



2024 SPRING CONVENTION



APRIL 21-24, 2024
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➤ **Case Study:**
**Structural Repairs for
an Elevated Plaza**

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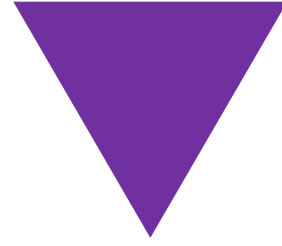
Haider Himairi, PE, LEED AP BD+C, F.ASCE

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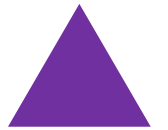
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➤ **LEARNING OBJECTIVES**

- Learn about Chicago's history of elevated plazas and roadways.
- Understand the methods of the structural and waterproofing investigations.
- Understand the environmental conditions that led to the observed distress.
- Learn how the repairs were designed, detailed, and implemented.



➤ **CHICAGO**
HISTORY



1850s

Buildings raised 4-8 feet above lake level



- Aid drainage of rainwater
- Install sewer system



1910s

First **two-level streets** were constructed



- Access elevated bascule bridges
- Pass over rail yards along the riverfront



1970s

First **three-level streets** were constructed



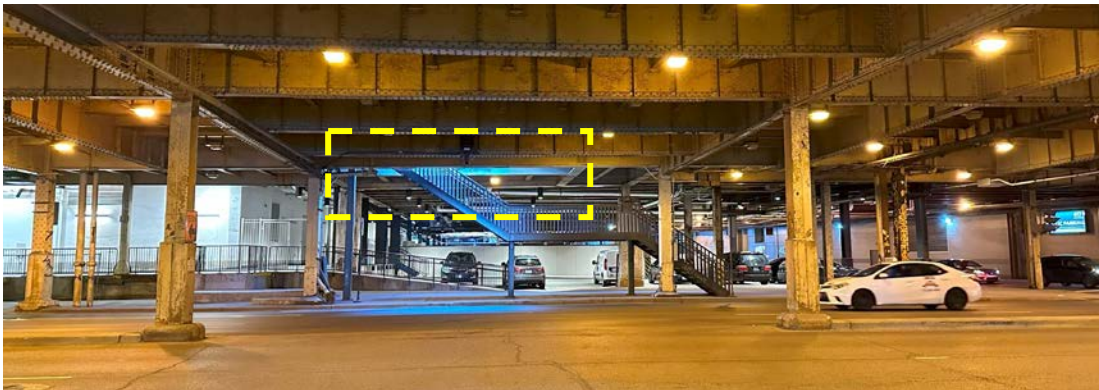
- Redevelopment of a former railyard and shipping terminal
- Upper level for local traffic
 - Middle for through traffic
 - Lower level for service and deliveries



