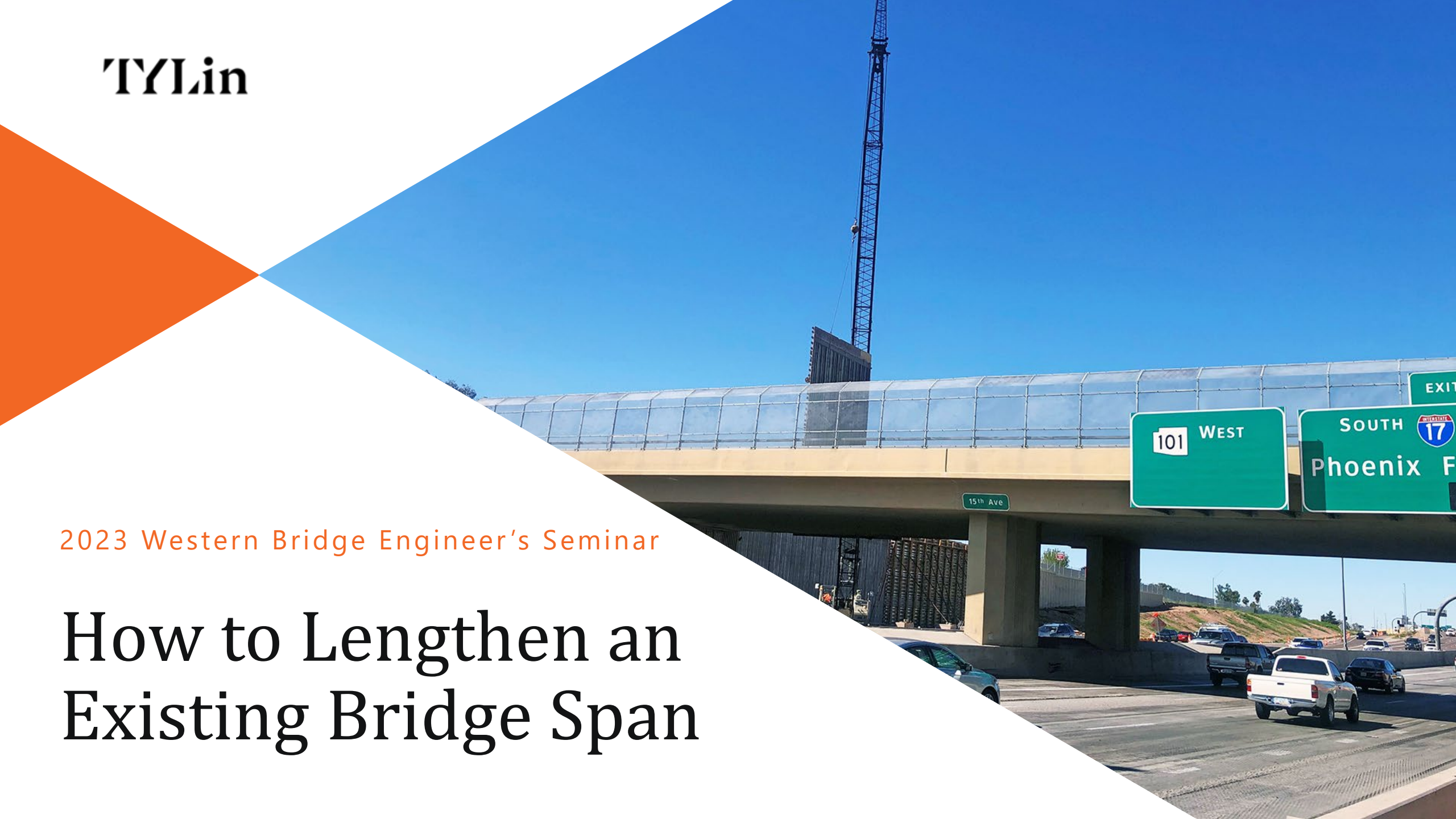
TYLin




2023 Western Bridge Engineer's Seminar

# How to Lengthen an Existing Bridge Span

# Project Team

JOINT VENTURE

**Coffman Ames** Joint Venture

DESIGN TEAM

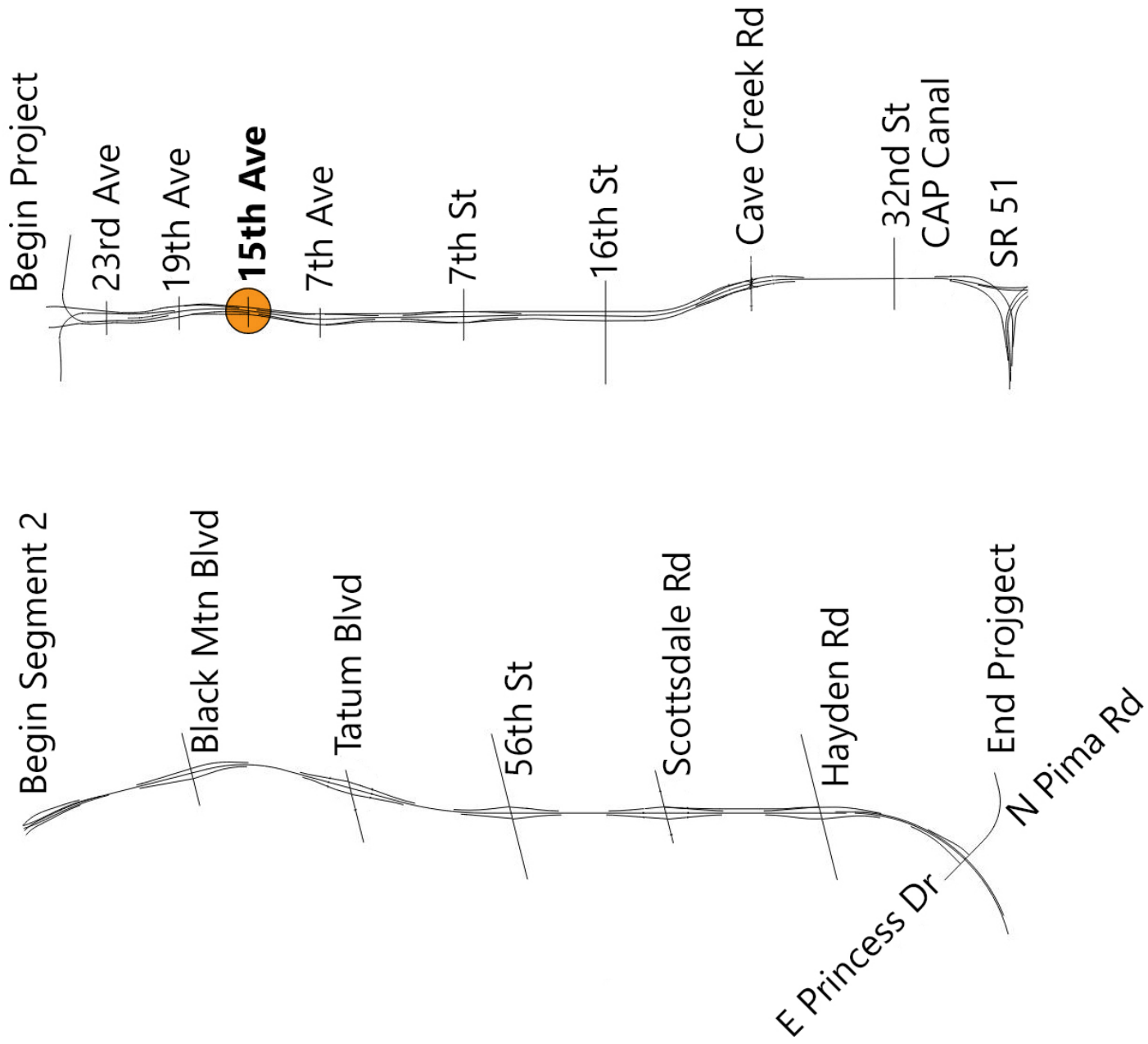
TYLin | AECOM

Kimley»Horn
Expect More. Experience Better.

Terracon

# Site Location

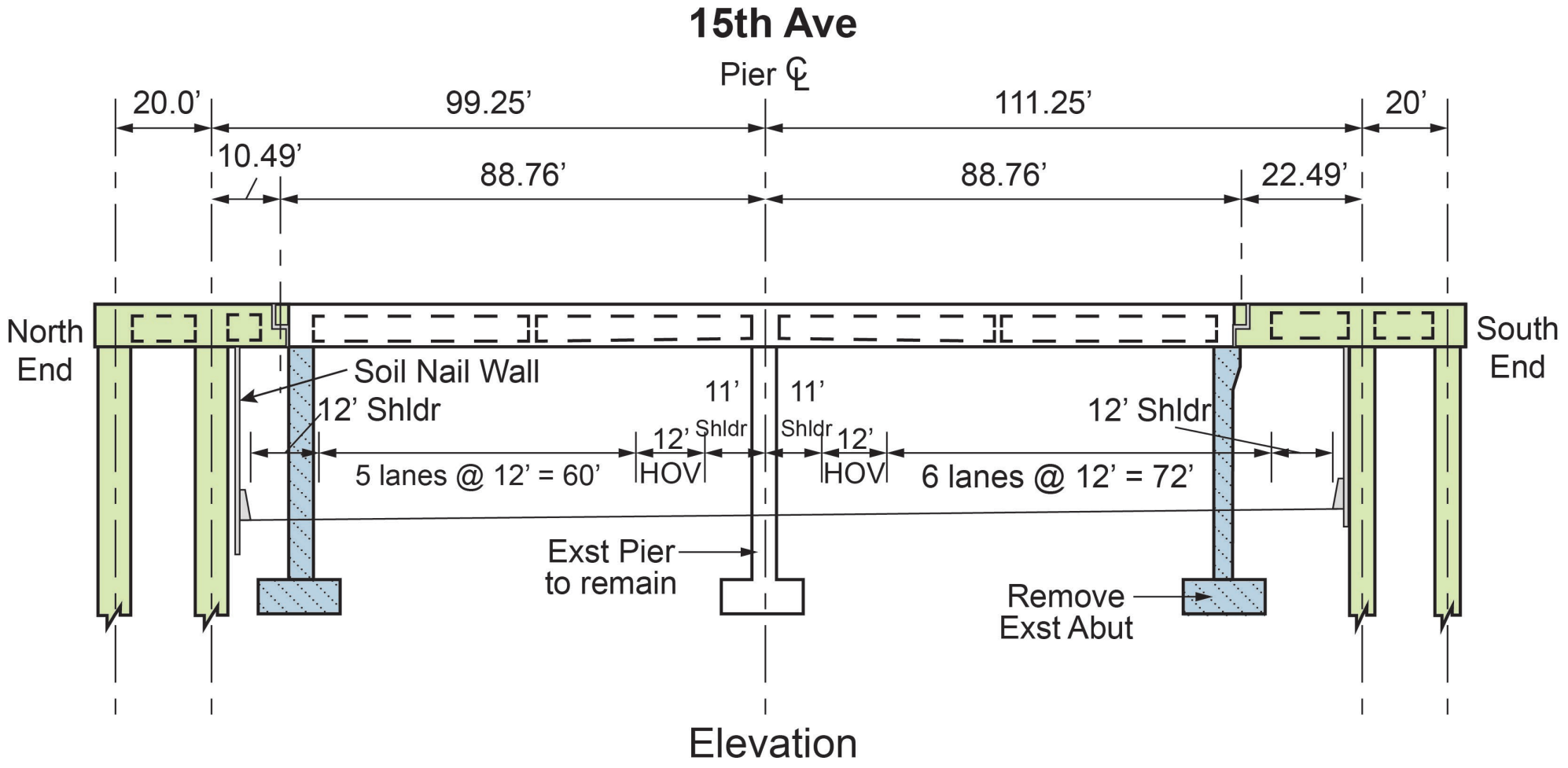
## SR 101L, I-17 TO PRINCESS DR

# 15th Avenue UP

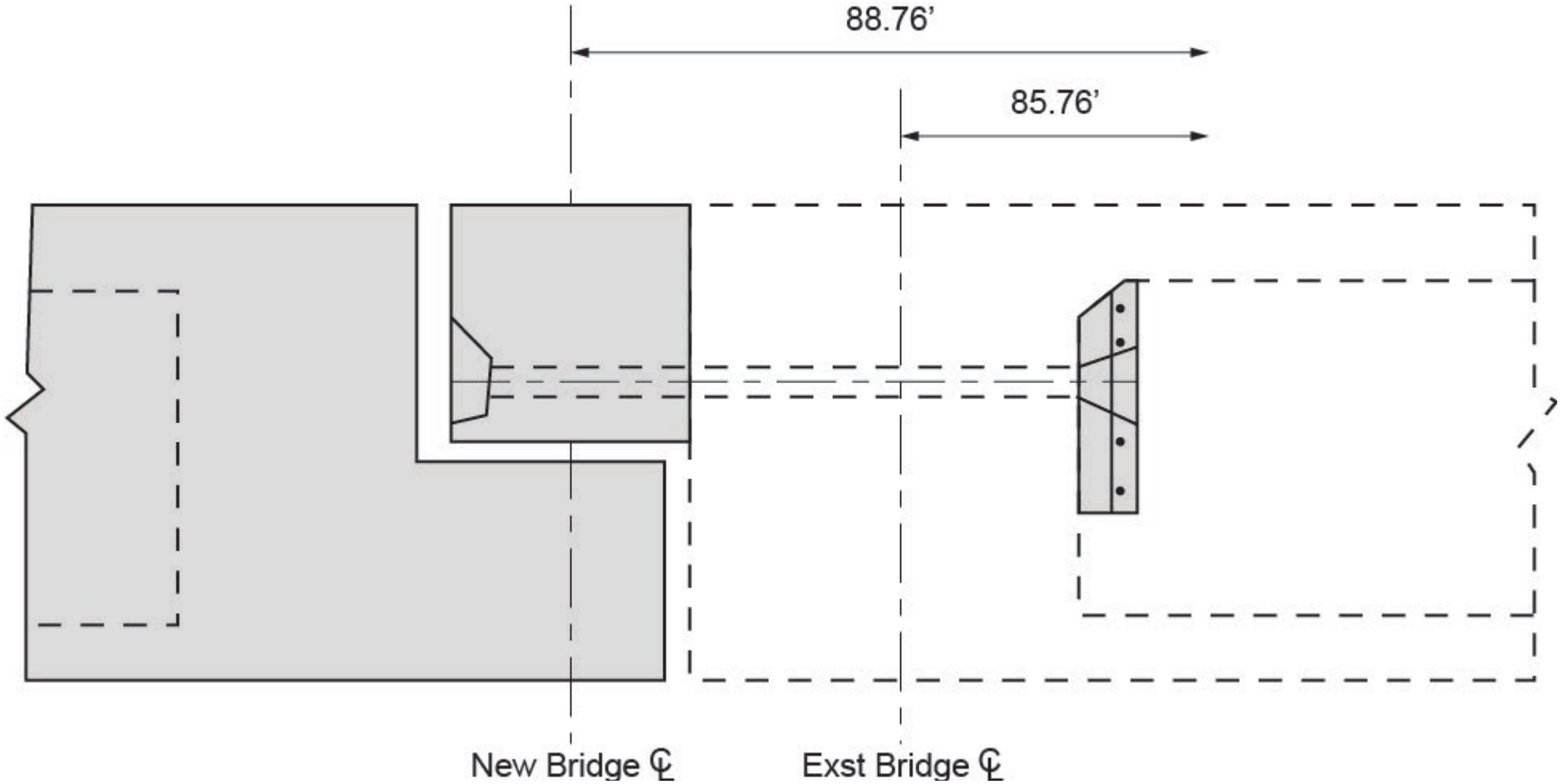
- Idea: How to lengthen a span?
- Alternate Technical Concept - ATC
  - Dimension Changes
    - Metric to English Lanes
    - Sidewalk 4.92 ft to 6.00 ft
  - Design Specification
    - Existing Bridge: AASHTO Std Specifications 17th Edition 2002
    - New Bridge: AASHTO LRFD Bridge Design Specifications, 8th Edition
  - Allowable Tension in Existing Bridge
    - 179 psi to 256 psi
    - AASHTO allowable 402 psi
    - Requested use of 4 sqrt(f'c) or 268 psi

# 15th Avenue UP



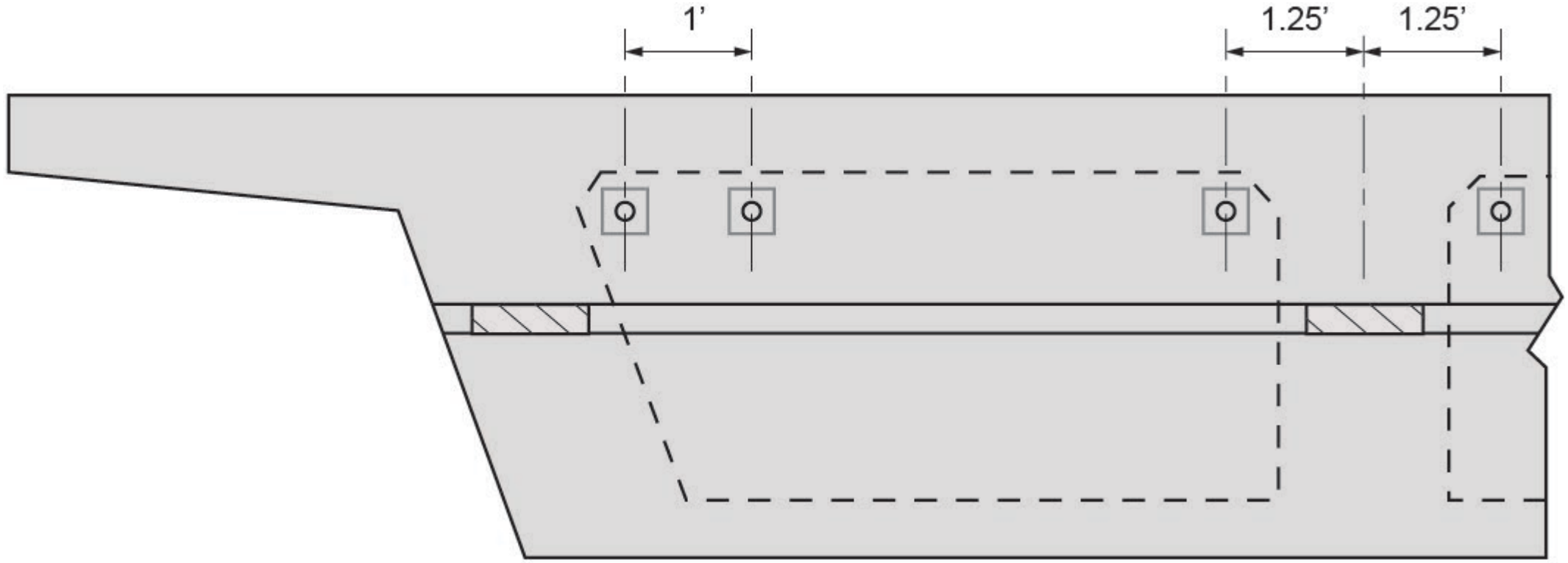
# 15th Avenue UP

## HINGE DETAIL



# 15th Avenue UP

## P/S BARS



# 15th Avenue UP

## CHANGES FROM PURSUIT

- Hinge Connection Changed
  - Top Corbel Connection Changed to Full Depth Connection
  - Added Bottom P/S Bars with Dowels
  - Existing Span increased from 3.00 feet to 4.77 feet
  - Tension increased from 179 psi to 256 psi to 300 psi
- Wall Changed
  - Soil Nail Wall Changed to Cast-in-Place Pier Wall
- End Span Changes
  - Frame 2 End Span increased to 25 feet

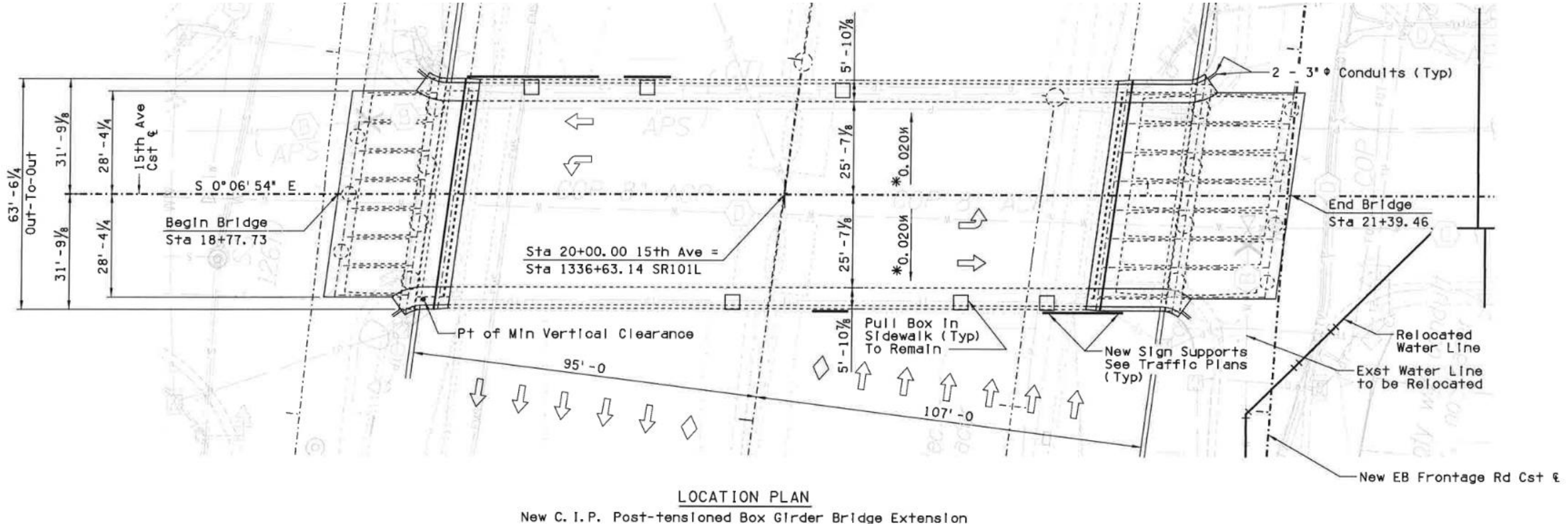
# 15th Avenue UP

## DESIGN ISSUES

- Conversion of Existing Metric to English
- Shallow Superstructure Depth (3.94 feet)
  - Hinge Design
  - Construction Access
- Use of Two Design Specifications
  - Existing: Standard Specifications 17th Edition 2002
  - New:  LRFD Bridge Design Specifications, 8th Edition
- Traffic Access on Frontage Road
- Existing Abutment Wall Strength

