TEXAS DEPARTMENT OF TRANSPORTATION

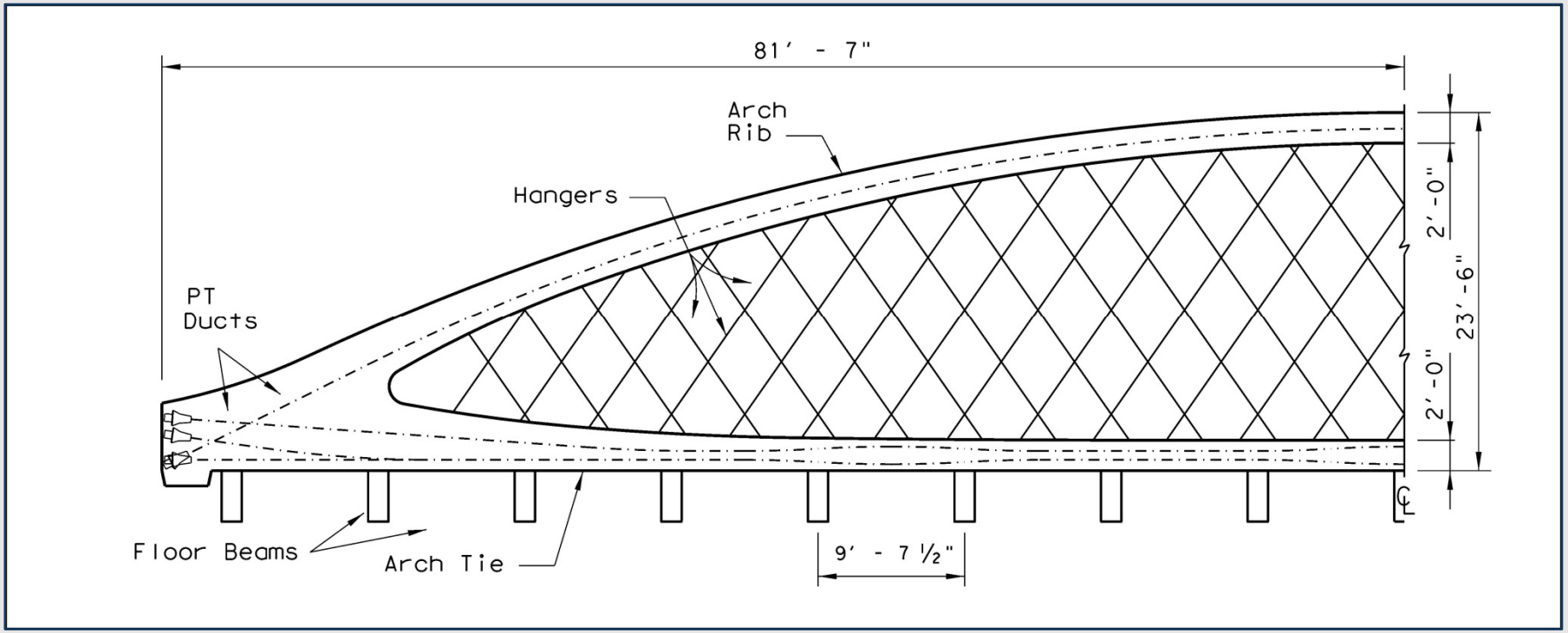
Post-tensioning System of the Precast Network Arches of the West 7TH Street Bridge

Courtney Holle, P.E.

