

# The Importance of the Grout Pocket Integrity in Unbonded Post-Tensioned Structures

Gabriel Jimenez, Ph.D., P.E., S.E., P.Eng.

Senior Principal

WALTER P MOORE

May 5, 2014

Norfolk, VA



- Background
- Specification
- Case Study
- Recommendations

## Outline





## Typical Design & Construction of PT Structures (Encapsulated)





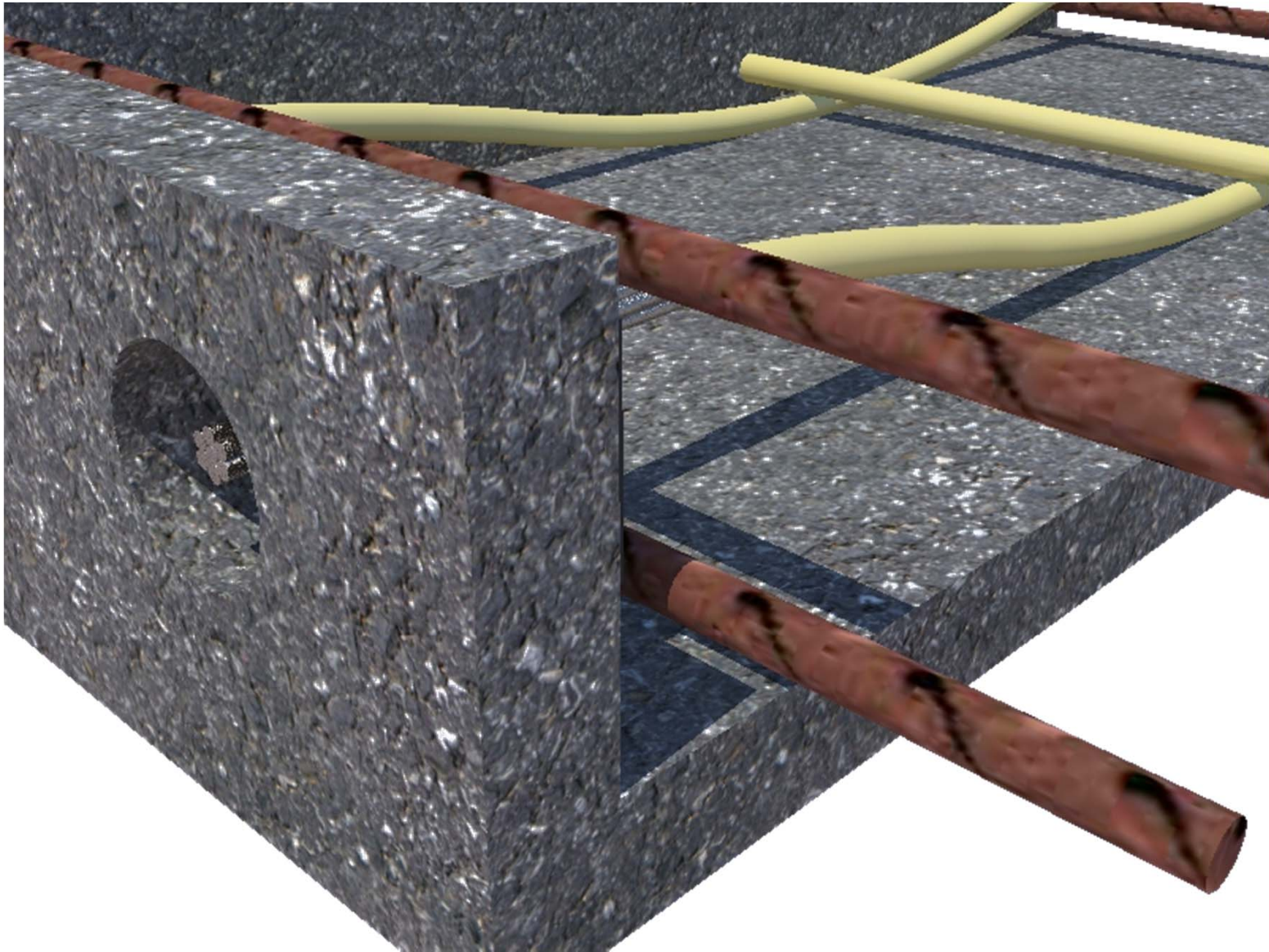
- Typical one-way PT system
- In non-aggressive environment, up to 12" of exposed strand is allowed in fixed ends
- Up to 1" is allowed in the stressing end
- Min. cover from exterior edge to wedge cavity area = 1.5" (non-aggressive)