# 15th Avenue UP

## PLAN

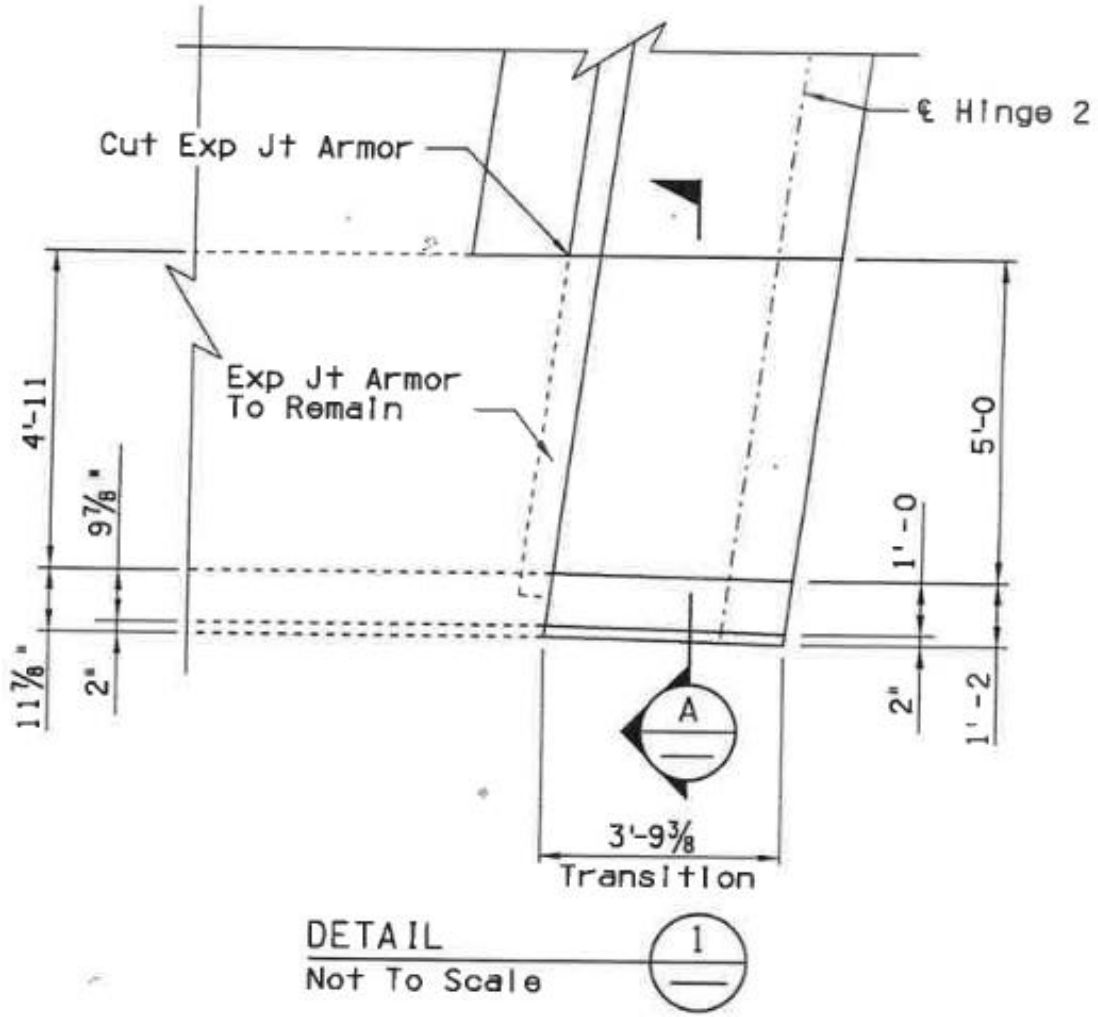



LOCATION PLAN

New C. I. P. Post-tensioned Box Girder Bridge Extension

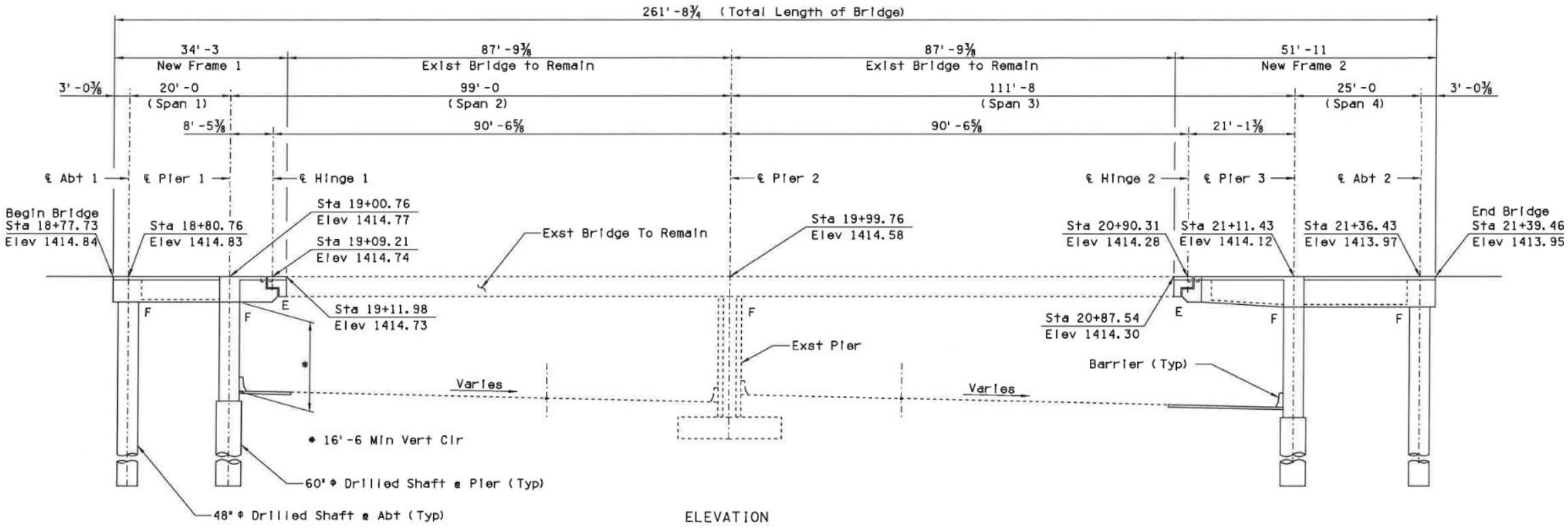
# 15th Avenue UP

## BRIDGE FLARE



# 15th Avenue UP

## ELEVATION

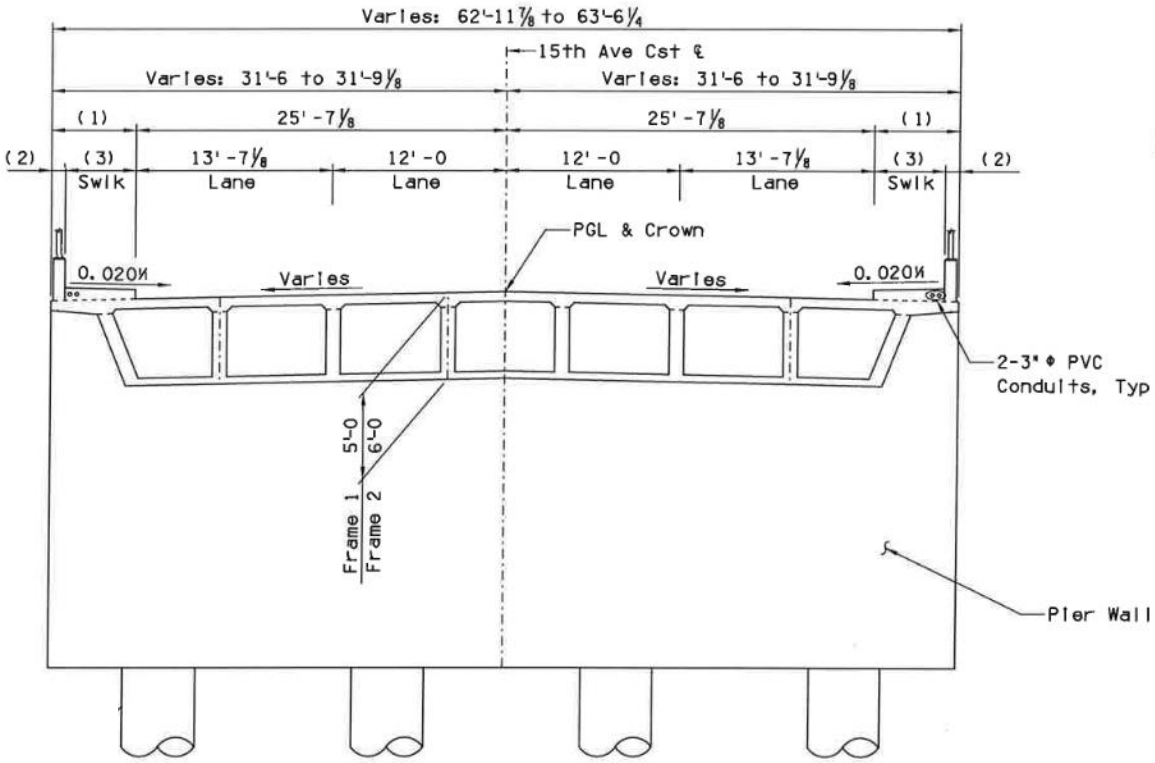


# 15th Avenue UP

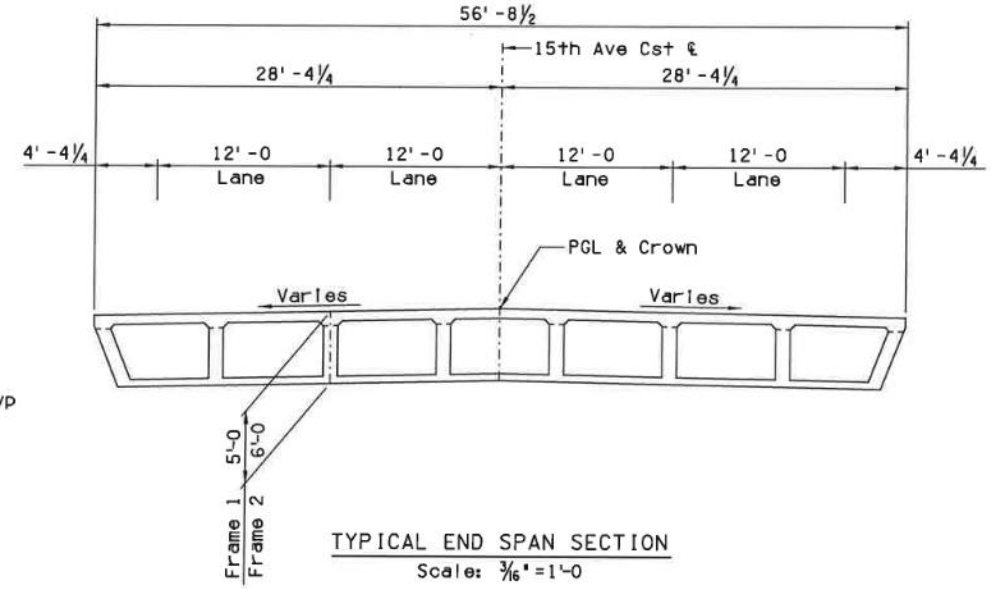
| Location | Span (feet) | Depth (feet) | Width (feet) | Structure Type |
|---|---|---|---|---|
| **Back Span 1** | 20.00 | 5.00 | 56.71 | Box Girder |
| **Overhang** | 8.45 | 5.00 | 63.00 | Solid |
| **Existing Span 2** | 90.55 | 3.94 | 63.00 | Box Girder |
| **Existing Span 3** | 90.55 | 3.94 | 63.00 | Box Girder |
| **Overhang** | 21.11 | Varies: 5.0 to 6.0 | 63.00 | Box Girder |
| **Back Span 4** | 25.00 | 6.00 | 56.71 | Box Girder |

# 15th Avenue UP

## TYPICAL SECTION




TYPICAL SECTION AT PIER
Scale: 3/16" = 1'-0




TYPICAL END SPAN SECTION
Scale: 3/16" = 1'-0

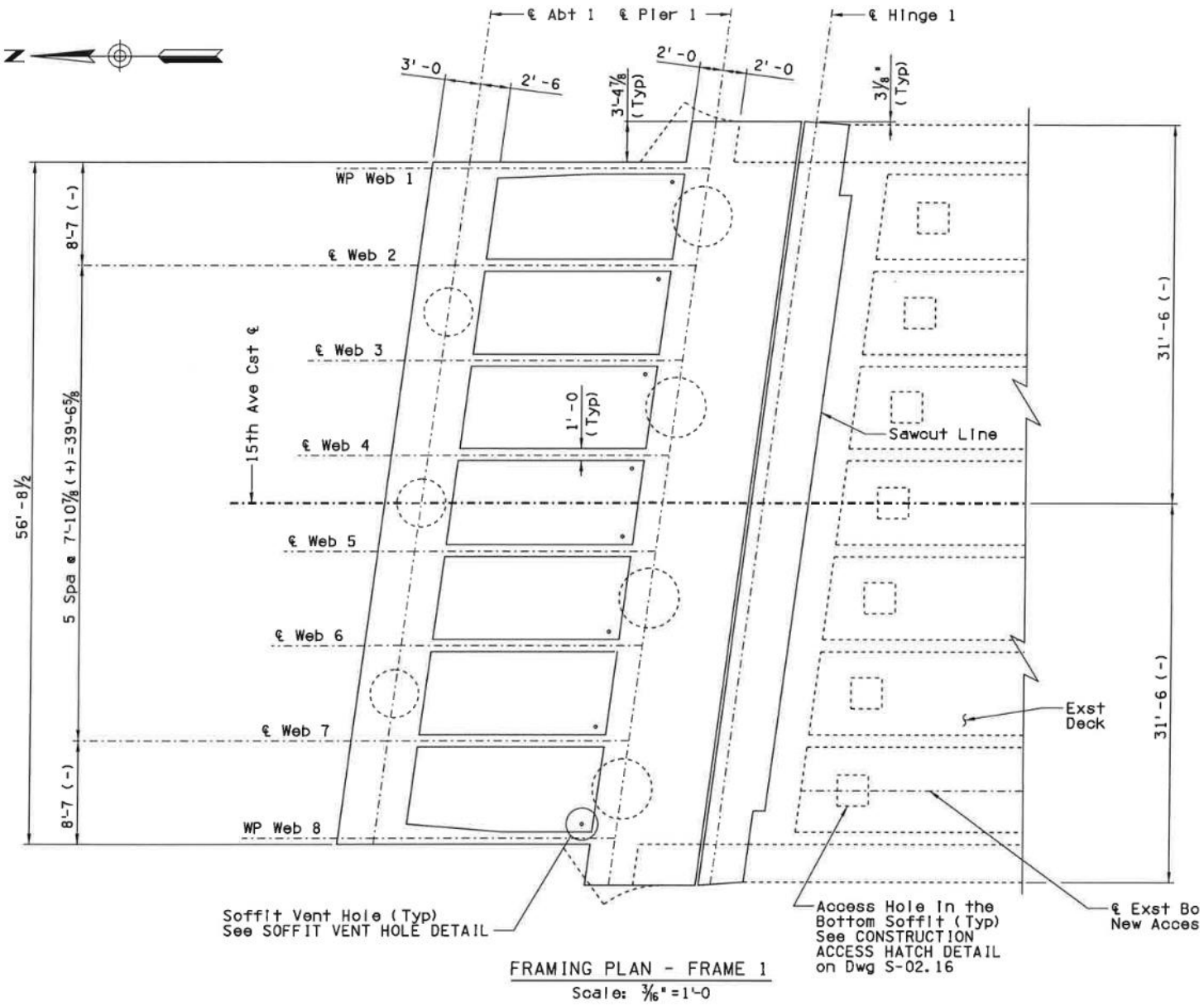
# 15th Avenue UP

| | Number Shafts | Diameter (inch) | Depth (feet) | Service Load Uplift (Kips) | Service Load Down (Kips) | Strength Load Uplift (Kips) | Strength Load Down (kips) |
|---|---|---|---|---|---|---|---|
| **Abutment 1** | 3 | 48 | 35.0 | -228 | 206 | -338 | 328 |
| **Pier 1** | 4 | 60 | 41.0 | | 869 | | 1170 |
| **Pier 3** | 4 | 60 | 48.5 | | 1109 | | 1496 |
| **Abutment 2** | 4 | 48 | 35.5 | -287 | 135 | -379 | 175 |