West 7th Street Bridge

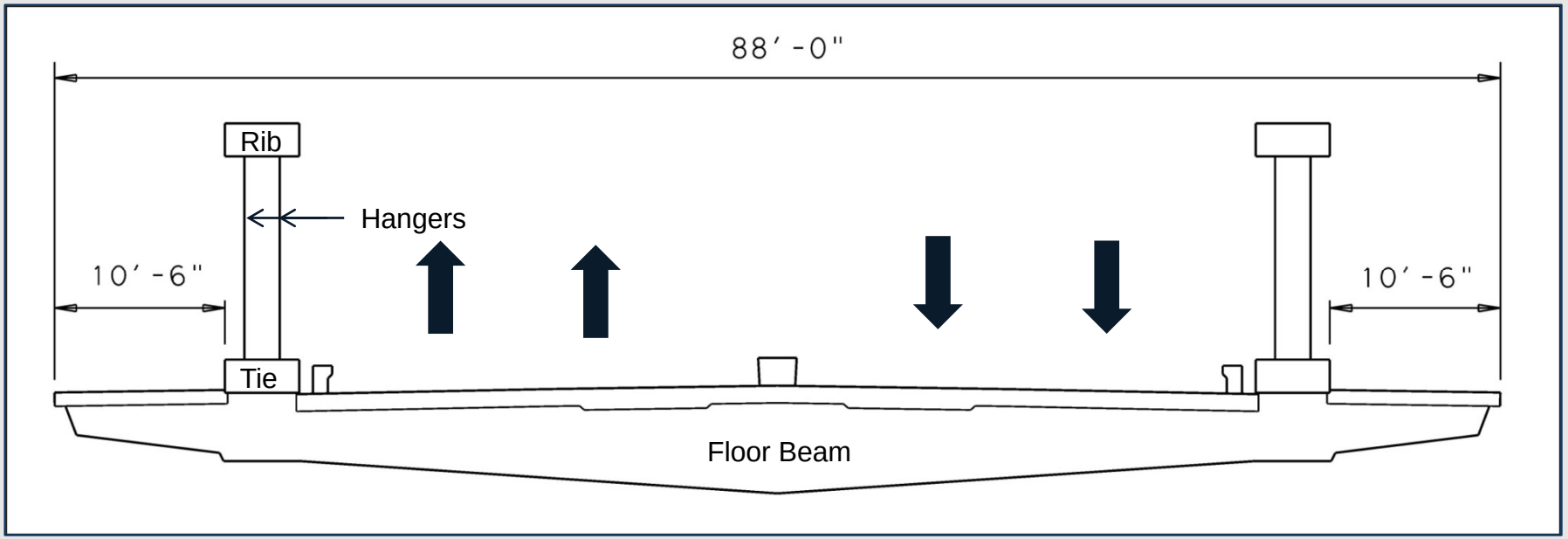
Photo Courtesy of Liam Frederick

Geometry



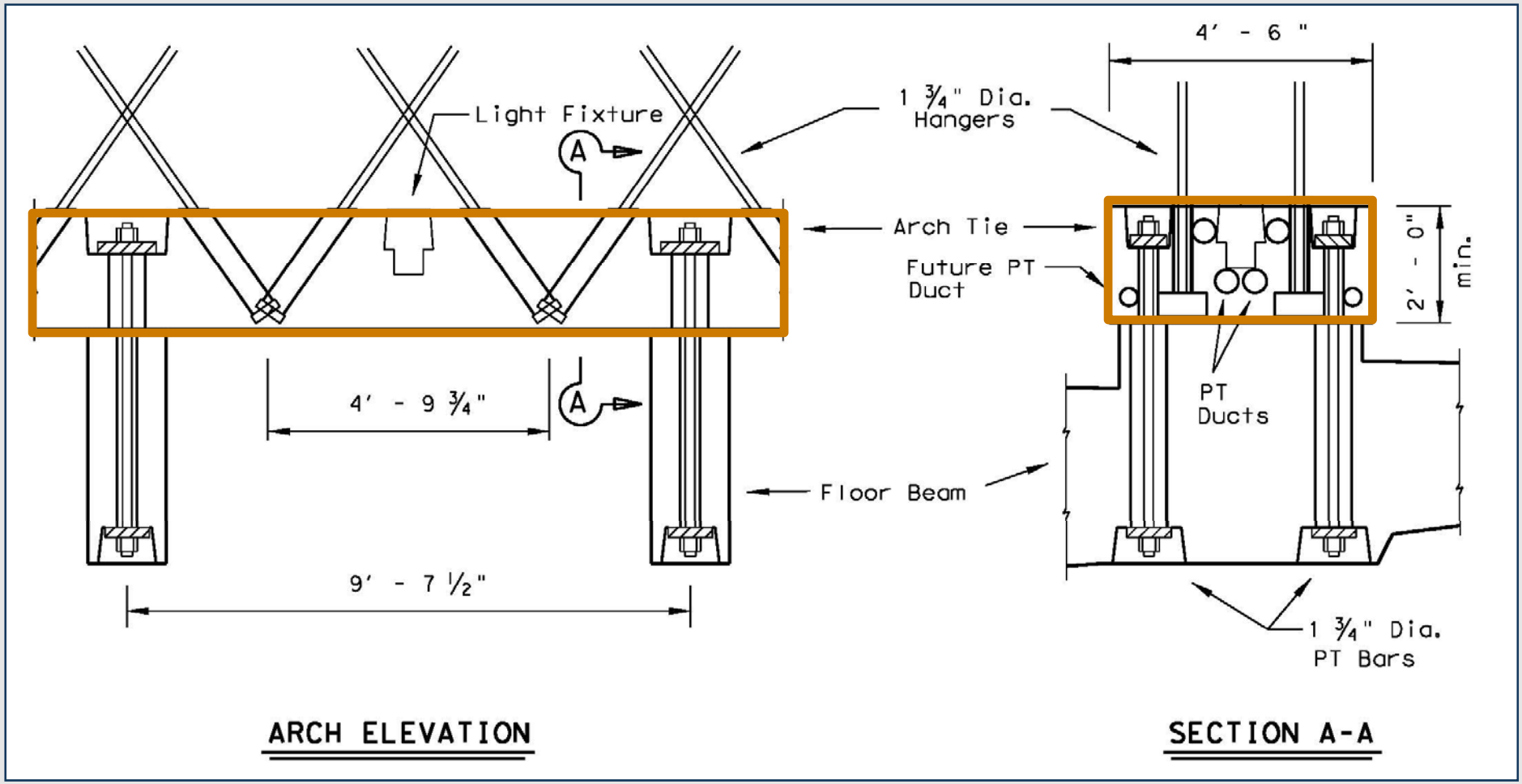
- 23’-6” Arch Height
