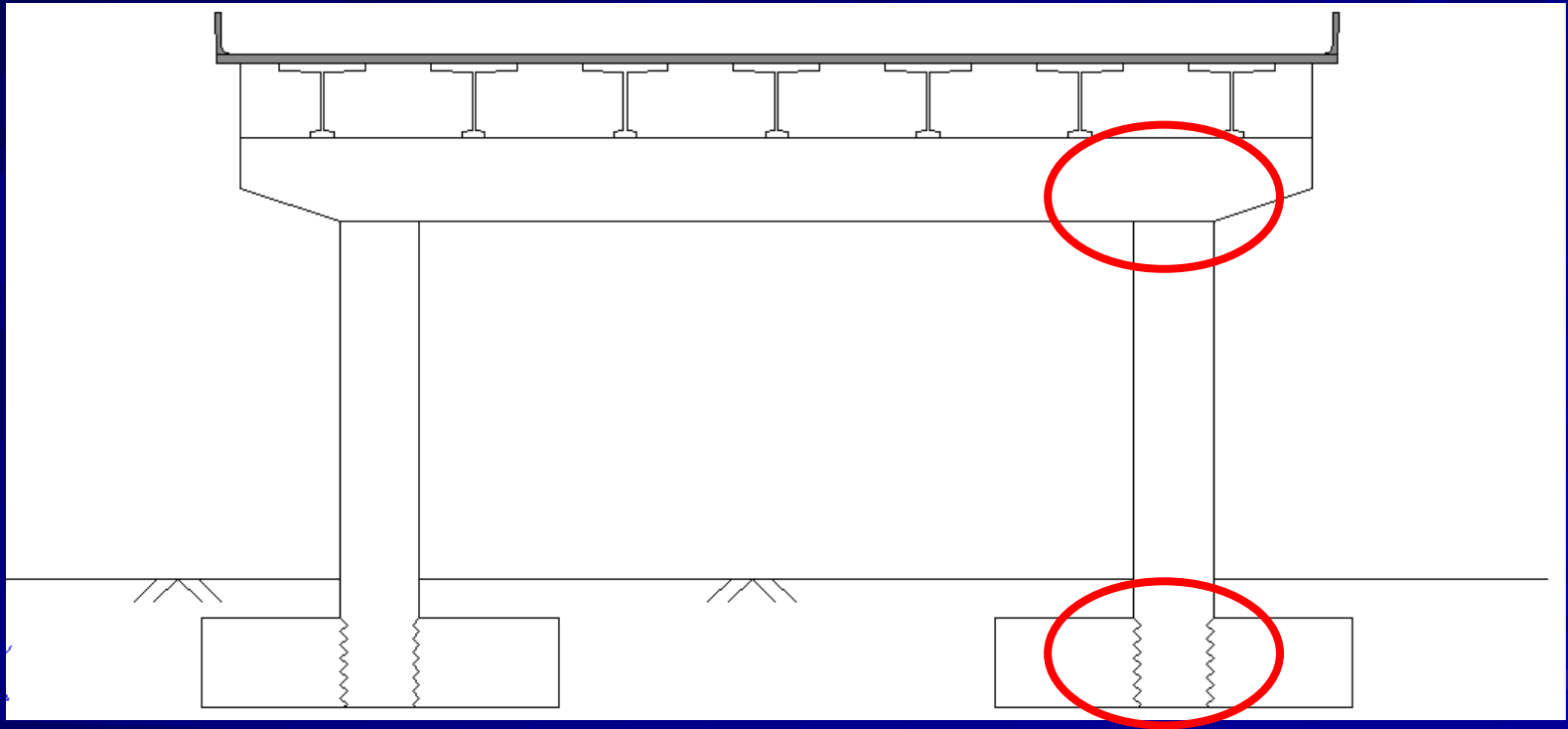
3) Place footing reinforcement and cast.

Construction Procedure



4) Set cap-beam, grout bars into ducts.

Construction Procedure



5) Place girders, diaphragms and deck.