# 15th Avenue UP

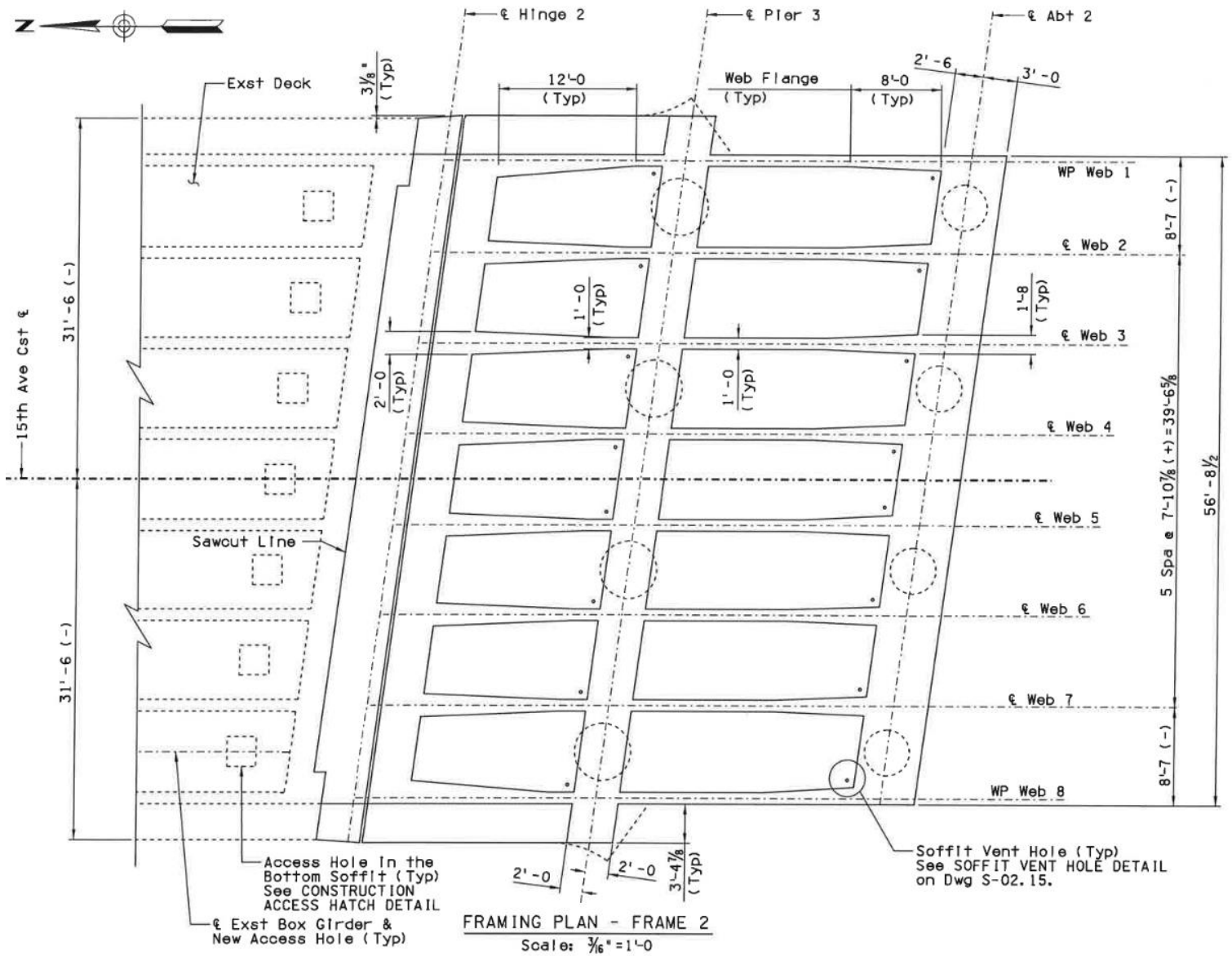
## FRAME 1

- Web Spacing
- DS Location
- Solid Span
- Flare
- Width Change



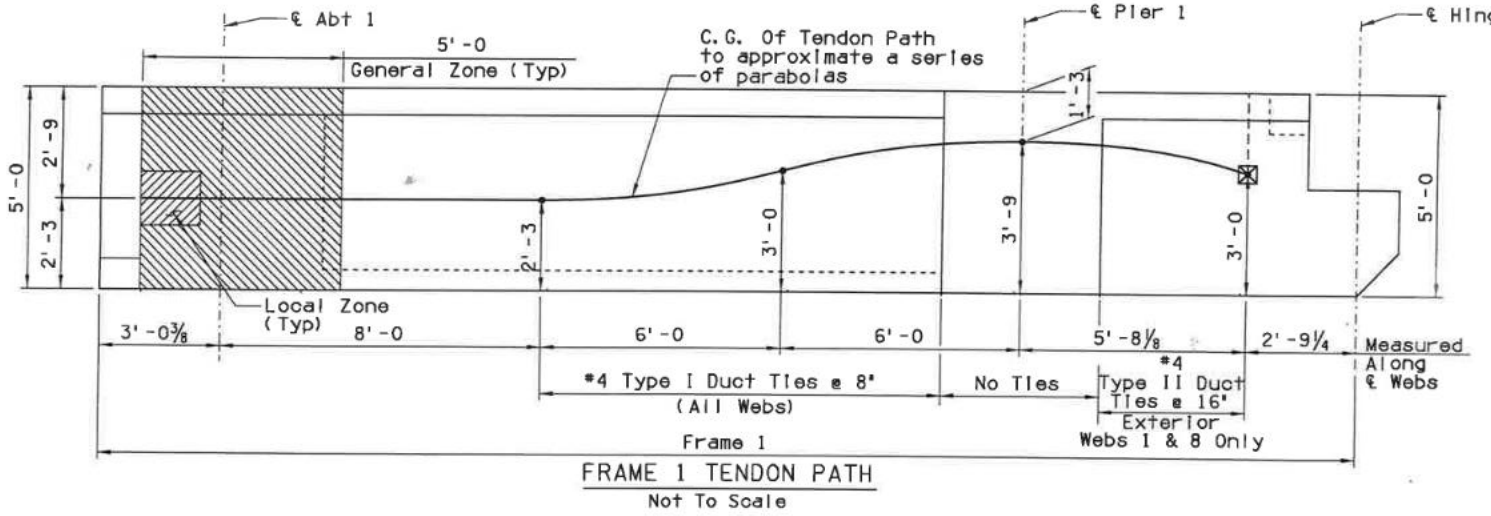
# 15th Avenue UP

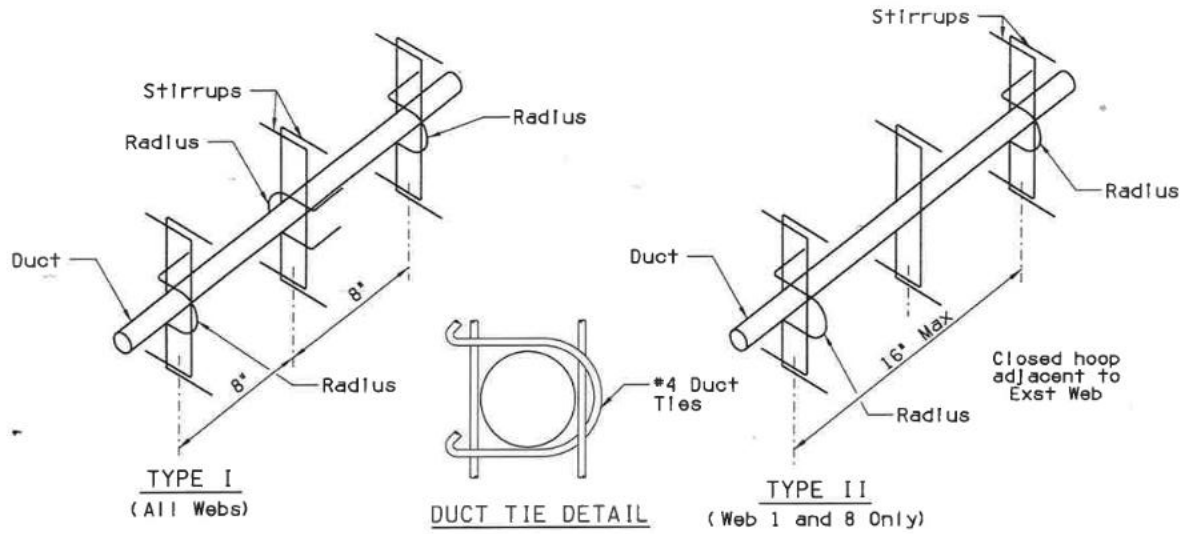
## FRAME 2



# 15th Avenue UP

## FRAME 1



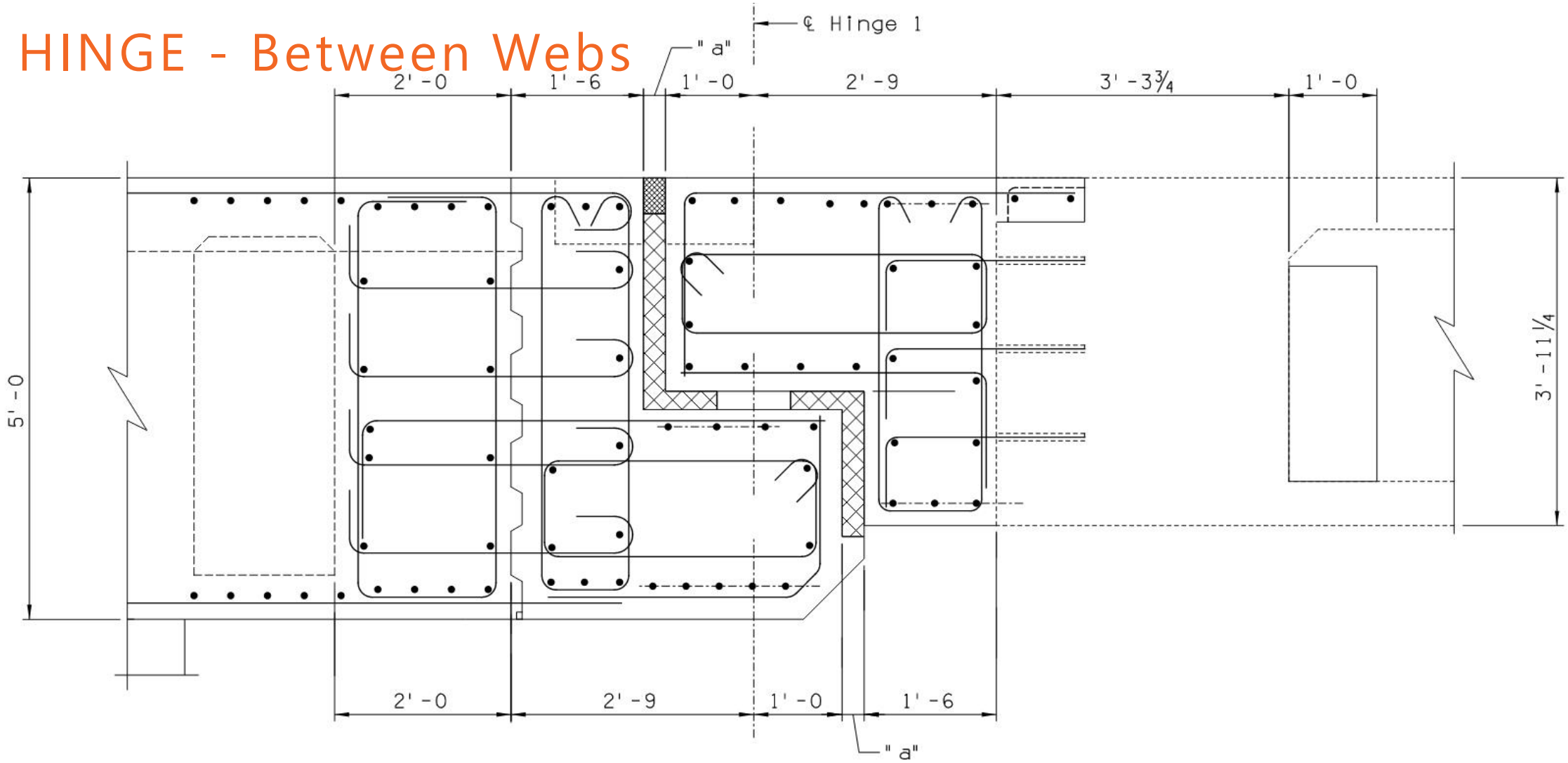



# 15th Avenue UP

| | Frame 1 | Frame 2 | |
|---|---|---|---|
| **Pjack** | 7031 | 16,874 | kips |
| **Number Strands** | 160 | 384 | (0.6" Dia.) |
| **Strands** | 20 | 48 | Per web |
| **Duct Ties** | Yes | No | |
| **f'c Deck** | 3.5 | 3.5 | ksi |
| **f'c Web** | 3.5 | 4.0 | ksi |