- 2’ Deep Arch Rib and Tie at Midspan
- 9’-7½” Floor Beam Spacing

Geometry



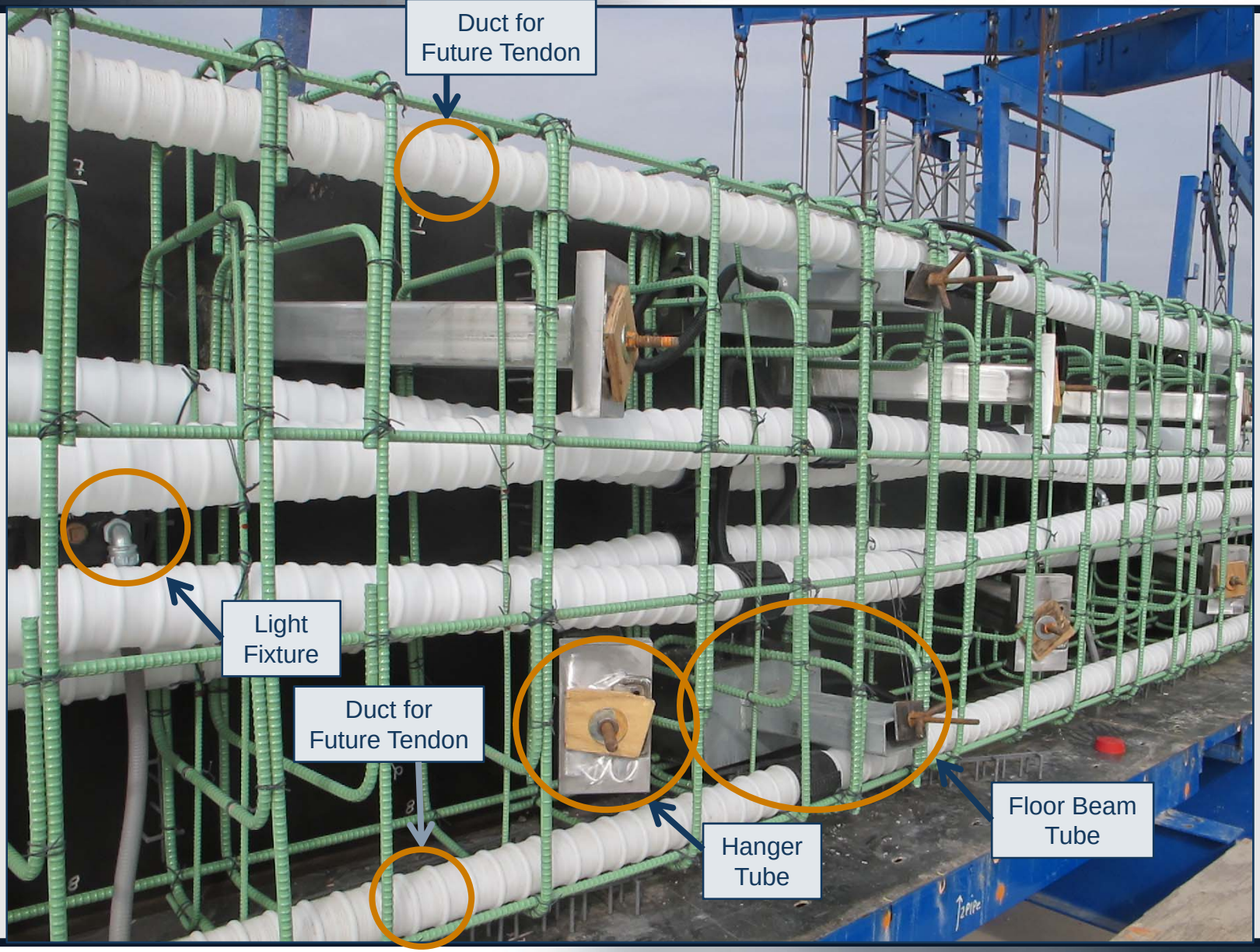
- 88 ft Overall Width
- 2 Lanes Each Direction
- 10.5 ft Sidewalk Width