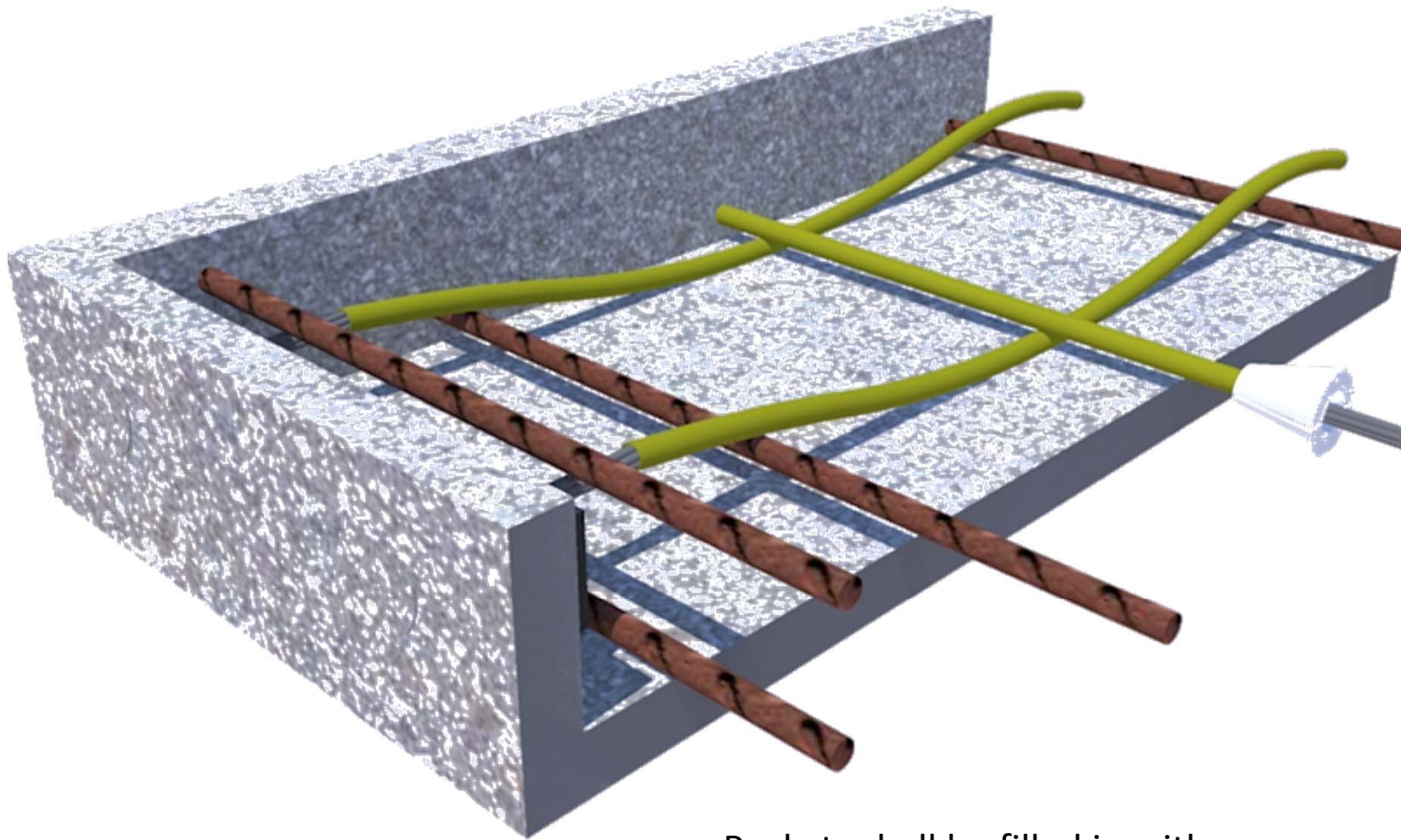
## Group pocket after stressing

- Construction debris, form release residues



- Strand protruding beyond wedges after cutting (0.5" & 0.75")
- Tendon tail should be cut immediately after elongation is approved





Pockets shall be filled in with:

- Non-metallic
- Nonshrink
- Chloride-free grout

ACI 423



## Frequently Asked Questions

### Proper Filling of Single-Strand Tendon Stressing Pockets

Answer from the PTI DC-70 Special Topics Committee

Revised July 2010 • Issue No. 11

Primary Author:  
Bob Sward

**Q** What is the proper material and procedure for filling single-strand tendon stressing pockets?

**A** As the first line of defense for the corrosion protection of the stressing anchorage, a quality stressing pocket patch is essential for the long-term durability of the post-tensioning system. A premixed cementitious non-shrink grout described in the following and applied correctly to a well-prepared surface is required for filling single-strand tendon stressing pockets.

A product best suited as a patch material is a high-quality premixed cementitious chloride-free non-shrink grout, mixed with limited amount of water per manufacturers' recommendation for use as repair material. These repair grouts are designed specifically for filling concrete voids in vertical and overhead applications and are suitable for filling single-strand stressing pockets. All major cementitious material suppliers have prepackaged non-shrink grouts.

The key to a quality stressing pocket patch is the use of the right patch material, the recommended surface preparation, and the proper mixing and application. These repair grouts must be mixed, applied, and cured per the manufacturer's recommendations. Stressing pockets should be free from all PT coating, grease, form release agents, dirt, loose concrete, debris, or any deleterious material. Although it is accepted practice to place a small amount of PT coating or grease on the tip of the pocket former that is inserted into the anchor wedge cavity (particularly with standard nonencapsulated anchorages), any portion of the pocket former that comes into contact with the surrounding concrete should be free from all PT coating, grease, and form release.

The inside surface of the pocket former recess should be cleaned with a wire brush or similar to ensure the proper bond of the patch material; a bonding agent may be applied. The recess must be immediately protected with filling material. An inspection of the surface preparation and filling of the anchorage pockets is highly desirable.

#### BACKGROUND

Many post-tensioning recommendations, including PTI Recommendations,<sup>1</sup> have long specified non-shrink, nonmetallic grouts with no chlorides for filling stressing pockets. In reality, these are shrinkage compensating grouts that expand in either the plastic and/or the hardened states to counteract the effects of shrinkage. These are high-quality grout materials that work well in confined spaces such as beneath base plates; in the application of a stressing pocket patch, the benefit is derived from its consistent quality that ensures a tight grout plug sealing the stressing pocket. Most non-shrink grout's Product Data Sheet will state material application limitations.

Plastic pocket formers currently available for most post-tensioning systems are specifically designed for ease of stripping and do not require any form release agents. If PT coating, grease, or any form of release agents have been applied to the sides of the pocket former, it will be necessary to physically remove the contaminants from the concrete surface inside of the stressing pocket prior to filling the pocket. This can be done by either sand blasting or using a wire brush.

#### DEFINITIONS

*Grout, PT stressing pocket*—a premixed cementitious chloride-free non-shrink grout mixed with limited amount of water per manufacturers' recommendation for use as repair material (non flowable). These repair grouts are designed specifically for filling concrete voids in vertical and overhead applications and are suitable for filling single-strand stressing pockets of post-tensioning tendons.

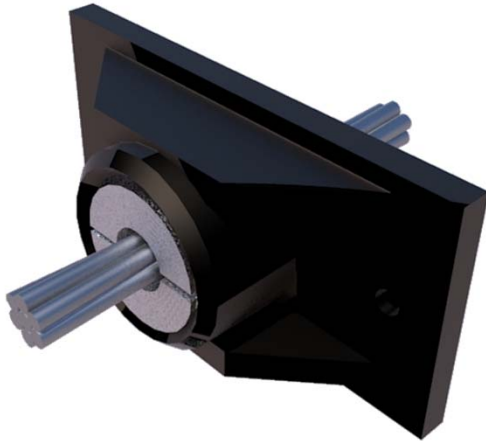
#### REFERENCES

1. *Specification for Unbonded Single Strand Tendons*, second edition, Post-Tensioning Institute, Farmington Hills, MI, 2000, 36 pp.