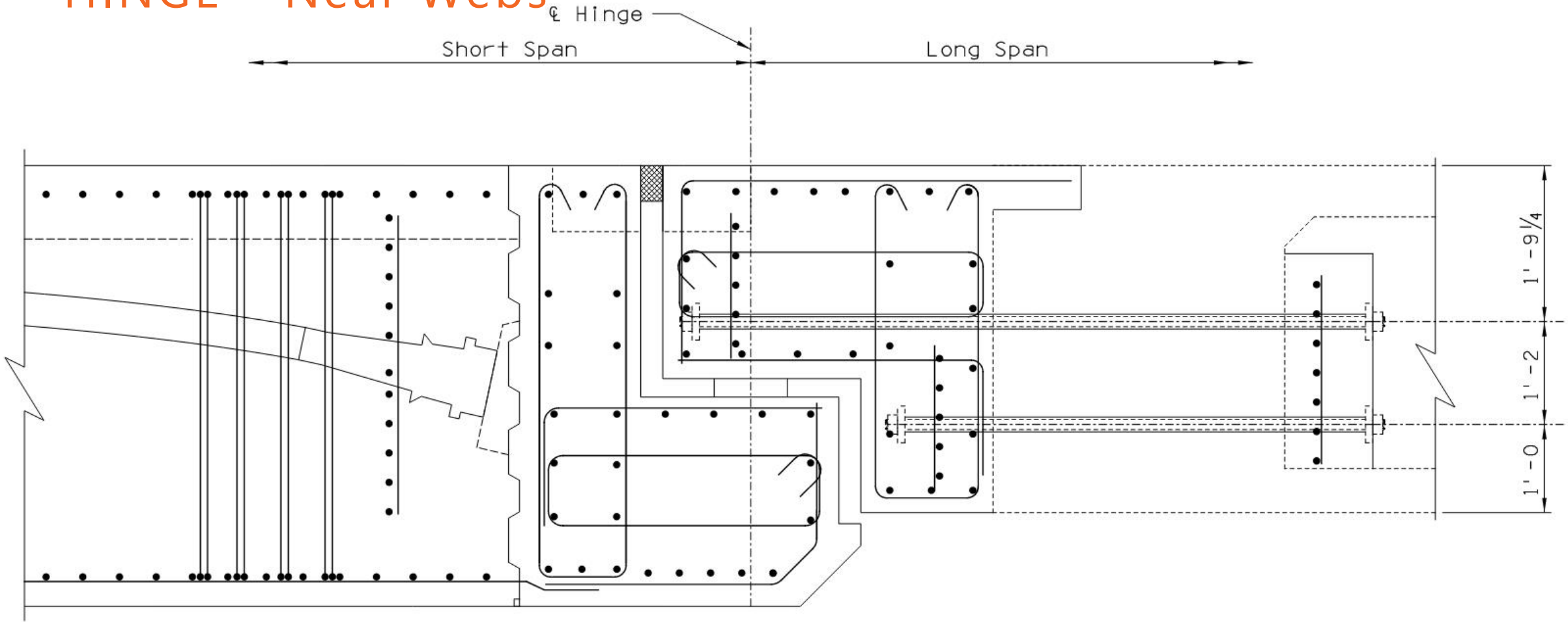
# 15th Avenue UP

## HINGE - Between Webs



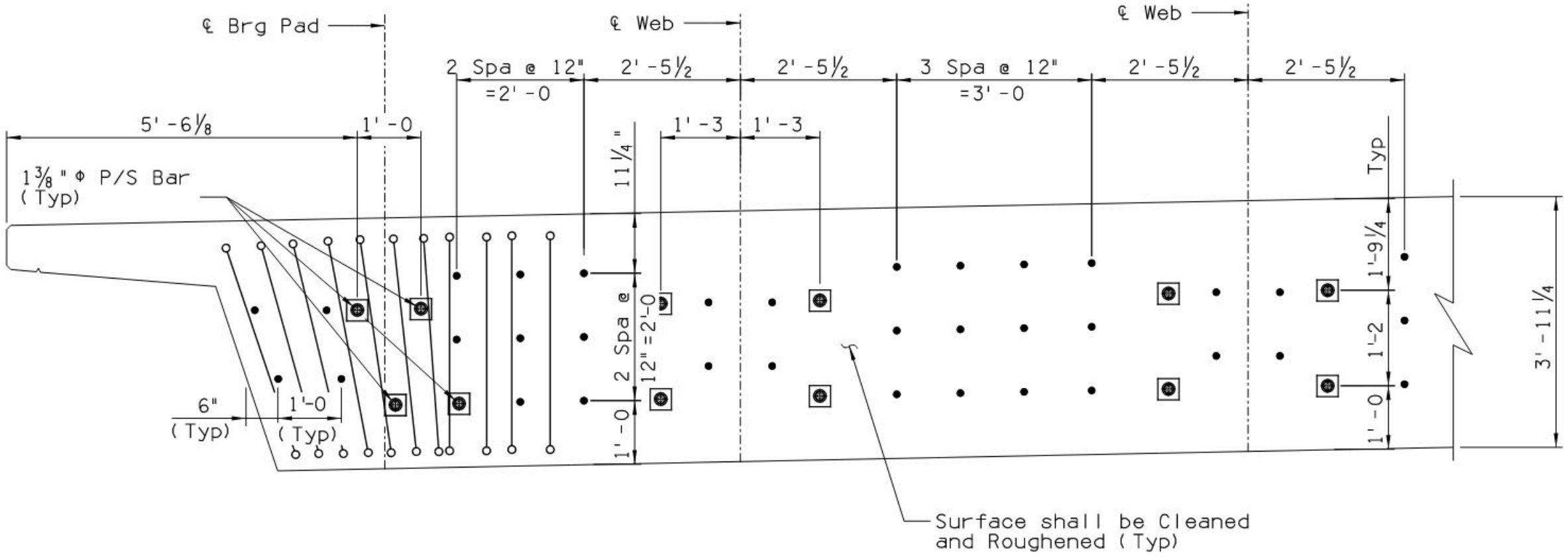
# 15th Avenue UP

## HINGE – Near Webs



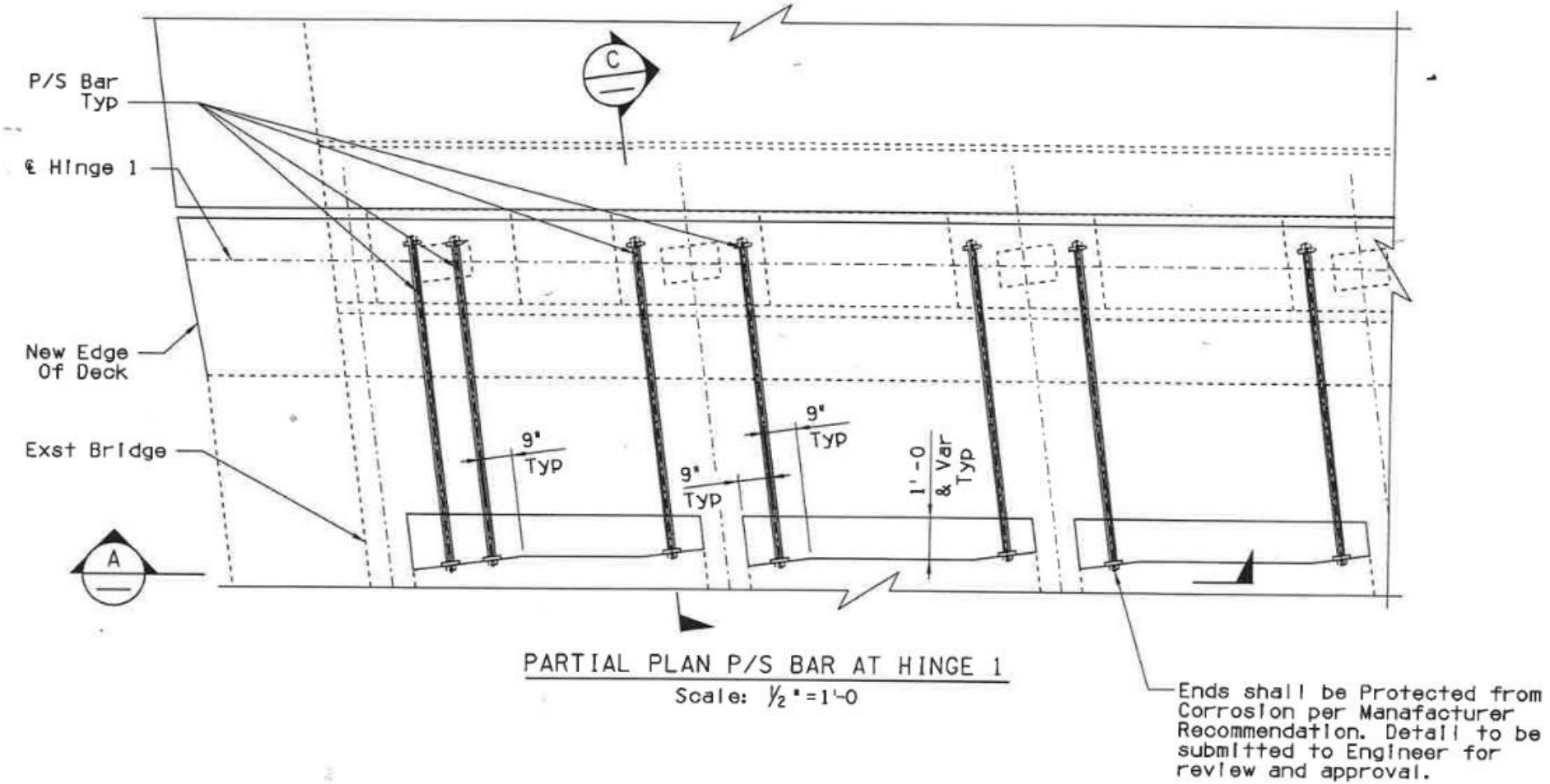
# 15th Avenue UP

## HINGE - Section



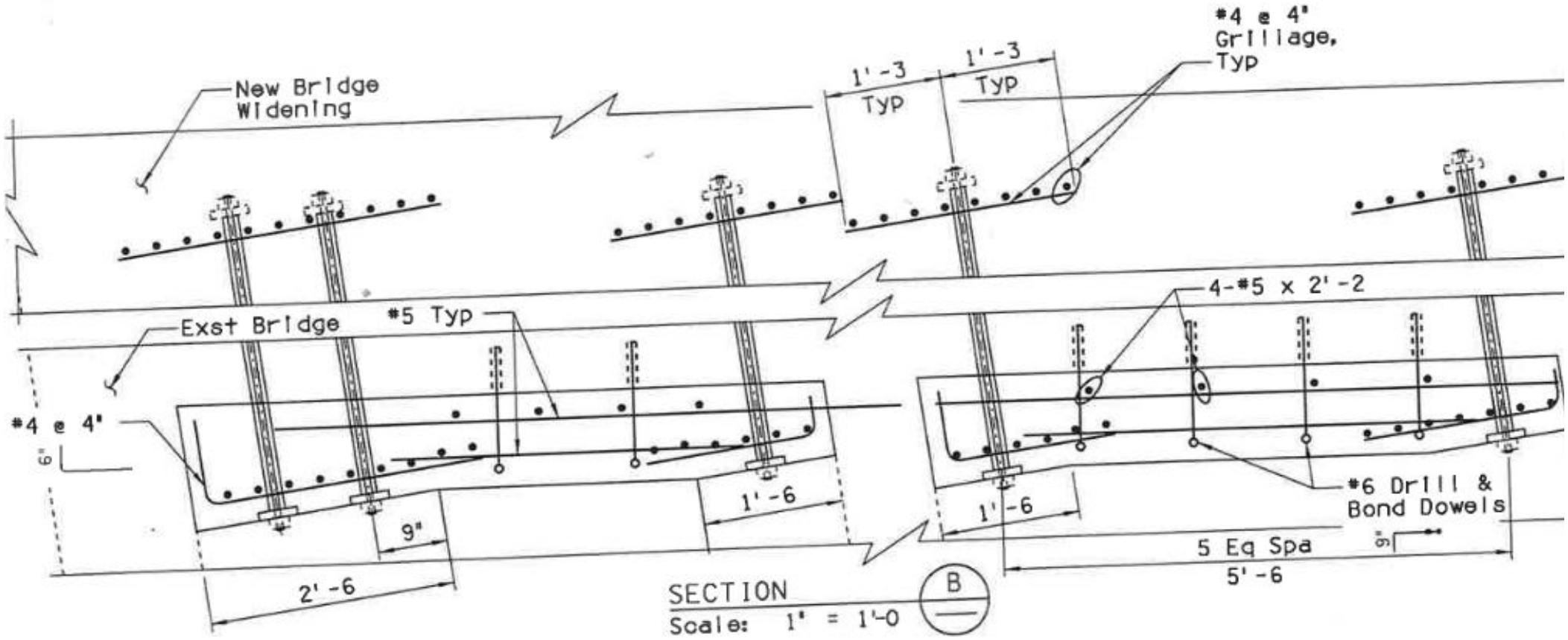
# 15th Avenue UP

## HINGE



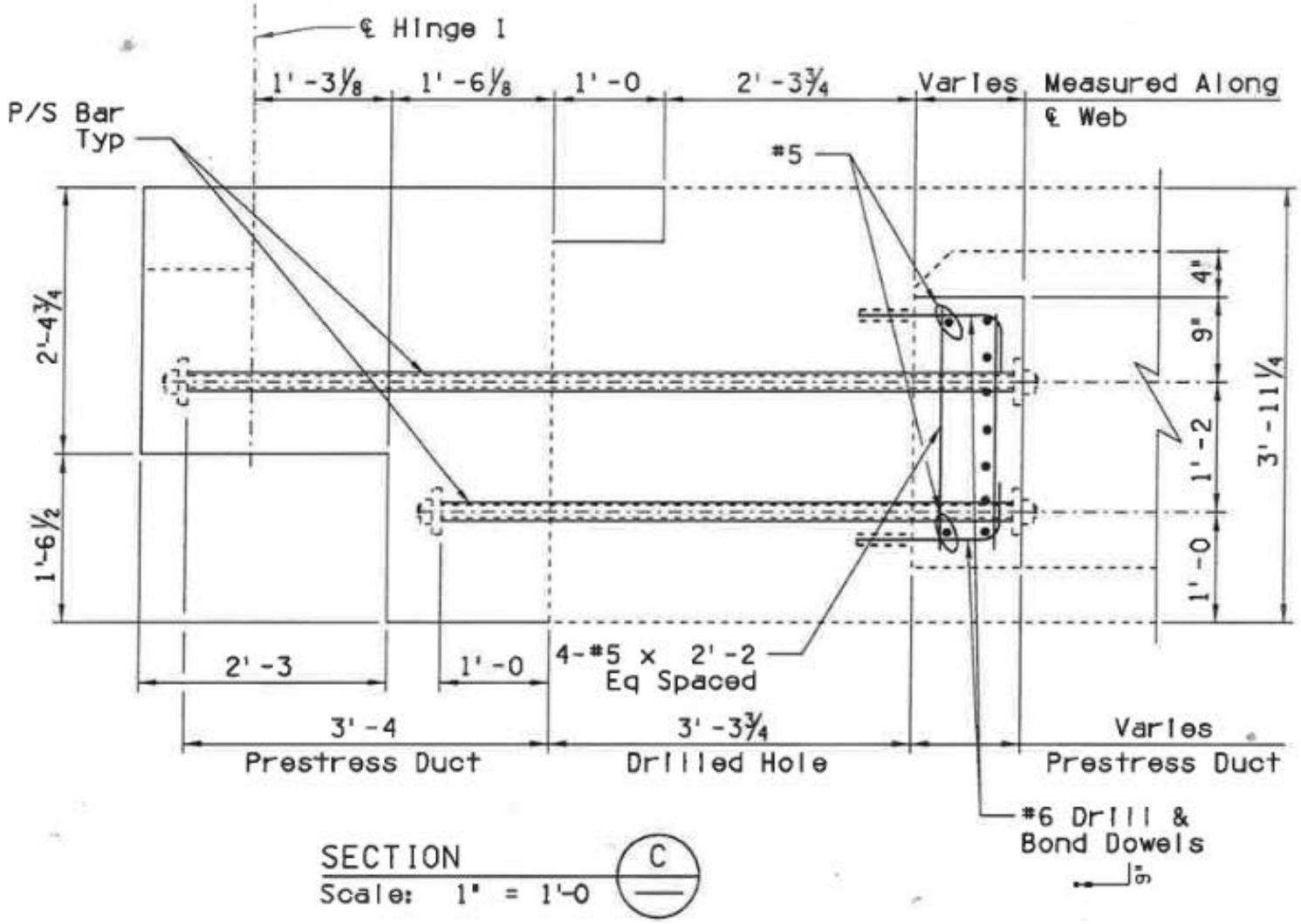
# 15th Avenue UP

## HINGE



# 15th Avenue UP

## HINGE

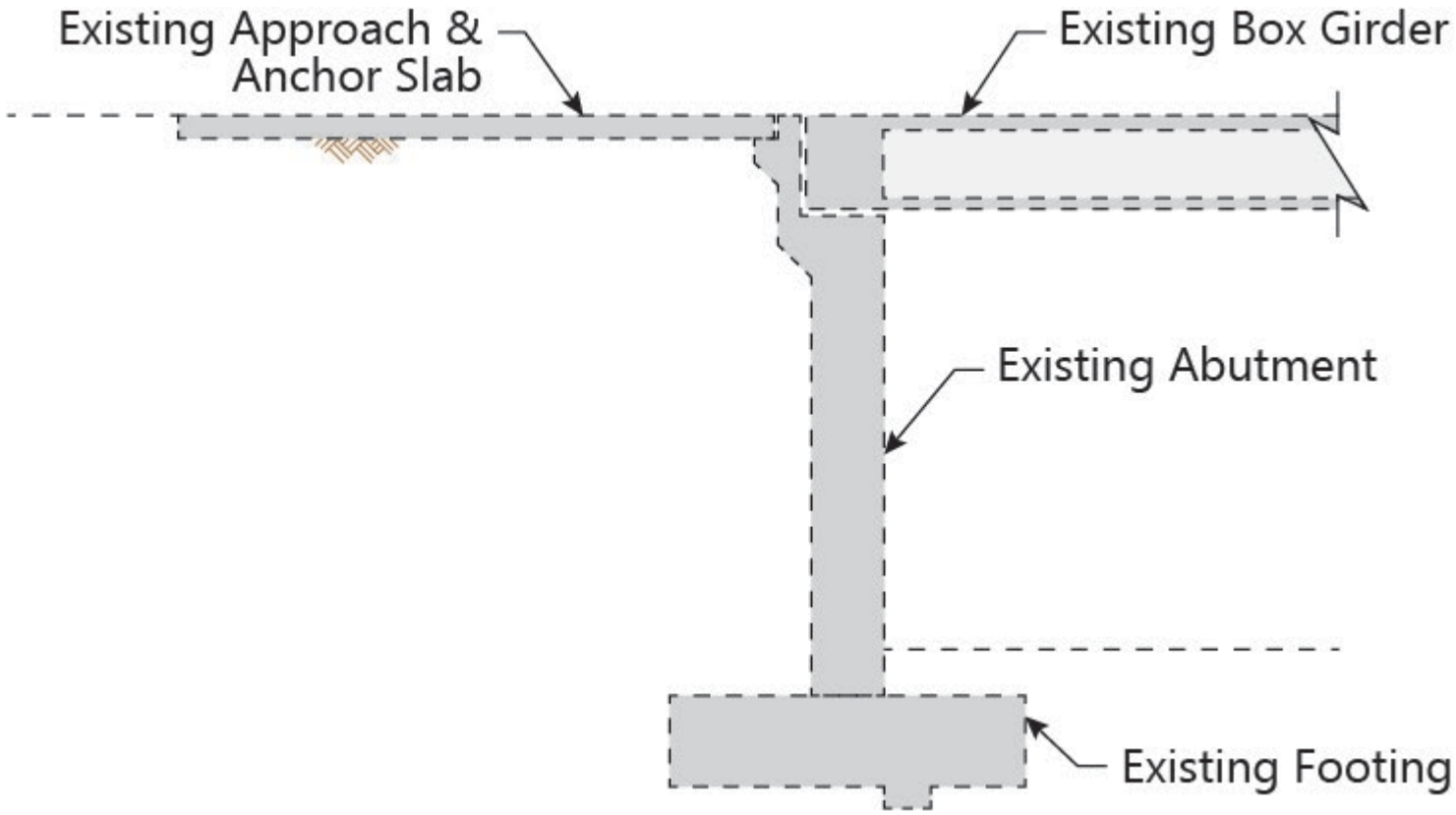


# 15th Avenue UP

| Item | |
|---|---|
| **Prestress Bar** | Type 2 Deformed |
| **Size** | 1 3/8" Diameter |
| **Area Bar** | 1.58 sq inch |
| **fpu** | 150 ksi |
| **Jacking** | 0.70 fpu |
| **Pjack Force** | 5309 kips per Frame |

