

# HYBRID COATINGS, CONCRETE RESTORATION & SEISMIC SURPRISES: A CALIFORNIA CASE STUDY

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12 April 2018



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San Francisco, CA

**SIMPSON GUMPERTZ & HEGER**



Engineering of Structures  
and Building Enclosures

- BS Civil Engineering
- MS Architectural Engineering
- 17+ years experience
- Building enclosure and structural engineering



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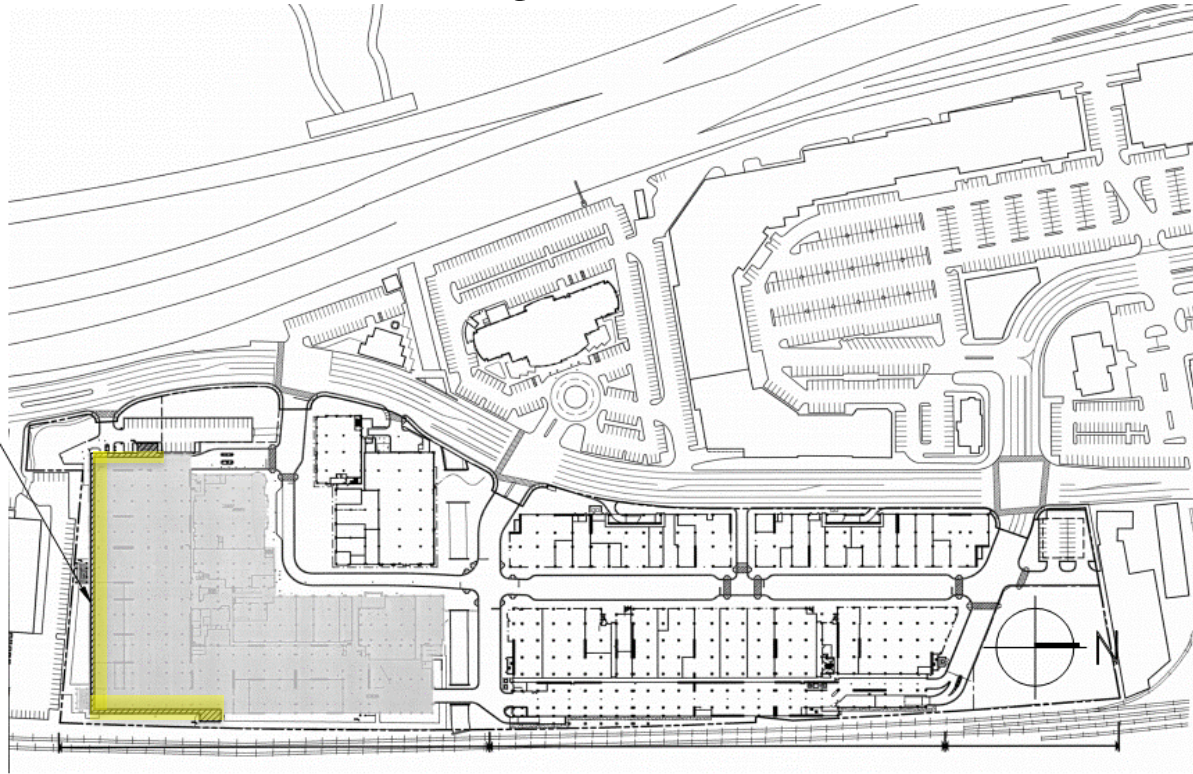
# Project Basics

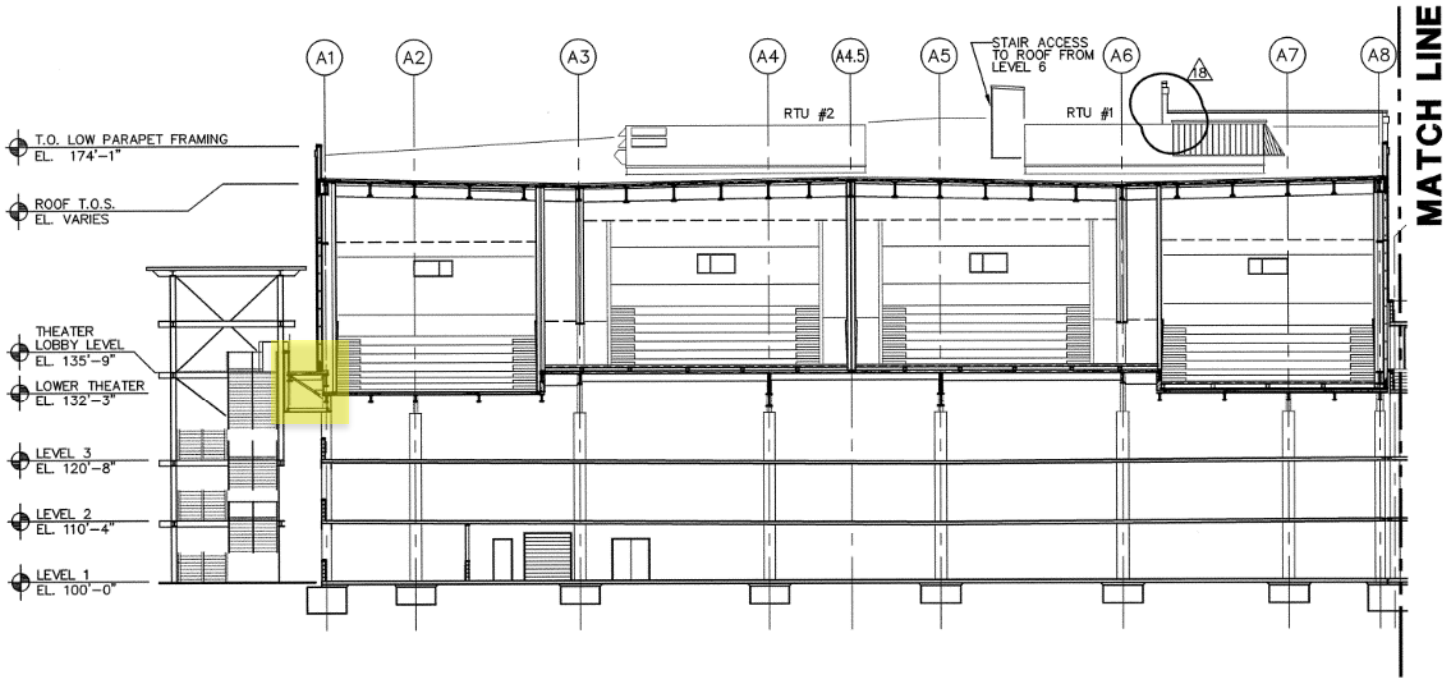
- Outdoor mall and movie theater complex
- Issues with exterior service corridor since day one
- Owner in need of reliable long-term fix