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➤ Elevated Streets



Tribune Tower plaza at Michigan Avenue



3-level section of Wacker Drive

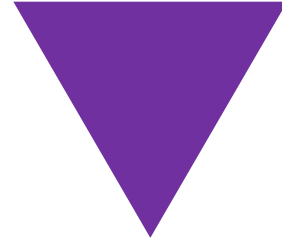
➤ Millennium Park



Millenium Park circa 1980s



Millenium Park circa 2010s



➤ **SUBJECT
PLAZA**



➤ Plaza Description

Upper Level

- Street level
- Pedestrian sidewalks
- Planters



Lower Level

- Service drive and loading docks
- Parking for valet
- Trash and recycling



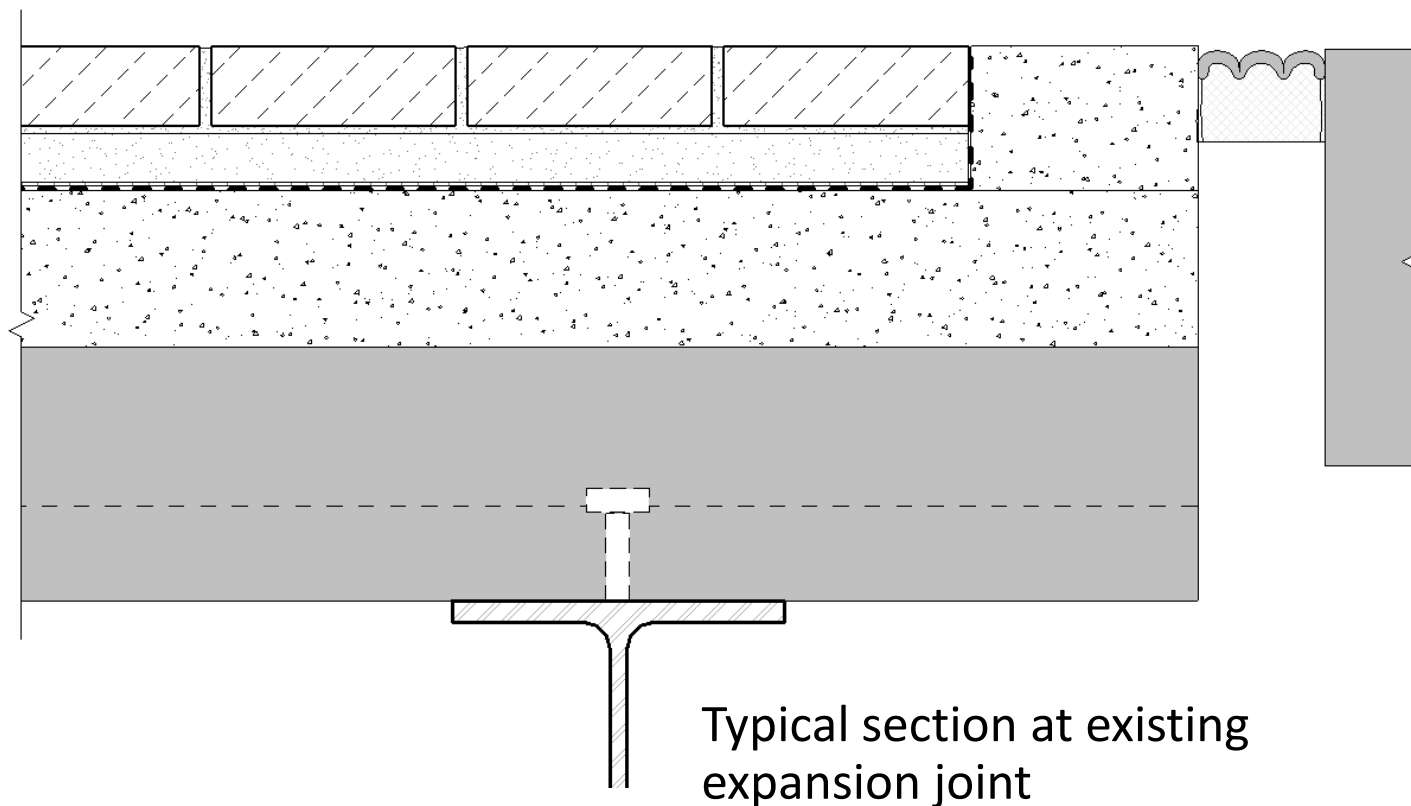
➤ Plaza Description

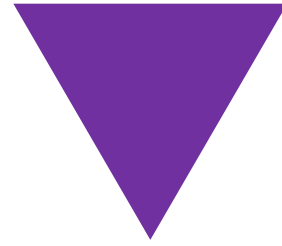
- Downtown Chicago
- Shared by several buildings
- Built in two phases in 1980s
- Entrances on two main streets
- Length of a city block, ~320ft



➤ Plaza Description

- Pavers
- Asphalt/sand setting bed
- Protection course
- Hot rubberized waterproofing
- Topping slab
- Composite concrete deck
- Steel frame