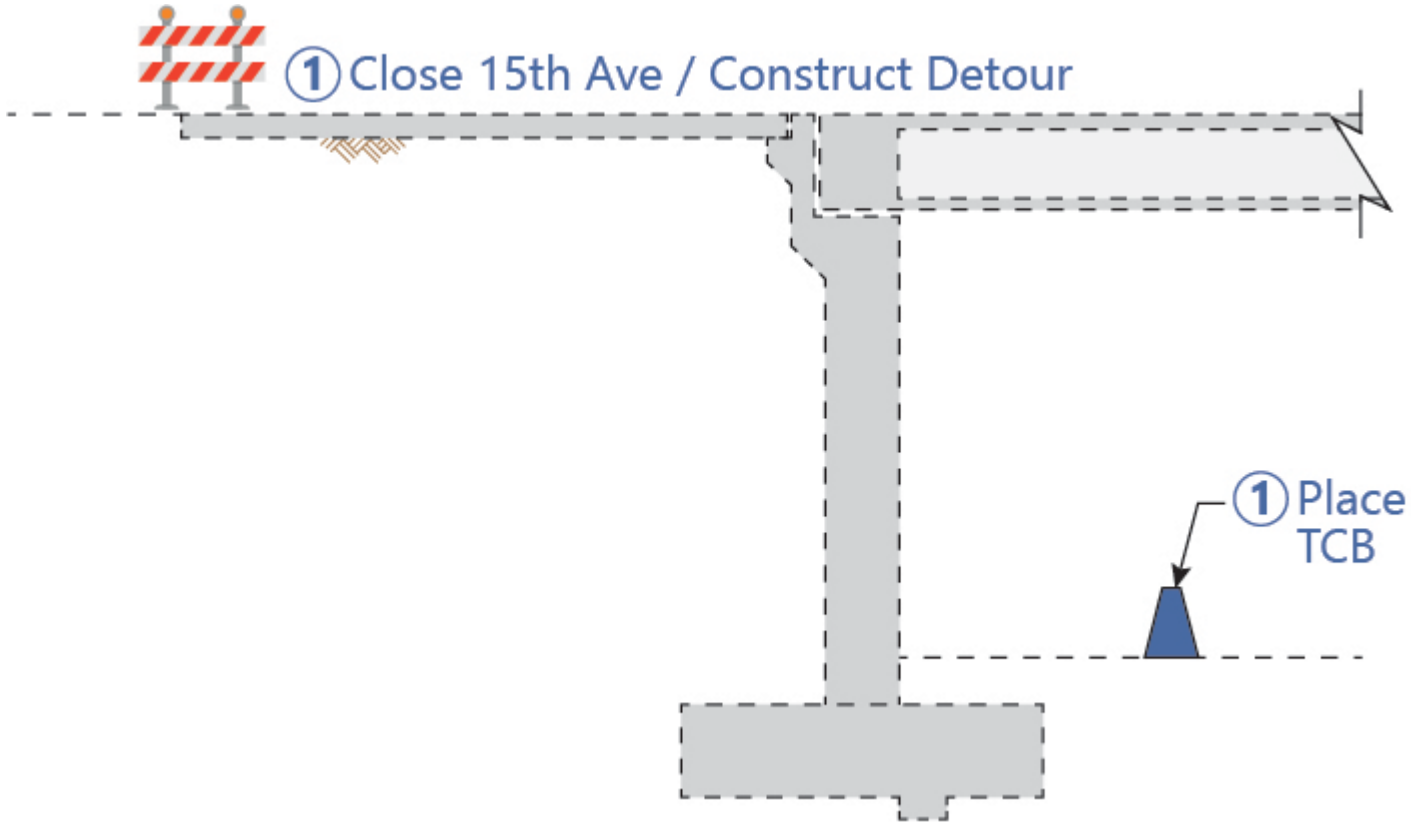
# 15th Avenue UP

## EXISTING



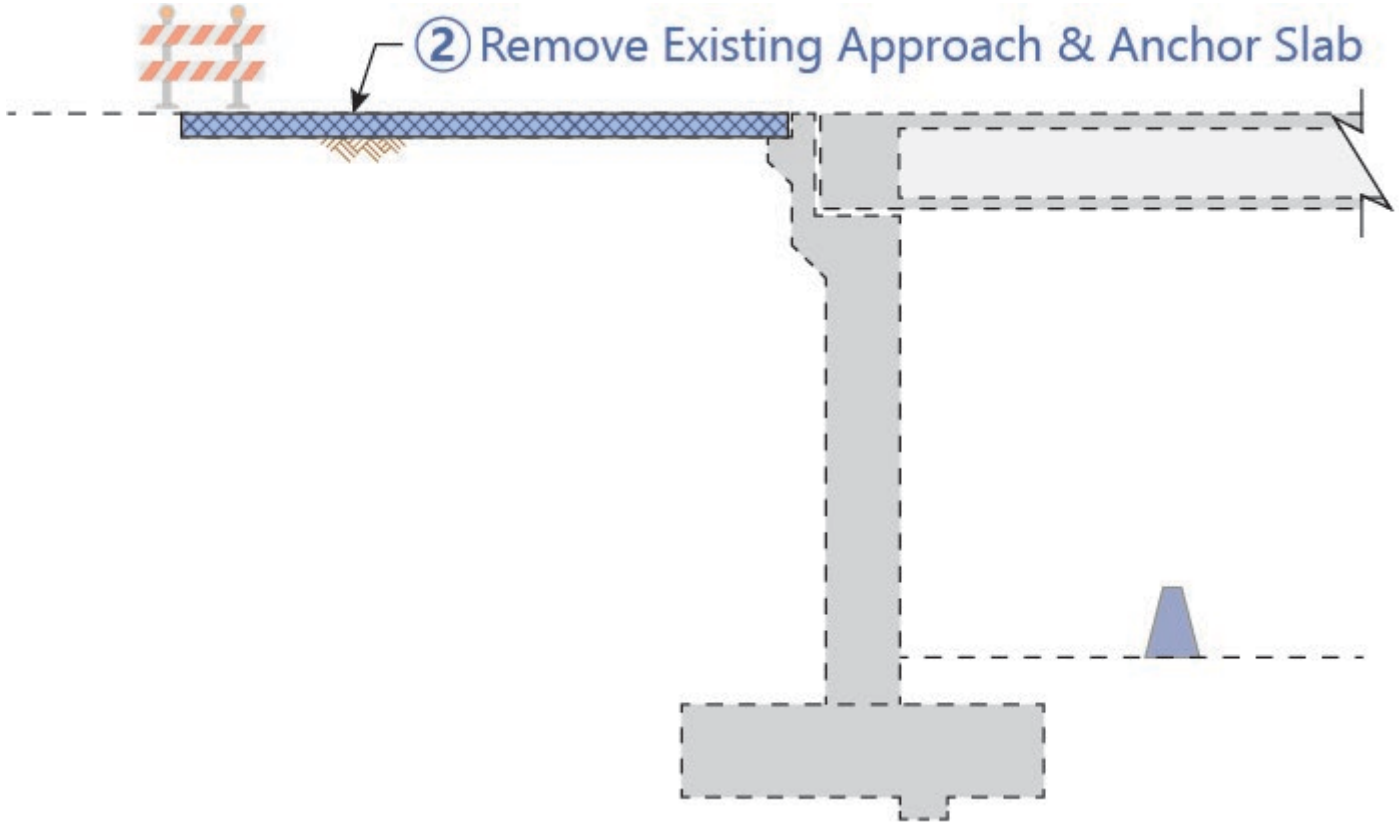
# 15th Avenue UP

## STAGE I » *Step 1*



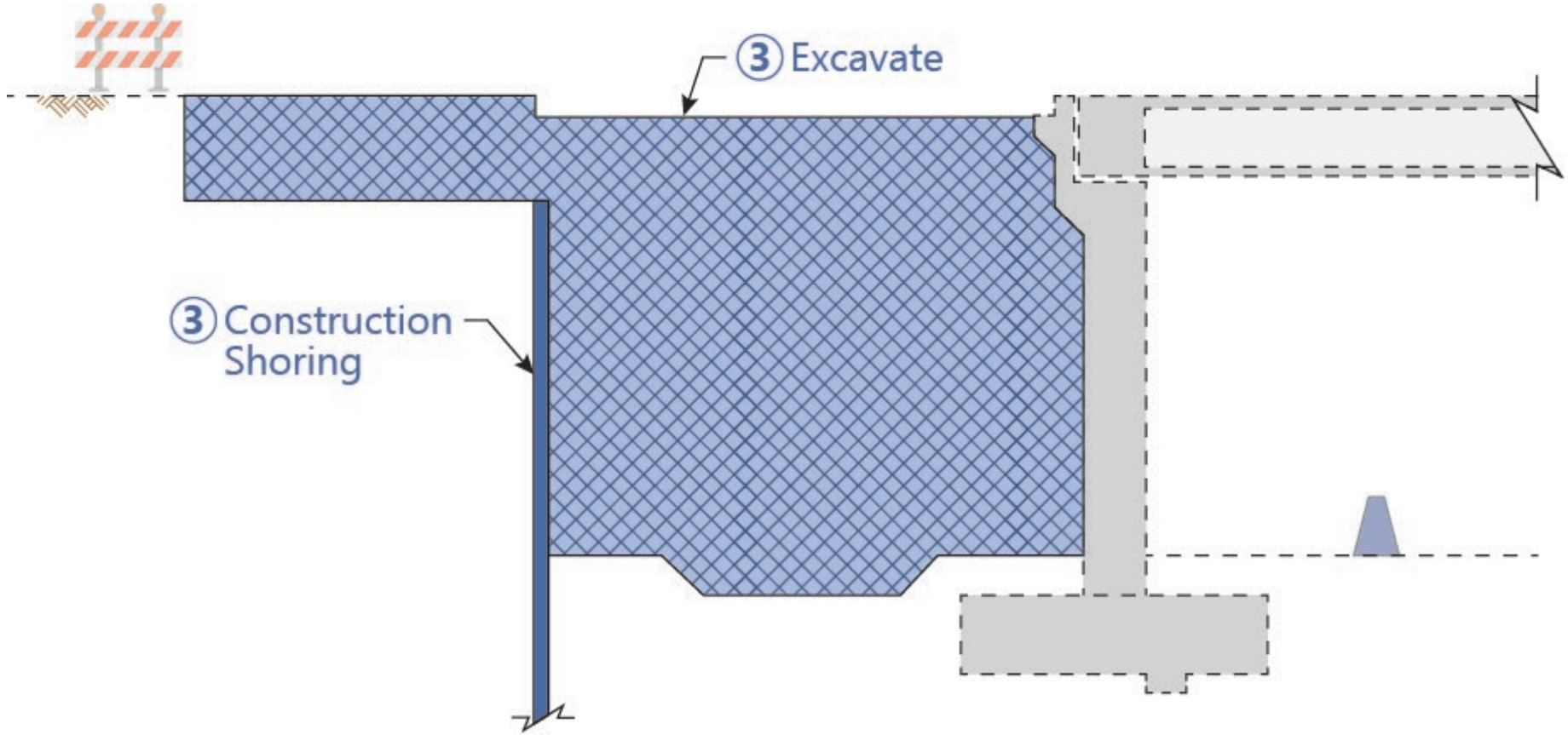
# 15th Avenue UP

## STAGE I » *Step 2*



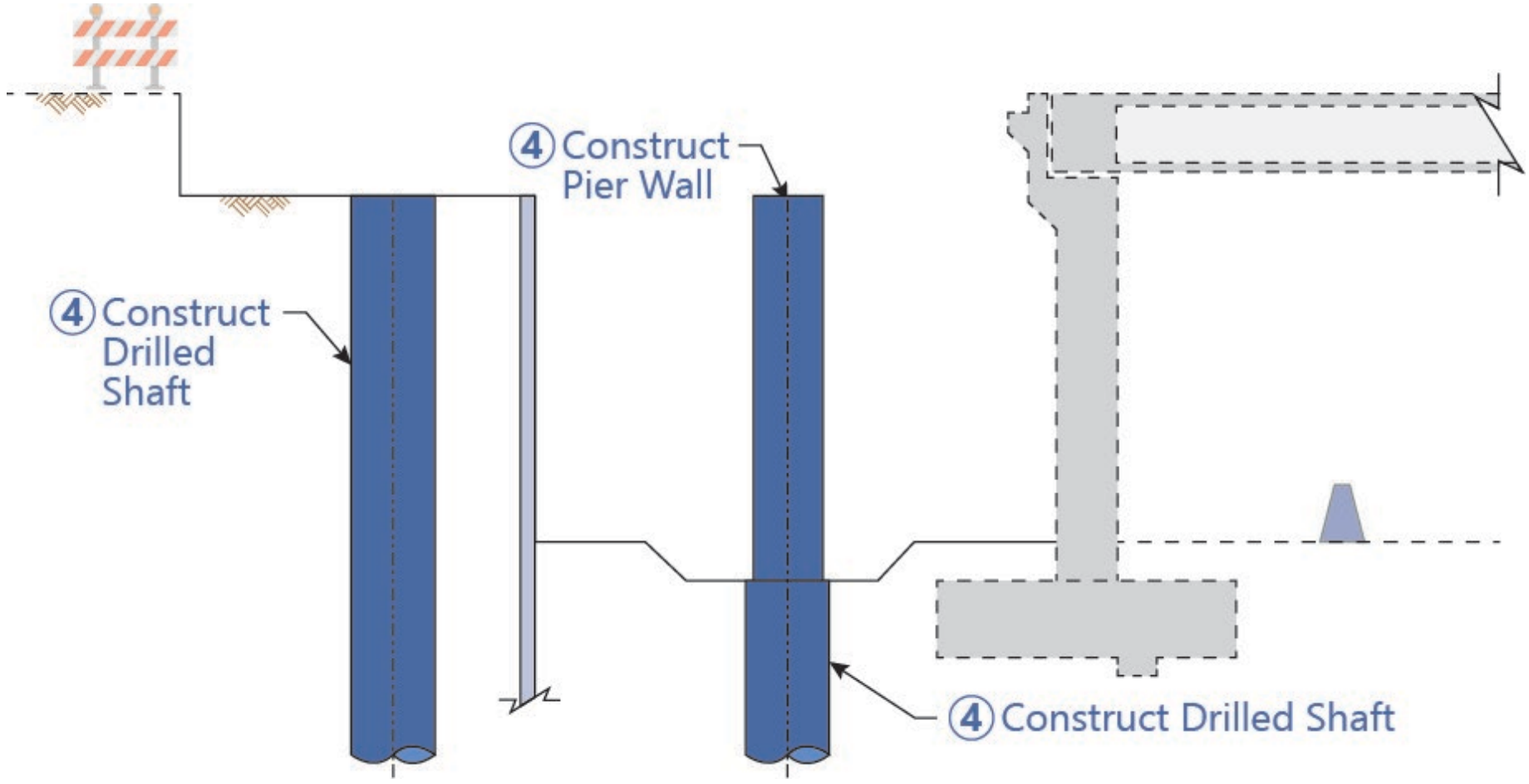
# 15th Avenue UP

## STAGE I » *Step 3*



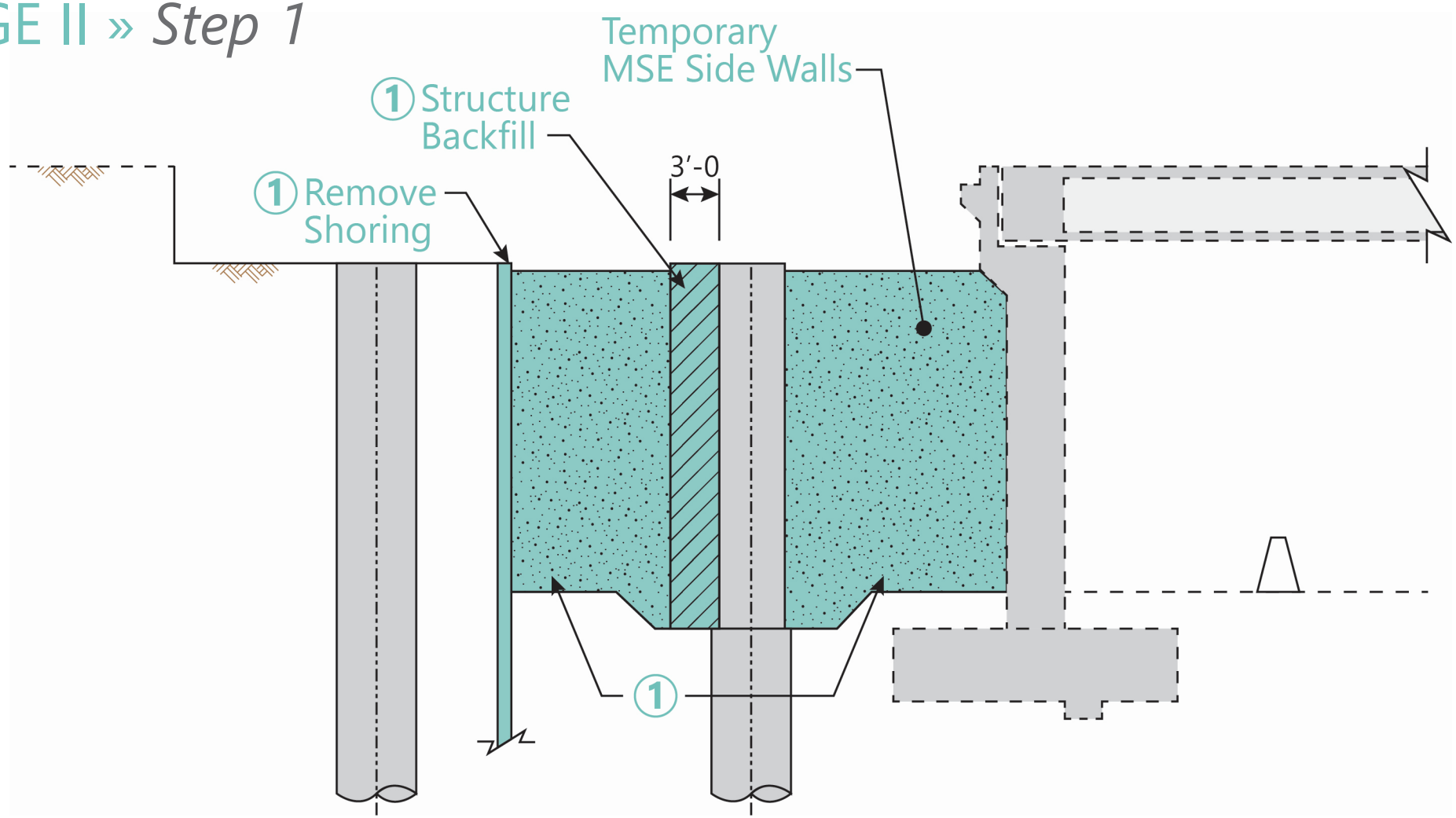
# 15th Avenue UP

## STAGE I » *Step 4*



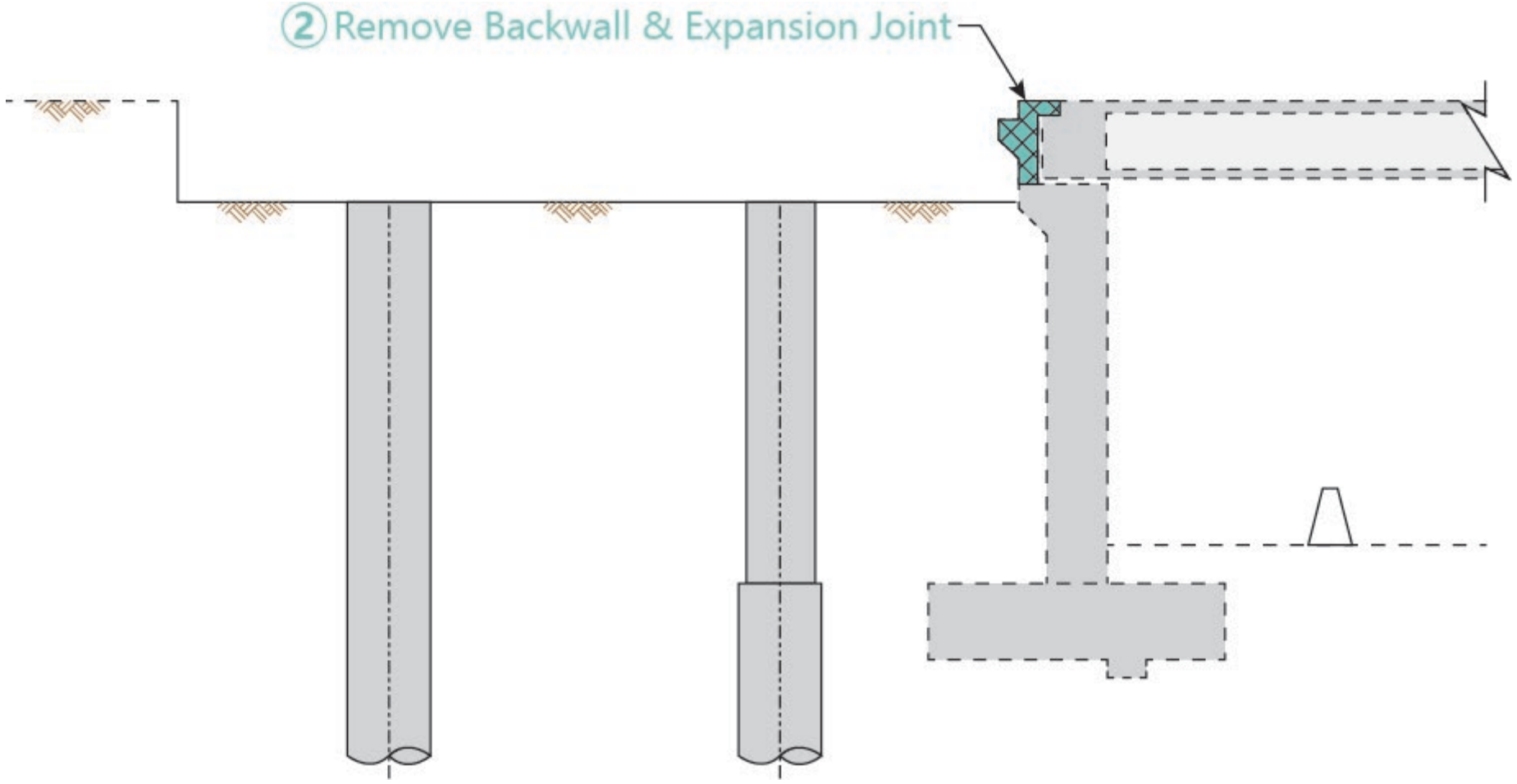
# 15th Avenue UP

## STAGE II » *Step 1*



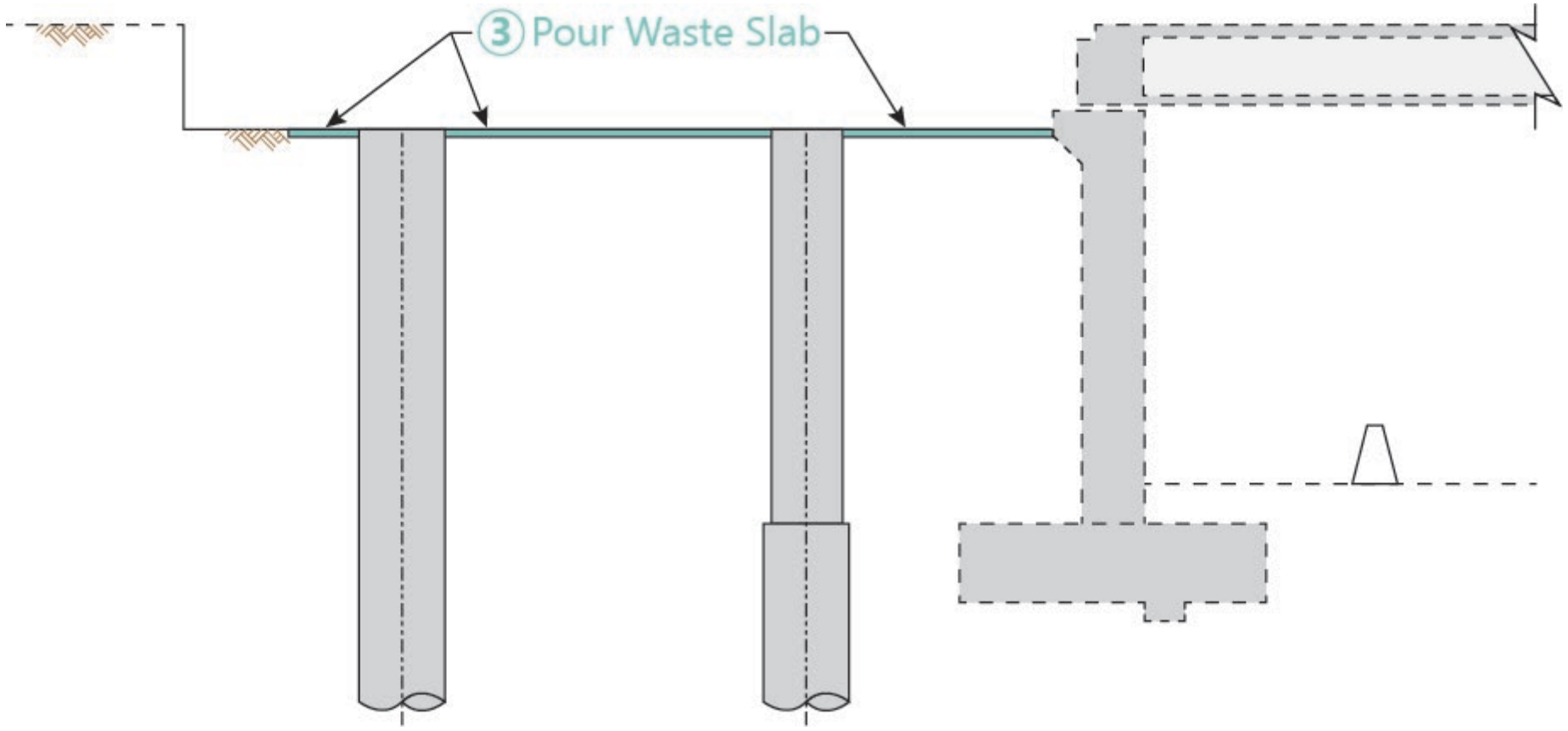
# 15th Avenue UP

## STAGE II » *Step 2*



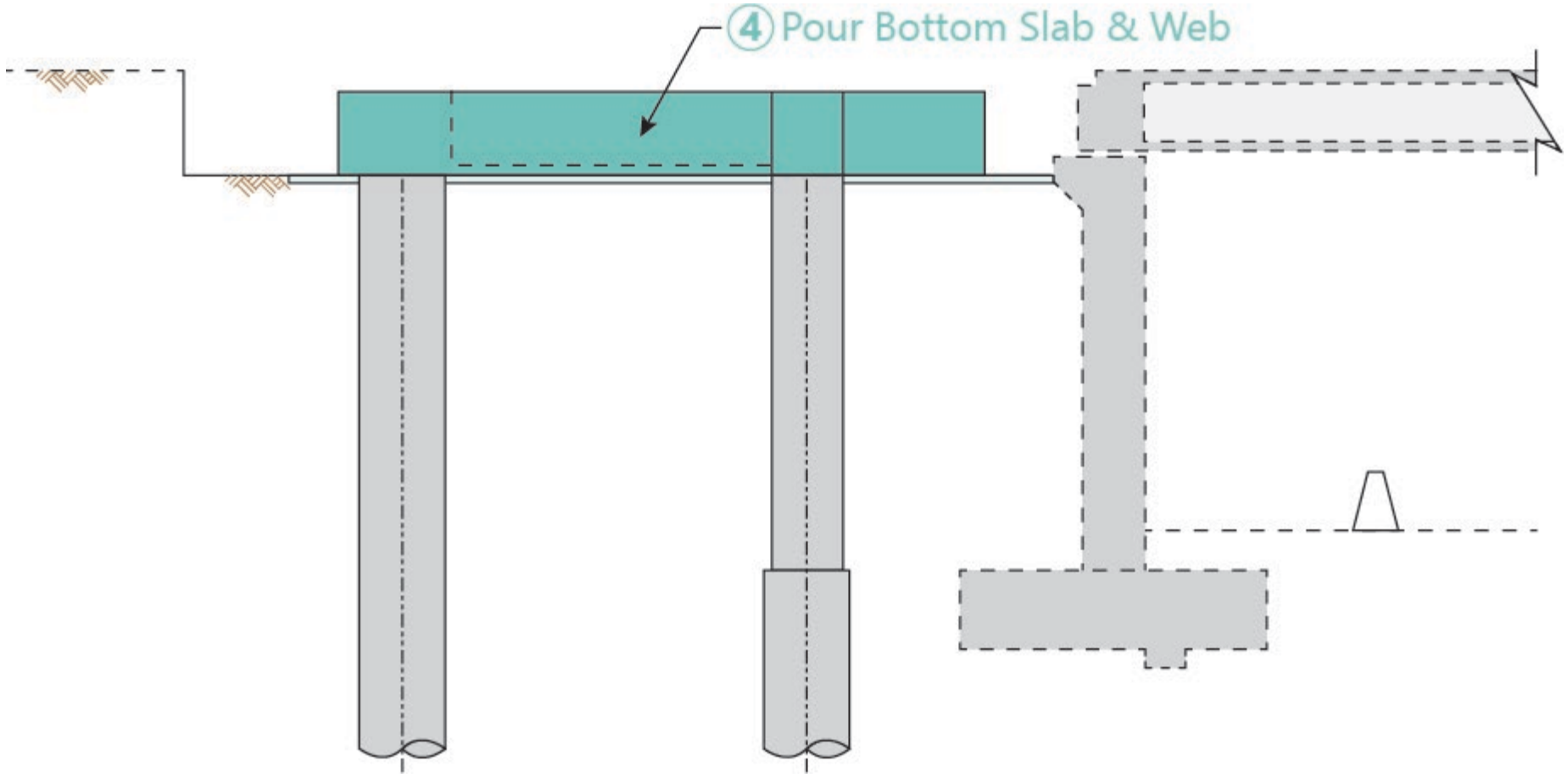
# 15th Avenue UP

## STAGE II » *Step 3*



# 15th Avenue UP

## STAGE II » *Step 4*



# 15th Avenue UP

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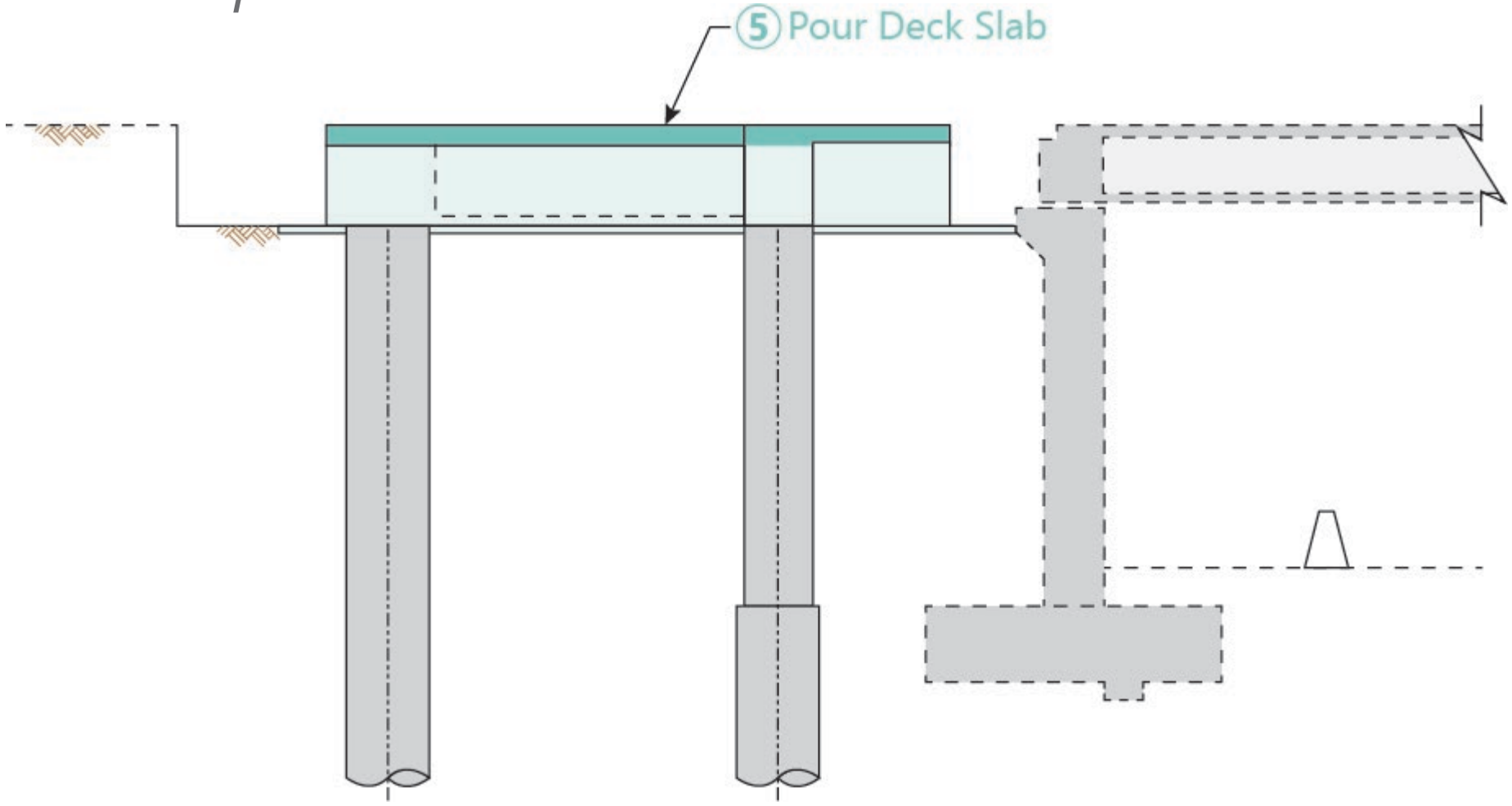
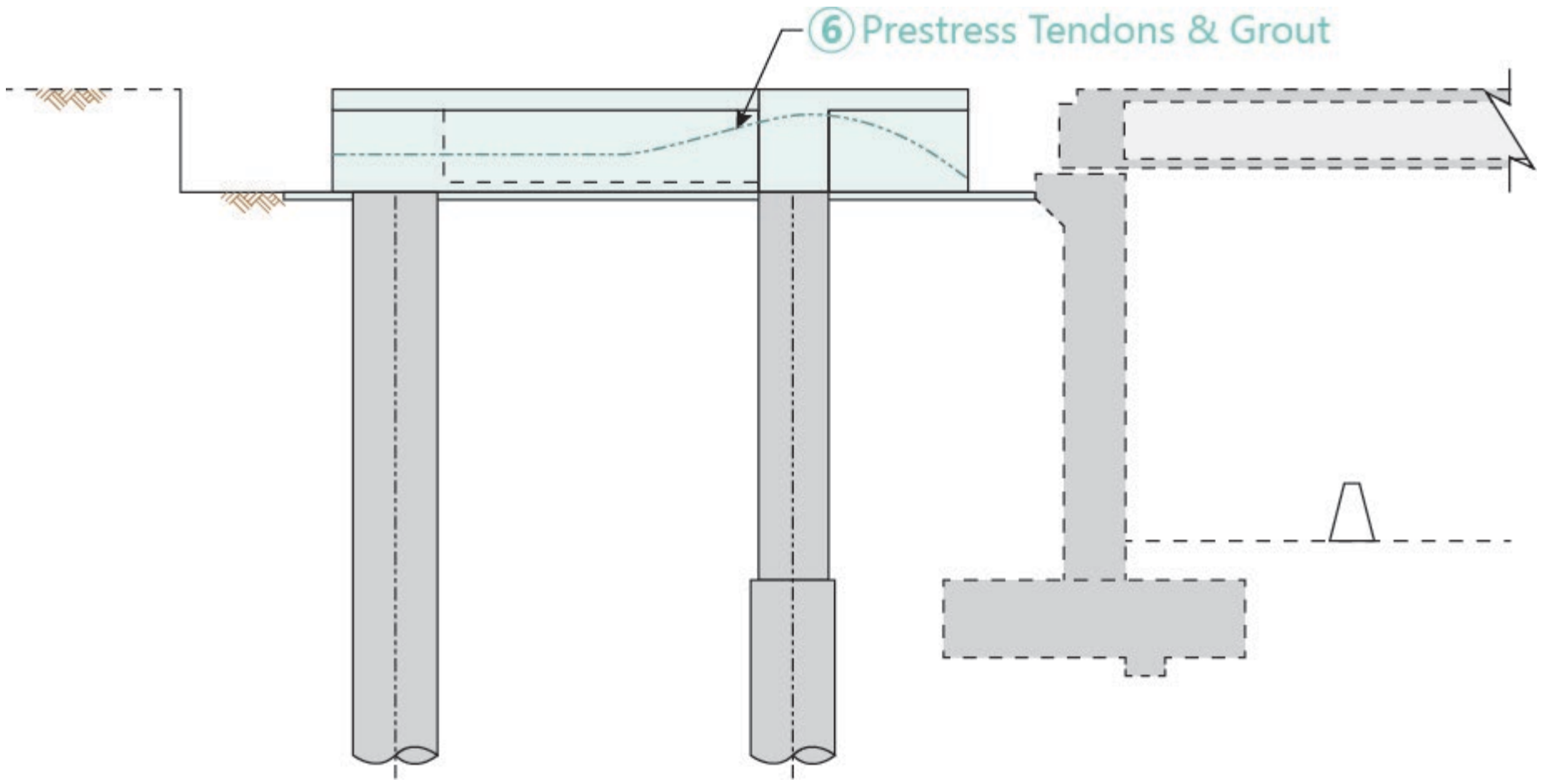