# Project Site

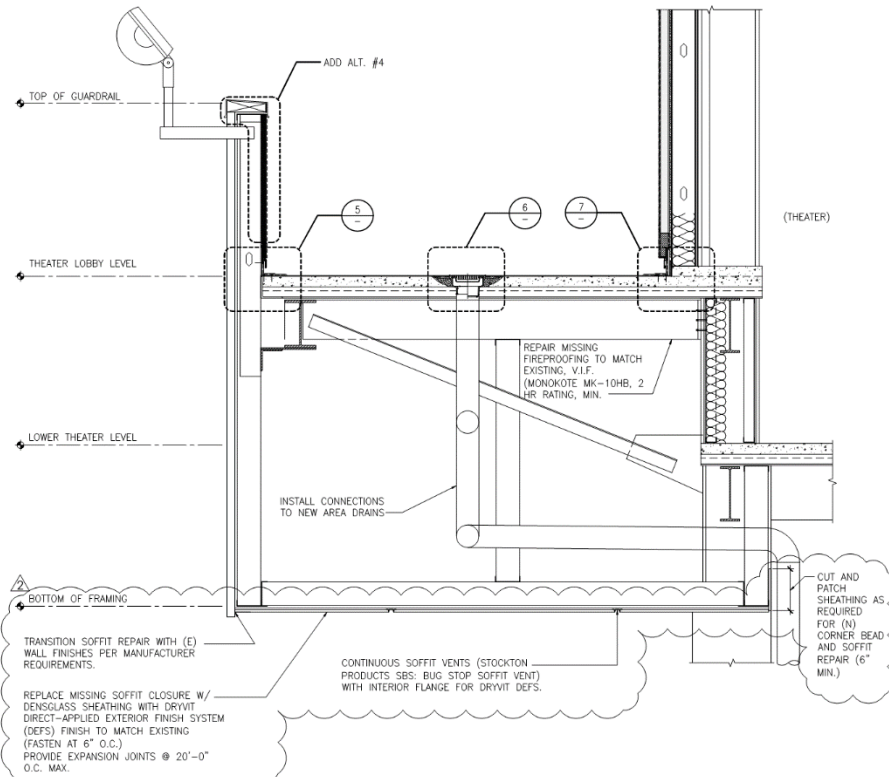
Service  
Corridor





**A** PARTIAL NORTH/SOUTH SECTION - LOOKING WEST 1/16" = 1'-0"





1 TYPICAL SERVICE CORRIDOR DECK

SCALE: 3/4"=1'-0", V.I.F.

# Service Corridor Section “The Catwalk”





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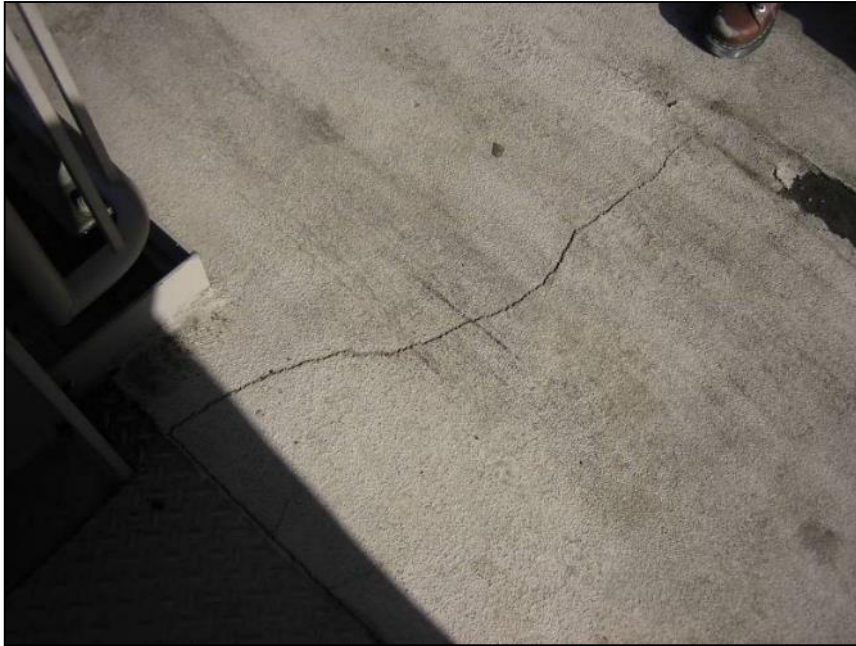


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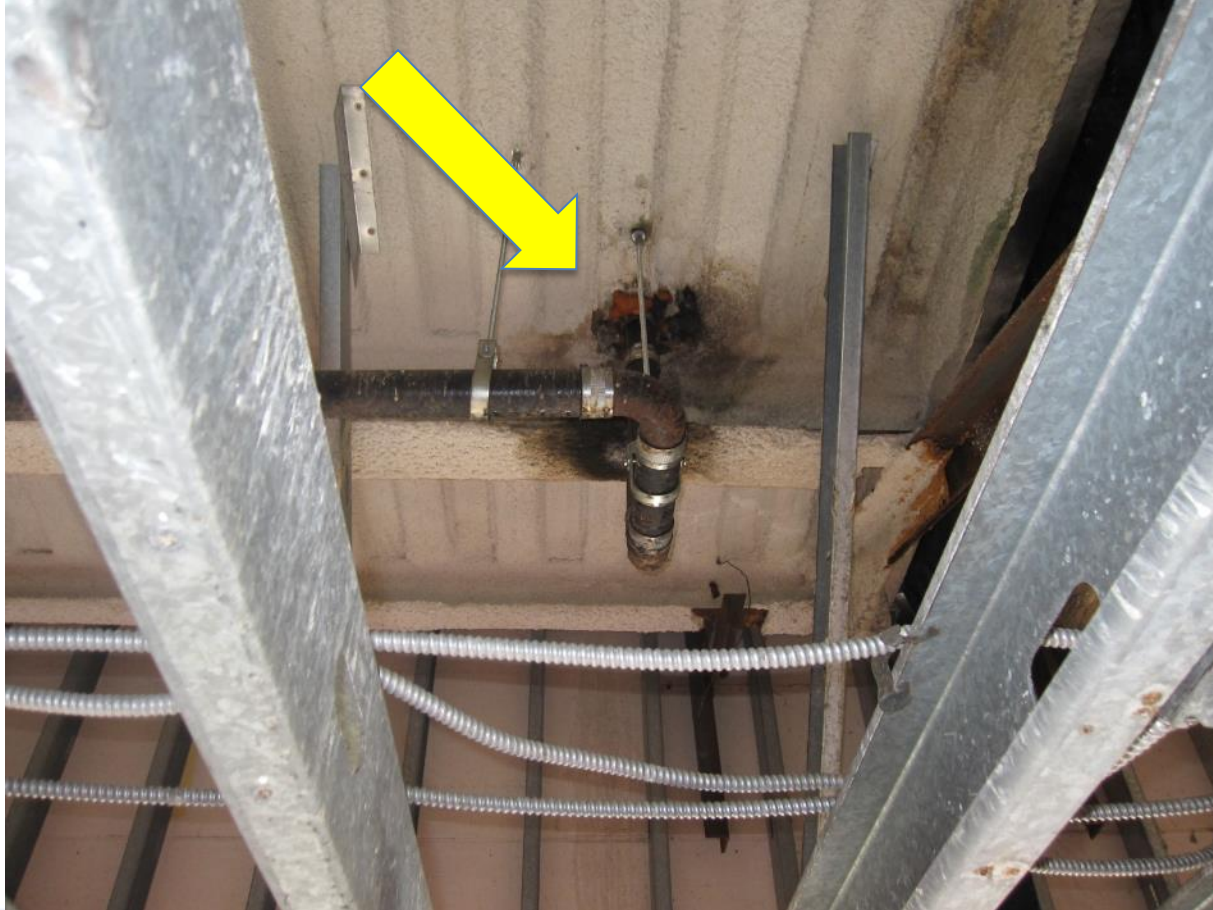


# Cracks, Spalls, and Unadhered Coatings



# Distress at Deck Drains





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# Failed Expansion Joint



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## Catwalk Soffit



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# Many questions...

- Why so much cracking and spalling?
- What materials were used?
- Why did they fail?
- Palletized hand trucks?