Geometry



- 4'-9 ¾" Hanger Spacing
- 4'-6" Arch Width

Tie PT Ducts and Embeds



Construction Sequence

Arch Cast Horizontally

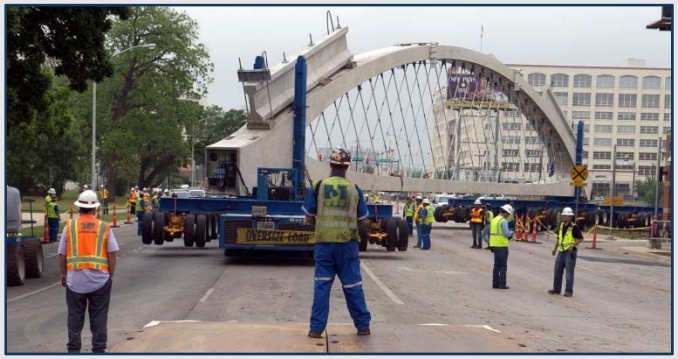
PT – Stage I

Arch Rotation

PT – Stage II

Hanger Tensioning

Arch Transport

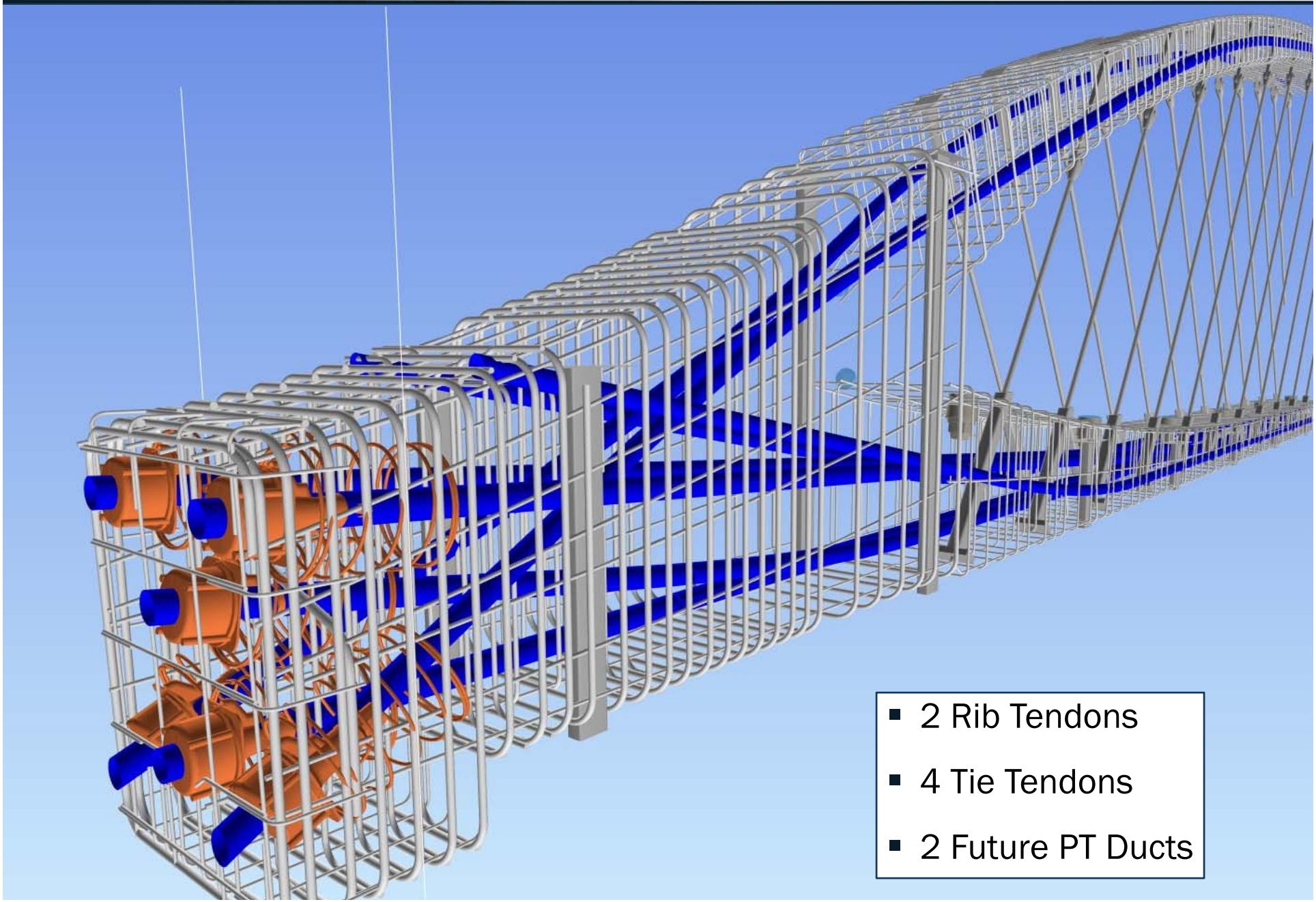


Hanging Floor Beams

Place Panels

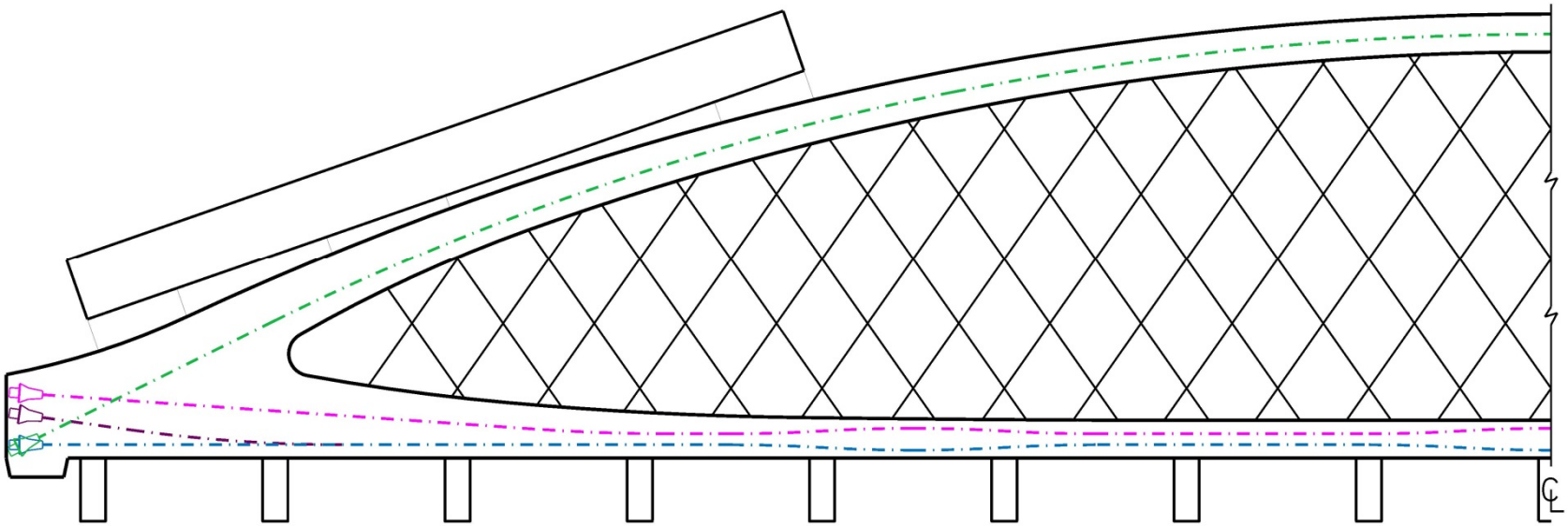
Bridge In Service

Knuckle Region