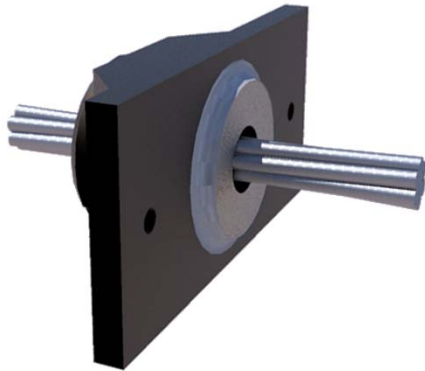


A product best suited as a patch material is a high-quality premixed cementitious chloride-free non-shrink grout, mixed with limited amount of water per manufacturers' recommendation for use as repair material. These repair grouts are designed specifically for filling concrete voids in vertical and overhead applications and are suitable for filling single-strand stressing pockets. All major cementitious material suppliers have prepackaged non-shrink grouts.

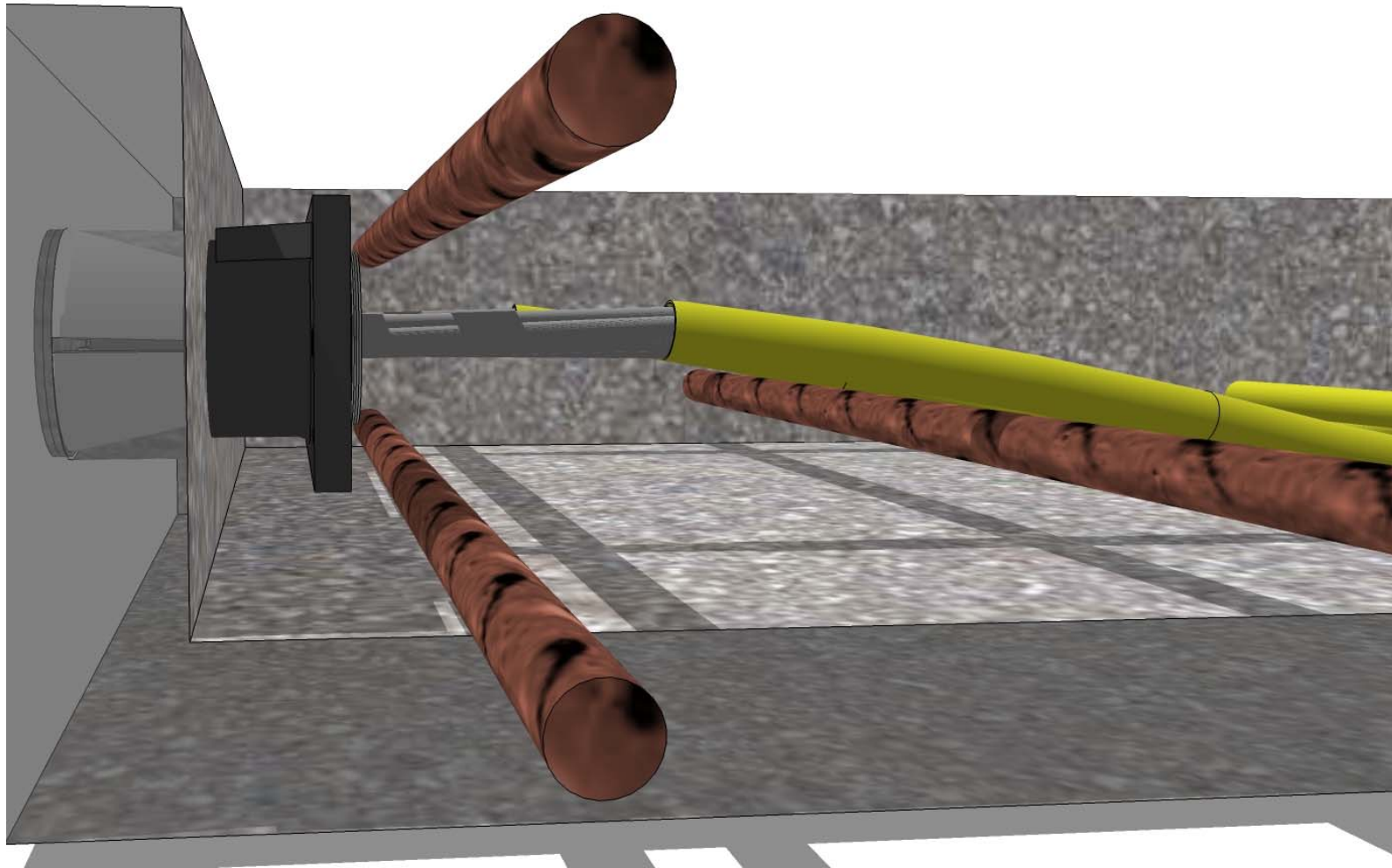
The key to a quality stressing pocket patch is the use of the right patch material, the recommended surface preparation, and the proper mixing and application. These repair grouts must be mixed, applied, and cured per the manufacturer's recommendations. Stressing pockets should be free from all PT coating, grease, form release agents, dirt, loose concrete, debris, or any deleterious material. Although it is accepted practice to place a small amount



