

October 17, 2023
ICRI 2023 Fall Convention



Rehabilitation of O'Hare International Airport Parking Garage



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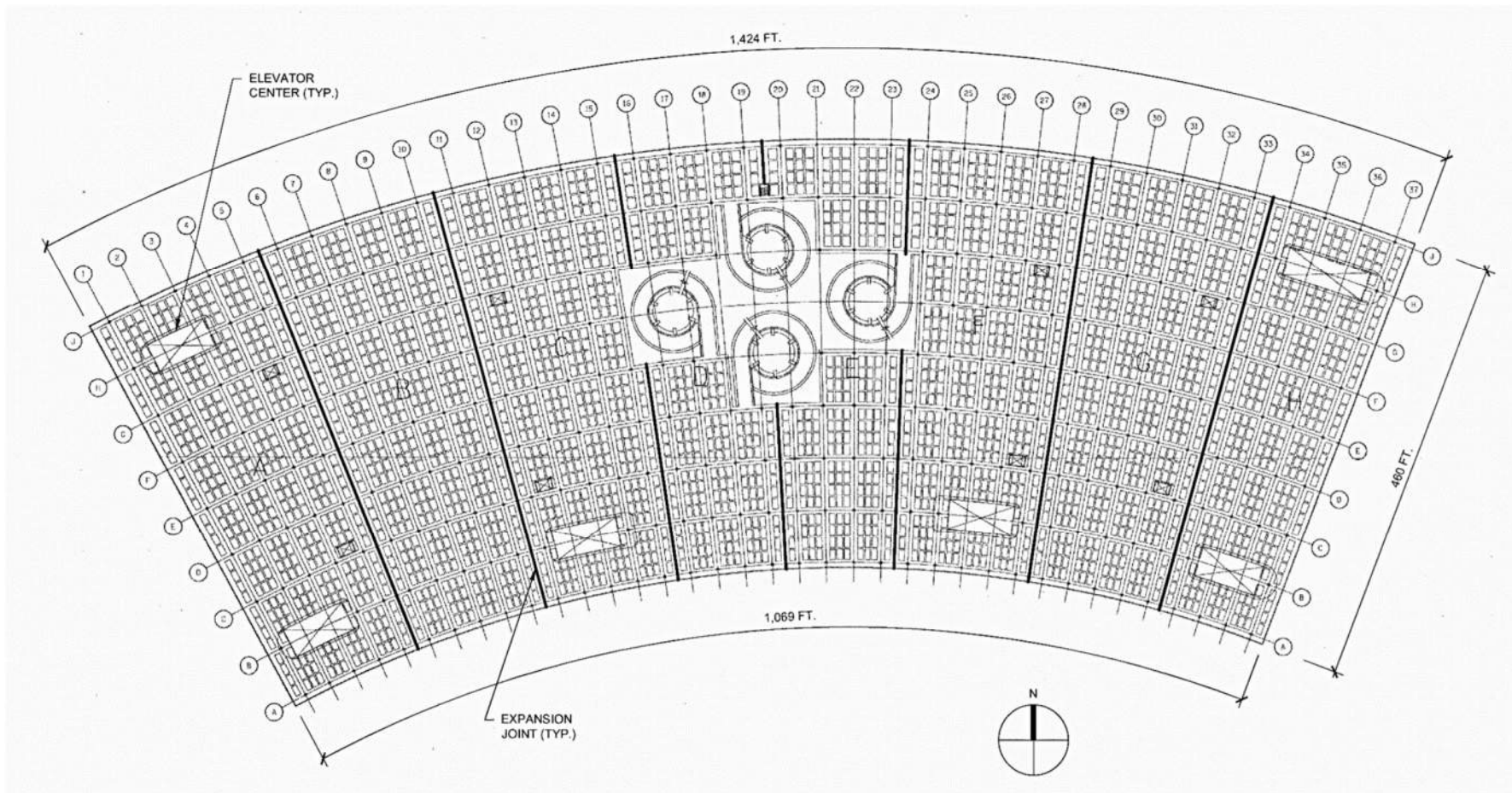
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The Structure