- 2 Rib Tendons
- 4 Tie Tendons
- 2 Future PT Ducts

Design of PT Layout



Arch Rotation

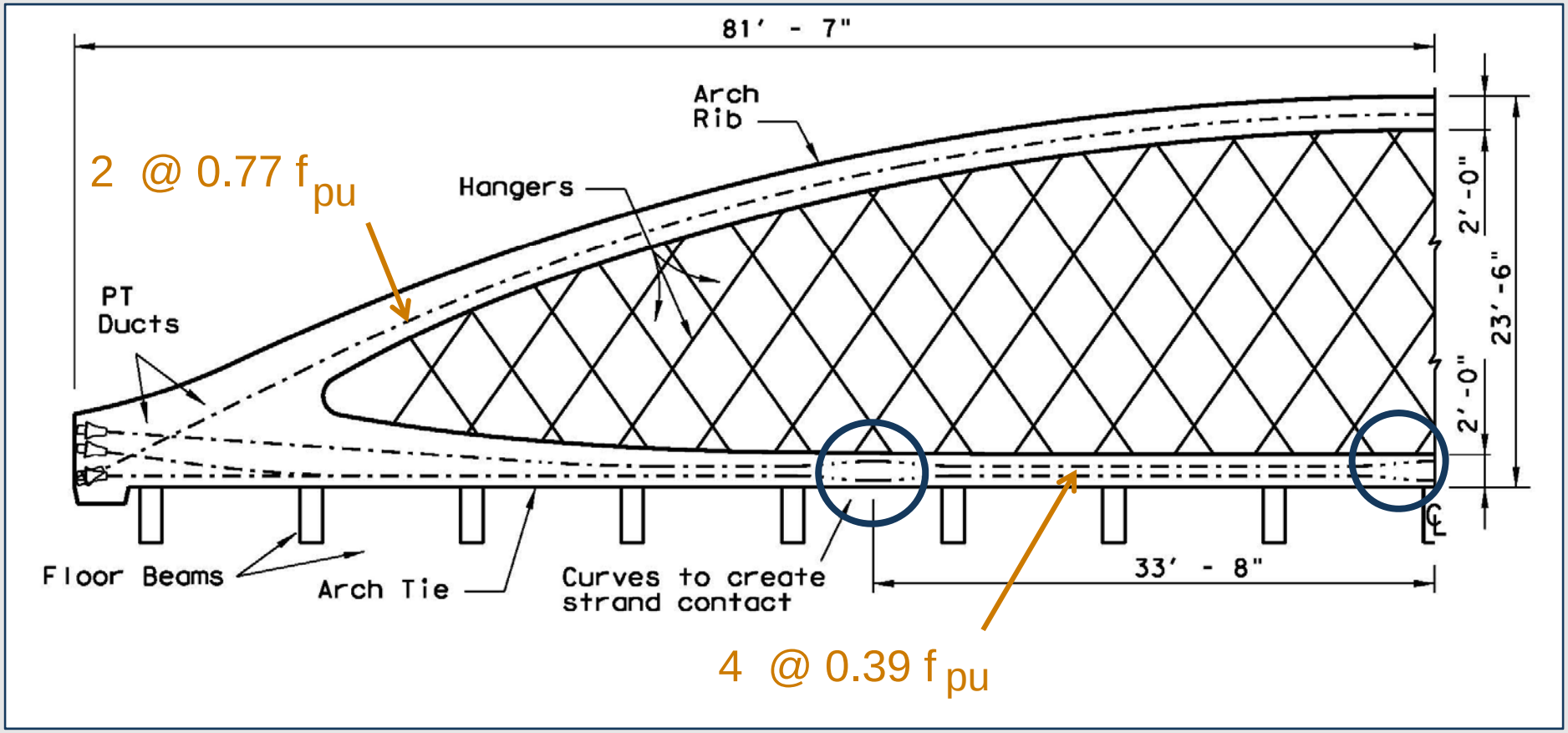
Hanger Tensioning

Bridge In Service

Rib Stiffening Element

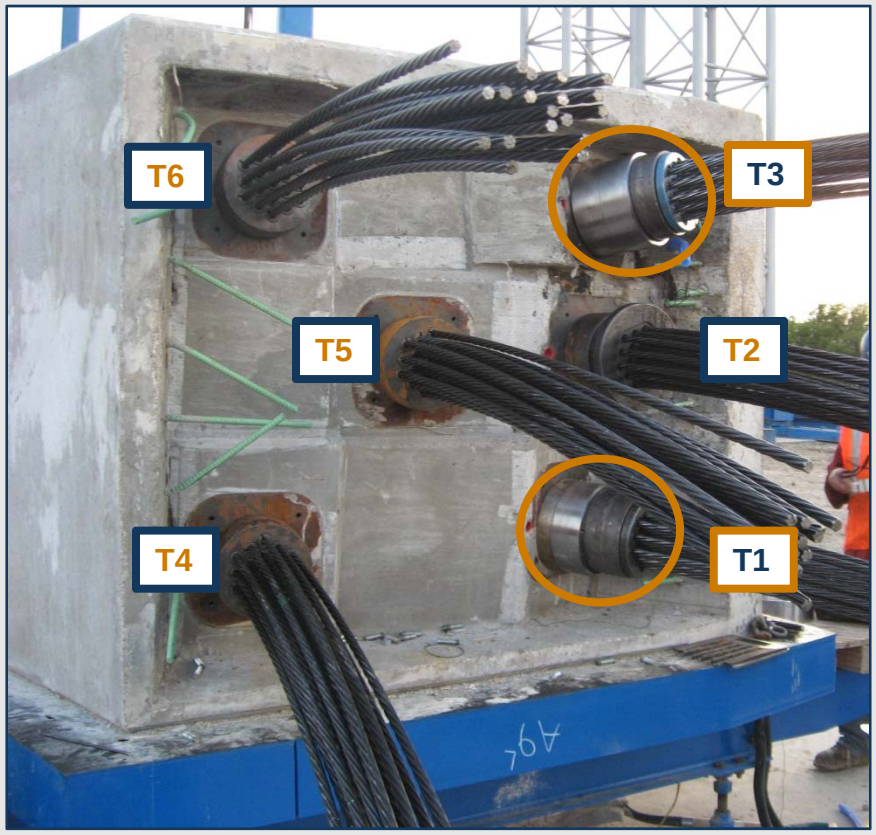
Arches Cast on its Side

PT – Stage I


81' - 7"
Arch Rib
2 @ 0.77 f pu
Hangers
PT Ducts
2'-0"
23'-6"
2'-0"
Floor Beams
Arch Tie
Curves to create strand contact
33' - 8"
4 @ 0.39 f pu