# As-Built Coating Terminations



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# As-Built Coating Terminations







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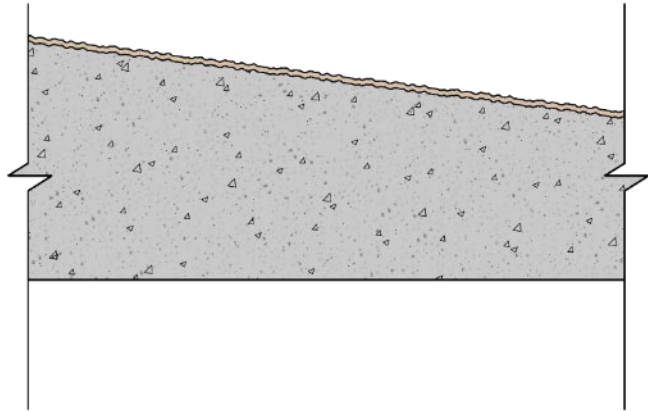
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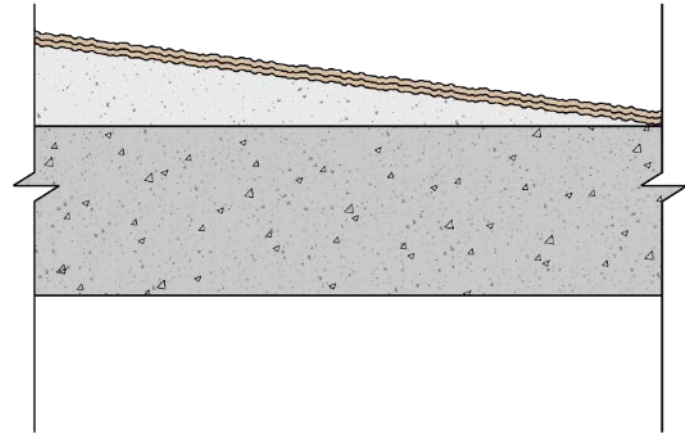
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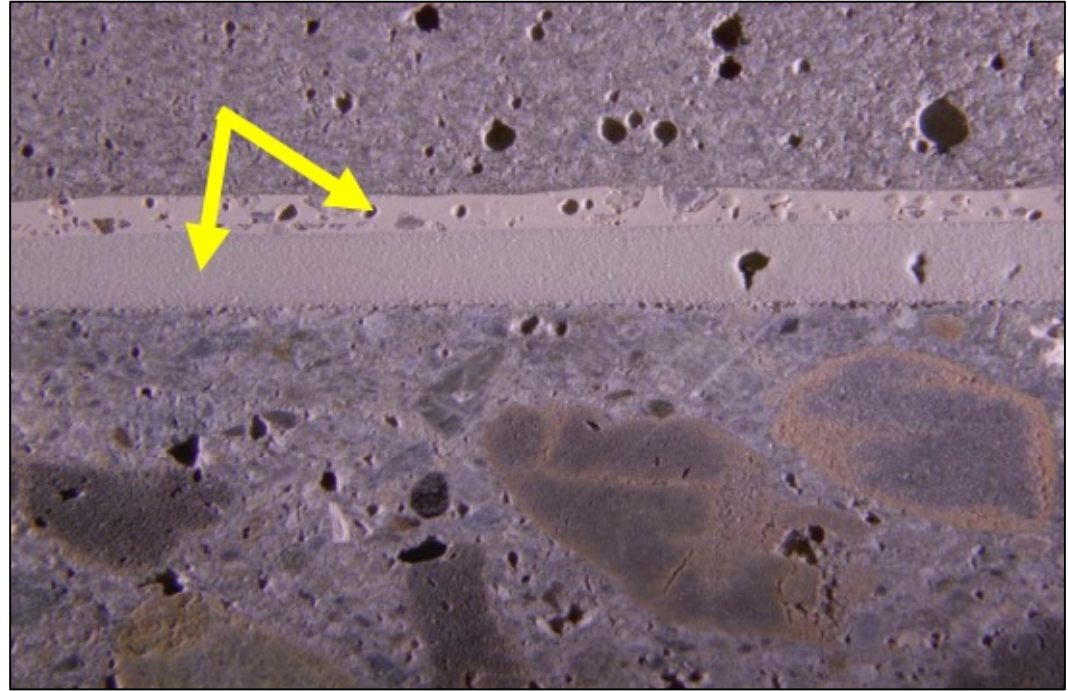
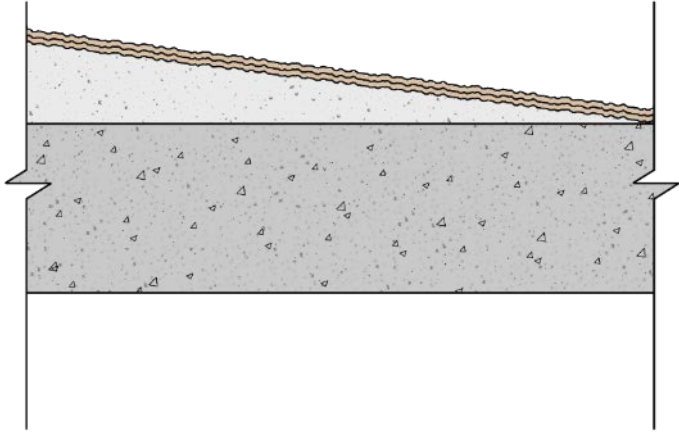
# Specified