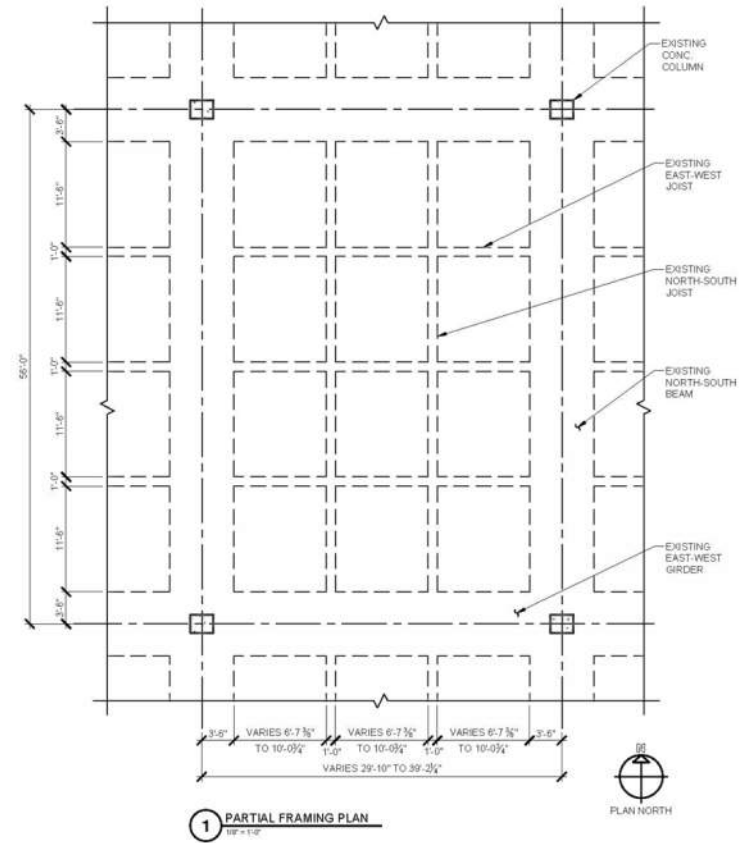
- Designed in 1968 and opened in 1973
- Light weight post-tensioned concrete
- Paper wrapped button-headed tendons
- 6 stories, with below grade offices, tunnels, and CTA Blue Line stop
- 2,600,000+ sq. ft. of supported slab
- 14,000+ ft. of expansion joint seals



The Structure



Typical Interior Bay



Condition Assessment

- Investigation performed in 2018
 - 15° F temperatures
 - Delamination survey (13%)
 - Visual survey
 - Cores for chloride testing and compressive strength
 - Inspection openings to review condition of post-tensioning



WJE

EVALUATION OF ELEVATED PARKING STRUCTURE
O'HARE INTERNATIONAL AIRPORT

Chicago, Illinois



Final Report
July 19, 2018
WJE No. 2017.7284

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Condition Assessment Findings

• Concrete Deterioration

- 150,000 sq ft of top surface delaminations (~6%)
- 5,000 sq ft of topping slab replacement
- 6,000 sq ft of vertical and overhead repairs
- 3,500 sq ft of concrete repairs on exterior surfaces
- 100% of expansion joint seals had failed
- Expansion joint block supports were failing
- Worn and debonding traffic coating

• Recommendations

- Concrete and PT repairs
- Replace expansion joint seals
- Repair PT column
- Traffic coating repairs
- Replacement of drains
- Expansion joint block replacement
- Painting and repair of steel spandrel panels

