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Technical Session 7
Strengthening and Repair
Considerations in Designing Post-Tensioning Repairs

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Presentation Goals

• Recognize factors that influence repair design
• Maintain load path for post-tensioning force during repairs
• Identify and avoid common issues during design and construction
• Understand de-tensioning and stressing operations
Outline

• Define the problem
  – Damage, deterioration, design

• Design the repair

• Construction
  – De-tensioning
  – Potential pitfalls
  – Stressing
WHAT WENT WRONG?
PLANNING AND DESIGN
(UNBONDED MONOSTRAND SYSTEMS)
Structure Information

• Type of structural system
  – One-way slab over beams
  – Two-way slab
    • Distributed
    • Distributed/banded
  – Other post-tensioned elements
    • Beams
    • Balconies
  – Openings/discontinuities

• Repair History
Add tendon anchors!

Construction joints?
Intermediate stressing anchors?
Field verify.
PT Information

• Type of post-tensioning system
  – Bars, buttonhead wires, monostrand
  – Bonded vs. unbonded

• Sheathing
  – Paper wrapped
  – Heat-sealed
  – Push-through
  – Extruded
Force Continuity

24 tendons = ~650 kips
Load-Carrying Capacity

• Evaluation
  – Service loads vs. code-prescribed factored design loads

• During construction
  – Restricted live load
  – Phased repairs
Durability

• Interior conditions
  – Adequate protection at end anchors

• Aggressive environment
  – Encapsulated systems
  – Sheathing repair
  – Surface-level protection

• Protection during construction
IMPLEMENTING REPAIRS
De-tensioning

• Grinder or sawcut
• Flame cut
  – Along length
  – End anchor
• Controlled release
  – Along length
  – End anchor
• Confirm that tension is released for full length of tendon.
Collateral Damage
Displaced wedge and projecting king wire

Retracted strand, missing wedges
Temporary Lock-Off Anchor

- Prevent de-tensioning of full length of tendon
- Sensitive to flatness of bearing surface
- Required sufficient clearance between tendons
- Not designed for permanent installation
Shoring During Construction

• Location of concrete openings
• Loss of tension for tendons through columns
4 de-tensioned tendons

Punching shear crack continues around column
Work near end anchors

- Slab edge
- Future repair opening for tendon parallel to slab edge
- Embedded tendon and anchor
Whoops.
Where is the force going to go?
Phased concrete placement

- New concrete receives post-tensioning force
- Restore force load path
- Accommodate hardware travel during stressing
Impact of Previous Repairs
Impact of Previous Repairs
Impact of Previous Repairs
Stressing

• Target force and elongation
  – 0.6*Pu or 0.65*Pu
  – Reduced creep, shrinkage, and shortening

• Multiple stressing points
  – Center stressing
  – End stressing
• “Short” elongation
  – Interferences
  – Construction joints
  – Binding from corrosion
  – Old PT repairs
Summary

• Address the problem
• Potential shoring requirements
• Maintaining load path for post-tensioning force
• De-tensioning challenges
• Construction pitfalls
• Stressing
Questions?

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