➤ **EXISTING
CONDITIONS**



➤ Drain Conditions

- Trench drain filled with concrete
- Remaining section of drain was backed up



➤ Drain Conditions



Drain pipe filled with sediment



Corroded drain pipe

➤ Structural Conditions

Worst case was below the infilled trench drain

- Corroded metal deck
- Corroded steel
- Deteriorated structural slab



➤ Structural Conditions



Hole through structural slab, rigid insulation at bottom of planter visible



Hole through a column flange

➤ Beam Shoring

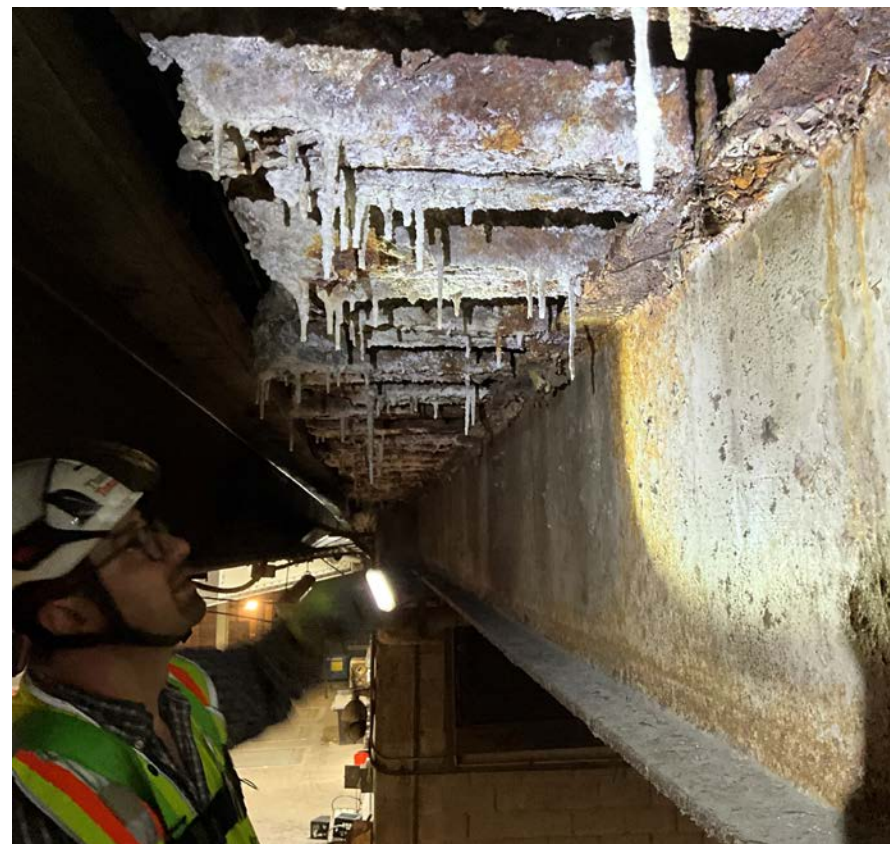


Shoring installed below beam



Completely corroded steel web and sheared-off beam-to-column connection

➤ **FIELD
INVESTIGATION**



➤ Topside Investigation

Investigative Openings

- Measure components of paver system
- Check condition of waterproofing



➤ Topside Investigation



Water test paper, indicating moisture



Debonded waterproofing

➤ Topside Investigation

Expansion Joints

- Cover plates often loose or damaged
- Joints filled with sand and sediment



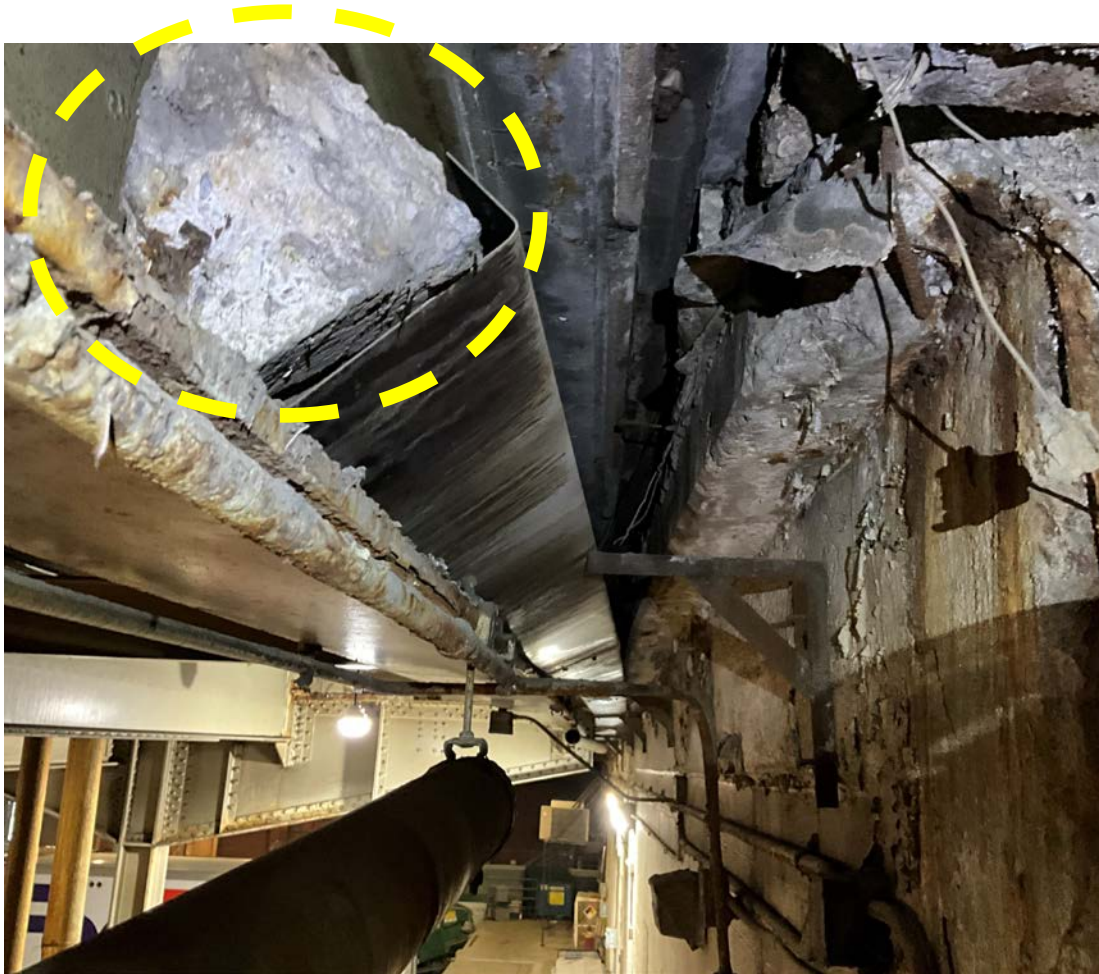
➤ Underside Investigation

Pick-and-Clean

- Remove overhead falling object hazards
- General identification of concrete and steel repair locations



➤ Underside Investigation



Drip pan that was damaged by falling concrete



Loose overhead concrete

➤ Underside Investigation



Corroded metal deck and deteriorated concrete



Corroded steel beam

➤ Underside Investigation



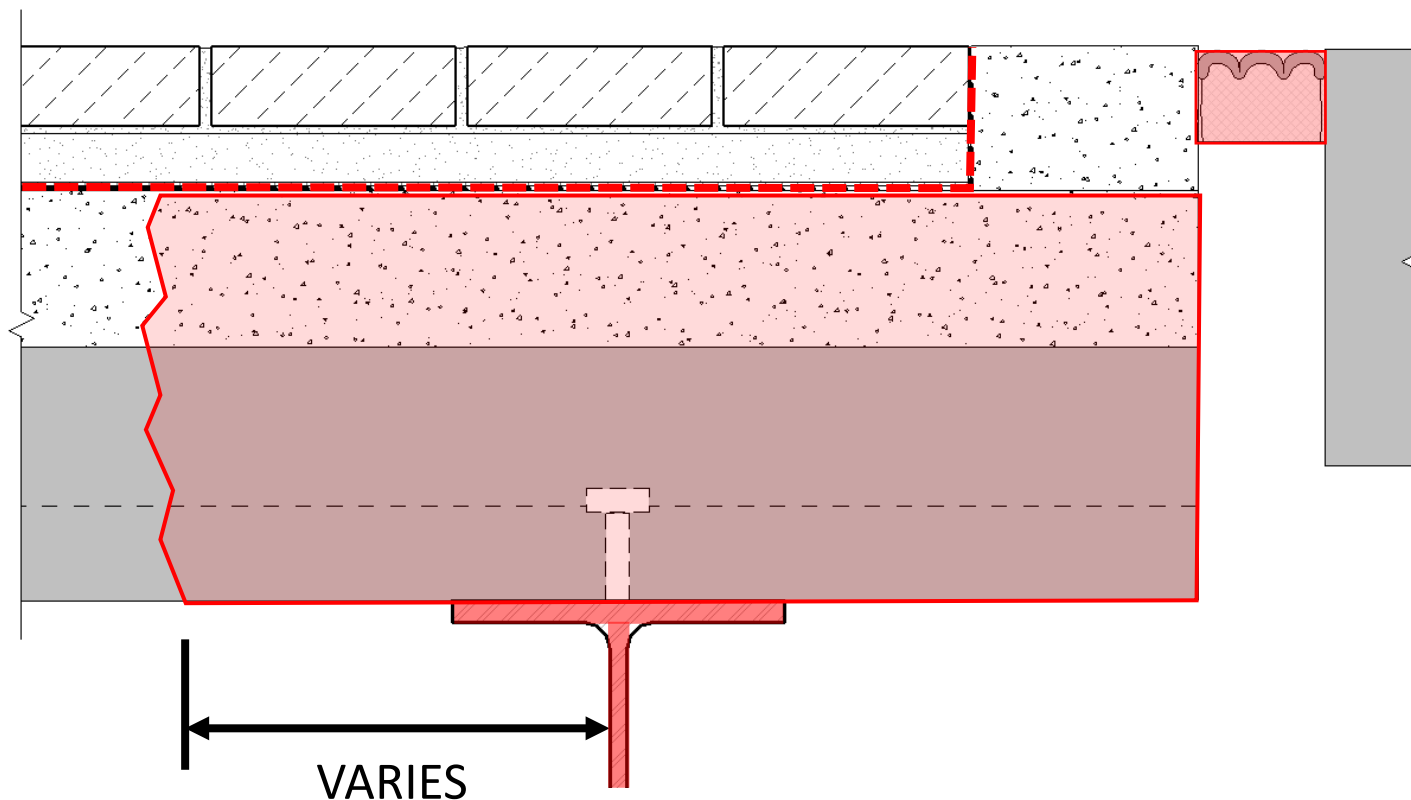
Deteriorated corbel and corroded baseplate