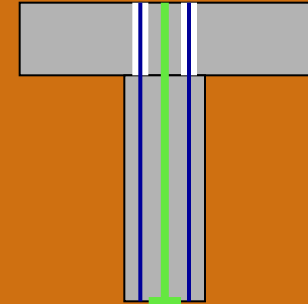
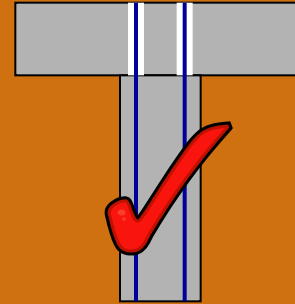
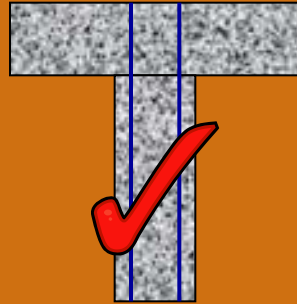
Connection Details

c.i.p.
RC (ref)

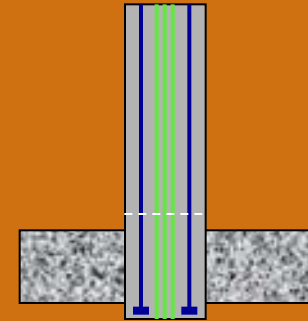
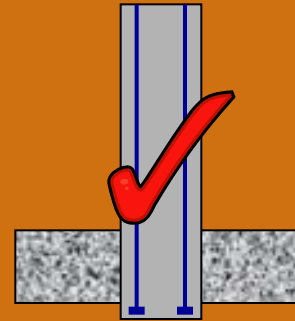
Precast
RC