Condition Assessment – Expansion Joints



Condition Assessment - Expansion Joint Blocks



Condition Assessment – Concrete Deterioration



Condition Assessment – Concrete Deterioration



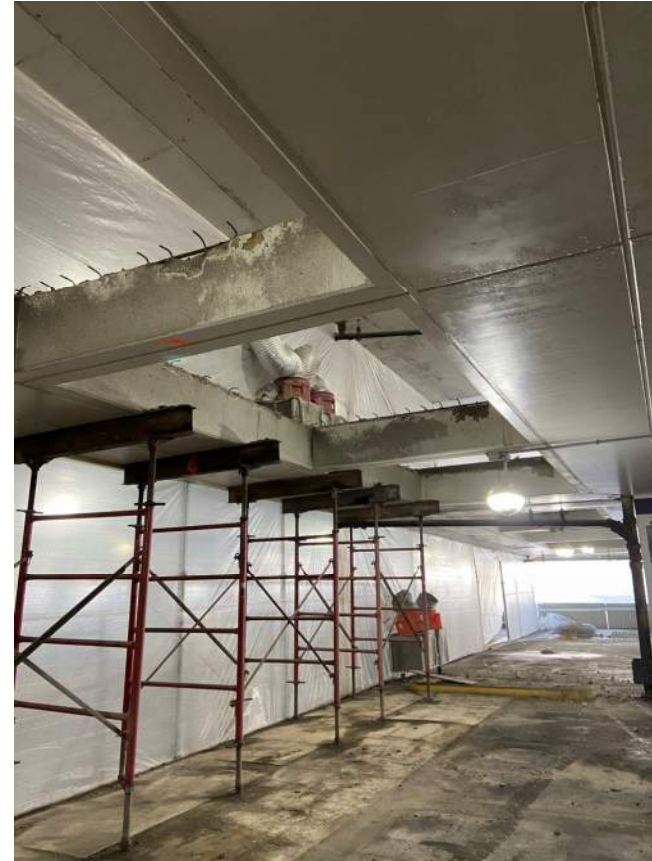
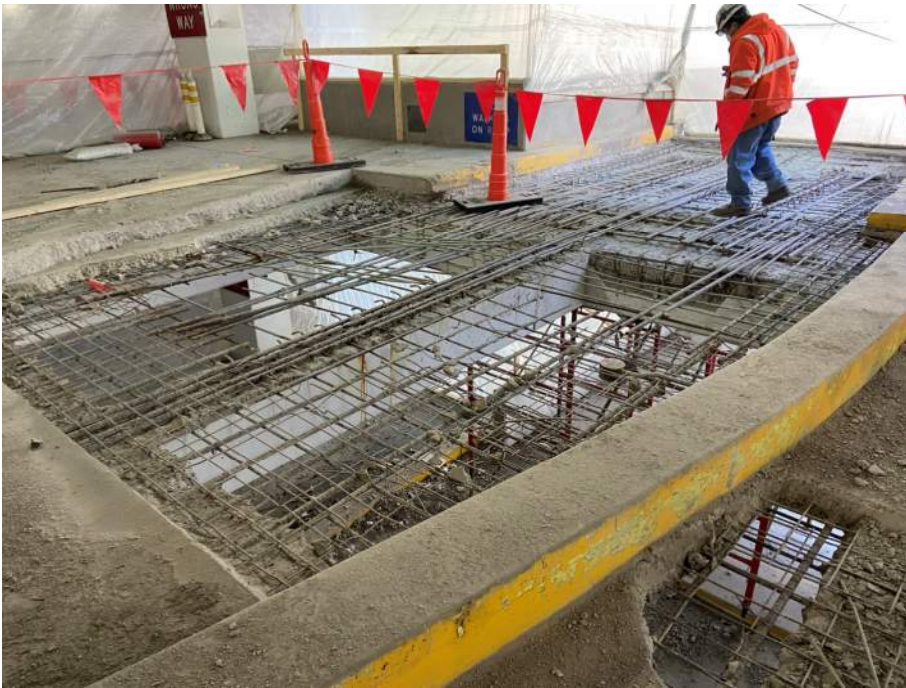
Condition Assessment - Drains



Repair Project

- Construction started fall of 2020
- Repair Quantities
 - Full depth - 100,000 sq. ft.
 - Topping slab – 3,300 sq. ft.
 - Ramp partial depth – 7,000 sq. ft.
 - Vertical and overhead – 4,500 sq. ft.
 - Reconstruct expansion joint ends – 21
 - 54.5 tons of epoxy-coated steel
 - Trench drains – 4,000 ft.
 - Winged EJS - 13,900 ft.
 - Precompressed EJS – 1150 ft.