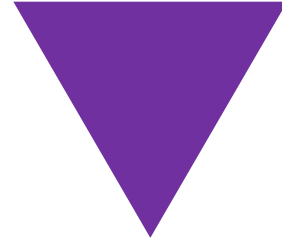


Exposed reinforcing behind generator

➤ Investigation Summary

- Waterproofing deteriorated
- Expansion joints failed
- Structural deck and topping unsound (extent varied)
- Steel corroded





➤ **REPAIR
PHASING**



➤ Repair Phasing

- Prioritize repairs for worst conditions
- Accommodate needs of building tenants
- Vehicular access



➤ Repair Phasing

- Shoring
- Phase 1
 - Priority area at corroded steel beams
- Phase 2
 - Remainder of plaza



➤ Repair Phasing

Split phases into smaller “stages”

- Always need drive lane open
 - Emergency vehicles
 - Shuttle bus
 - Cars and taxis
- Always need service drive open
 - Deliveries
 - Waste removal
- Always need pedestrian access

Other considerations

- Waterproofing terminations and tie-ins
- Temporary finishes
- Road plates over open joints
- Fencing
- Traffic control
- Temporary signage for businesses

➤ Repair Phasing

Phase 1

- Two stages, split down roadway
- One-way plaza drive
- One lane service drive
- Valet parking open



➤ Repair Phasing

Phase 2

- Three stages
- East, center, then west
- Valet parking and service drive partially closed when working above