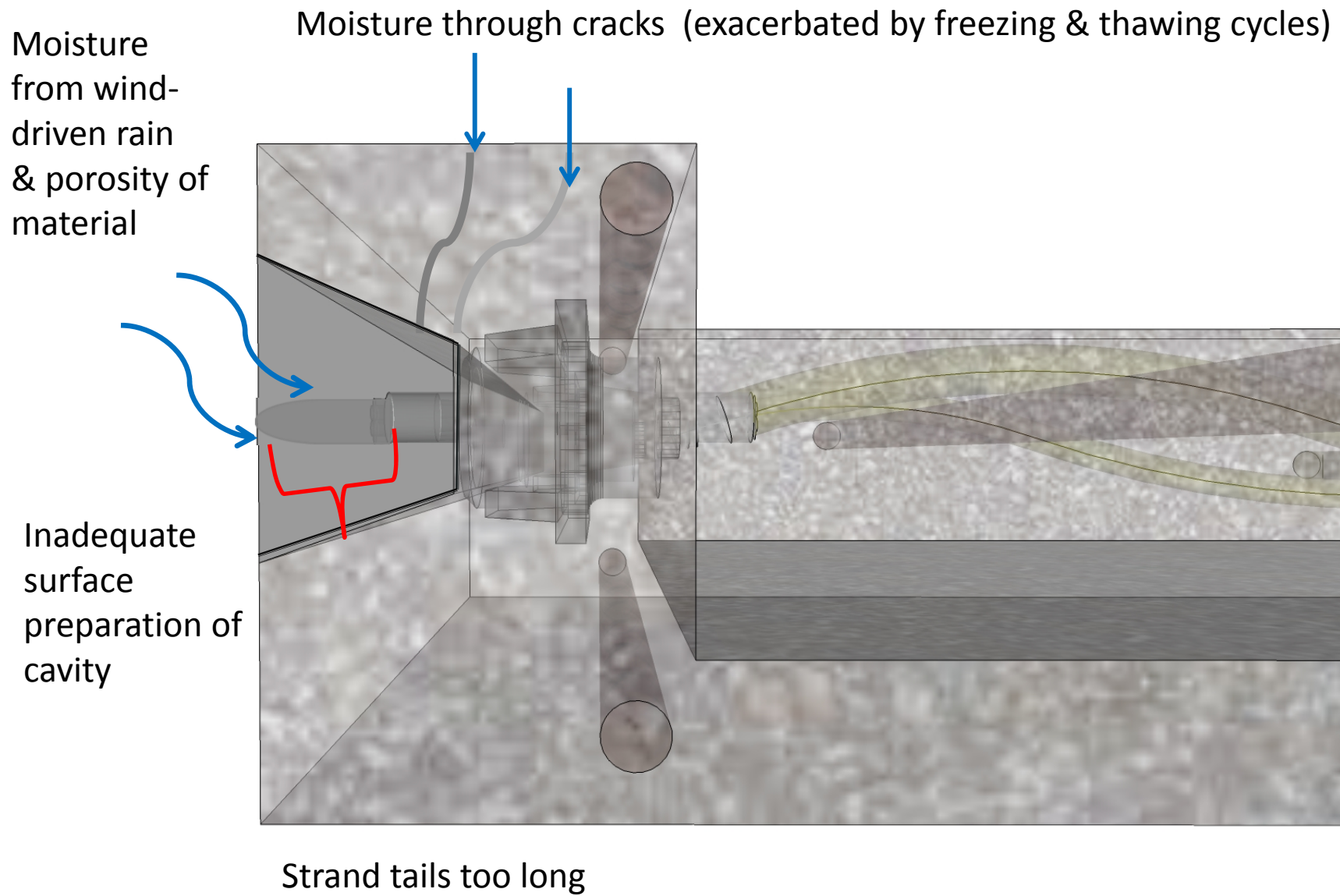
Serviceable  
condition of  
Anchors



# Deterioration Mechanism

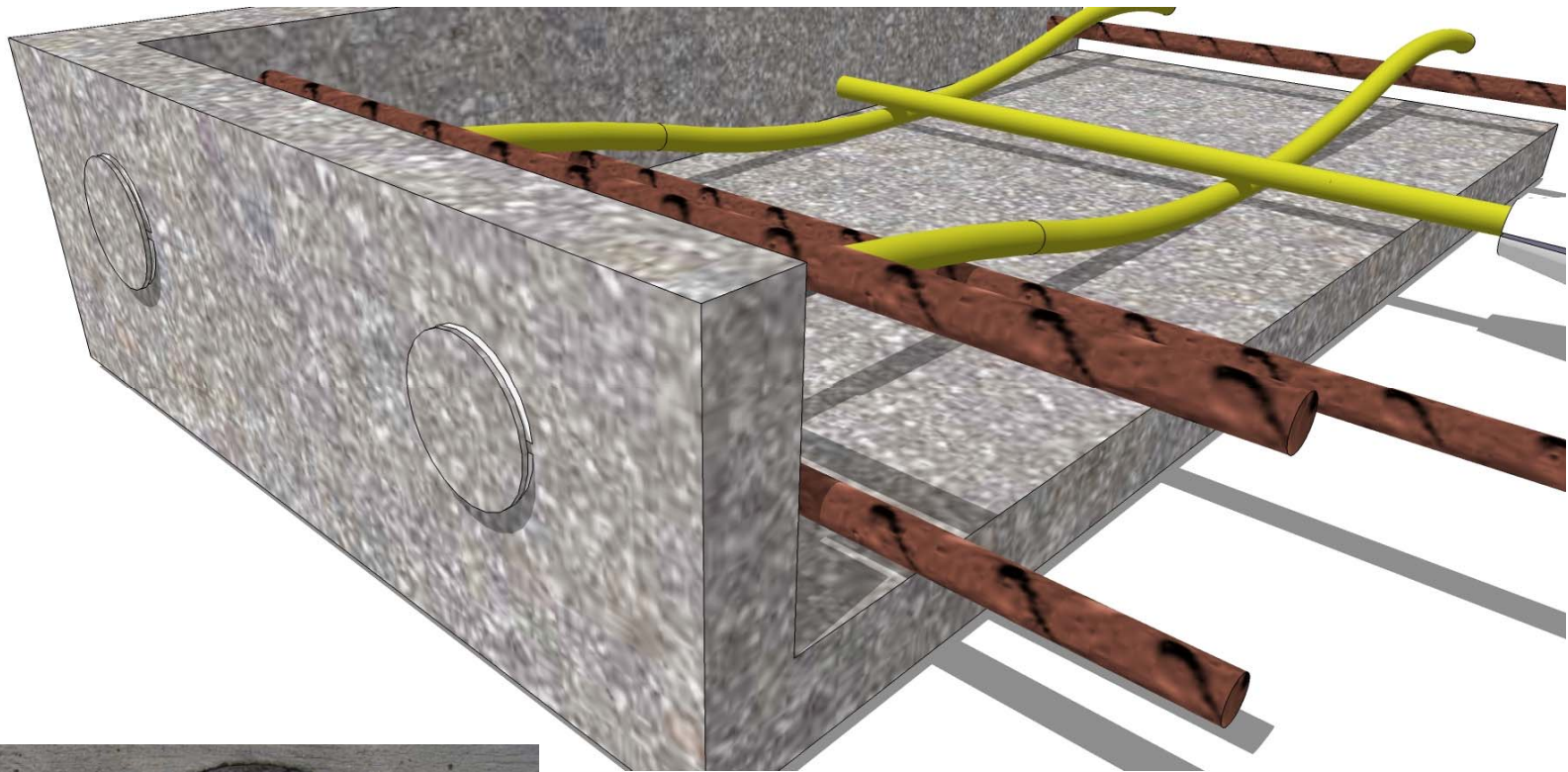






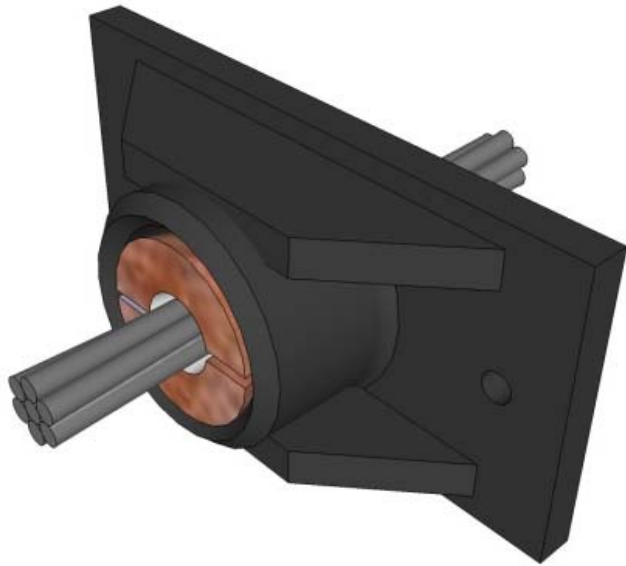


- Cracking & deterioration of patching material
- In a standard system - is the only protection for the wedges and strand extension
- In an encapsulated system – second layer of protection