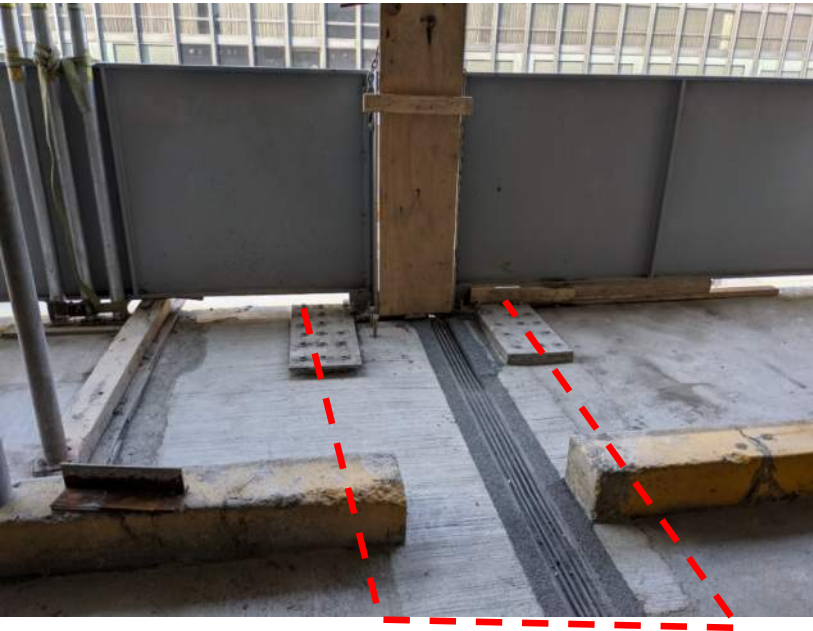
Demolition



Concrete Repairs



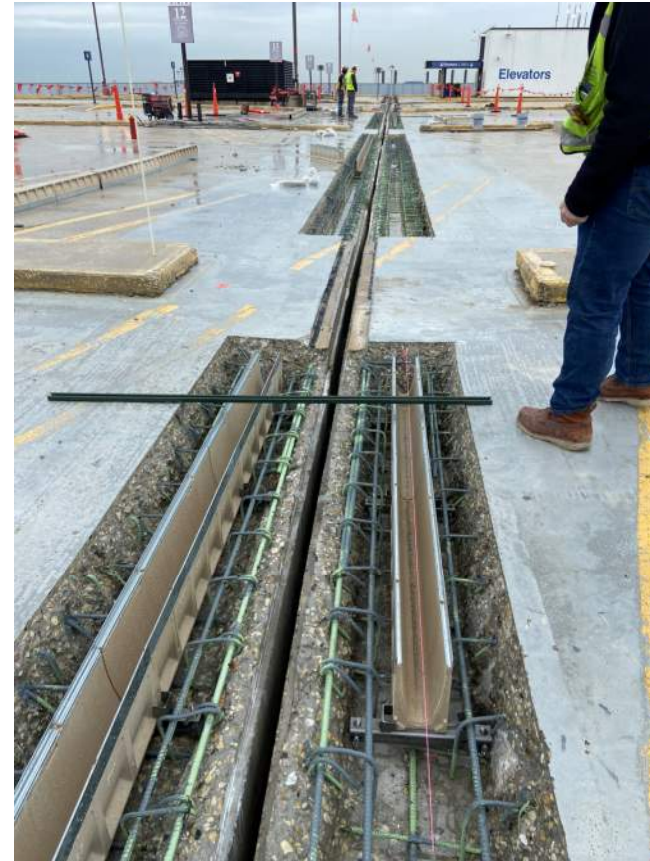
Expansion Joint Block Replacement



Expansion Joint Straightening