Curves in Tie PT Duct

PT – Stage I

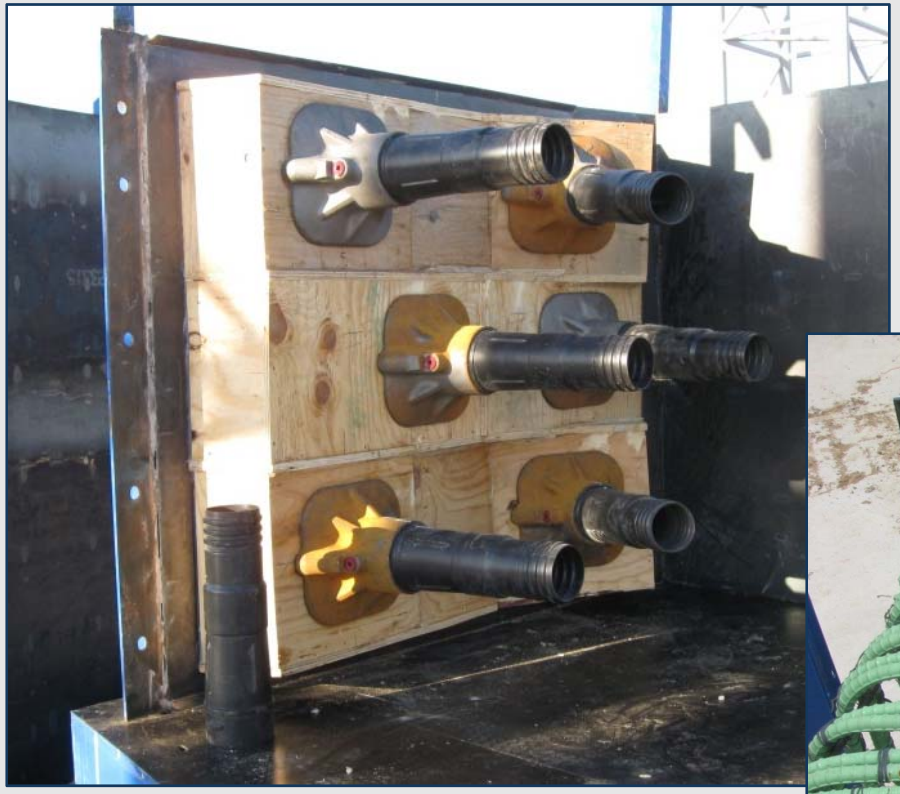


Stressing Order

- T1, T3, T2, T4, T5, T6: 52ksi, 104ksi
- T1: 156ksi
- T3, T1: 208ksi

- 19 Strand Tendons
- 0.62in Diameter Strand

End Region

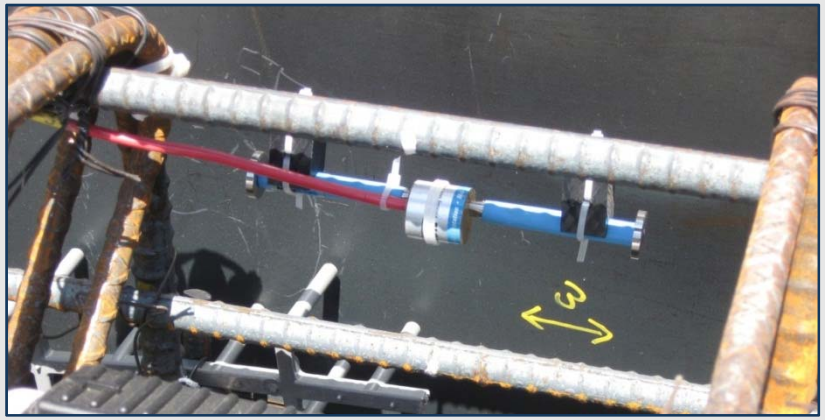


Arch Rotation

- 6 Lifting Frames

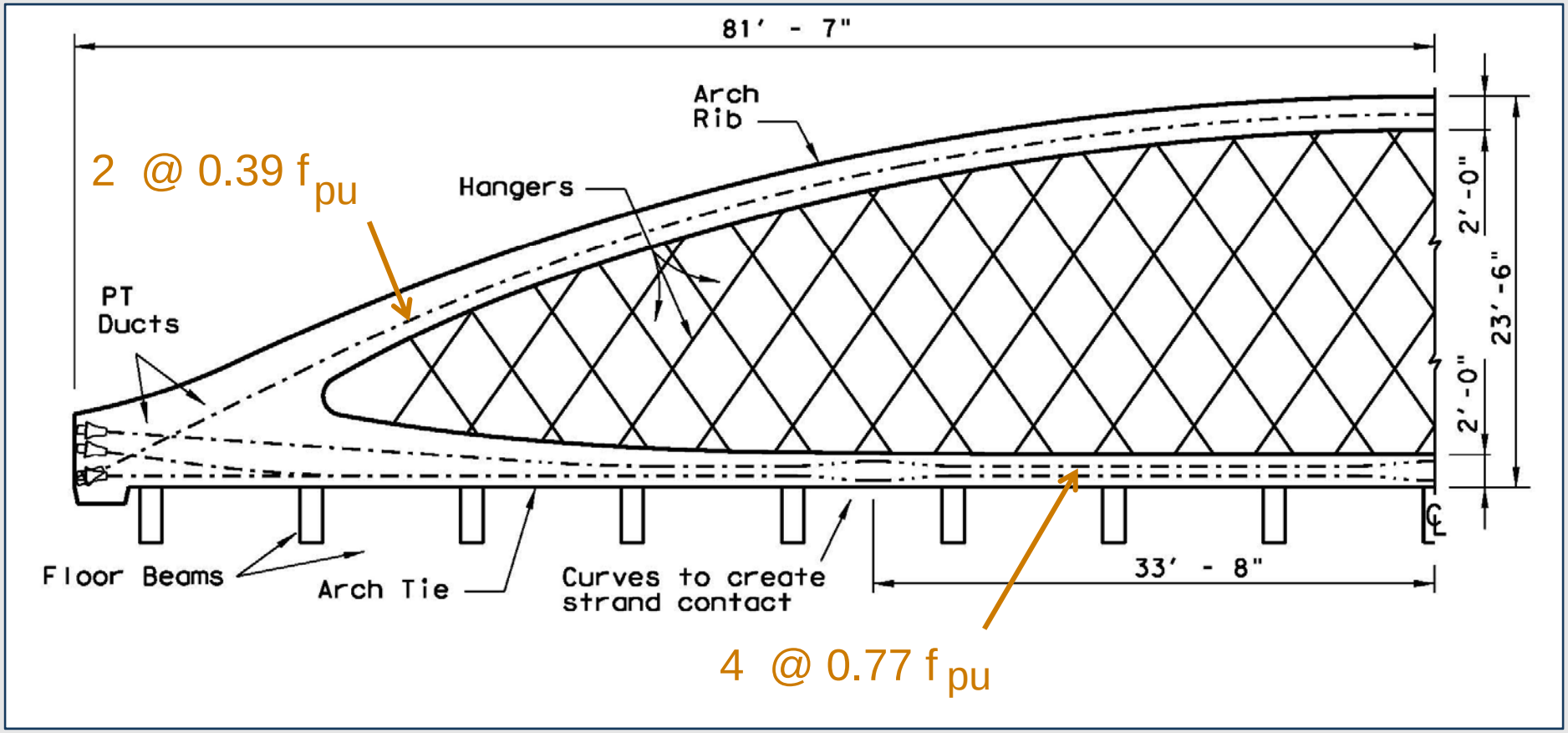
Arch Rotation Video

Instrumentation of the Arch

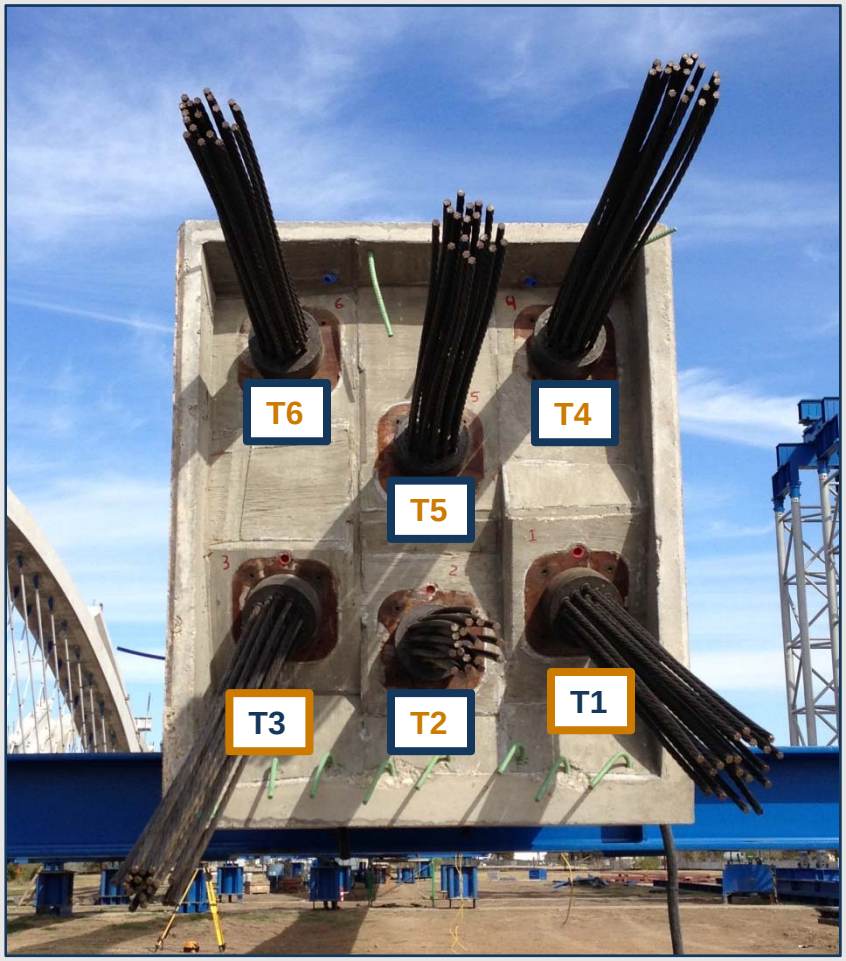


- University of Texas at Austin
- Vibrating Wire Gages

PT – Stage II


81' - 7"
Arch Rib
2 @ 0.39 f pu
Hangers
PT Ducts
2'-0"
23'-6"
2'-0"
Floor Beams
Arch Tie
Curves to create strand contact
33' - 8"
4 @ 0.77 f pu