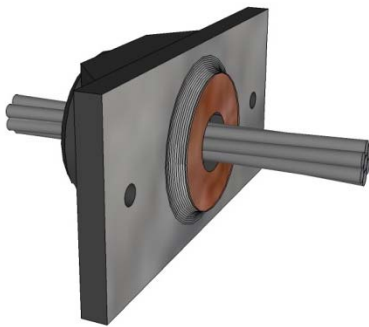


- Shrinkage and debonding of patching material





Corrosion  
deposits at  
cable/wedge  
interface



Case study

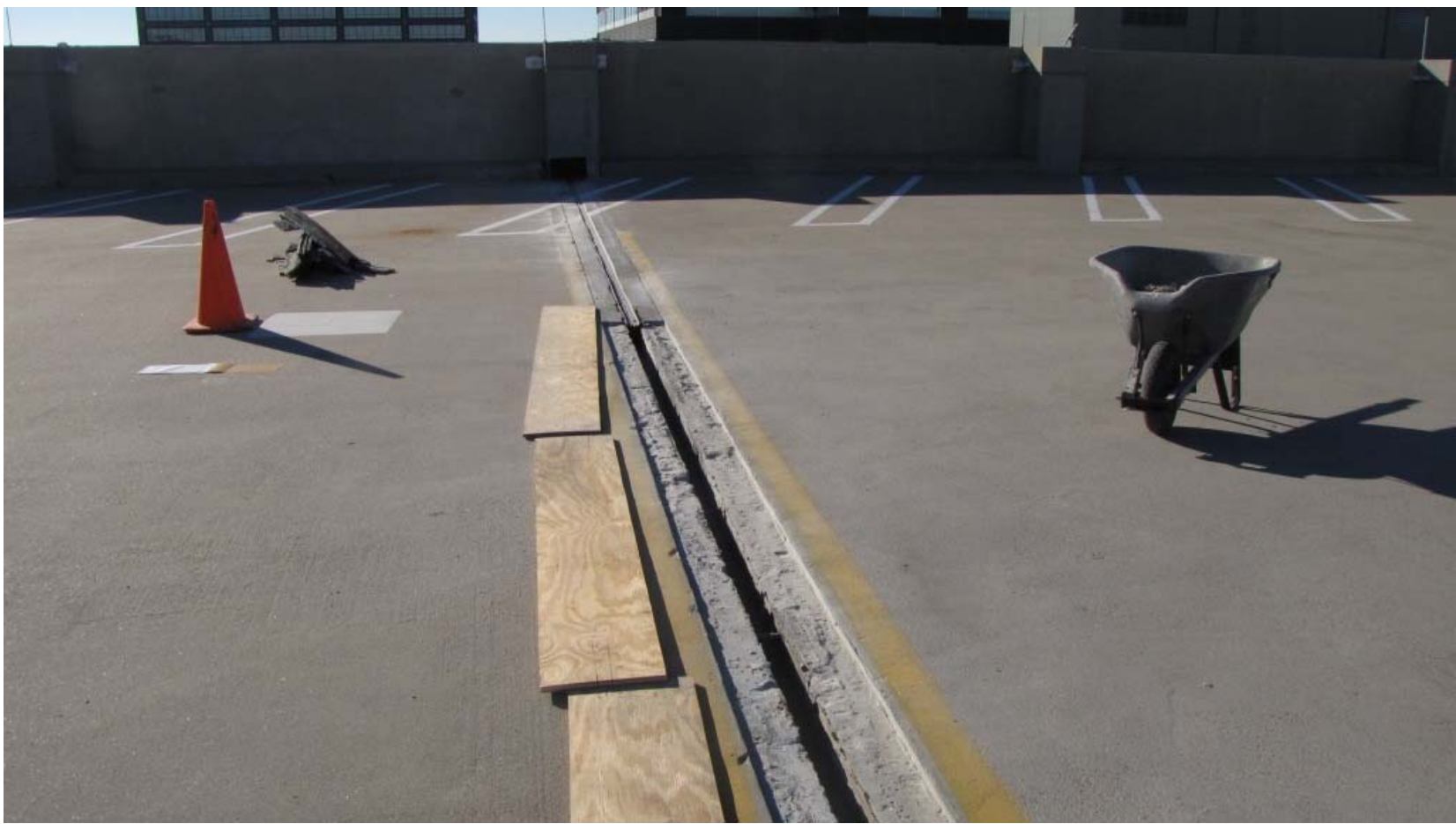


# Parking Structure



8- level Cast-in-place PT system  
2 Expansion Joints







## Anchor Pocket Condition



800 corroded anchors

# Broken Tendons





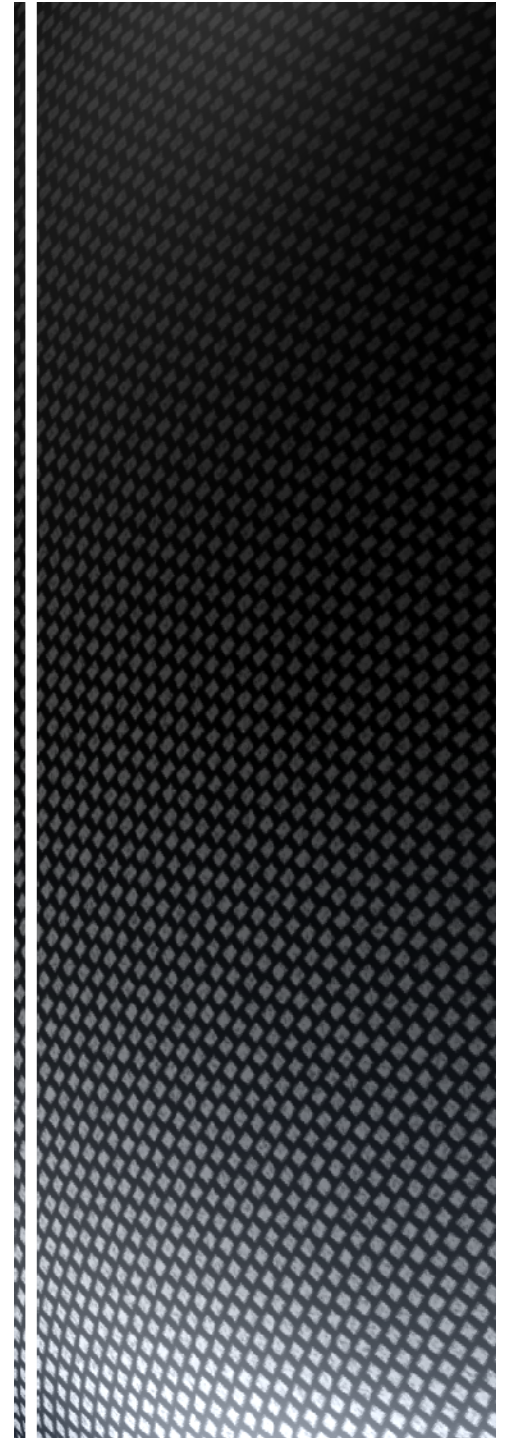
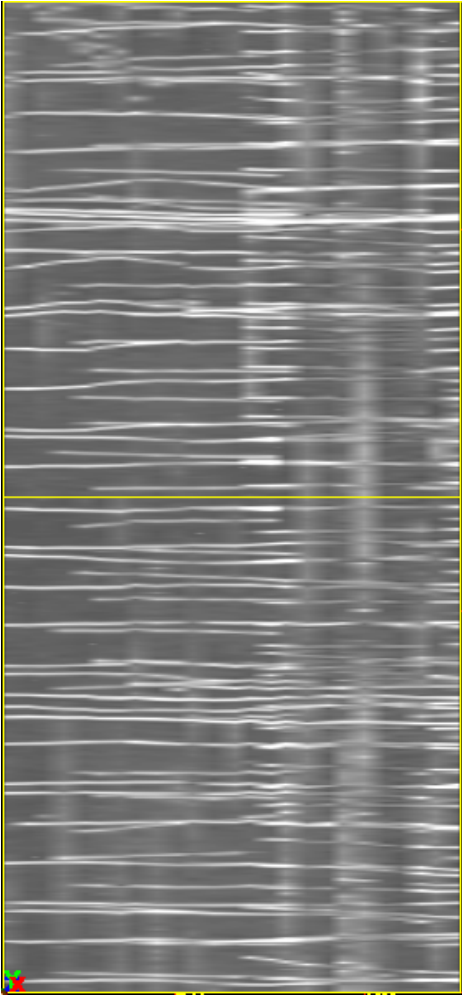
# Protocol for Evaluation