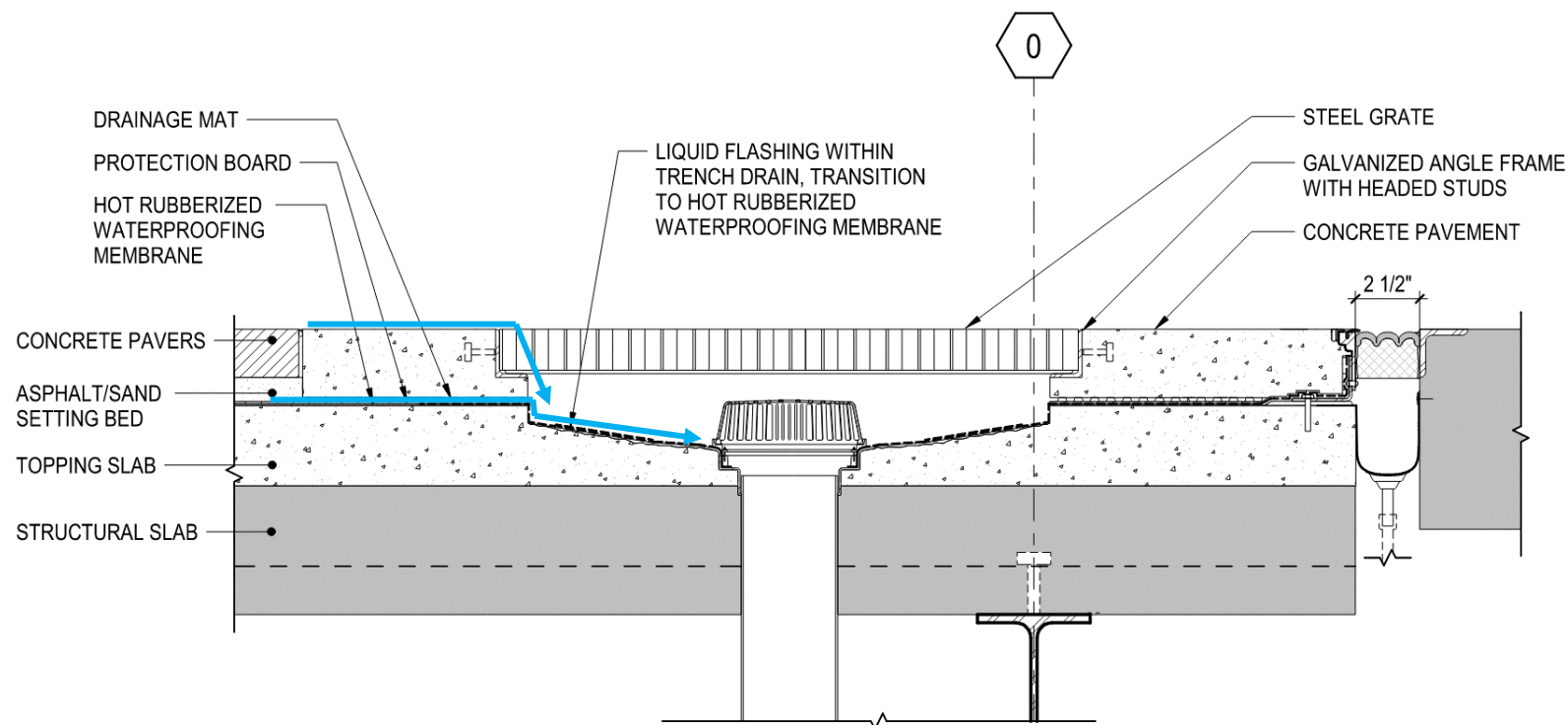


➤ **TRENCH
DRAIN
REPAIR
METHODS**



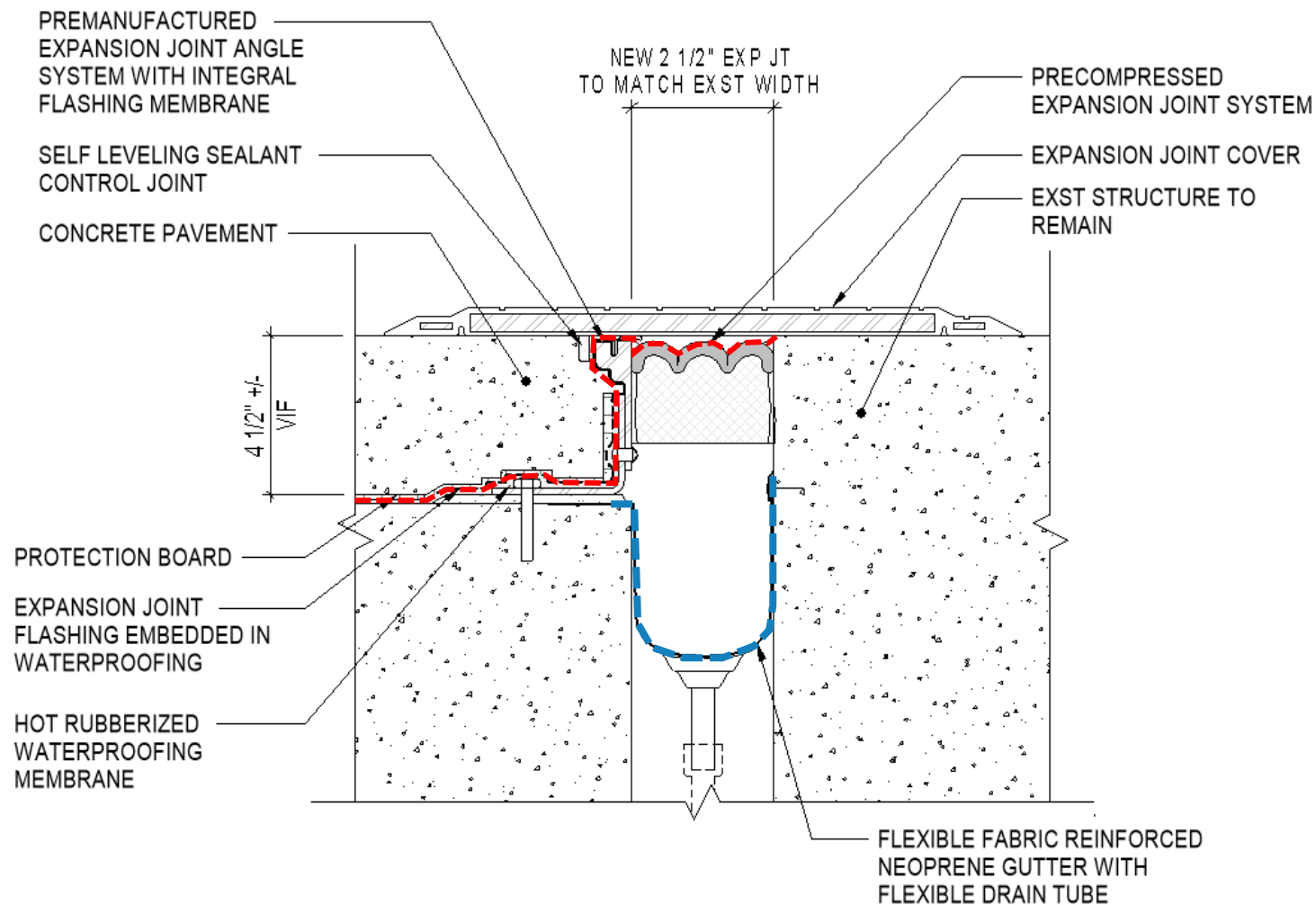
➤ Trench Drain Repairs

- Custom bi-level trench drain
- Low profile
- ADA considerations for grating



➤ Expansion Joint

- Plaza expansion joint system with edge angle
- Primary barrier in red
- Secondary in blue



➤ Trench Drain Repairs



Unsound concrete removed



Cleaned steel, applied zinc-rich coating,
and added supplemental reinforcing

➤ Trench Drain Repairs

- New structural slab
- Mockup frame for grate to verify slopes and pitches
- Prepare for new topping slab



➤ Trench Drain Repairs

- New topping slab with profiled basin
- Drain set in topping
- Prepare for concrete curbs



➤ Trench Drain Repairs

- Temporarily plated
- Grate and expansion joint to be installed with Stage 2



➤ **CONCRETE
REPAIR
METHODS**



➤ Concrete Repairs



During investigation



After pick-and-clean

➤ Concrete Repairs

- Unsound concrete removed
- Cleaned steel and applied zinc-rich coating



➤ Concrete Repairs

- New form-and-pour structural slab
- Bag mix for small areas, ready-mix for large areas