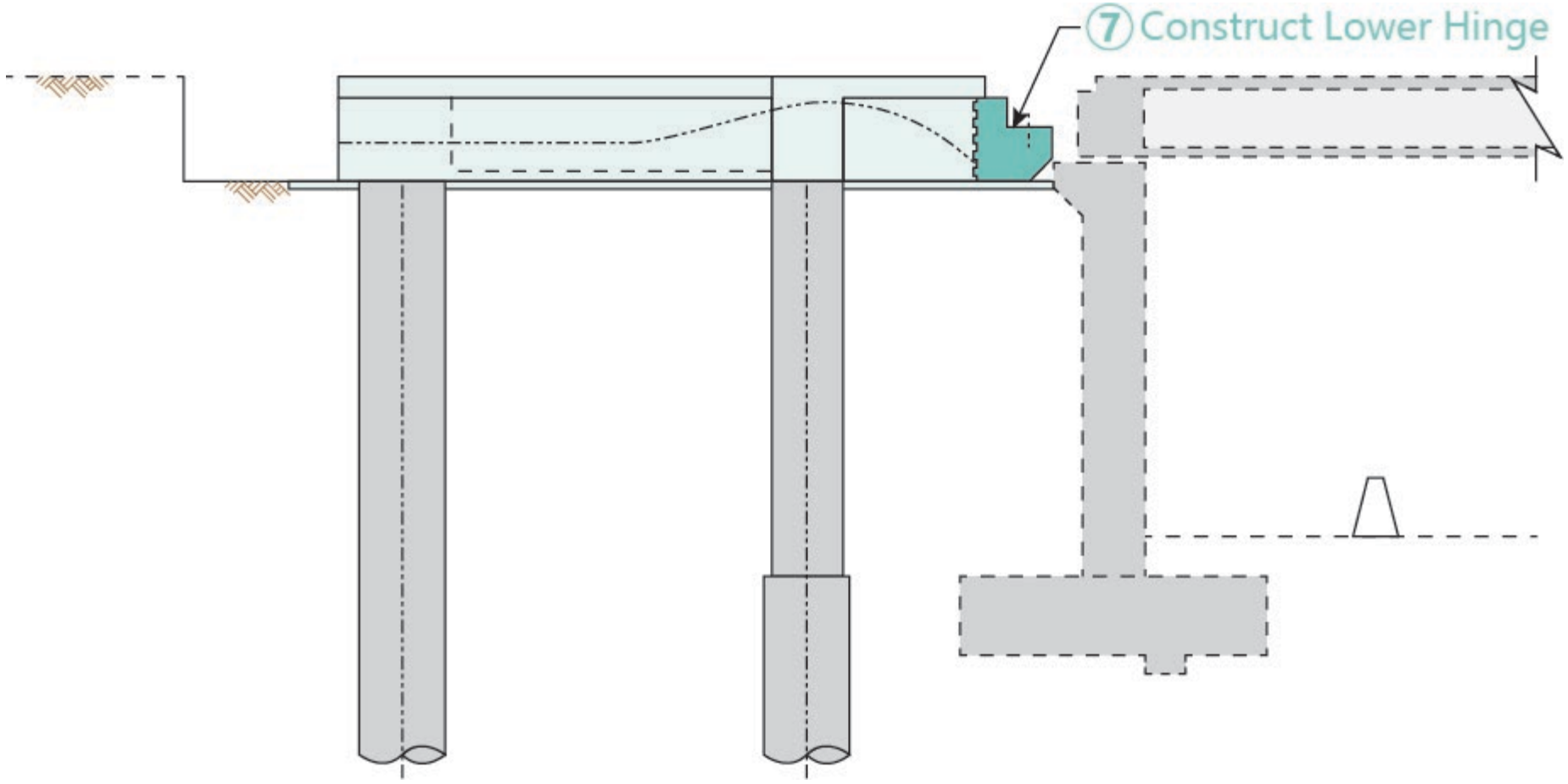
# 15th Avenue UP

## STAGE II » *Step 6*



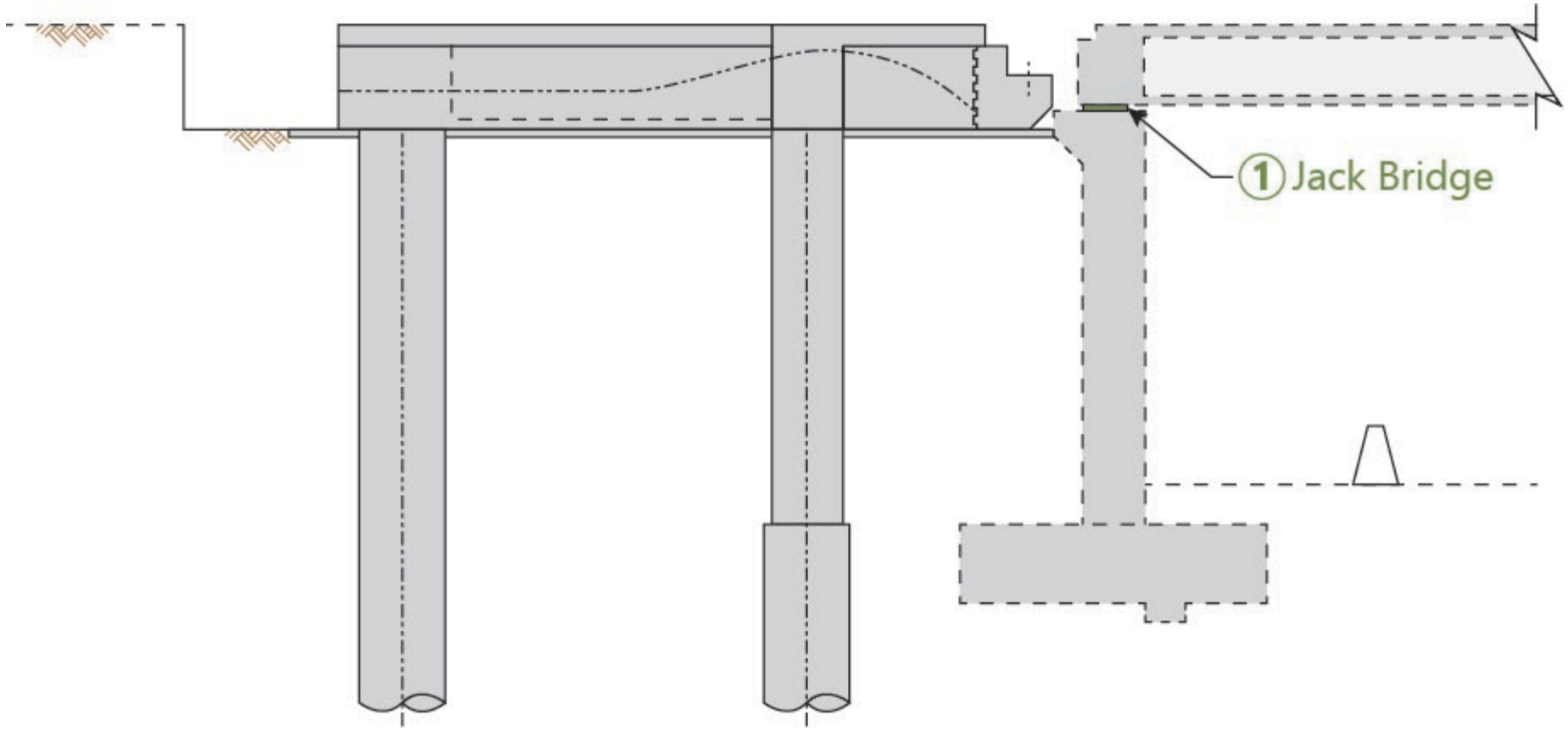
# 15th Avenue UP

## STAGE II » *Step 7*



# 15th Avenue UP

## STAGE III » *Step 1*



# 15th Avenue UP

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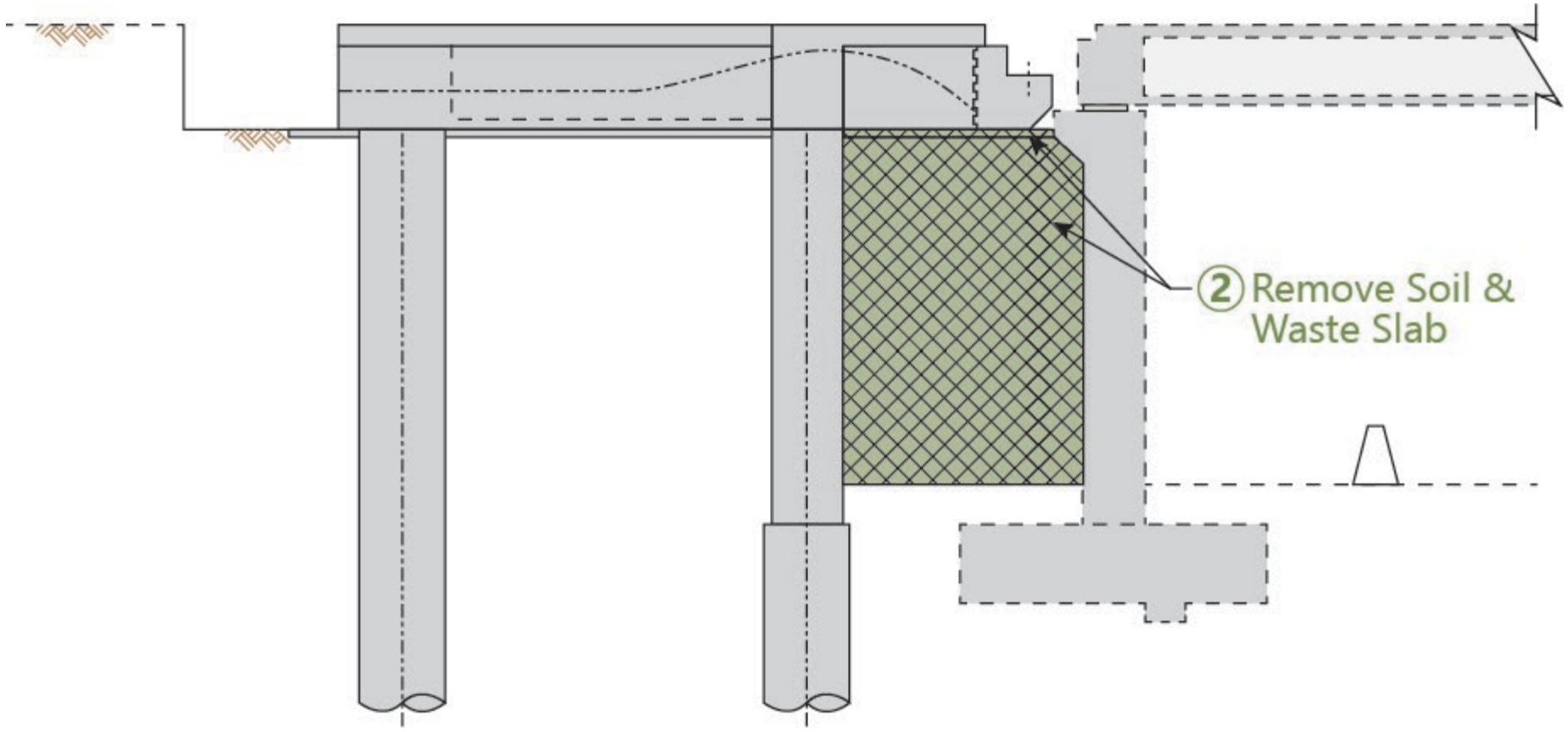
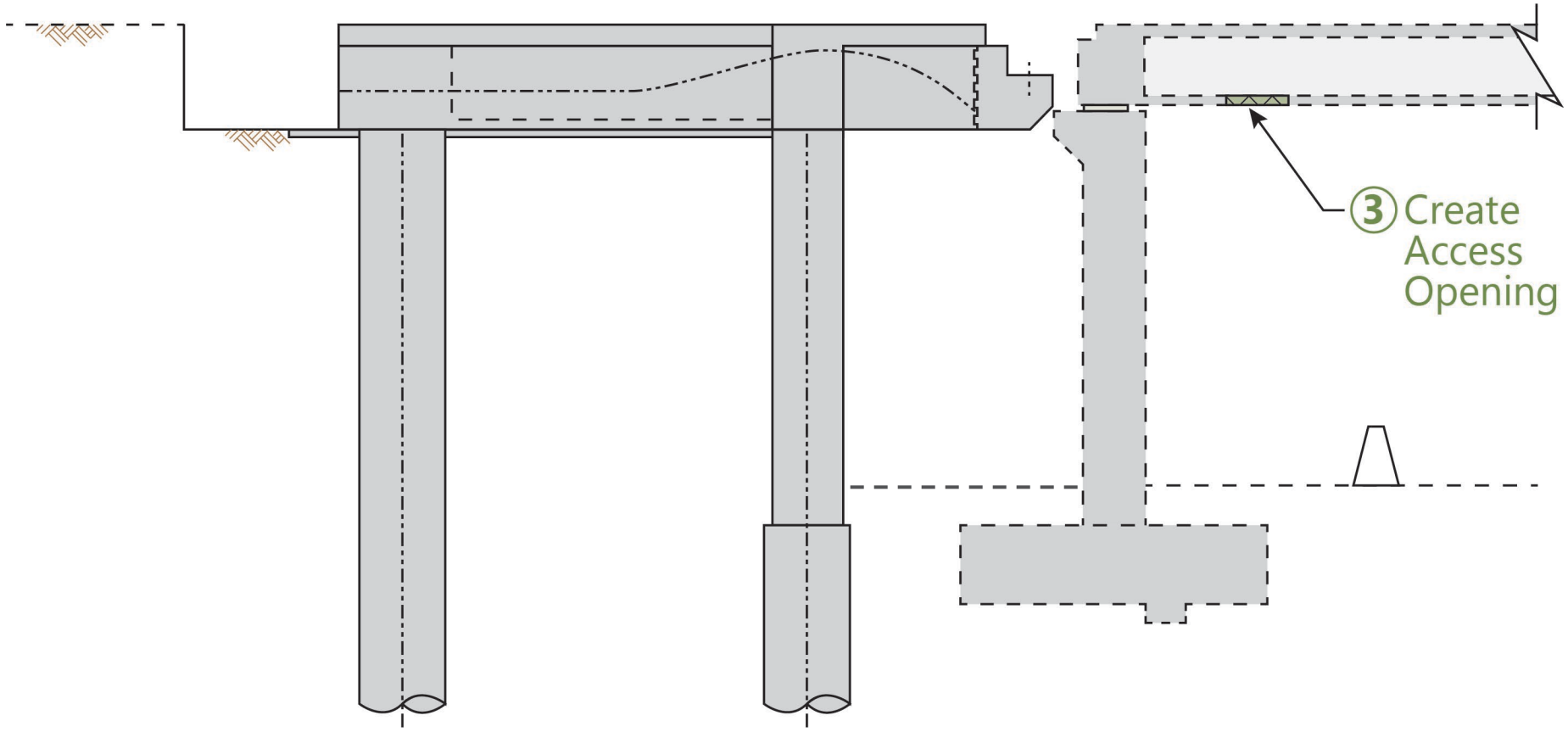