Precast
prestressed

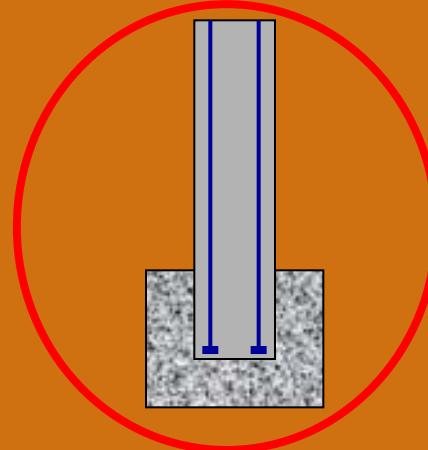
Cap-beam
to column



Column to
spread footing



Column to
drilled shaft

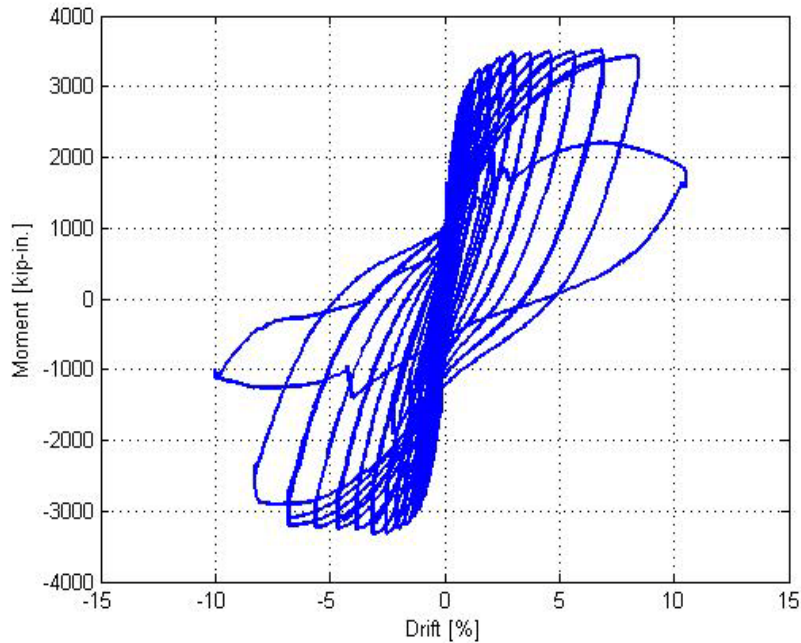


Drilled-Shaft Connection



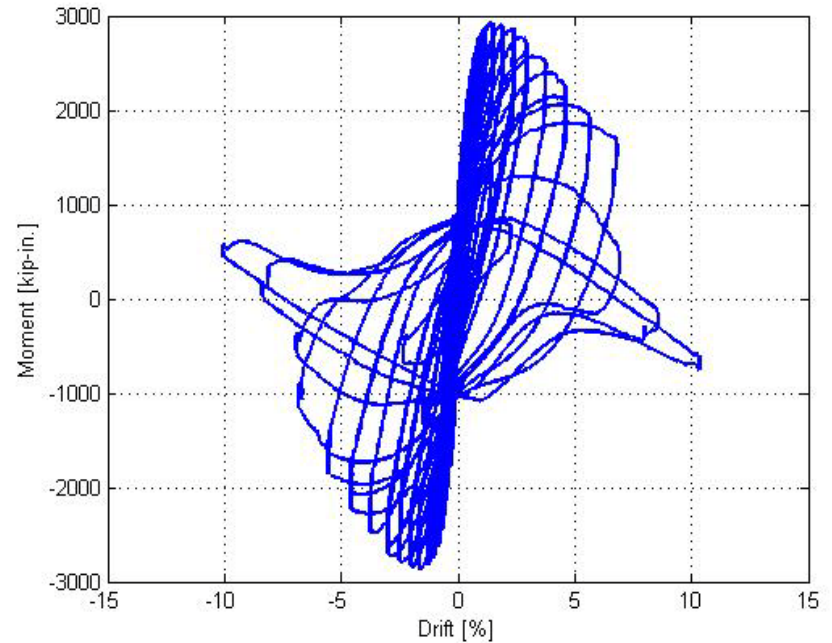
DS-1

- Full transverse reinforcement in transition region



DS-2

- Less transverse reinforcement in transition region



DS-1



DS-2



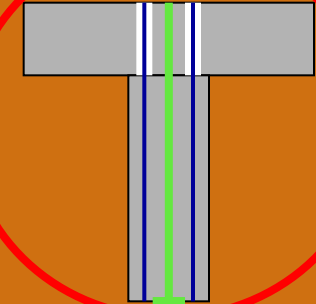
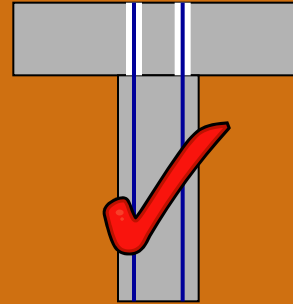
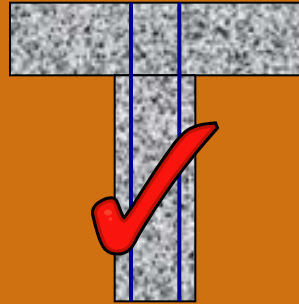
Connection Details

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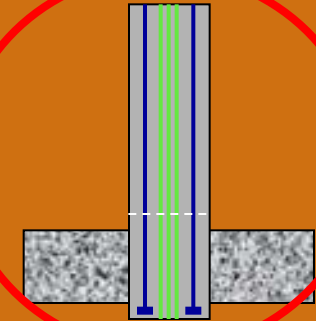
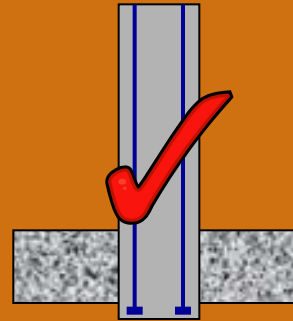
Precast
RC

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prestressed

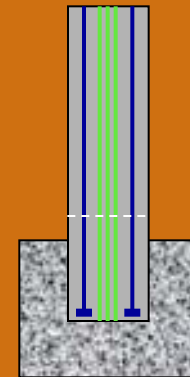
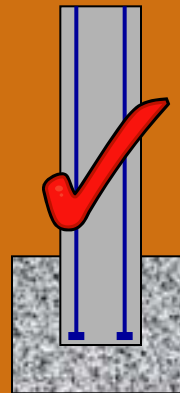
Cap-beam
to column