➤ Concrete Repairs



Completed encasement repair



Completed shotcrete repair

➤ **STEEL
REPAIR
METHODS**



➤ Steel Repairs

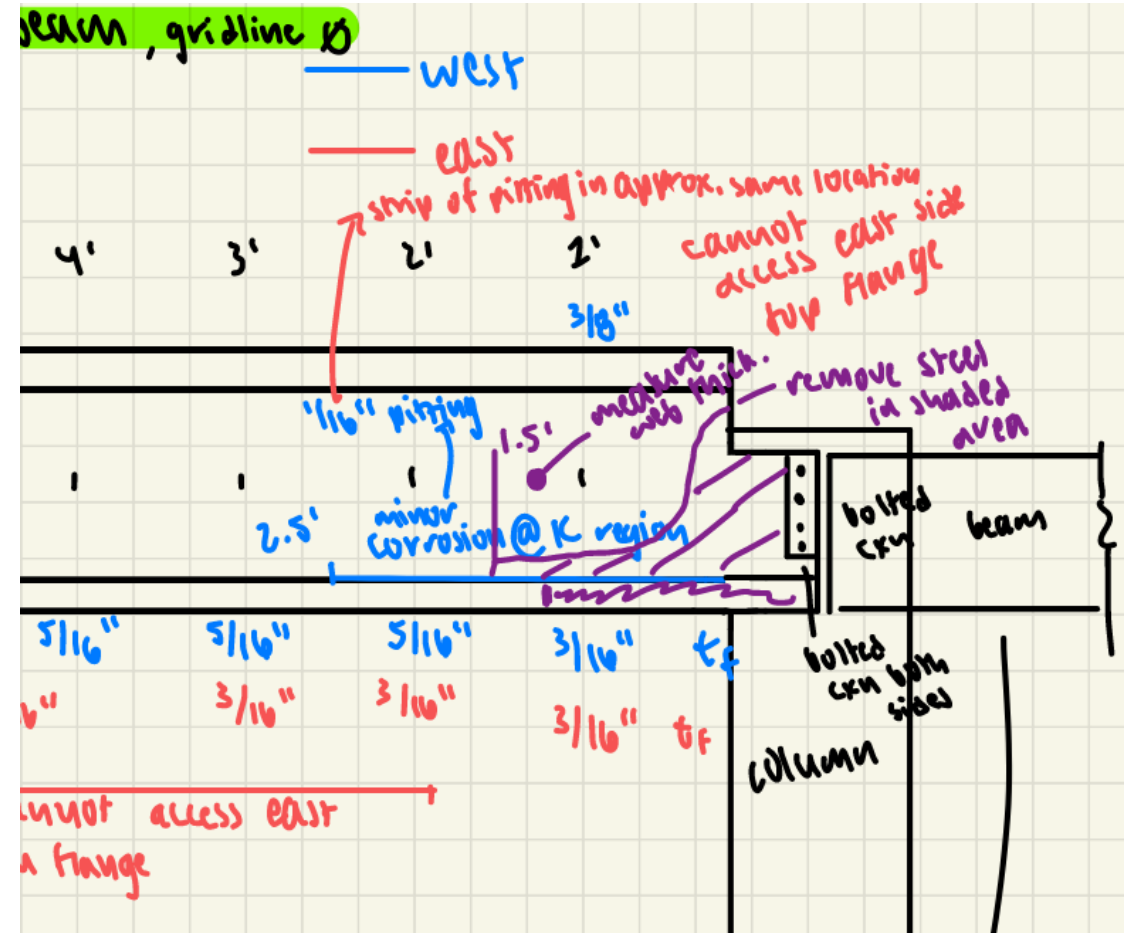
- Shoring in place
- Contractor removed corrosion and sandblasted steel