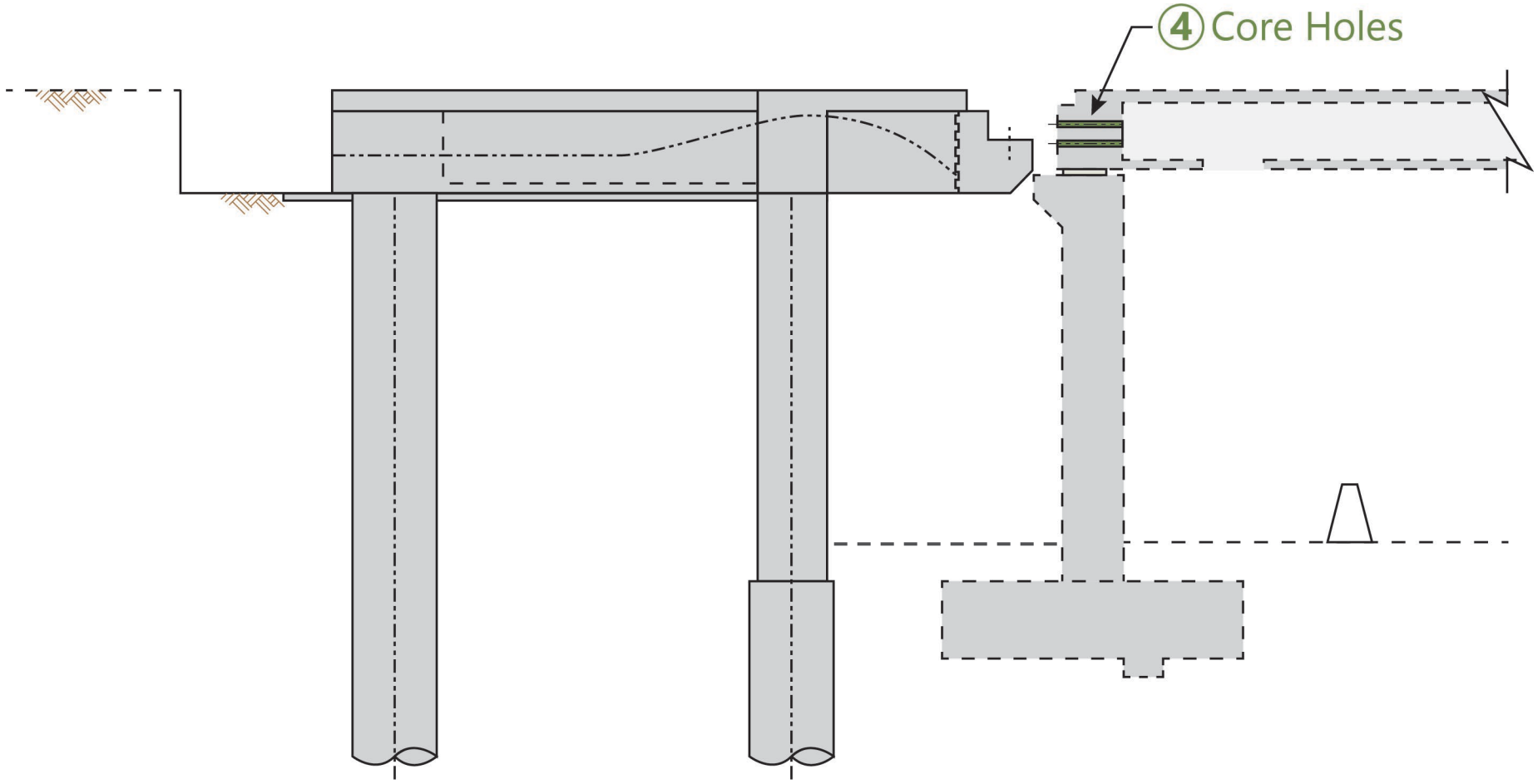
# 15th Avenue UP

## STAGE III » *Step 3*



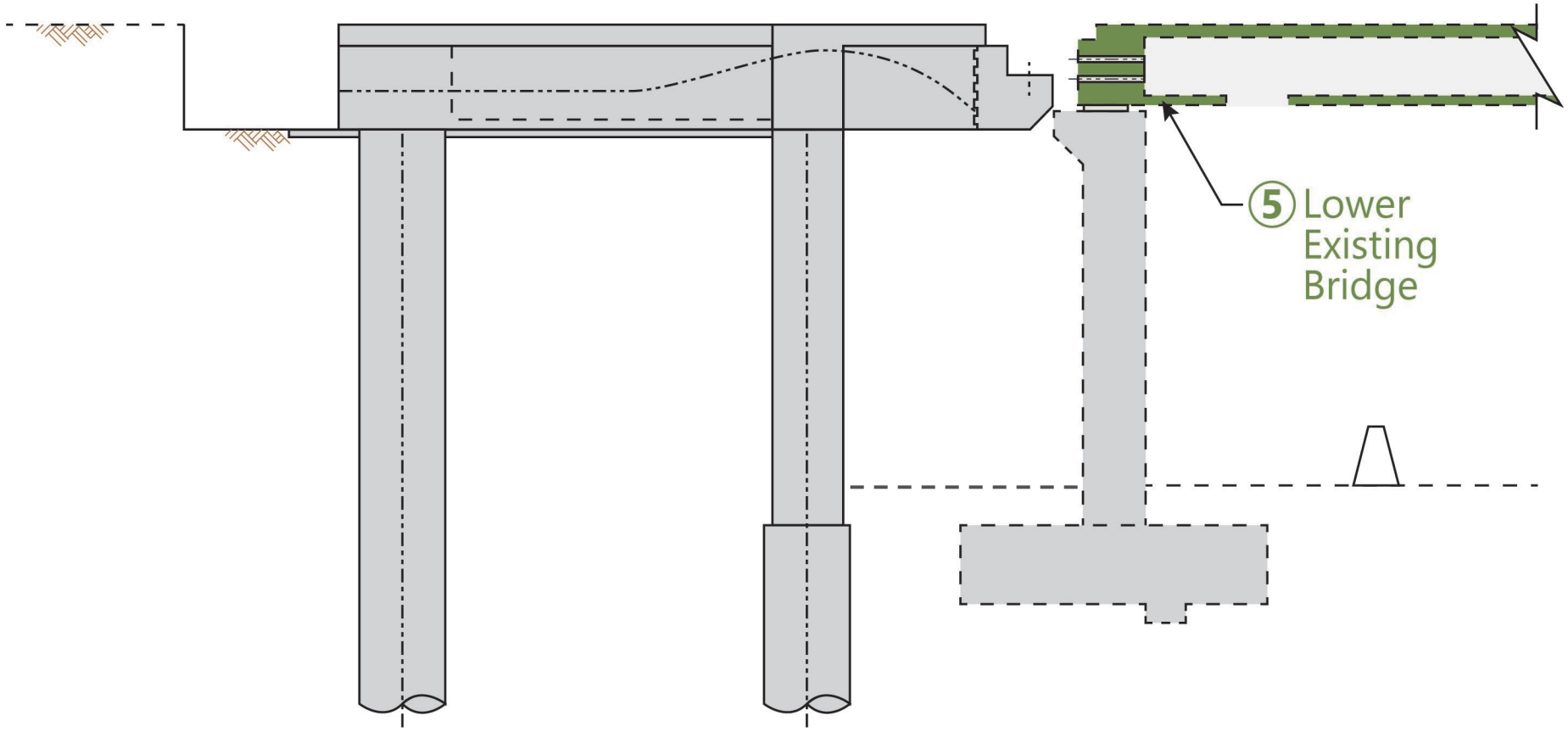
# 15th Avenue UP

## STAGE III » *Step 4*



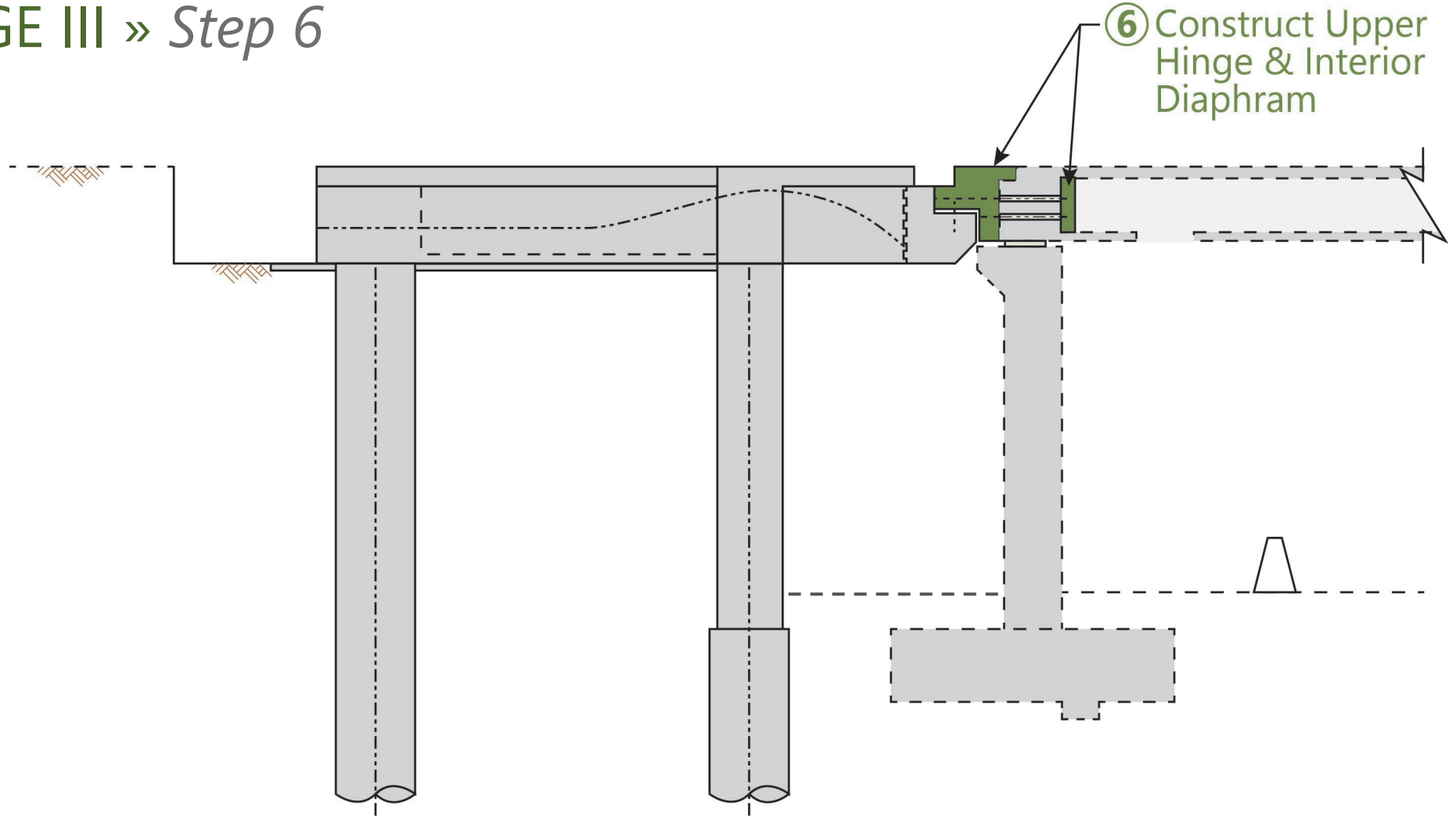
# 15th Avenue UP

## STAGE III » *Step 5*



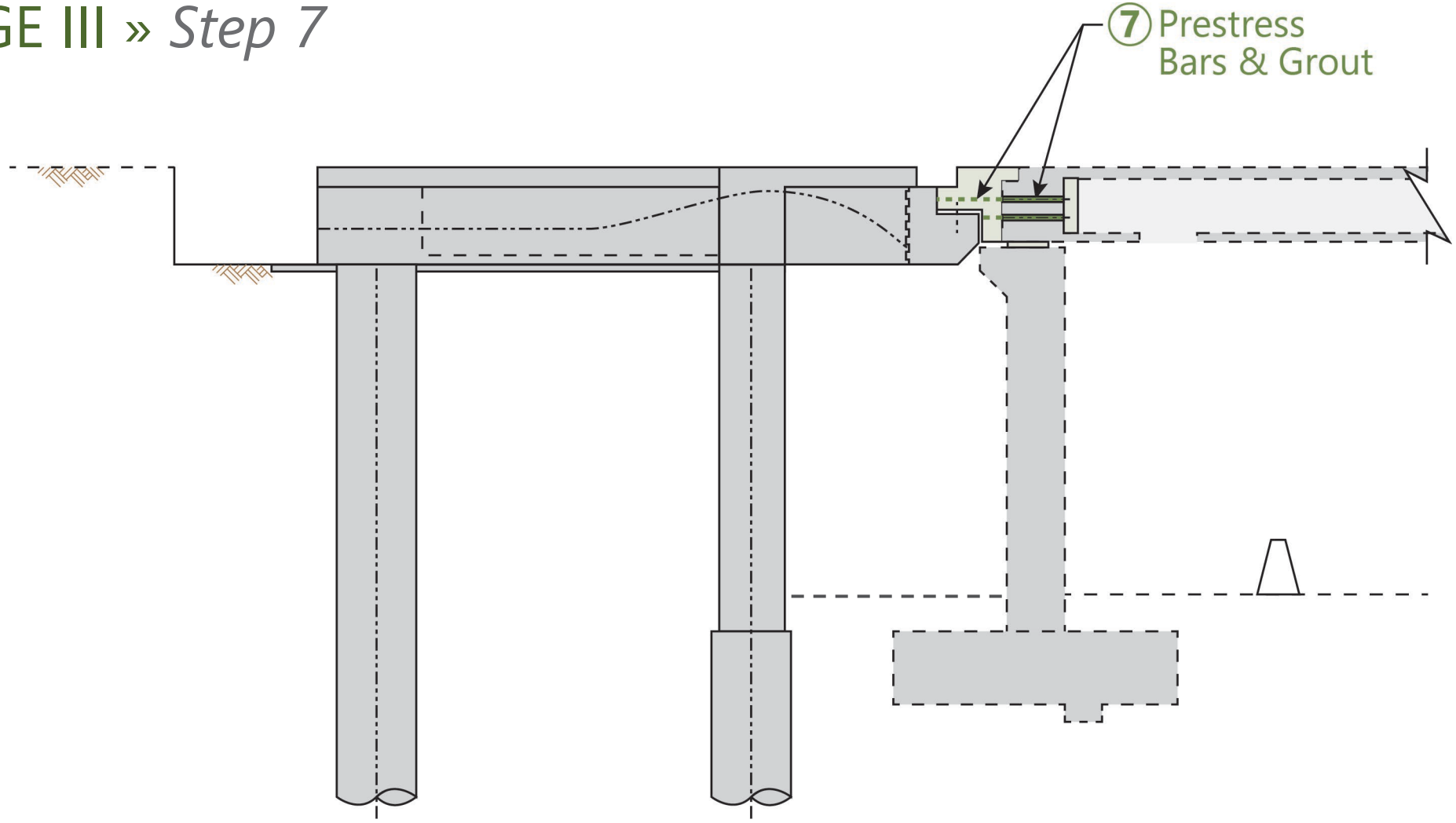
# 15th Avenue UP

## STAGE III » *Step 6*



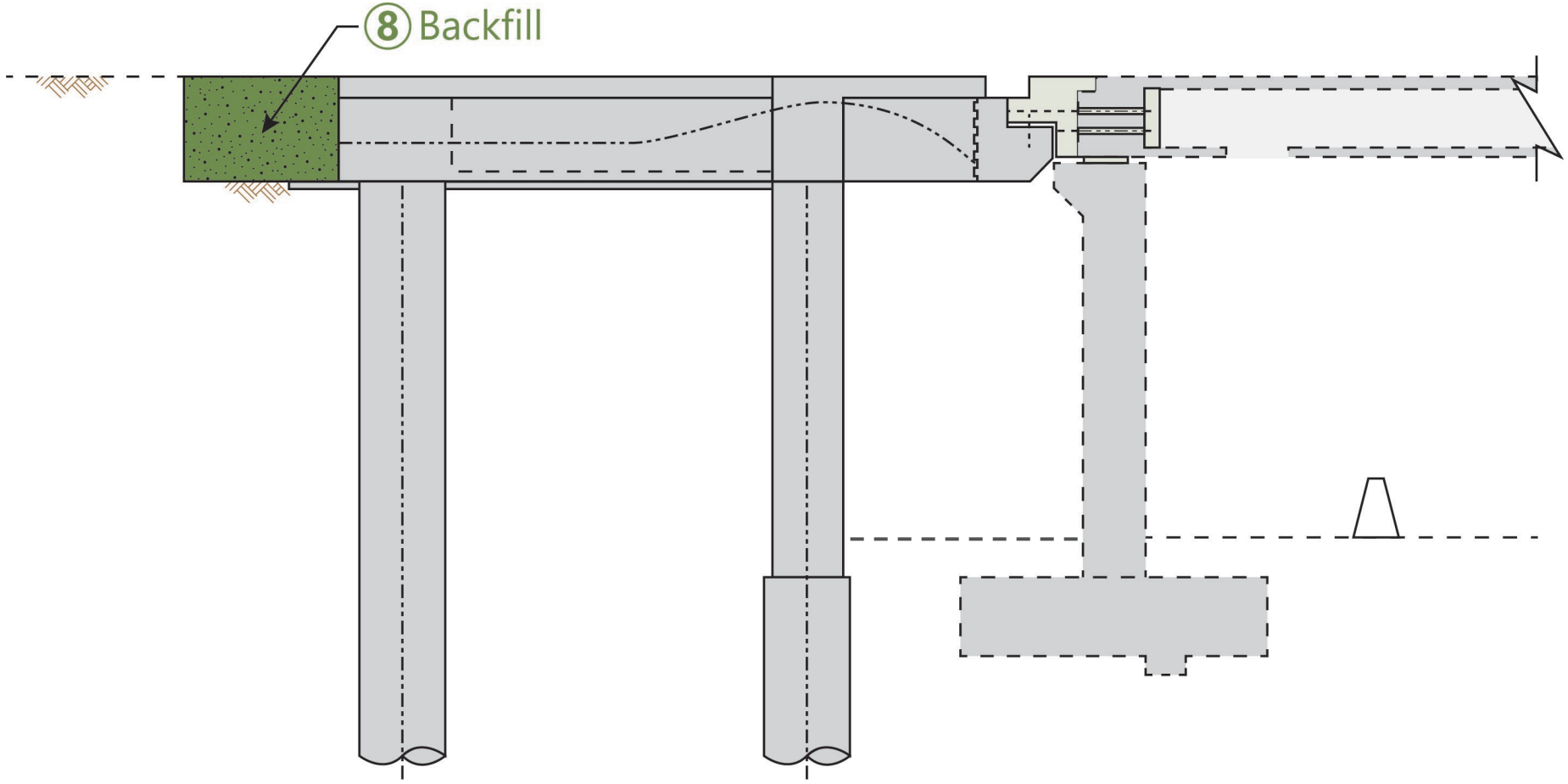
# 15th Avenue UP

## STAGE III » *Step 7*



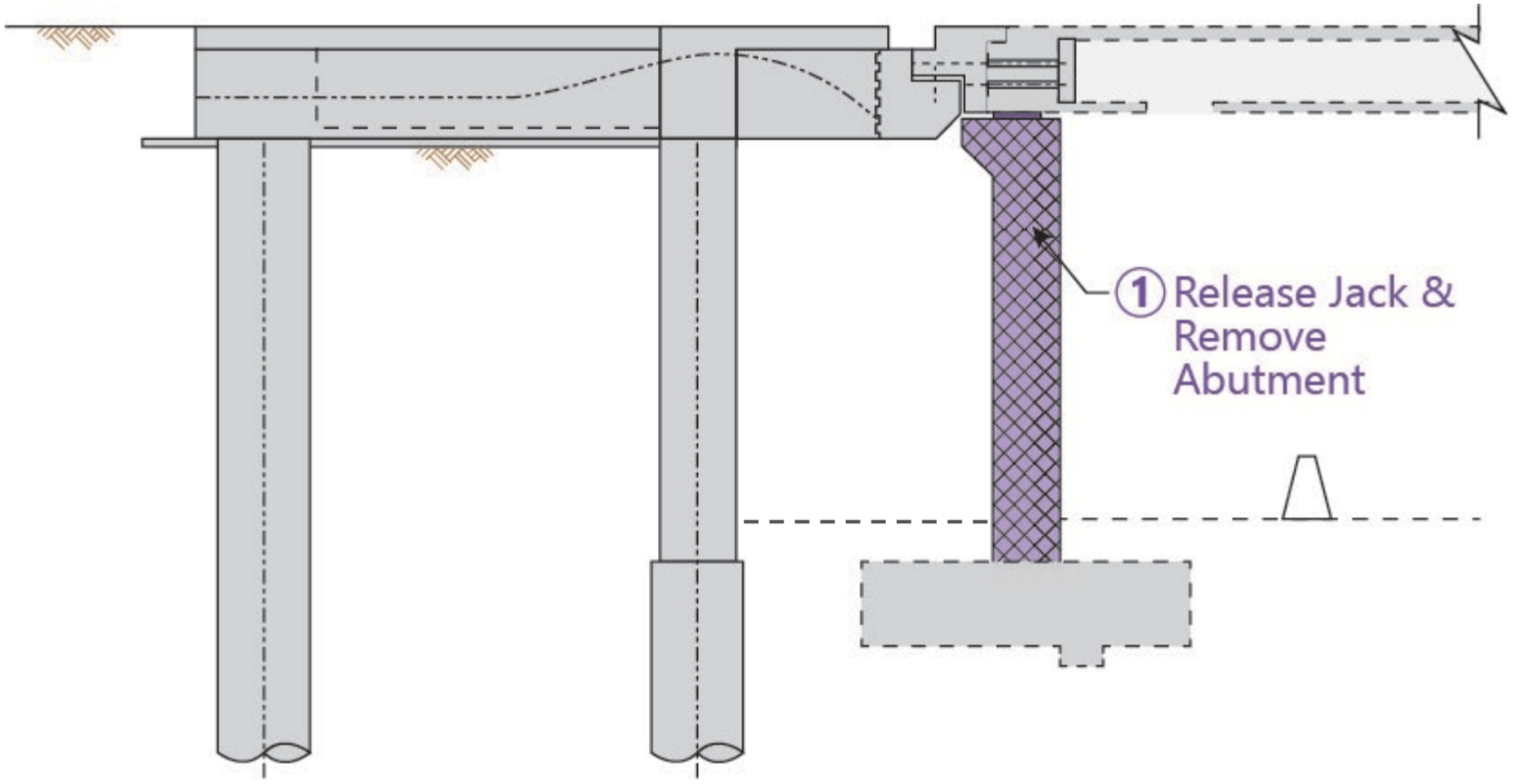
# 15th Avenue UP

## STAGE III » *Step 8*



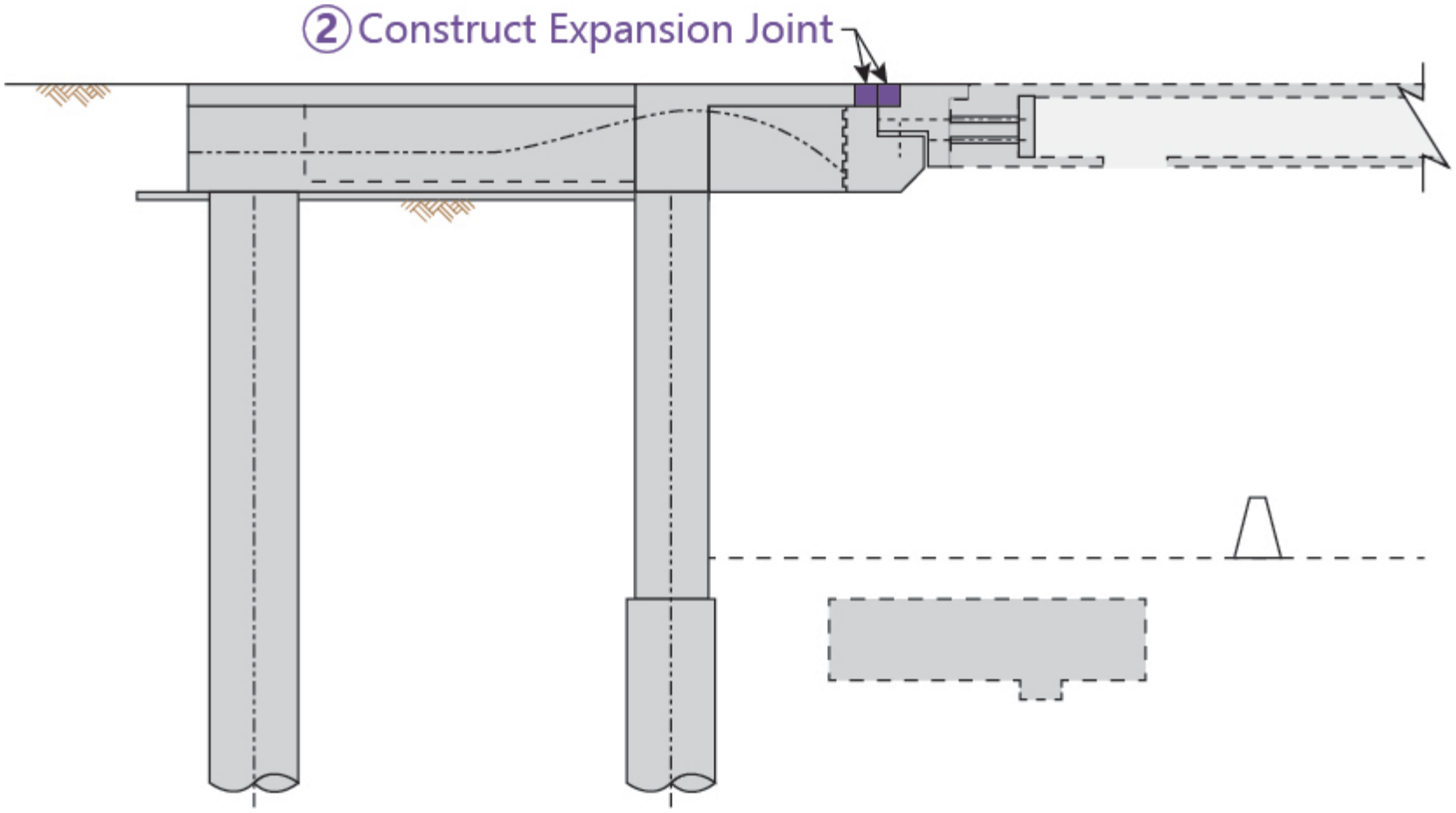
# 15th Avenue UP

## STAGE IV » *Step 1*



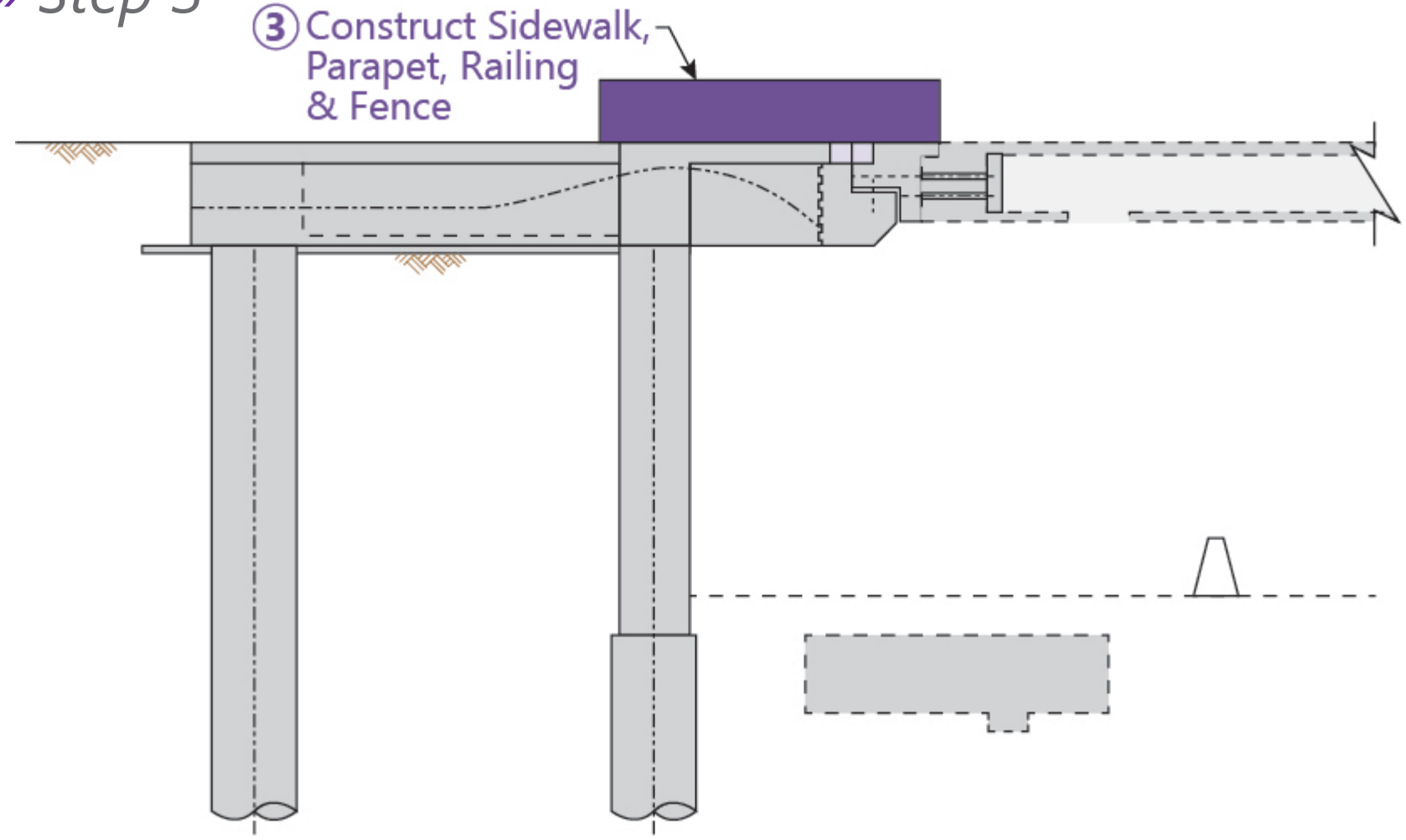
# 15th Avenue UP

## STAGE IV » *Step 2*



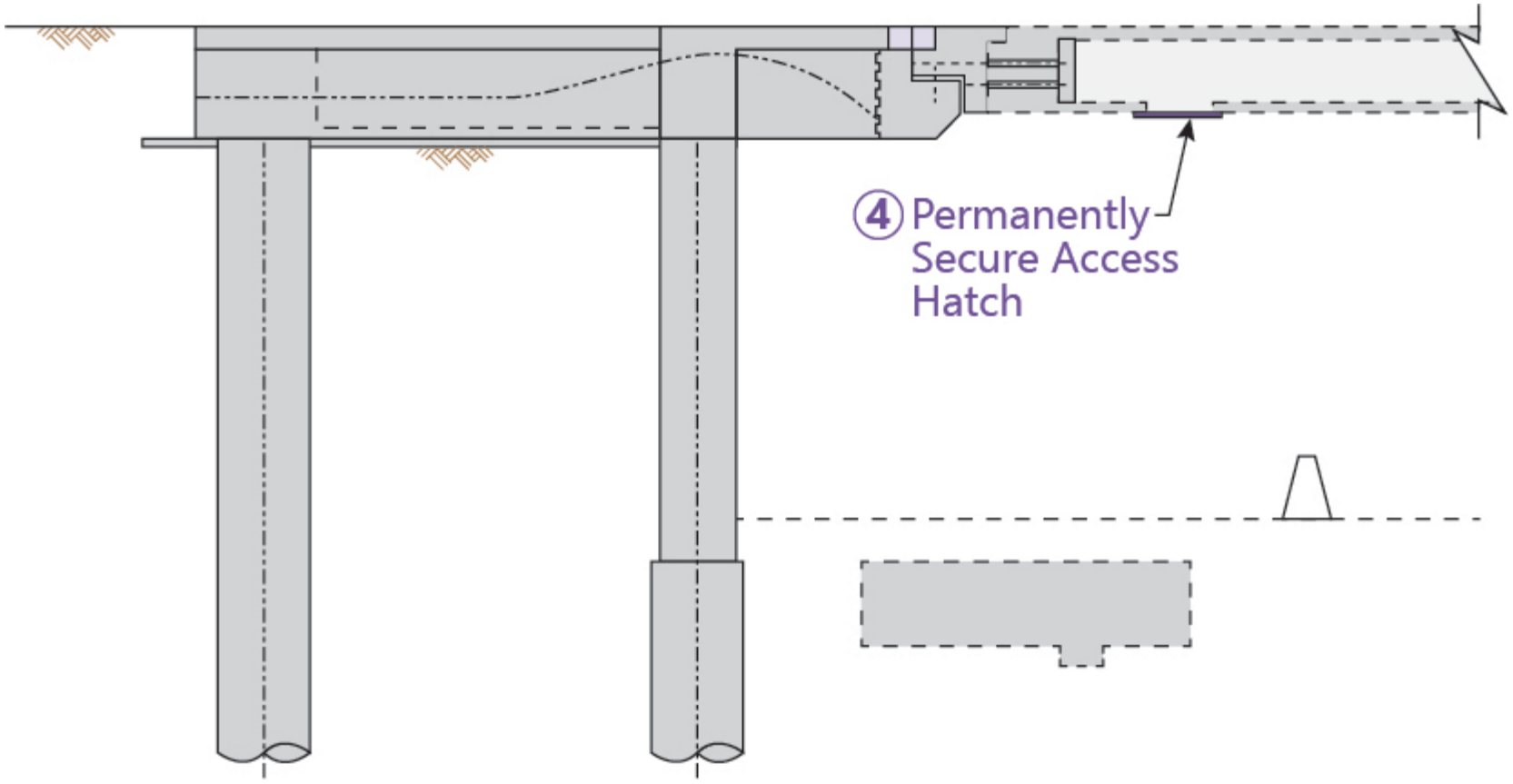
# 15th Avenue UP

## STAGE IV » *Step 3*



# 15th Avenue UP

## STAGE IV » *Step 4*



# 15th Avenue UP

- FHWA Field Inspection
- Request to Review Plans and Calculations
- Questioned Lack of Strut-and-Tie Analysis
- Performed Analysis
- RESULT:
  - No changes to any rebar size
  - No changes to any location
  - FHWA Questioned lack of Supplemental Reinforcement

# 15th Avenue UP

5.8.2.5.3a – General

The limiting compressive stress at the node face, fcu, shall be taken as:

fcu = m v f'c

v = concrete efficiency factor:

- 0.45 for structures that do not contain crack control reinforcement
- As shown in Table 5.8.2.5.3a-1

5.8.6.3 – Crack Control Reinforcement

Structures ….. which have been designed using the efficiency factor of Table 5.8.2.5.3a-1 shall contain orthogonal grids of bonded reinforcement.