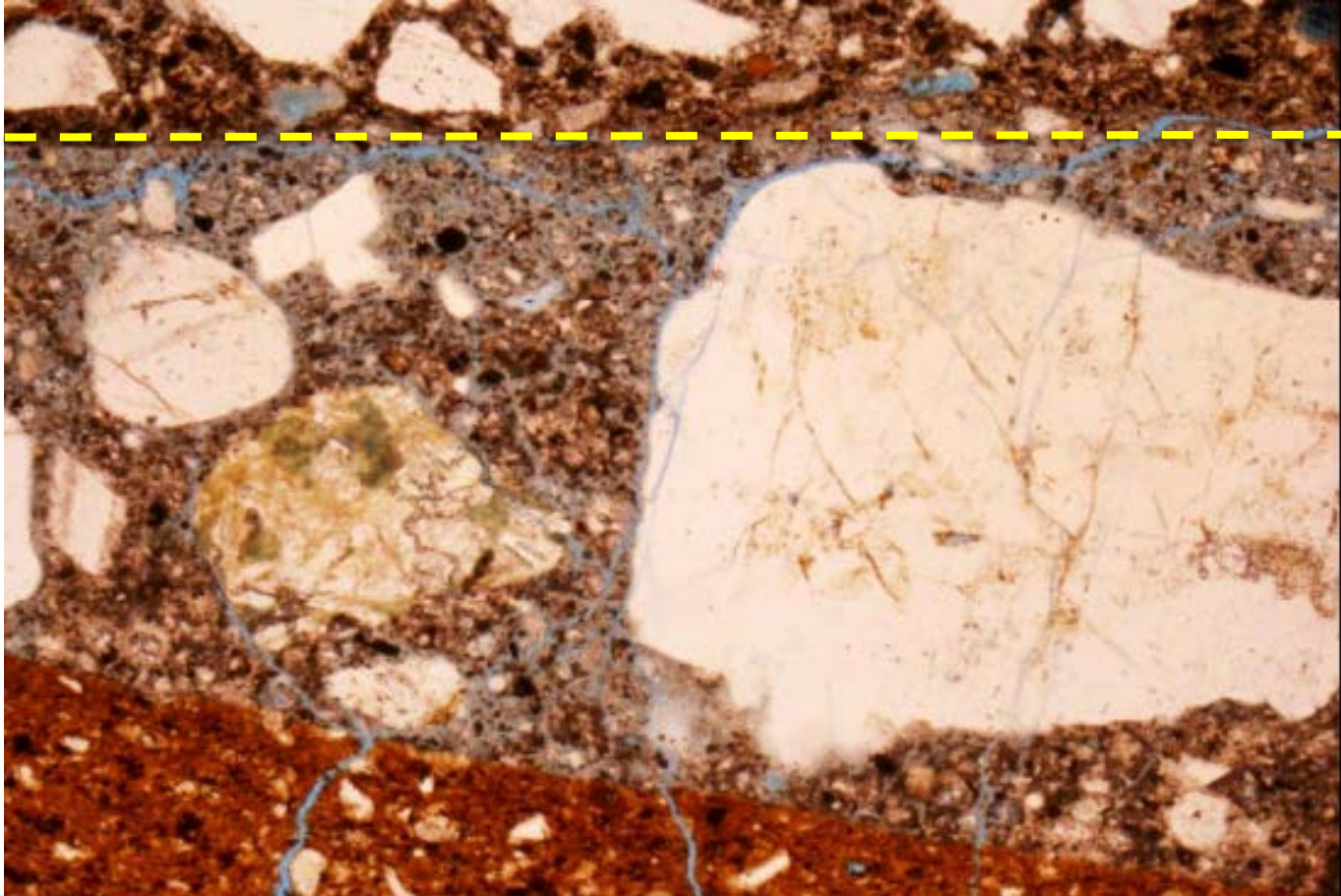


# As-Built



# Petrographic Analysis





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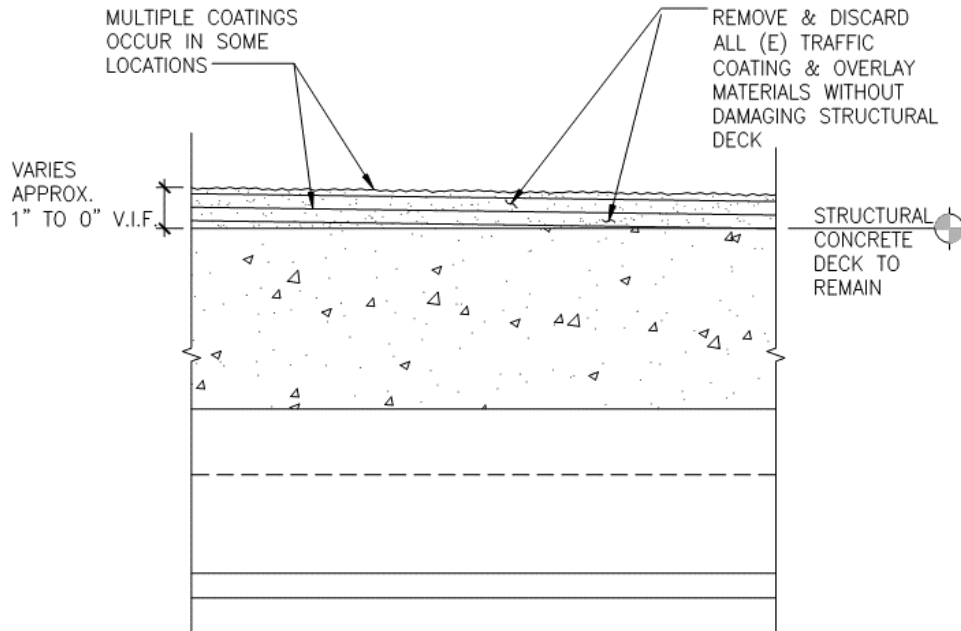
# But wait...



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# This deck was stacked...



- Failed coating
- Broken drains
- Unbonded overlay
- Flat structural deck
- Heavy palletized hand jacks
- “Catwalk” must remain open...