➤ Steel Repairs



Markings on beam for field notes



Field notes with thickness and pitting measurements

➤ Steel Repairs



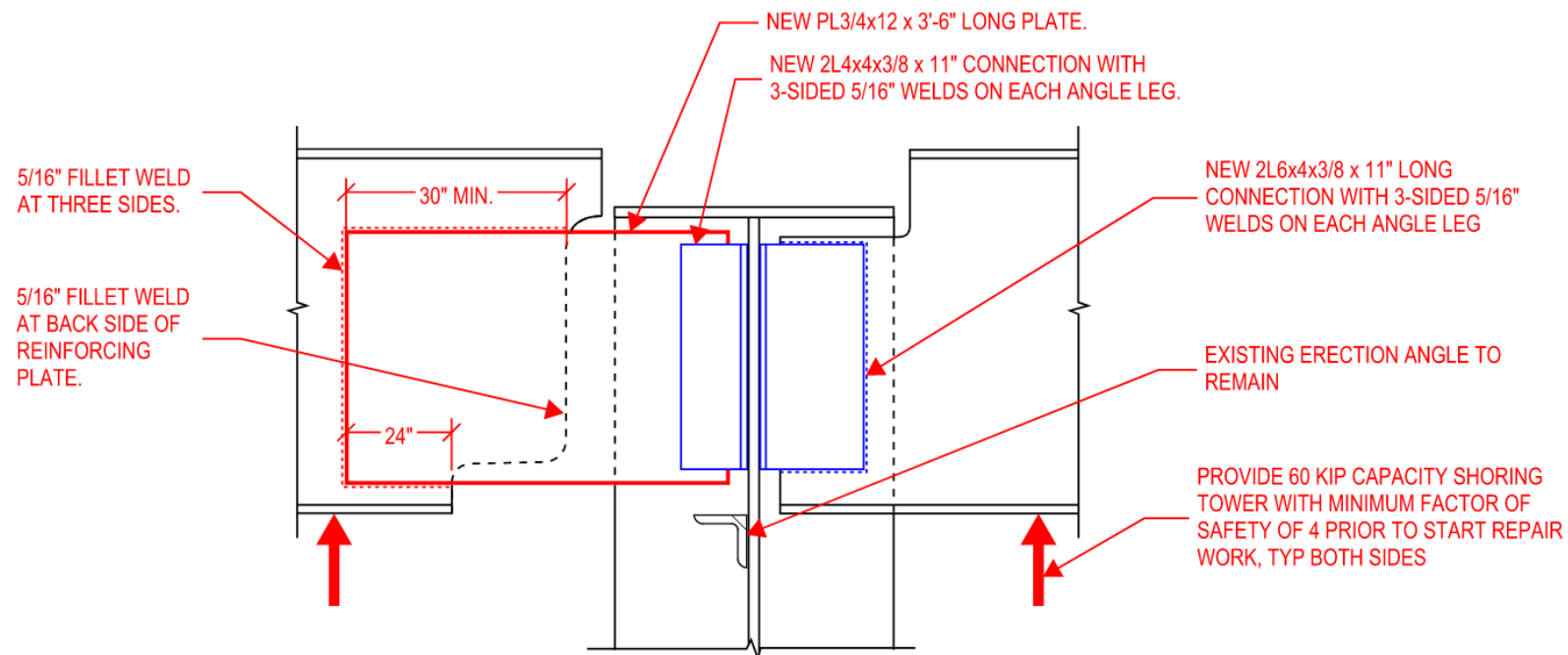
V-WAC gage for measuring pitting



Calipers for measuring thicknesses

➤ Steel Repairs

- Design 3-sided weld group between beam web and plate
- Replace double-angle connections with new



➤ Steel Repairs

- Ironworkers cut out deteriorated steel, welded new plate
- Coated with high-performance coating