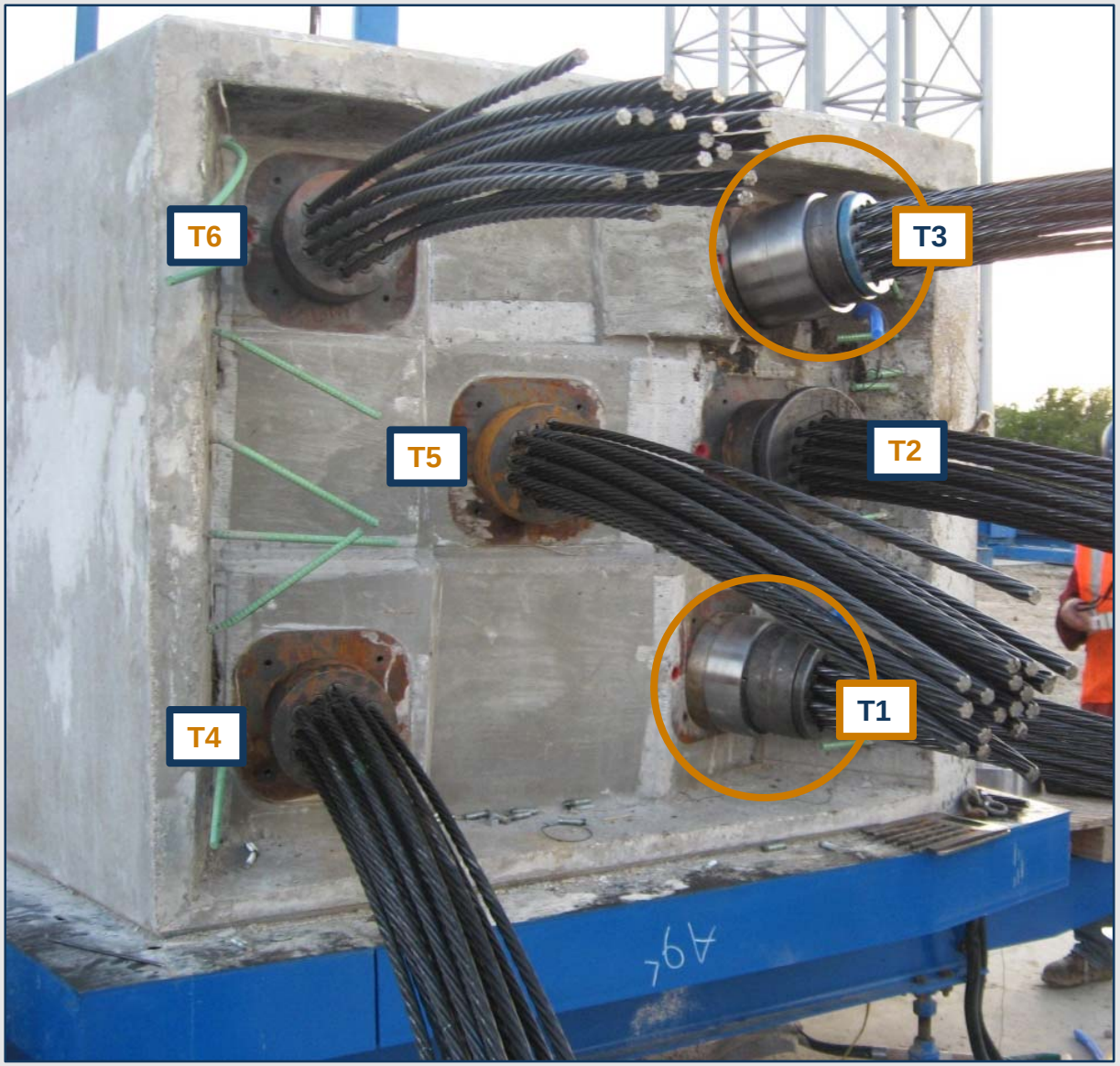
PT – Stage II



Stressing Order

- T2, T4, T5, T6: 156ksi, 208ksi
- T1,T3: 52ksi (De-stressing)
  - Shims Removed from Both Ends
- T1, T3: 104ksi

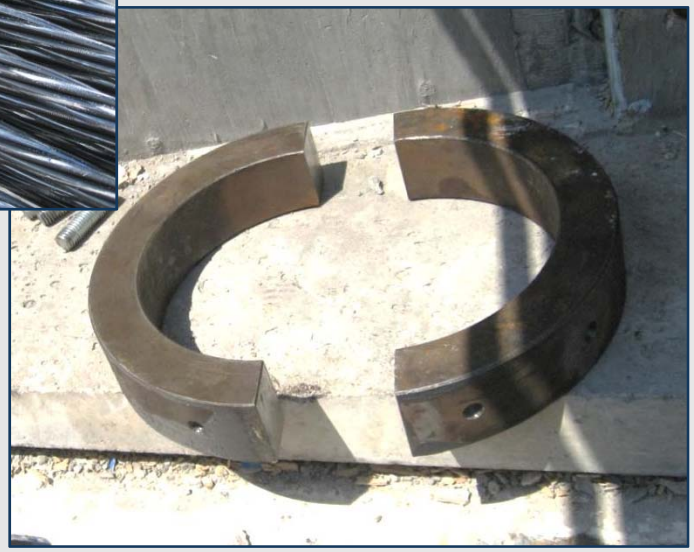
De-stressing Shims



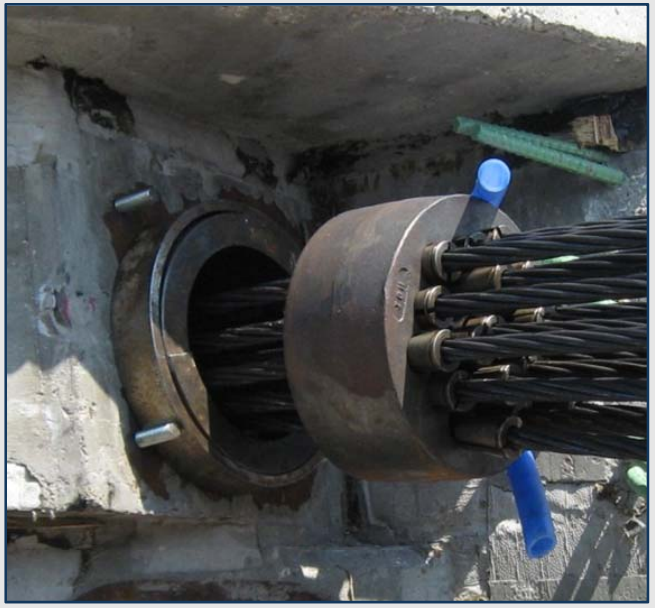
De-stressing Shims

Protection Rings
(8 ¼” ID & 9” OD)