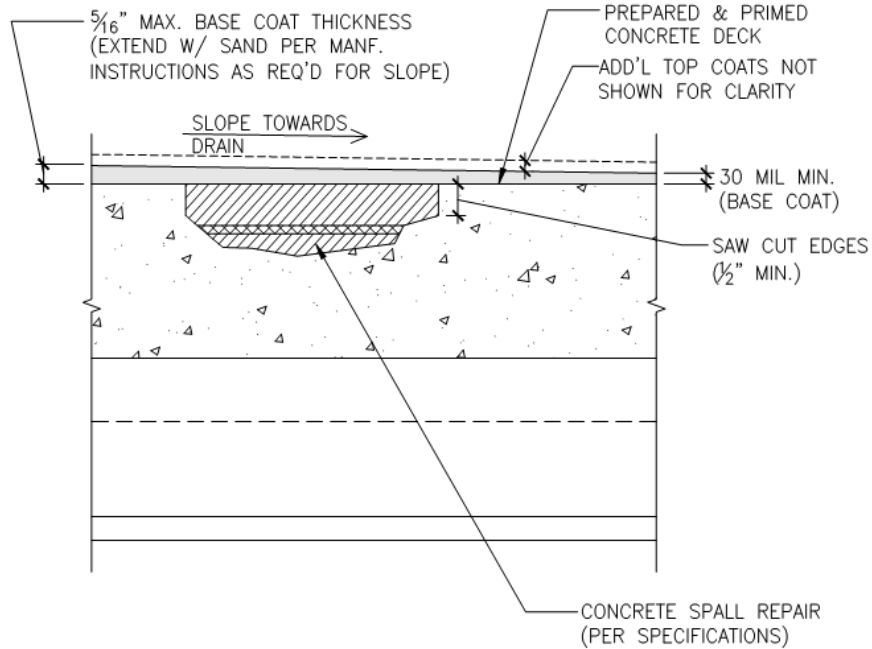


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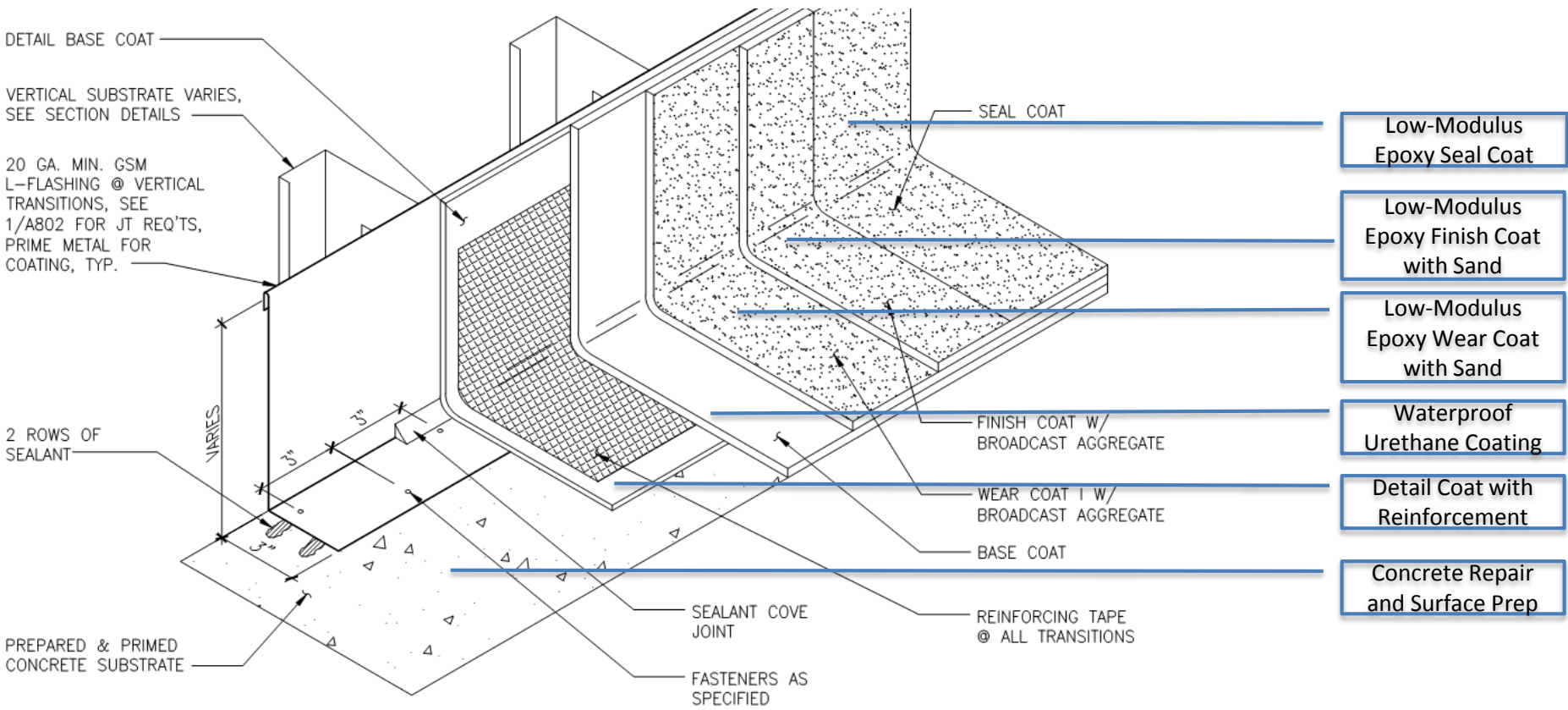


# Repair Strategy

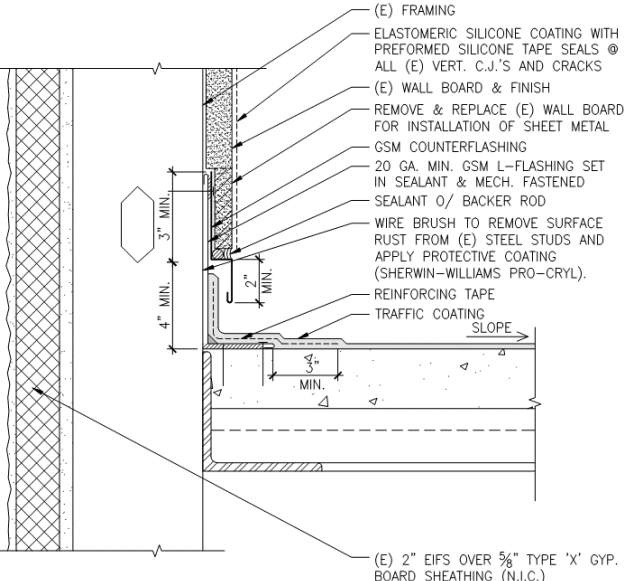


- Restore concrete deck
- Eliminate sloping compound
- Reliable waterproofing
- Build-up “bird baths” where feasible
- Tough wear resistance

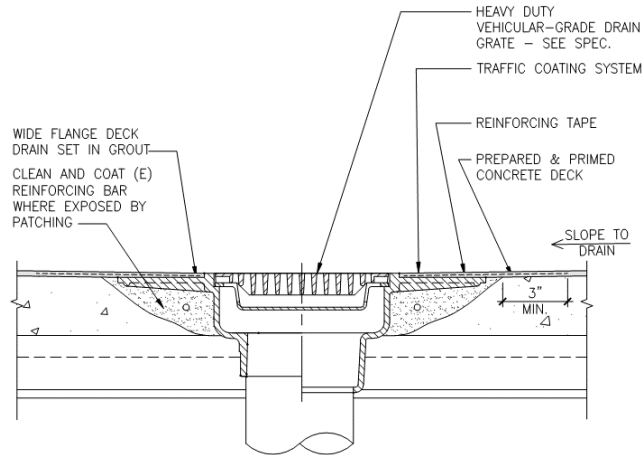




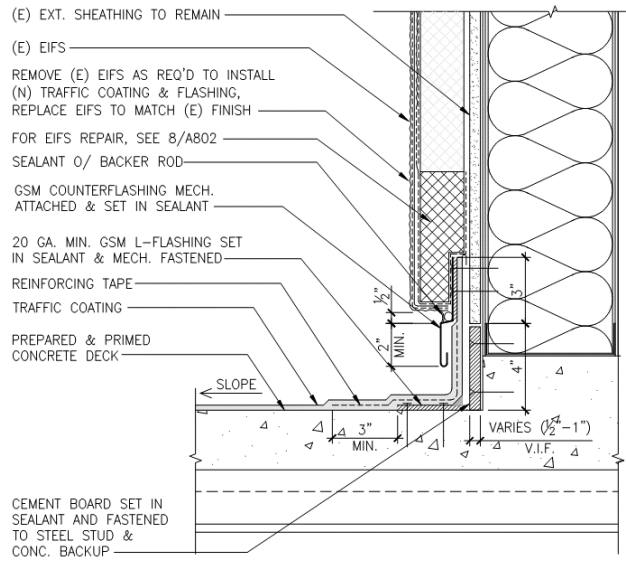
# Typical Details



5 TRAFFIC COATING TERMINATION @ PARAPET  
 SCALE: 3"=1'-0"



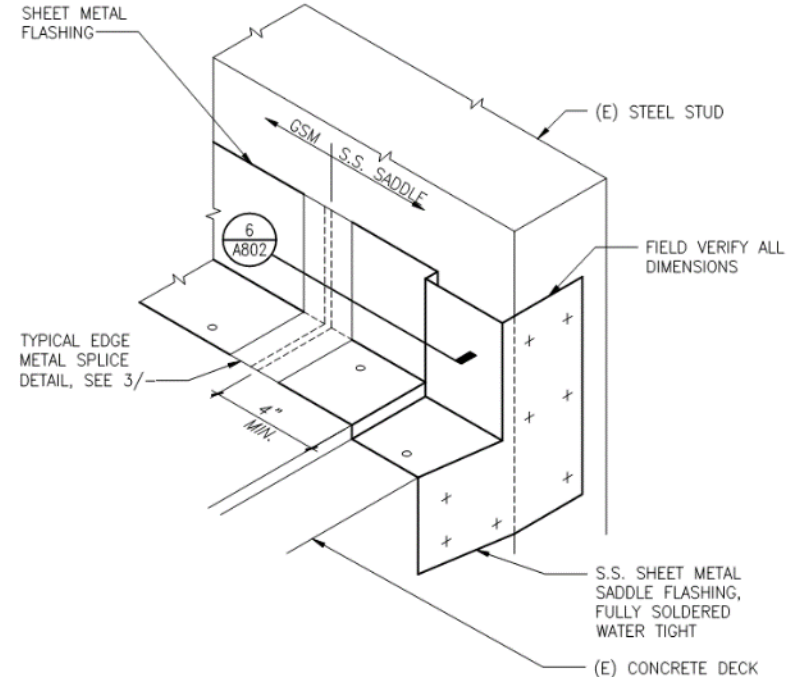
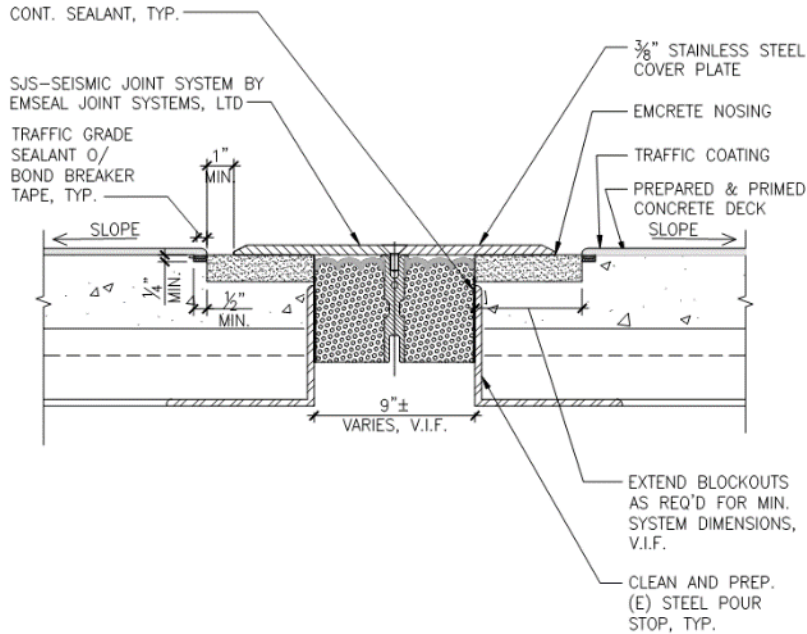
6 TRAFFIC-RATED DRAIN  
 SCALE: 3"=1'-0"