Trench Drain Replacement



Post-Tensioning Repairs

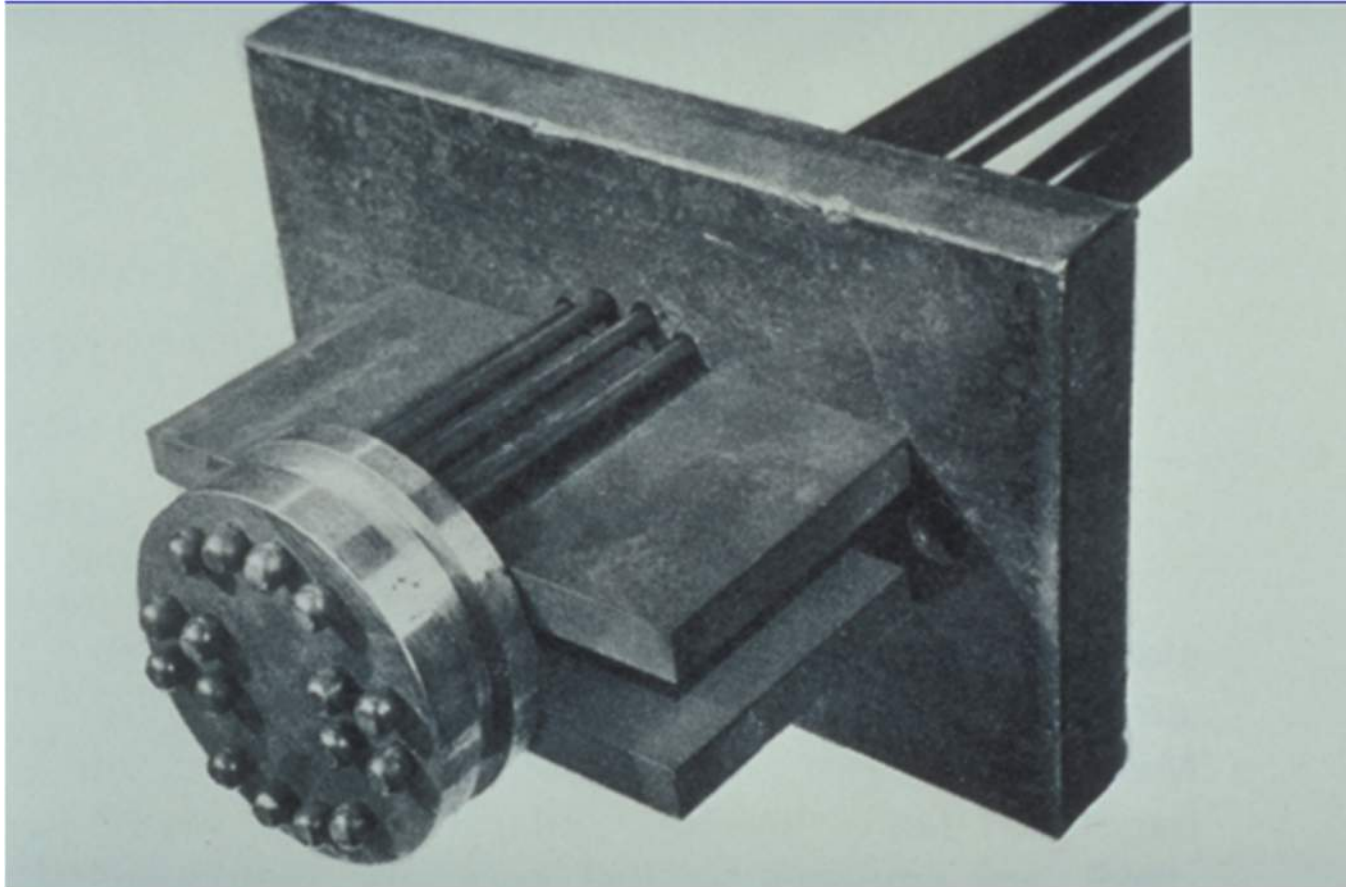


Post-Tensioning Repairs



- 170 ft. of 20 wire tendon
- 8 tendon repairs with rebuilding of live end anchorages