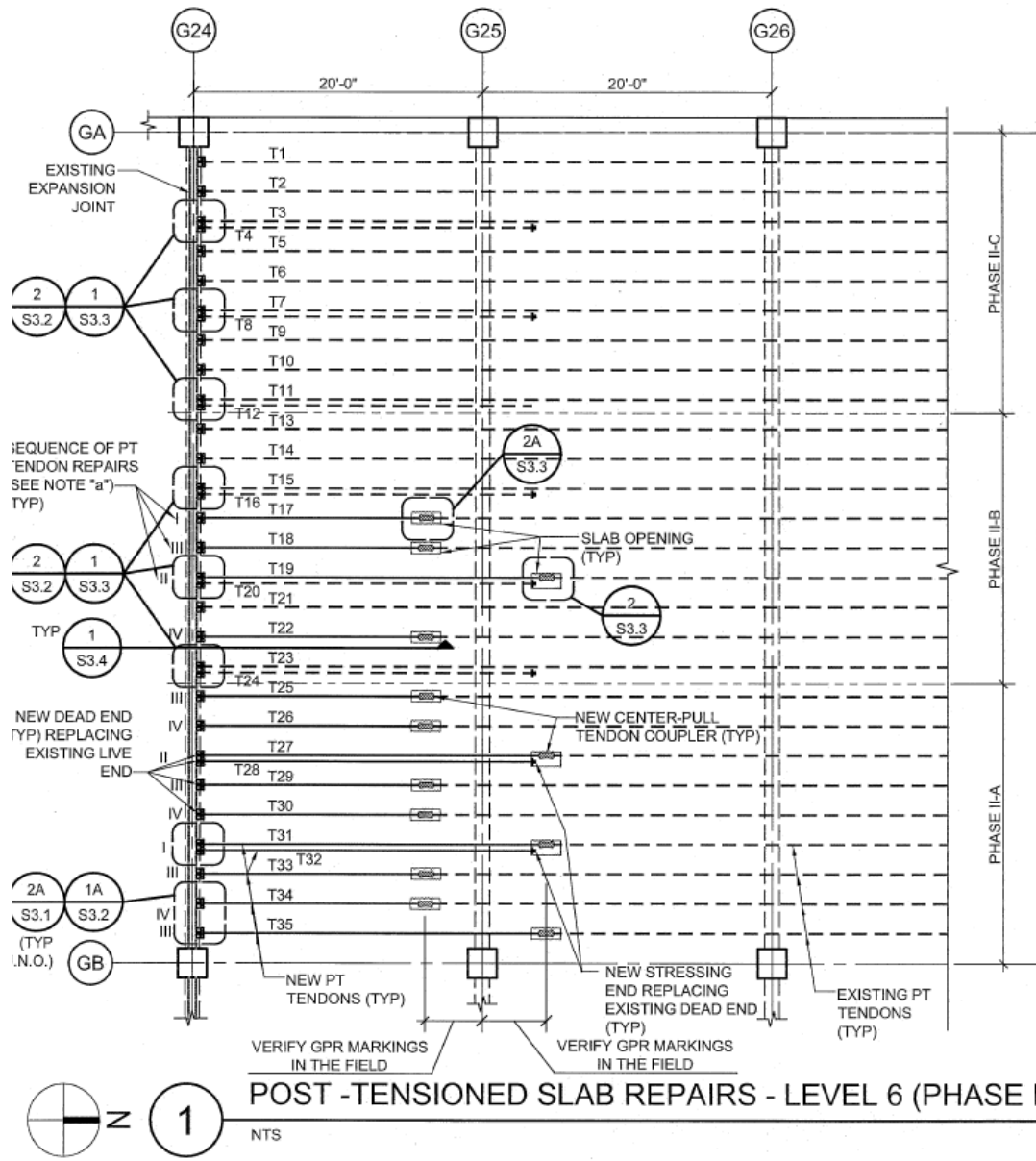
# GPR Survey

Expansion Joint

- Corroded PT strand/wedges
- Uniform Tendons
- Added Tendons



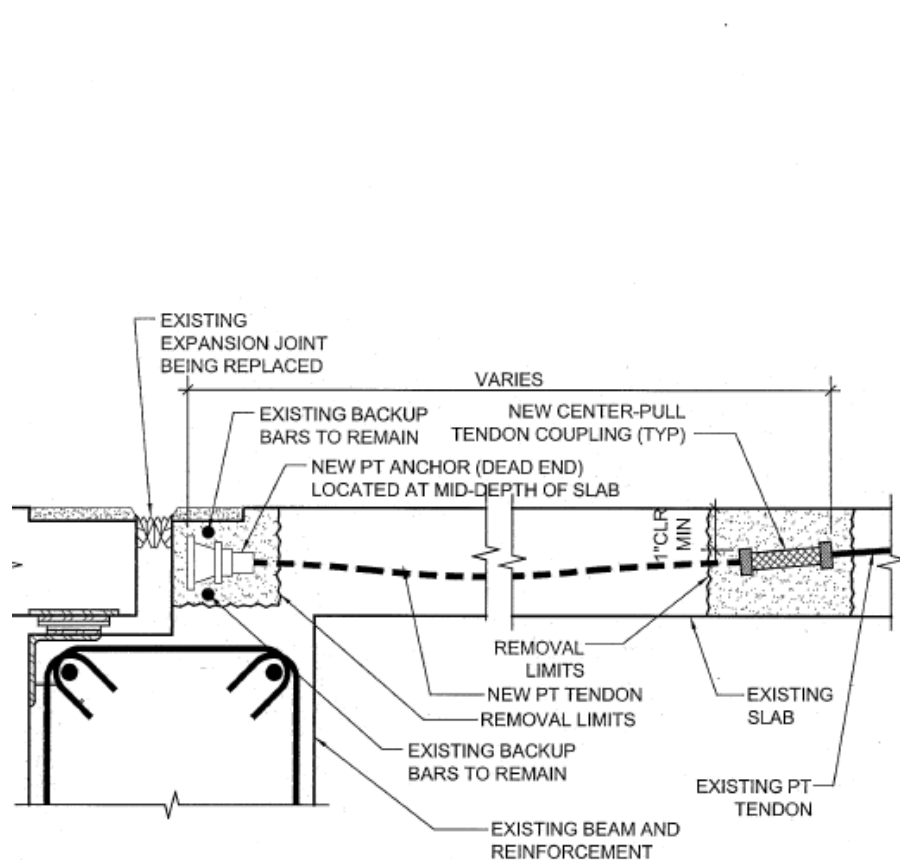




## Repair Strategy

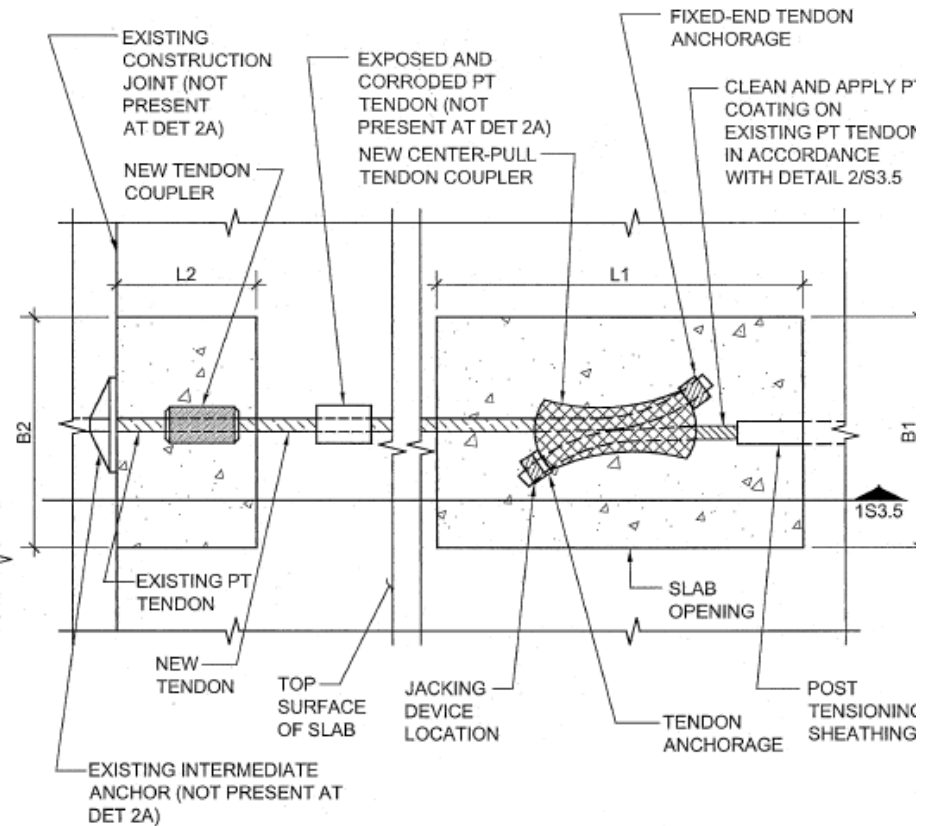


# Repairs



## NOTES:

1. DE-TENSION ANY TENDONS DESIGNATED FOR REPAIR. REVIEW NOTES ON SHEETS S2.1, S2.2, S2.3, AND S2.4 FOR SEQUENCE REQUIREMENTS.
2. REMOVE CONCRETE WITHIN SECTIONS SHOWN SHADED.
3. REPLACE TENDON SEGMENT BETWEEN NEW PT ANCHOR AND CENTER-PULL TENDON COUPLER WITH NEW PT TENDON.
4. RE-TENSION TENDONS TO THE PRESTRESS FORCE SPECIFIED IN THE GENERAL NOTES.
5. REPAIR MATERIAL SHALL BE EMACO T430 BY BASF. WET CURE PATCHES FOR AT LEAST 3 DAYS. STRICTLY FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR PRODUCT INSTALLATION.



## NOTES:

1. DIMENSIONS B1, L1, B2, L2 SHALL BE AS NEEDED TO ALLOW FOR INSTALLATION OF NEW COUPLERS AND STRESSING RAM, AND FOR EXPECTED MOVEMENT OF COUPLER DURING STRESSING OPERATIONS.