Column to
spread footing



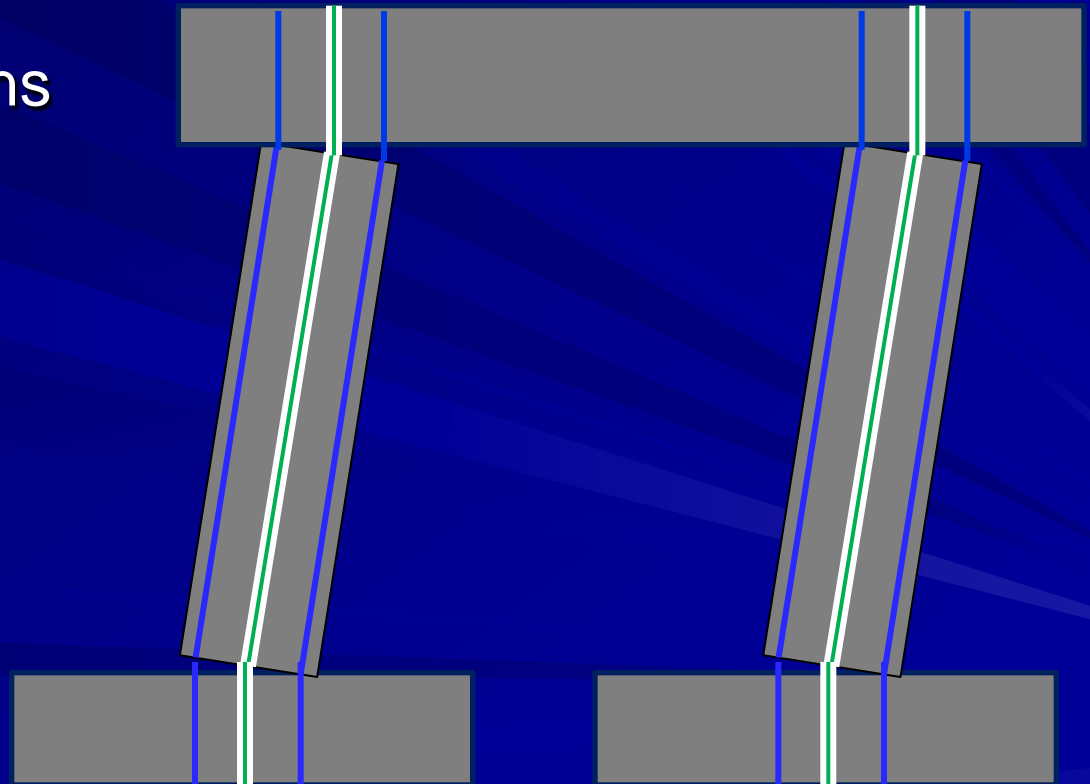
Column to
drilled shaft



Prestressed System

Self-centering structural systems

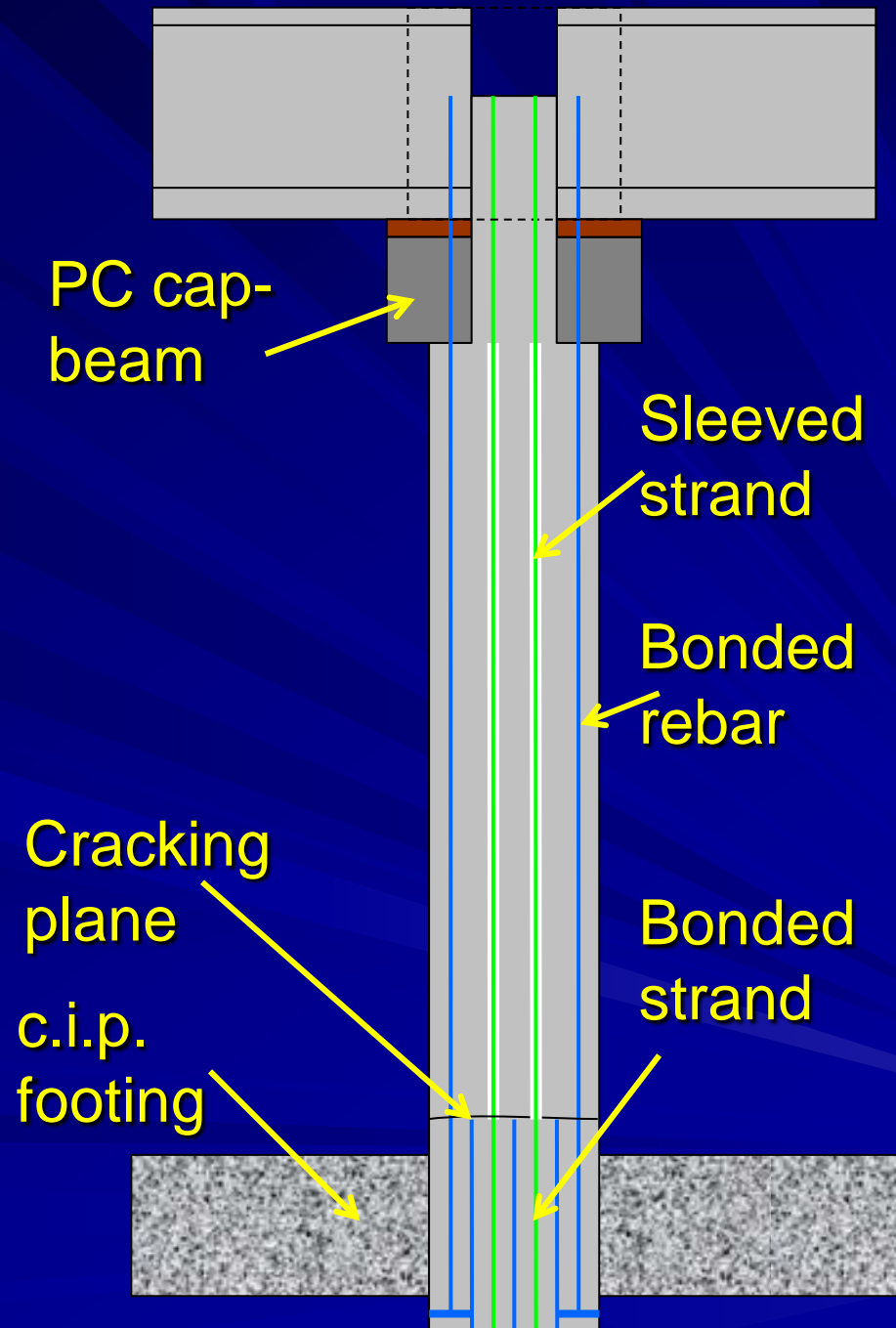
- Unbonded prestressing tendons for elastic restoring force.
- Yielding steel for energy dissipation.