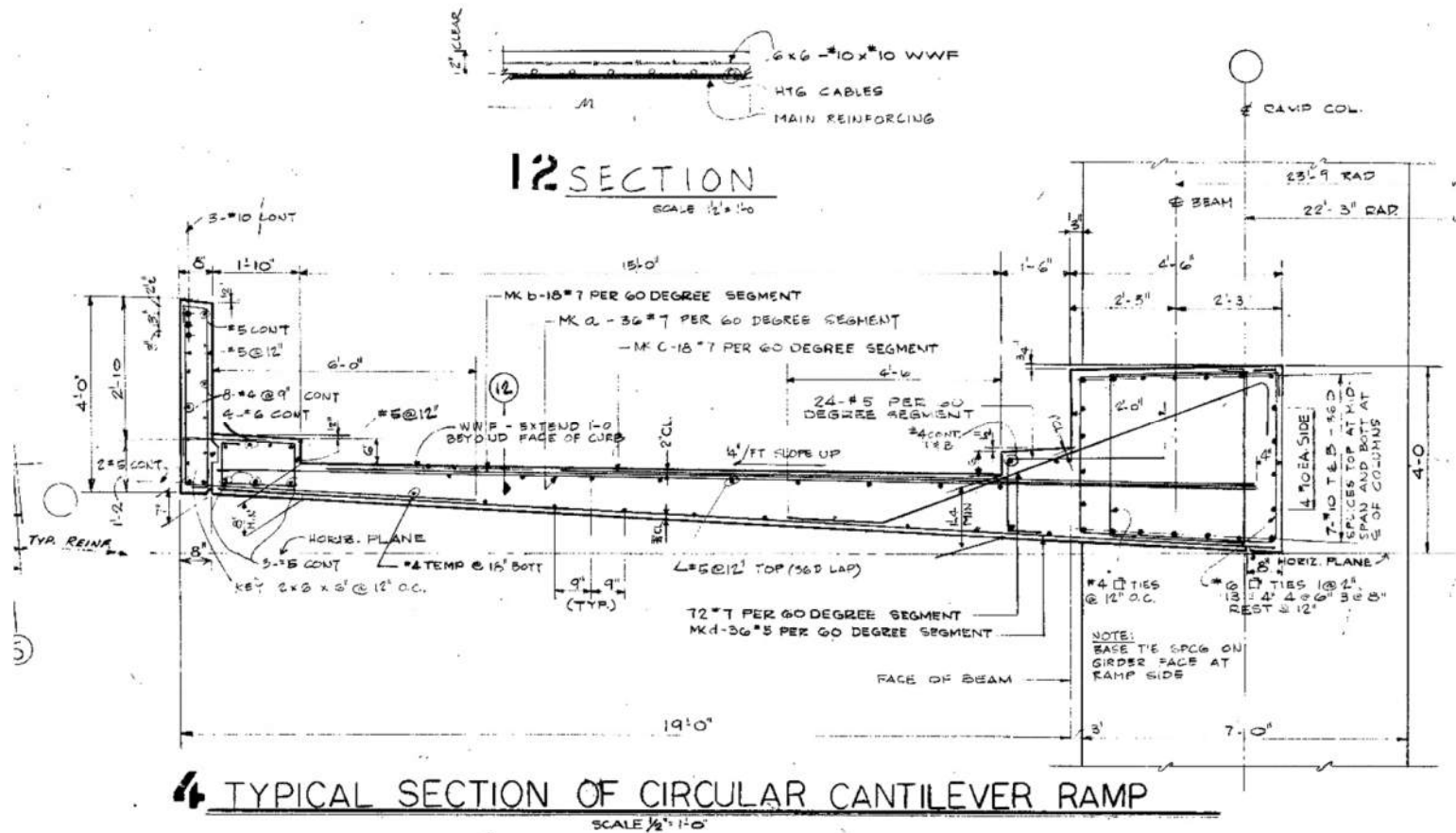
Button-Head Tendon Anchor



External PT Column Repair

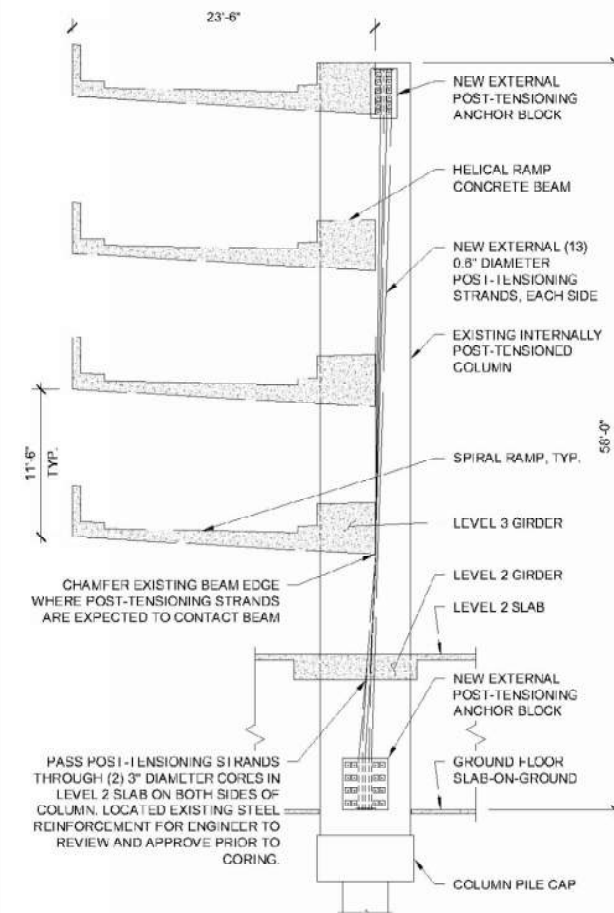


Typical Cross-Section of Spiral Ramps (reproduced from original drawings)



External PT Column Repair

- Original PT
 - 3 tendons with 42 wires each
 - ~1,000,000 lbs of PT force
 - At least 10 wires were failed, unknown condition of remaining wires
 - Difficult access to investigate
 - Continued deterioration
- External PT Repair
 - (13) 0.6 in. diameter 7-wire strands in each new tendon
 - (12) 1 ¼ in. diameter Dywidag bars in anchor blocks to transfer new force