2. SEE NOTES IN 2/S3.3 FOR ADDITIONAL INFORMATION.



Repair Execution





## Repair Execution







## Repair Execution

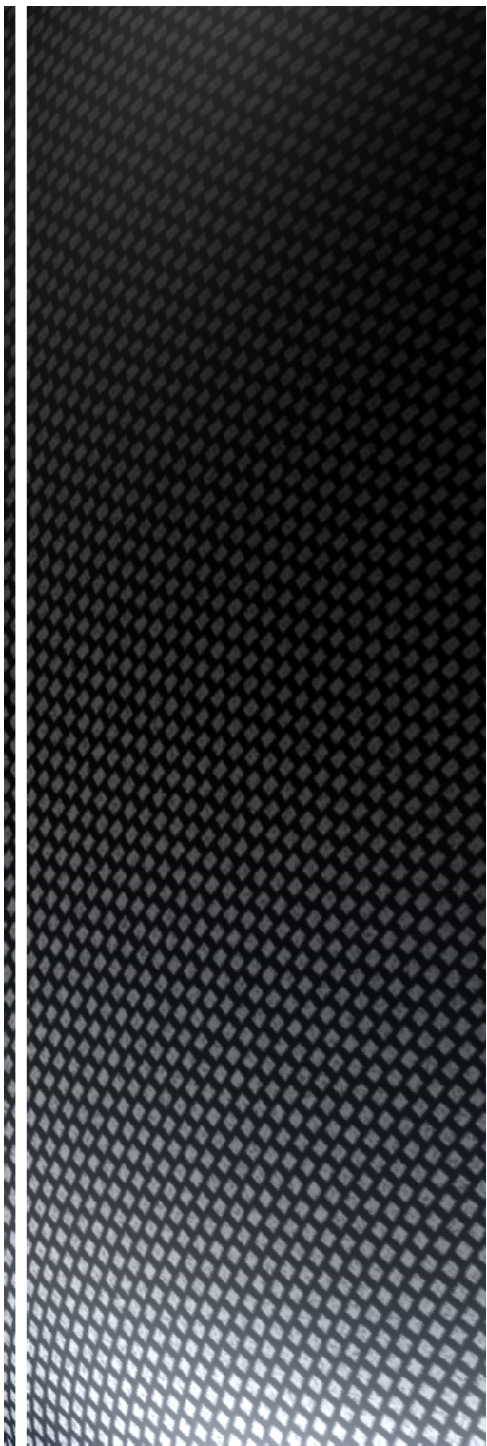












## Lessons Learned

- Poor selection and application of grout materials

(1981)

Cost to patch grout  
pockets \$90,000



(2010)

Cost to replace tendons &  
Expansion Joints  
\$7,000,000

- For new structures:
  - Utilize full encapsulating systems
  - Require capping reports
  - Utilize premixed cementitious chloride-free non-shrink grout in strict accordance with manufacturers' recommendations
  - Follow PTI FAQ No. 11
- For existing structures:
  - Replace existing grout pockets approximately every 8 – 10 years (depending on exposure)
  - Utilize premixed cementitious chloride-free non-shrink grout in strict accordance with manufacturers' recommendations
  - Follow PTI FAQ No. 11
  - Consider applying waterproofing membranes over the concrete edges

## Recommendations