Av = 0.003* bw*sh

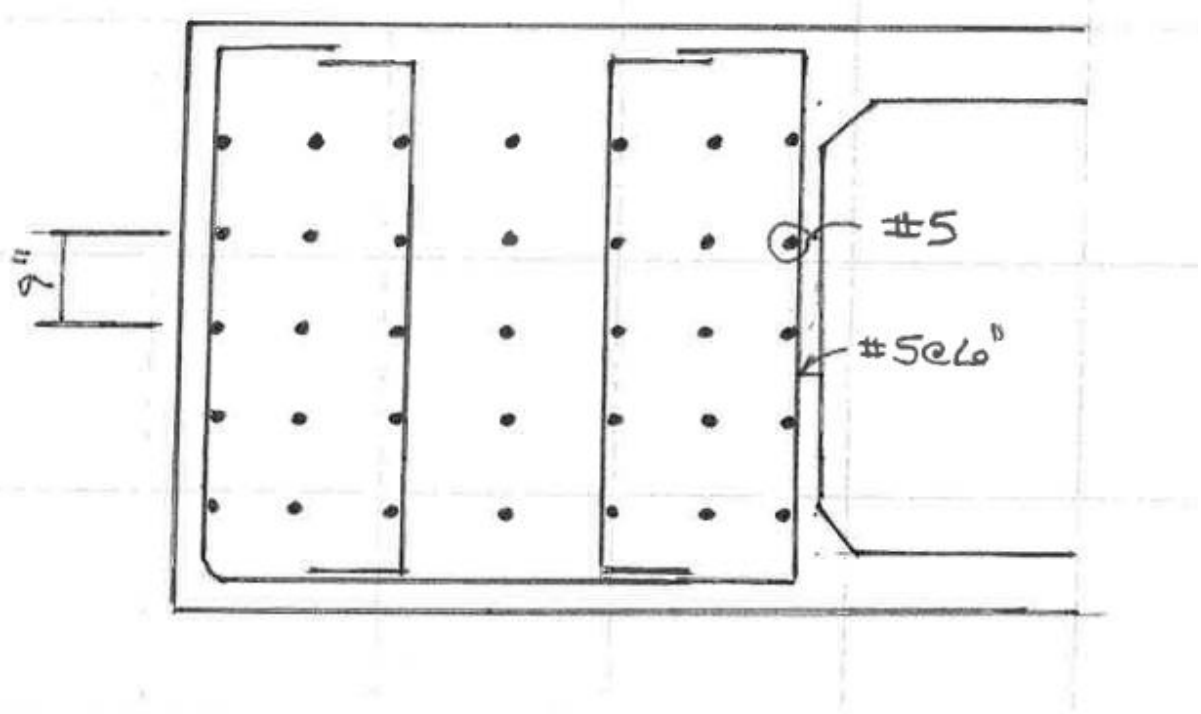



**Table 5.8.2.5.3a-1—Efficiency Factors for Nodes with Crack Control Reinforcement**

| Face | Node Type | | |
|---|---|---|---|
| | CCC | CCT | CTT |
| Bearing Face<br>Back Face | 0.85 | 0.70 | $0.85-\frac{f'_c}{20\ \text{ksi}}$<br>$0.45 \le \nu \le 0.65$ |
| Strut-to-Node Interface | $0.85-\frac{f'_c}{20\ \text{ksi}}$<br>$0.45 \le \nu \le 0.65$ | $0.85-\frac{f'_c}{20\ \text{ksi}}$<br>$0.45 \le \nu \le 0.65$ | |

# 15th Avenue UP

- ADOT Policy Status
- Proposal to Study When/Where Analysis Method Used

# 15th Ave UP

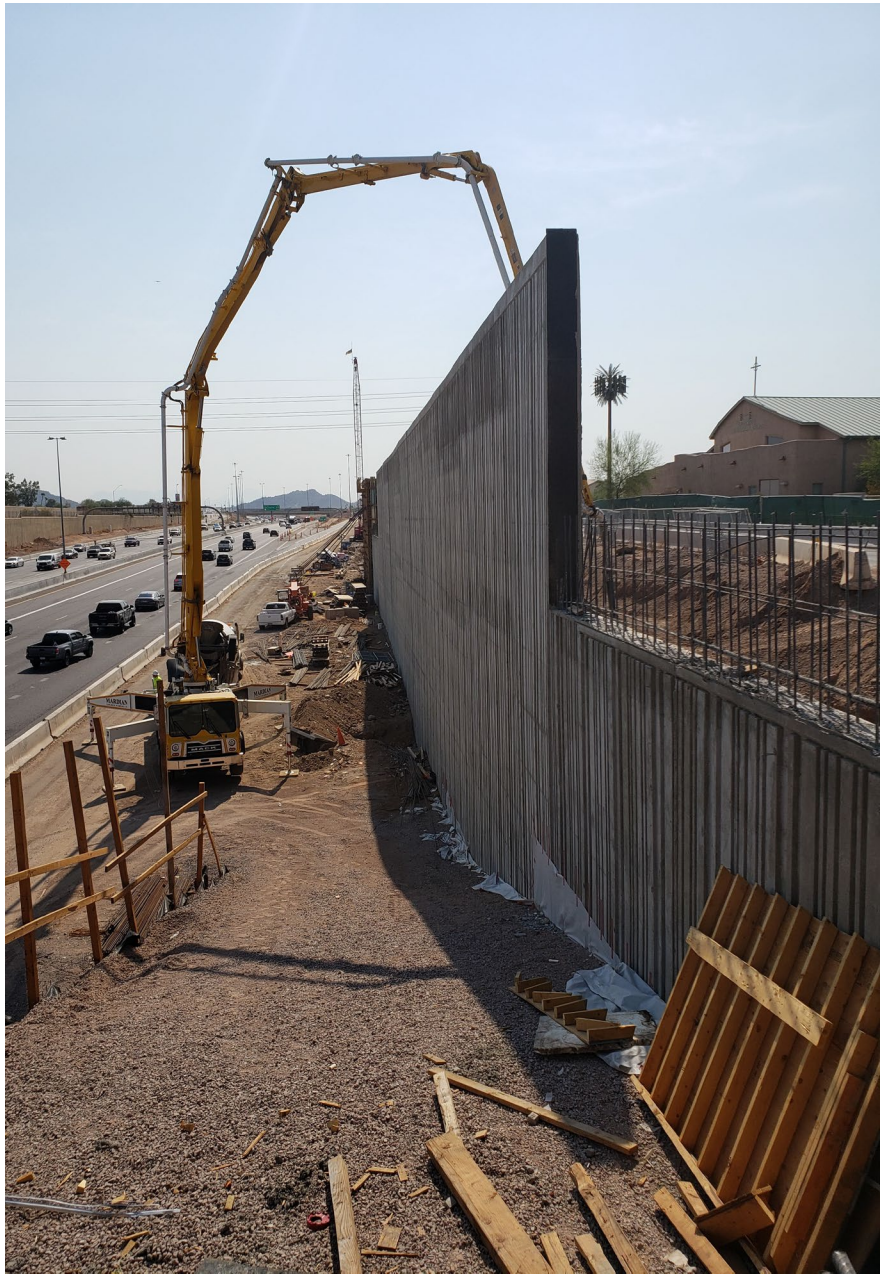
## SHORING & APPROACH WALLS

# 15th Ave UP

## RETAINING WALL

# 15th Ave UP

## WALLS



# 15th Ave UP

## BACK SPAN

# 15th Ave UP

## WEB FORMS

# 15th Ave UP

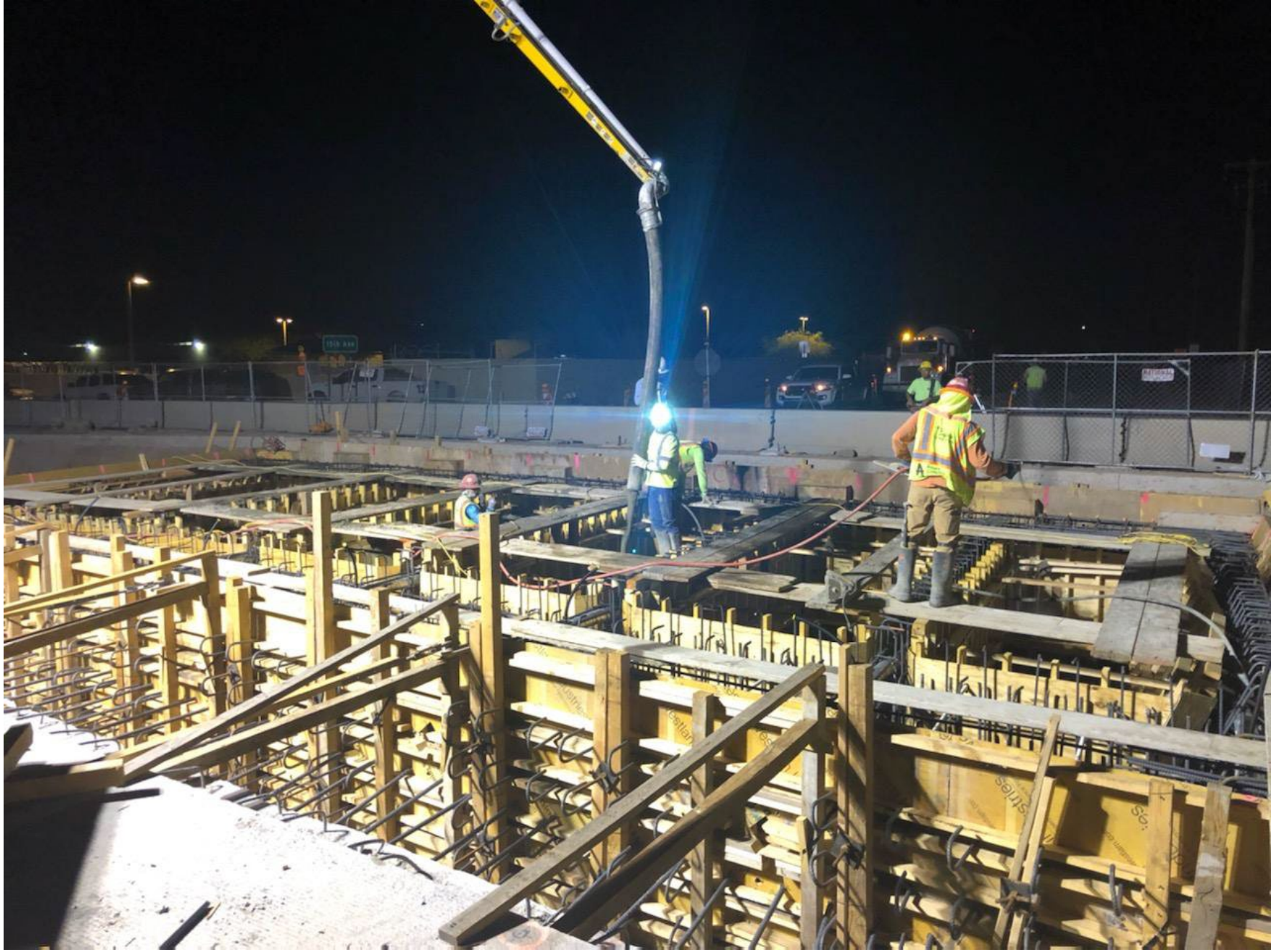
END SPAN

ABUTMENT CAP

ROOM TO PULL

# 15th Ave UP

## BOTOM SLAB & WEB POUR

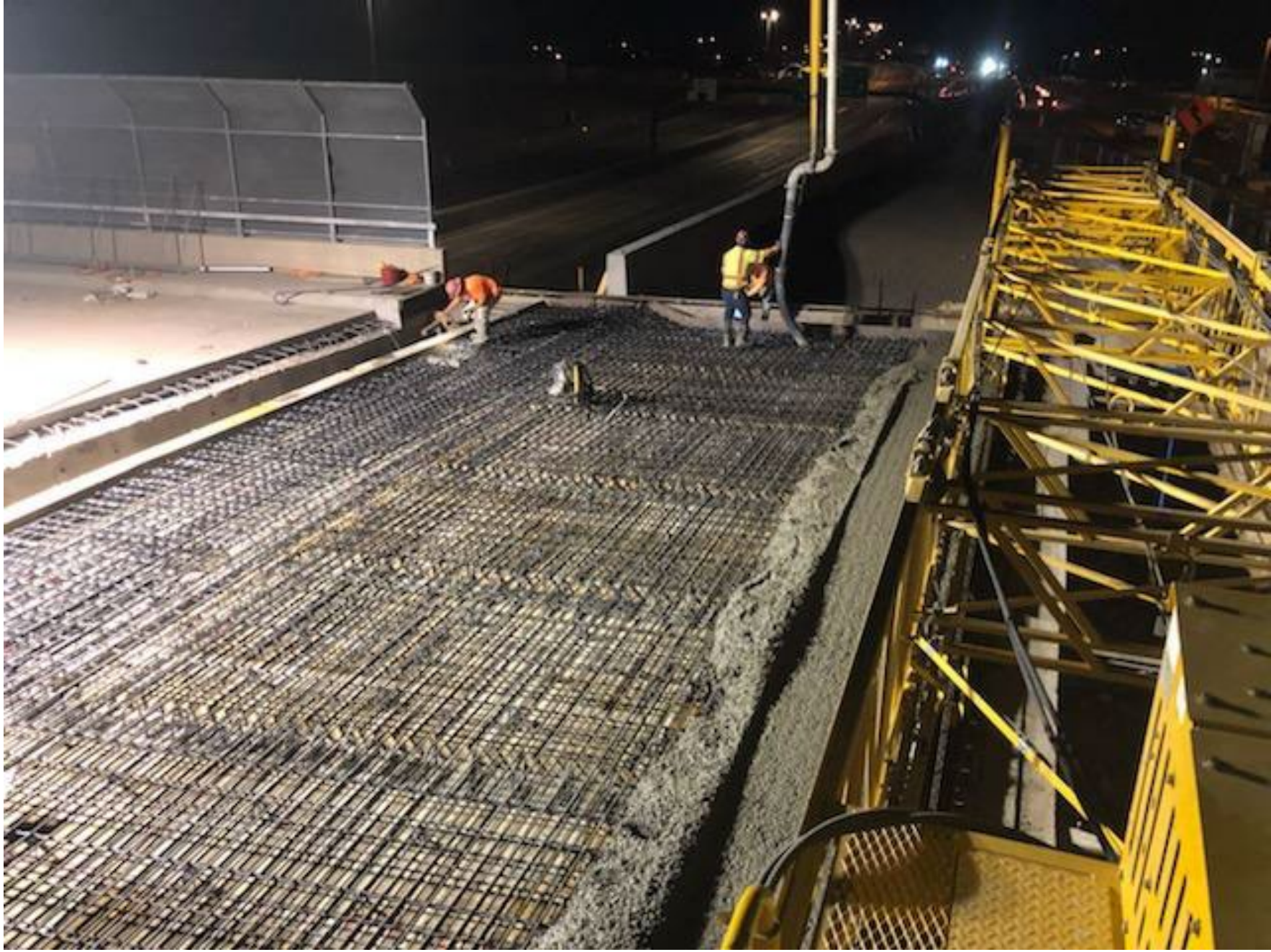


# 15th Ave UP

## DECK REINFORCING

# 15th Ave UP

## DECK POUR



# 15th Ave UP

# 15th Ave UP

## HINGE

# 15th Ave UP

## ACCESS HOLES
## JACKING

# 15th Ave UP

JACKING

ANALYSIS EXISTING

ABUTMENT CAP

# 15th Ave UP

## EXISTING CELL

# 15th Ave UP

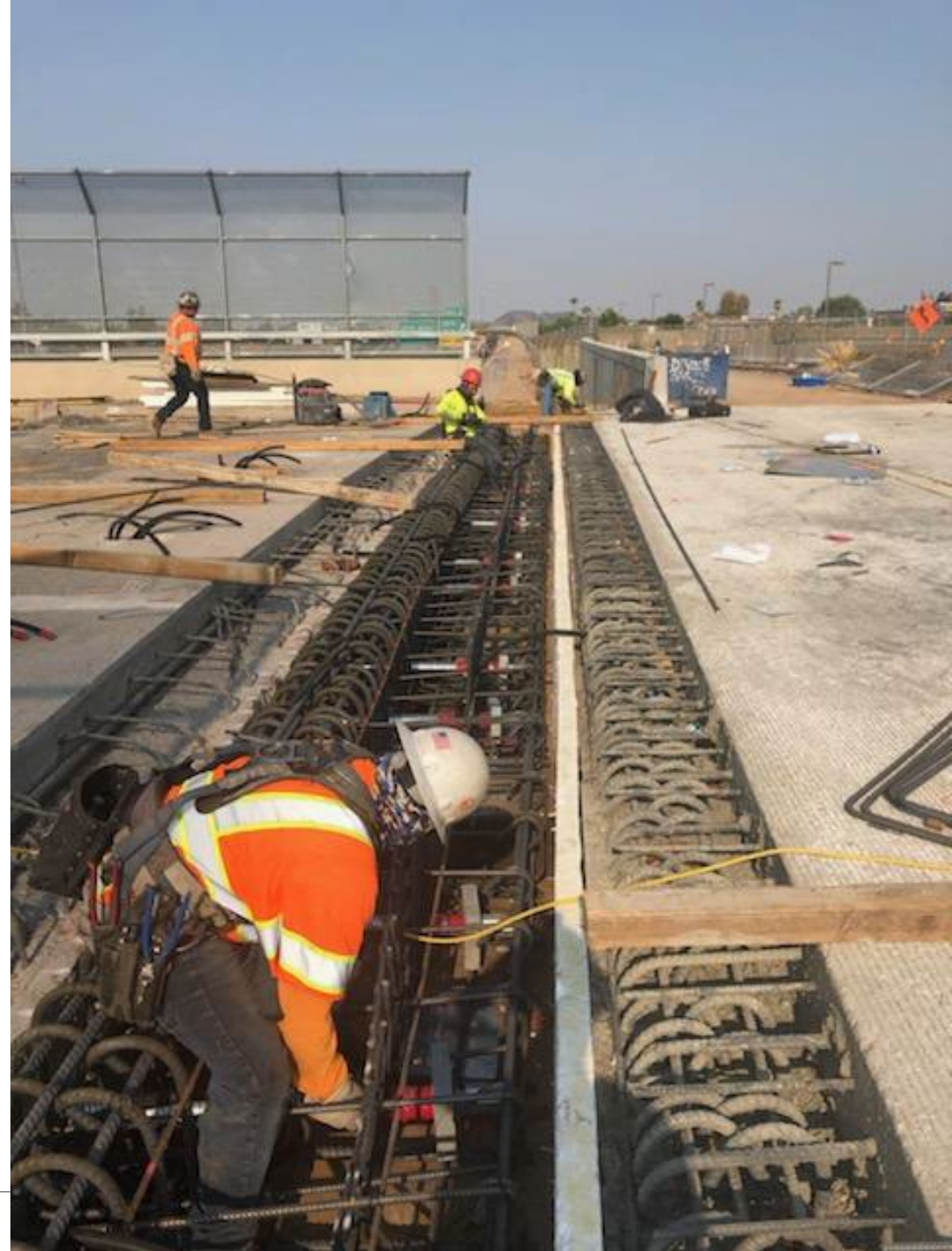
## INSIDE CELL

# 15th Ave UP

# 15th Ave UP

## HINGE DETAILS

# 15th Ave UP

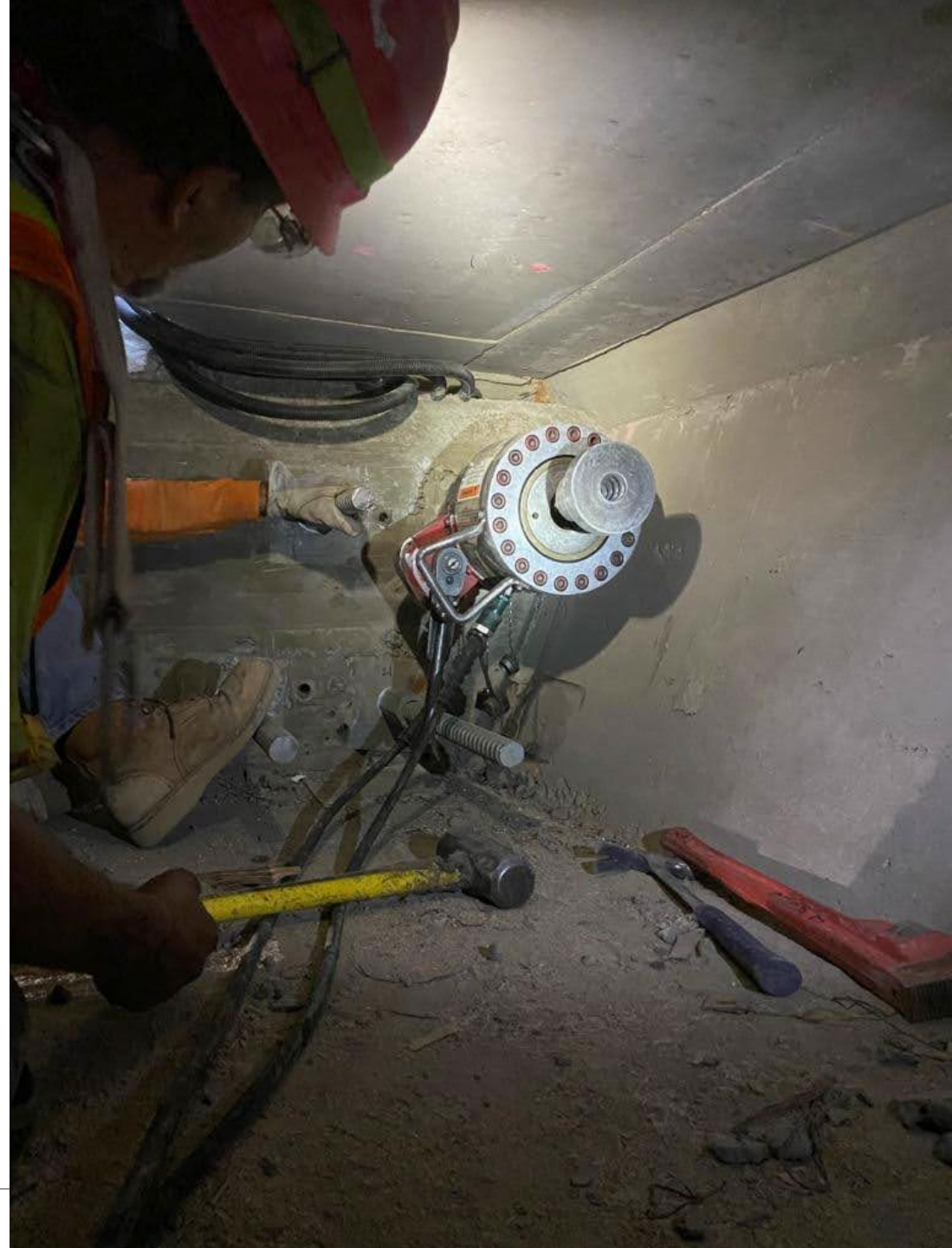


# 15th Ave UP

## P/S BAR DUCTS

# 15th Ave UP

## PRESTRESS JACKING



# 15th Ave UP

ABUTMENT REMOVAL

# 15th Ave UP

LOOKING NORTH

# 15th Ave UP

## EXPANSION JOINT

# 15th Ave UP

LOOKING SOUTH

# 15th Ave UP

LOOKING SOUTH

TYLin

2023 Western Bridge Engineer's Seminar

# Questions?