7 TRAFFIC COATING TERMINATION @ THEATER WALL  
 SCALE: 3"=1'-0"



# Seismic Joint Details



4

EXPANSION JOINT SECTION @ DECK

SCALE: 3"=1'-0"

3

EXPANSION JOINT SHEET METAL SADDLE FLASHING TRANSITION

SCALE: N.T.S.



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# Construction Phase

- Phasing plans
- Demolition off-hours
- Close coordination with users
- Mockups





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# Mock-Ups

- Surface prep ICRI CSP 3-4
- Primers
- Peel strength testing (ASTM D903)
- Benchmark application quality





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**“Things are going well.. right?”**



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Guess  
again...



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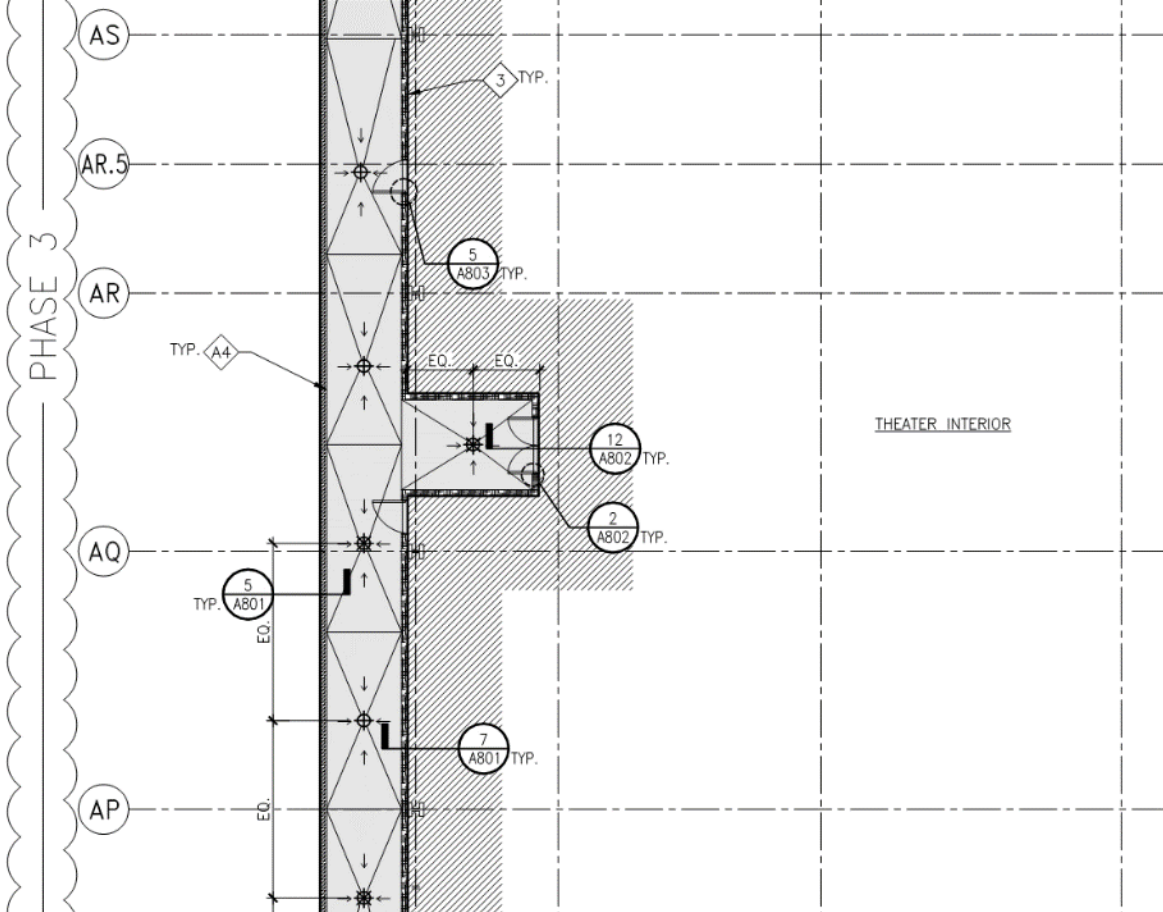
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## More trouble at the Drains...

- RFI
- No. 6 bars cut at drains
- Does it matter?
- Work stops...