External PT Column Repair



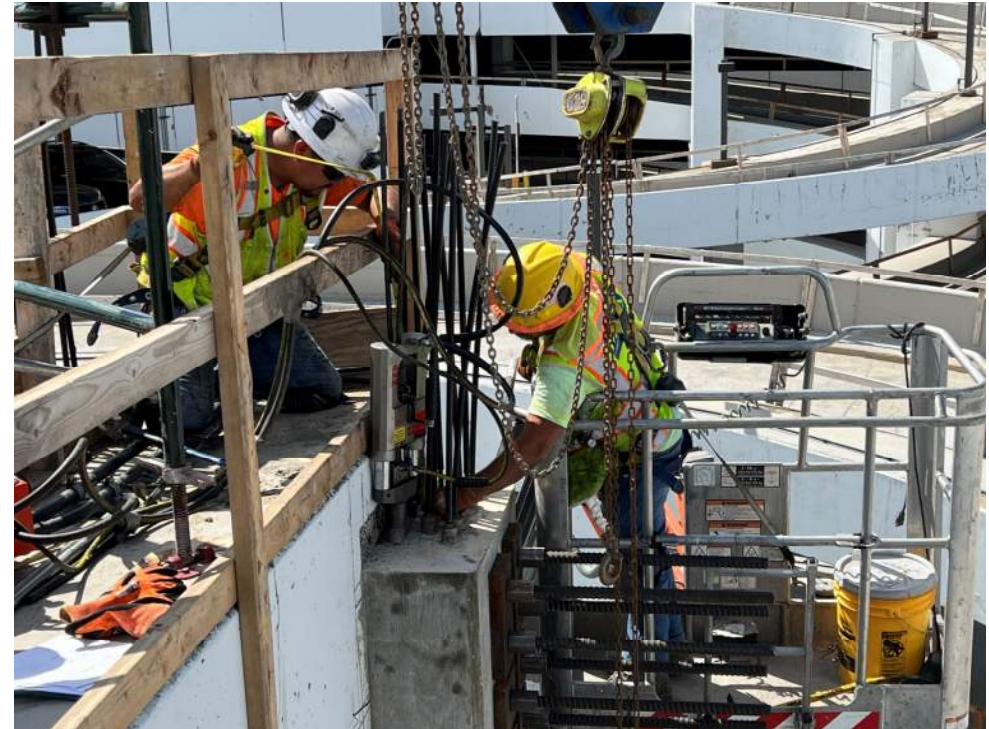
External PT Column Repair



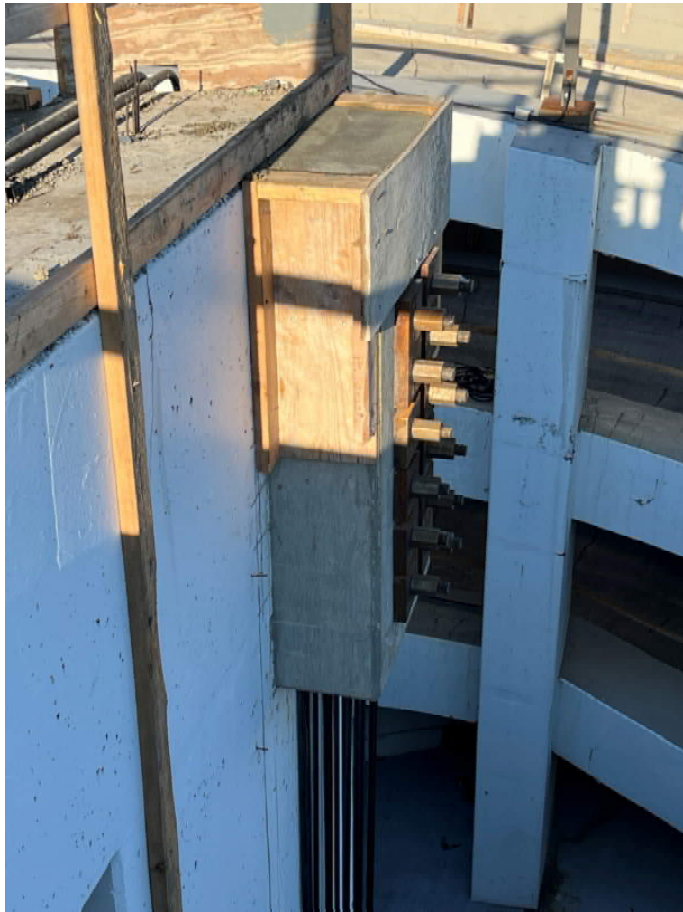
External PT Column Repair Stressing



External PT Column Repair



External PT Column Repair



External PT Column Repair



External PT Column Repair



Before



After installation of
waterproofing membrane



Challenges

- Dust control
- Maintaining operation of garage
- Strict schedule with high liquidated damages
- Watchful eye of insurance issuer
- Material supplies
 - Deformed, epoxy-coated mesh, 4x8 of multiple sizes
 - Rebar coating supply ran out mid-project
- All year work
- On-going deterioration
- Quantity growth



Closing

- Project completed Fall 2022
- Successful project thanks to the cooperation between the Owner, Construction Manager, Concrete Repair Contractor, Post-Tensioning Subcontractor, and Engineer



Acknowledgement

In addition to the presenters, the key members of the WJE team on this project were James Donnelly, Timothy Gregor, Tracy Naso and Kenneth Marley.

Awards

- **Post-Tensioning Institute (PTI) 2023** - Award of Merit Repair, Rehabilitation and Strengthening Category
- **Structural Engineers Association of Illinois (SEAOI) – 2023** Excellence in Engineering Award Finalist, Renovation/ Retrofit/ Preservation Category
- **International Concrete Repair Institute – 2023** Award of Excellence in the Parking Garage Category



Questions?

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