Pre-Tensioned System

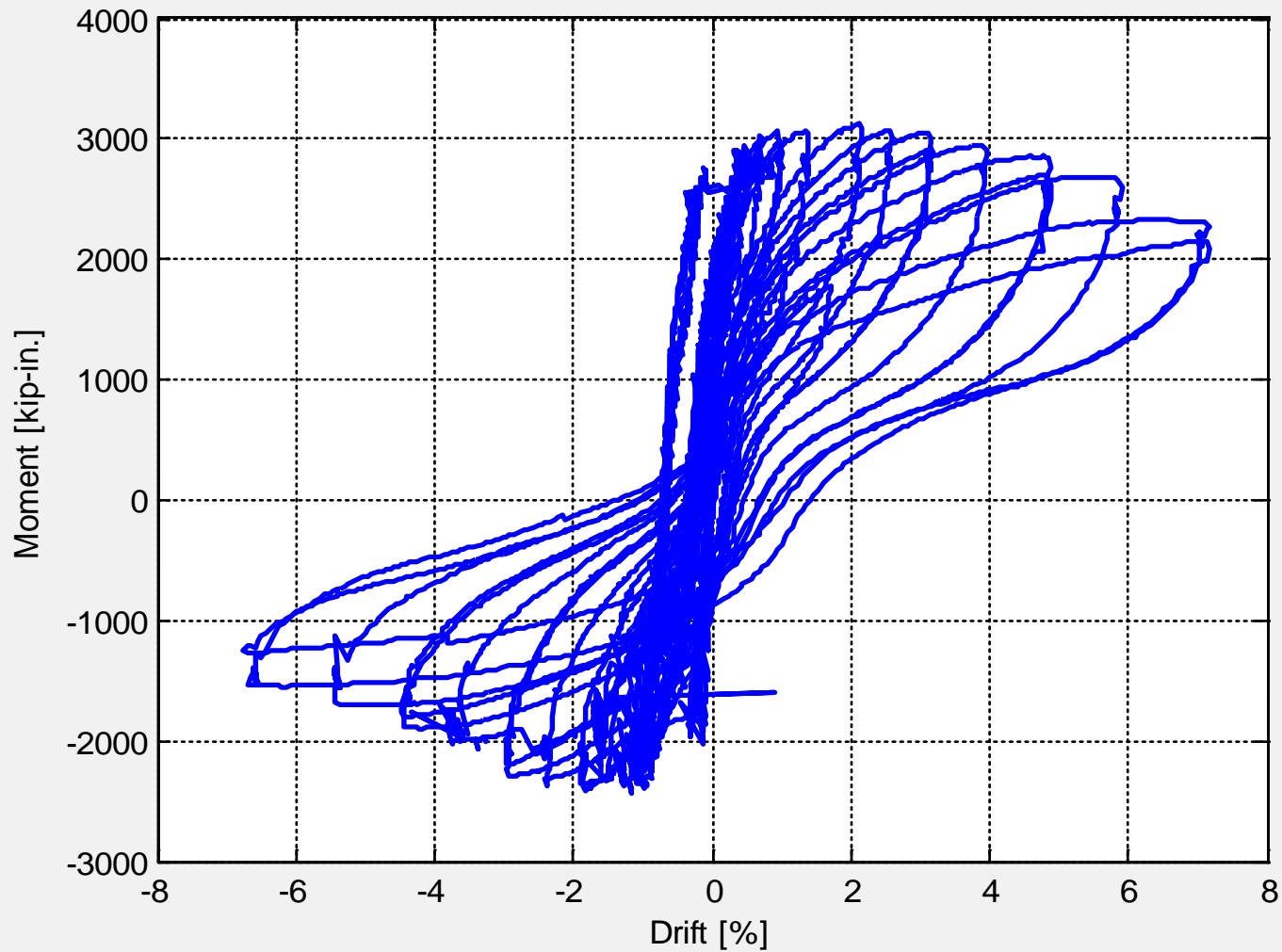
1. Pre-tensioning solves corrosion problems perceived to exist in post-tensioning.
2. Pre-tension in a plant.
 - Good QC.
 - Special equipment and extra site time for post-tensioning are not needed.
 - Can add rebars for energy dissipation.