➤ Steel Repairs



Before

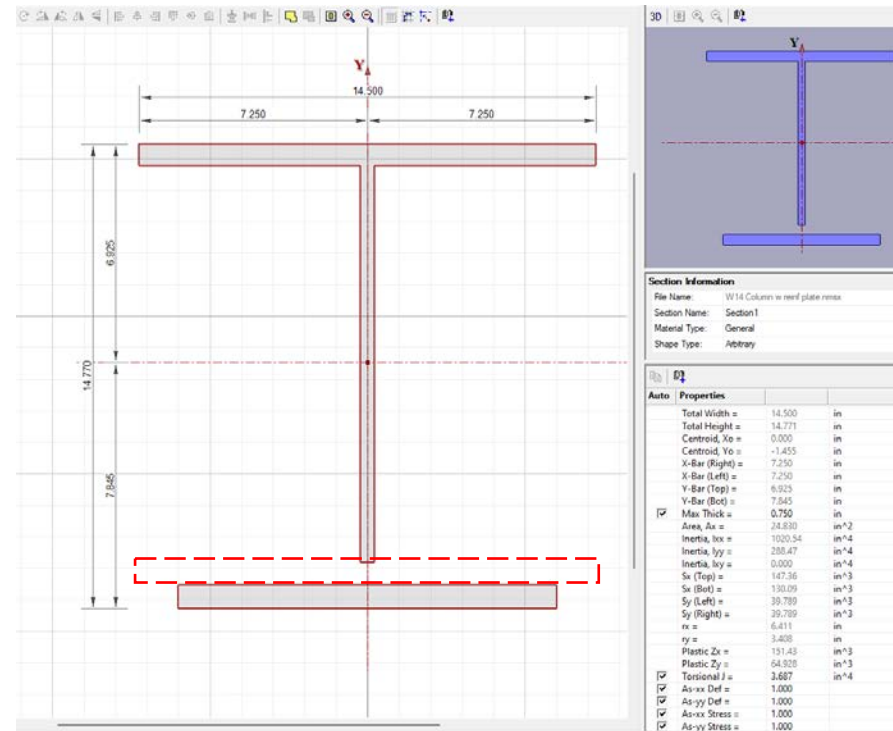


After

➤ Steel Repairs



Before



Analytical model – consider new reinforcing plate only



After

➤ Steel Repairs

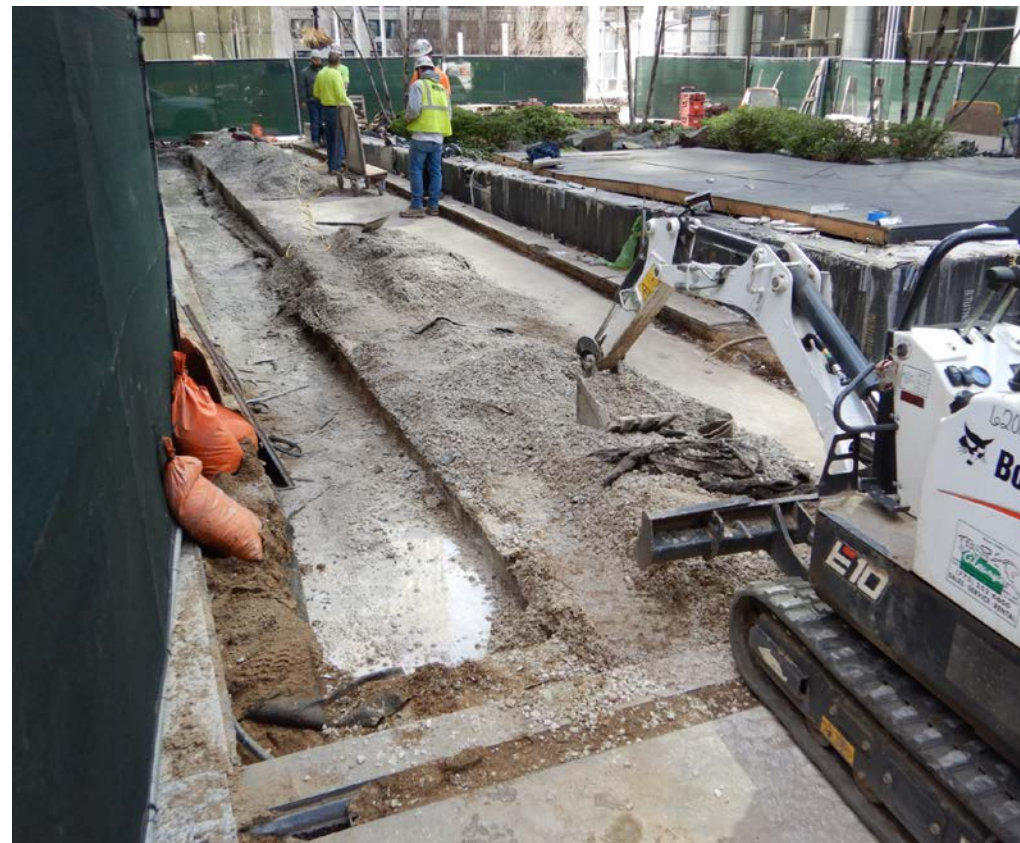


Before



After

➤ **UNIQUE
CONDITIONS**



➤ Planter Repairs



Planter clad with granite



Cracked granite paver

➤ Planter Repairs



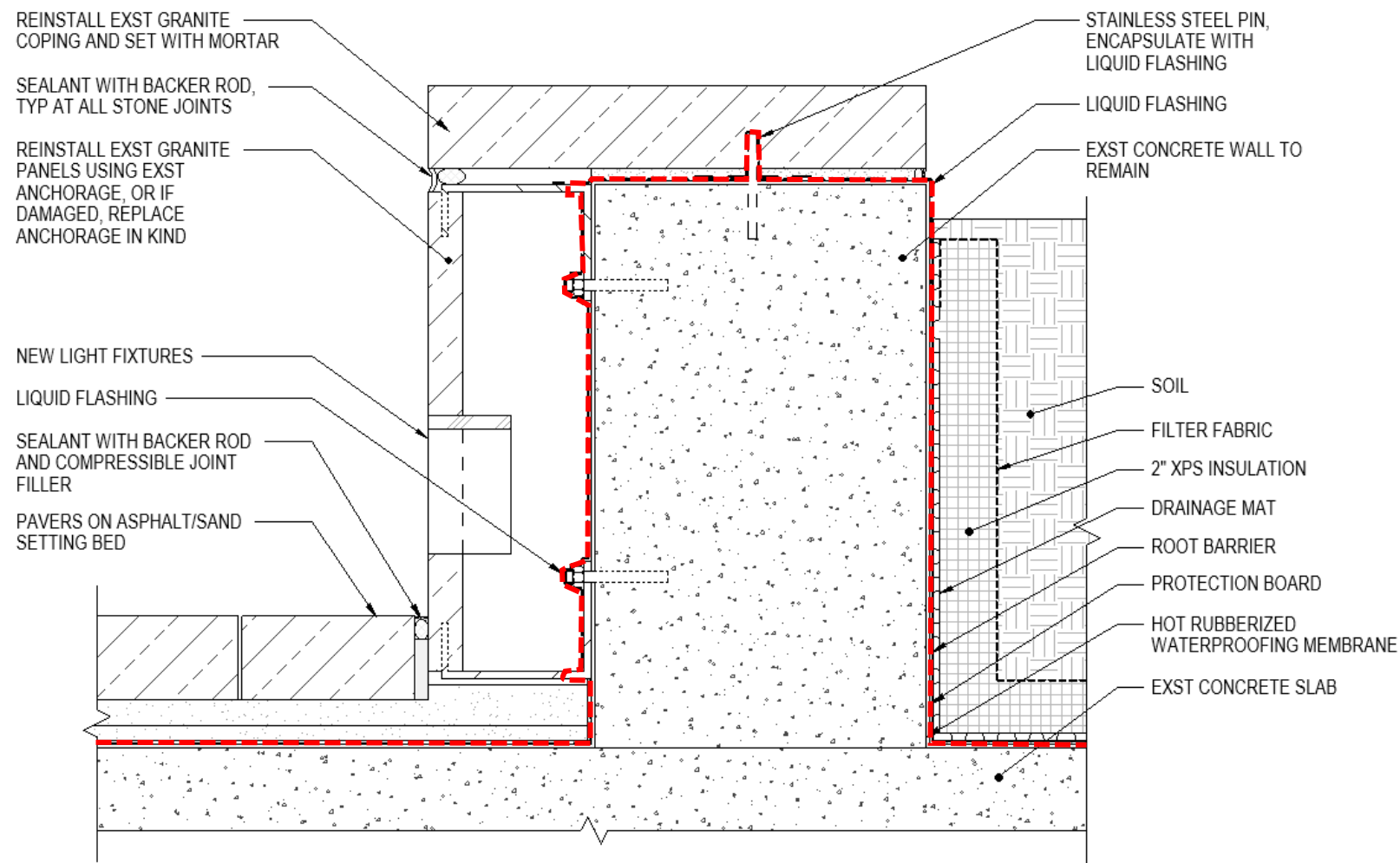
Setting bed bonded to underside of thin granite units



Planter with granite and waterproofing removed

➤ Planter Repairs

- Salvage existing granite cladding and coping
- Encapsulate concrete planter wall
- Waterproofing in red



➤ Stone Fill

- No topping slab
- No drainage
- Up to 14 inches of stone fill



➤ Expansion Joint

- Uncovered a section of joint that was filled solid
- No movement capacity



➤ Future Phases



Temporary paver installation in progress



Tying in temporary pavers to existing

➤ Future Phases



Flagpole and lights at topside



Flagpole attachment from underside



➤ **Questions?**

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