21 of 24 Drains  
Impacted

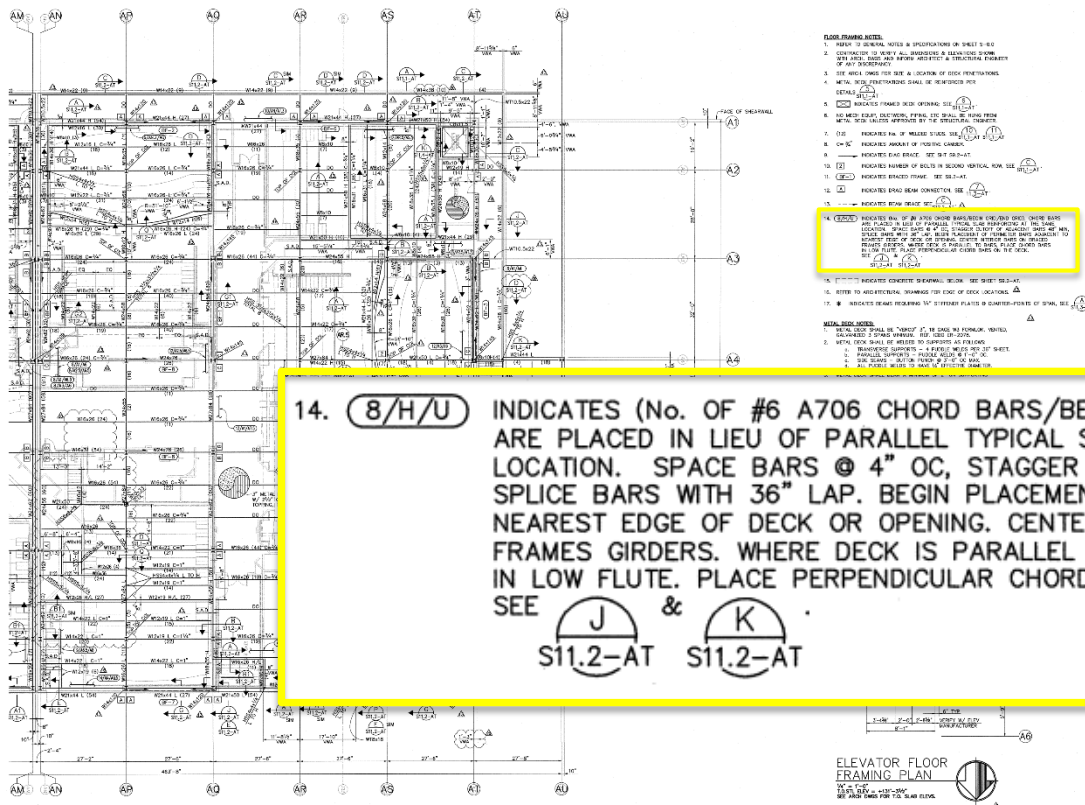




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# Chord Reinforcement (Seismic)

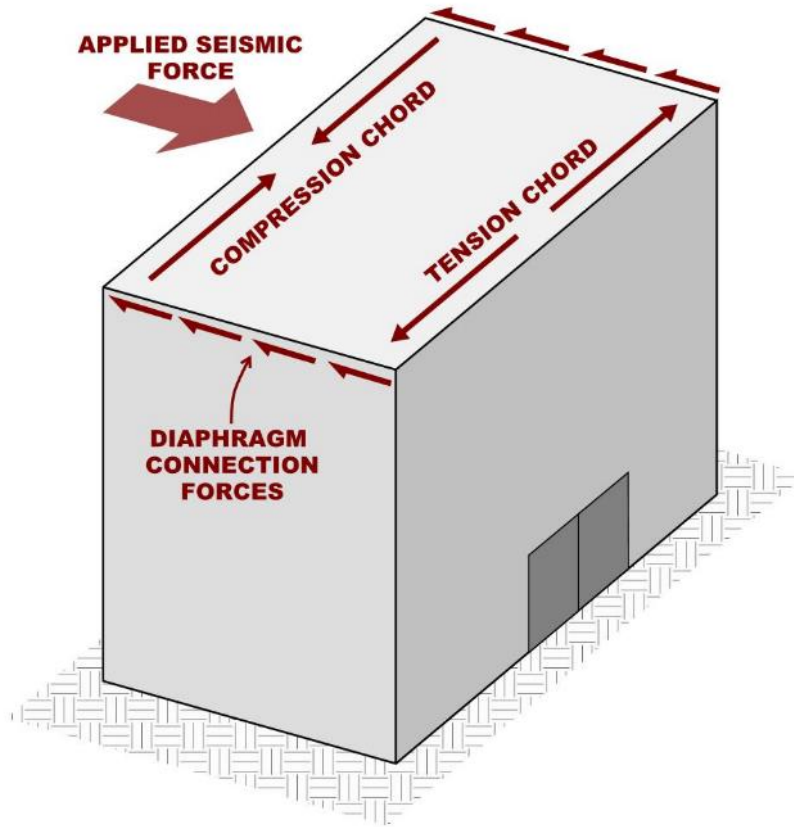


14. **(8/H/U)** INDICATES (No. OF #6 A706 CHORD BARS/BEGIN GRID/END GRID). CHORD BARS ARE PLACED IN LIEU OF PARALLEL TYPICAL SLAB REINFORCING AT THE SAME LOCATION. SPACE BARS @ 4" OC, STAGGER CUTOFF OF ADJACENT BARS 48" MIN, SPLICE BARS WITH 36" LAP. BEGIN PLACEMENT OF PERIMETER BARS ADJACENT TO NEAREST EDGE OF DECK OR OPENING. CENTER INTERIOR BARS ON BRACED FRAMES GIRDERS. WHERE DECK IS PARALLEL TO BARS, PLACE CHORD BARS IN LOW FLUTE. PLACE PERPENDICULAR CHORD BARS ON THE DECK. SEE **(J)** & **(K)** S11.2-AT S11.2-AT

PARTIAL THEATER LEVEL 4 FLOOR FRAMING PLAN No. 2  
 TOTAL AND HIGH (LO) TOP OF STEEL CL. = 1102'-00"  
 METRIC: 330.76 M AND HIGH (LO) TOP OF STEEL CL. = 337.10 M  
 100% TOP OF STEEL CL. = 100'-00"  
 TOP OF STEEL = BOTTOM OF METAL DECK

ELEVATOR FLOOR FRAMING PLAN  
 100% TOP OF STEEL CL. = 100'-00"  
 100% TOP OF STEEL = BOTTOM OF METAL DECK





“Chord Forces”

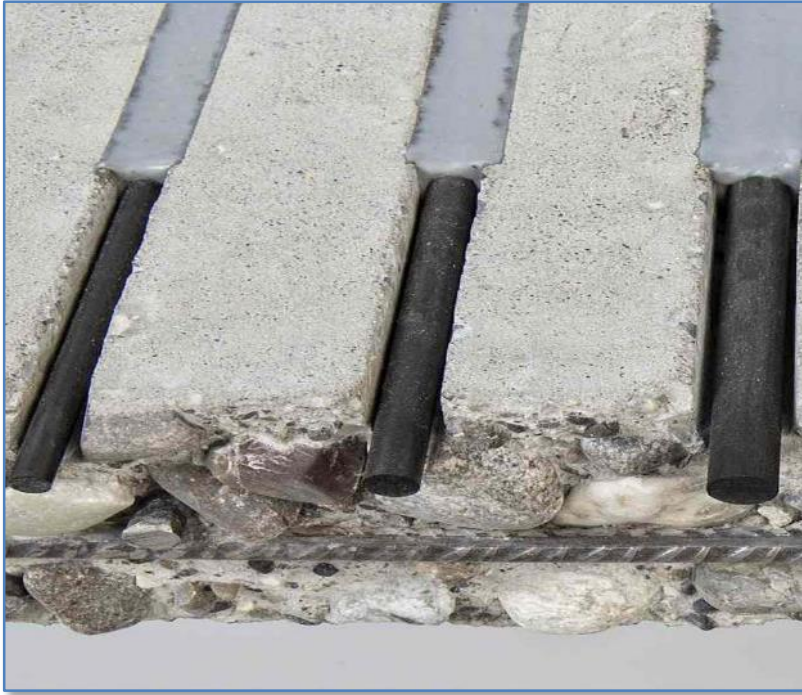


# Seismic Solutions?

- ~~Supplemental bracing~~
- ~~Extend demo and splice rebar (where feasible)~~
- ~~Perform analysis to determine DCRs~~
- Carbon Fiber Reinforced Polymer (CFRP) Reinforcement