Pre-Tensioned System





Load vs. Displacement



Preliminary Results

1. Re-centering good up to 4% drift.
2. Failure initiated by bar buckling, followed by fracture.
3. No strands broke.
4. Damage to concrete at interface.

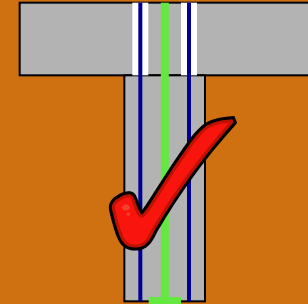
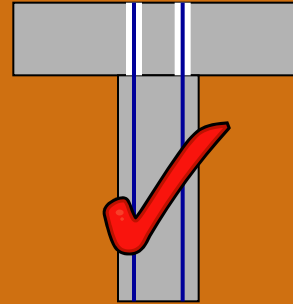
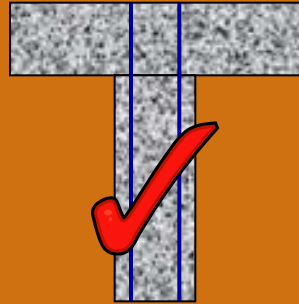
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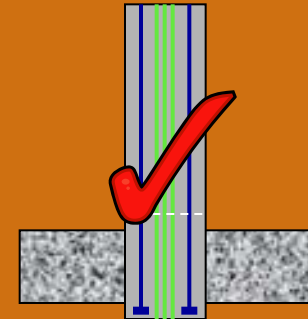
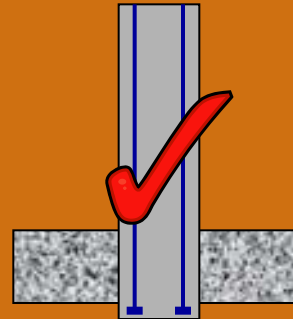
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RC

Precast
prestressed

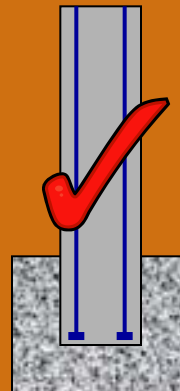
Cap-beam
to column



Column to
spread footing



Column to
drilled shaft



Current Effort

1. Data Analysis
2. Analytical Models (residual displacements)
3. High-Performance Materials
4. Dynamic Tests