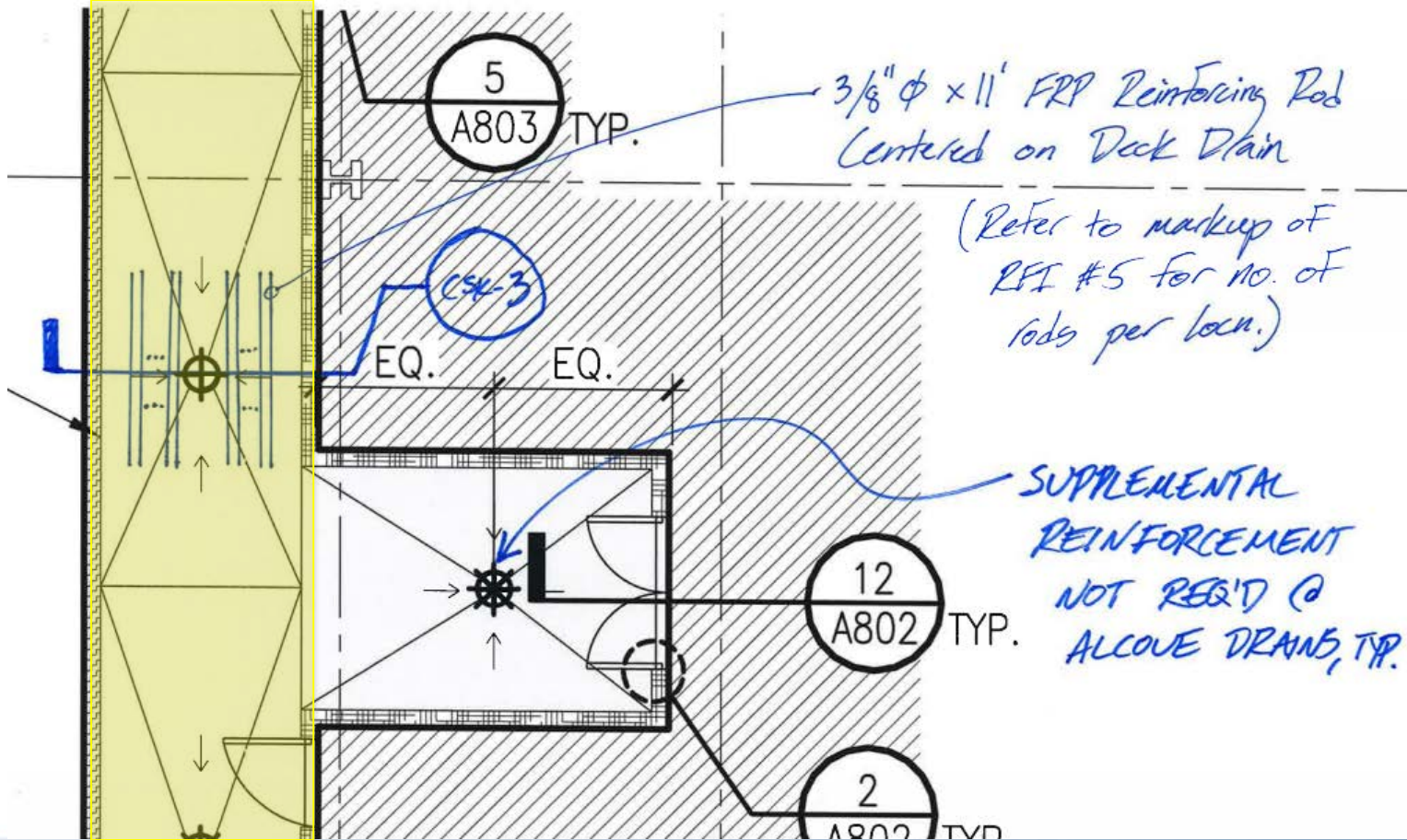


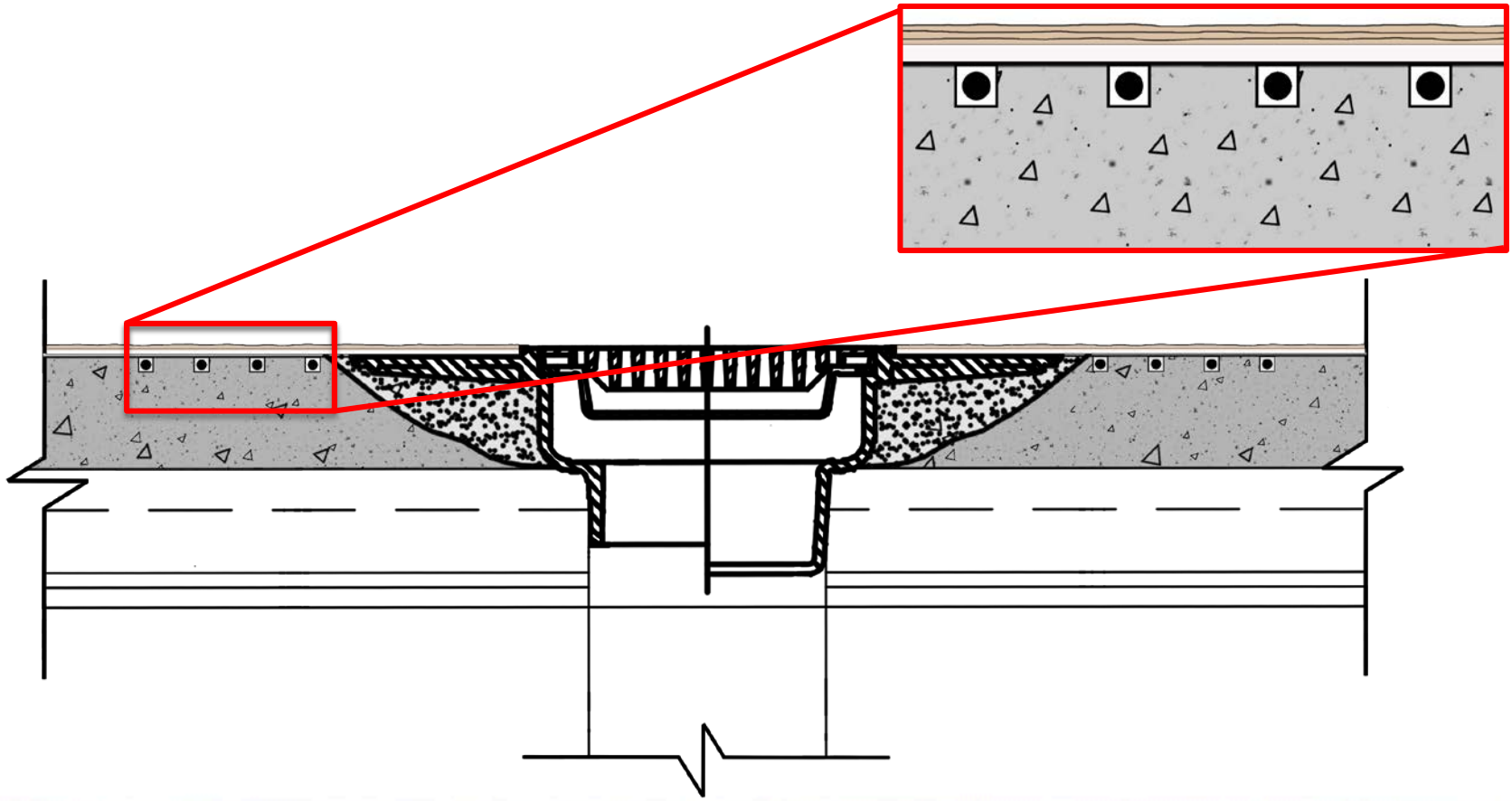


## CFRP Reinforcing Rods

- Near surface application
- Compatible with specified coating repairs
- Readily available
- Familiar to restoration subcontractor already on the job









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Back on track...



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Project  
Completed  
2016



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# 2018 Update...



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# Thank You

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