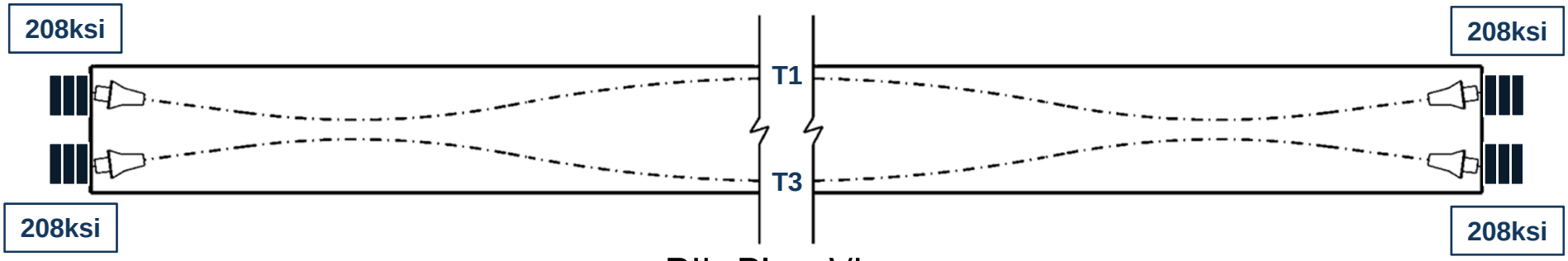
De-stressing Shims
(6”ID & 8”OD)



De-stressing Shims



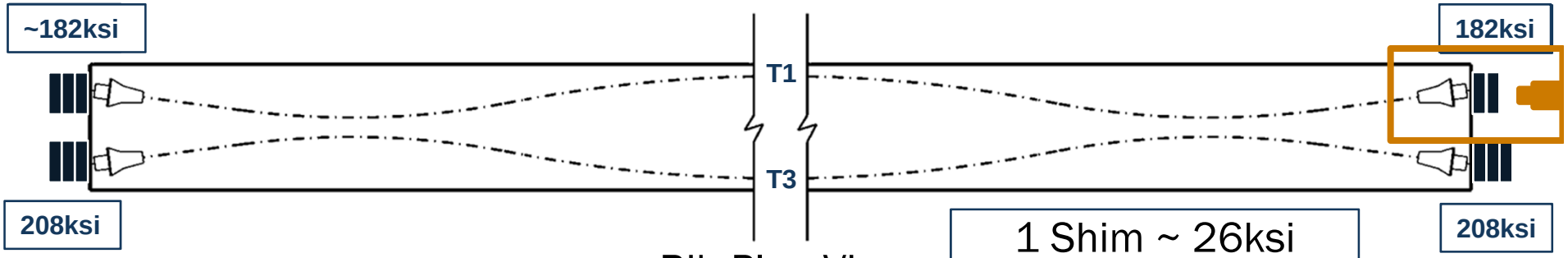
De-stressing Rib Tendons



Rib Plan View

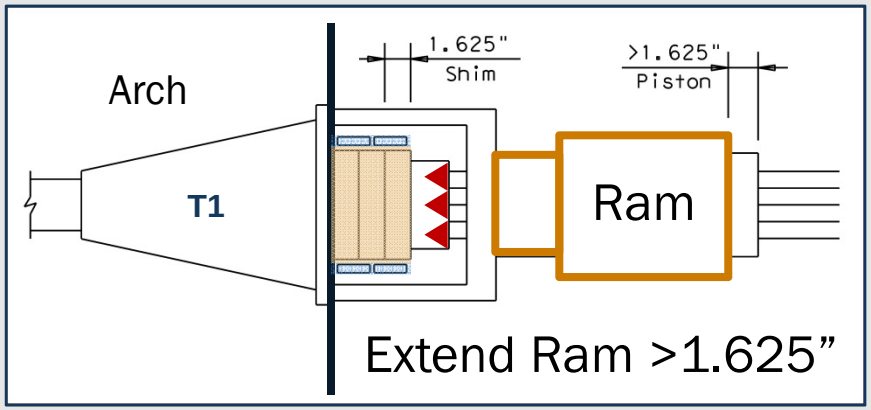
- 6 Shims per tendon
- 3 Shims on each tendon end
- 1 Shim = 1.625” Theoretical Elongation ≈ 26ksi ($^1/_8$ of 0.77f_{pu})
- 2 Shims = 3.25” Theoretical Elongation ≈ 52ksi ($^1/_4$ of 0.77f_{pu})
- 3 Shims = 4.875” Theoretical Elongation ≈ 78ksi ($^3/_8$ of 0.77f_{pu})
- 6 Shims = 9.75” Theoretical Elongation ≈ 156ksi ($^3/_4$ of 0.77f_{pu})
- Leaving ~52ksi in Rib Tendons at the end of de-stressing (208ksi–156ksi =52ksi)

De-stressing Rib Tendons

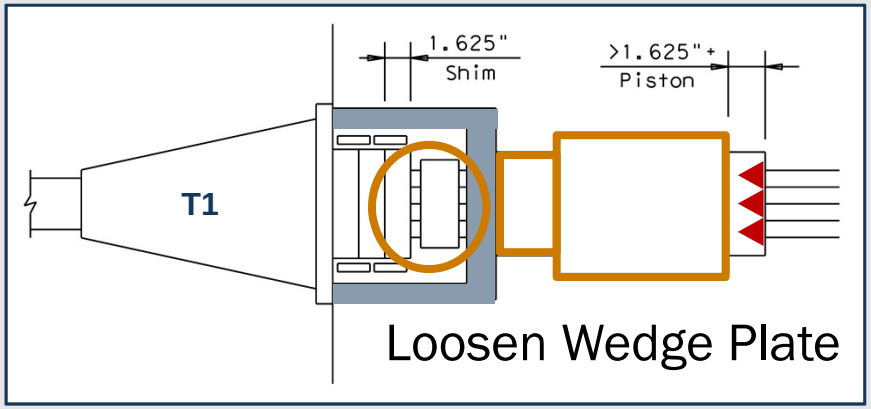


Rib Plan View

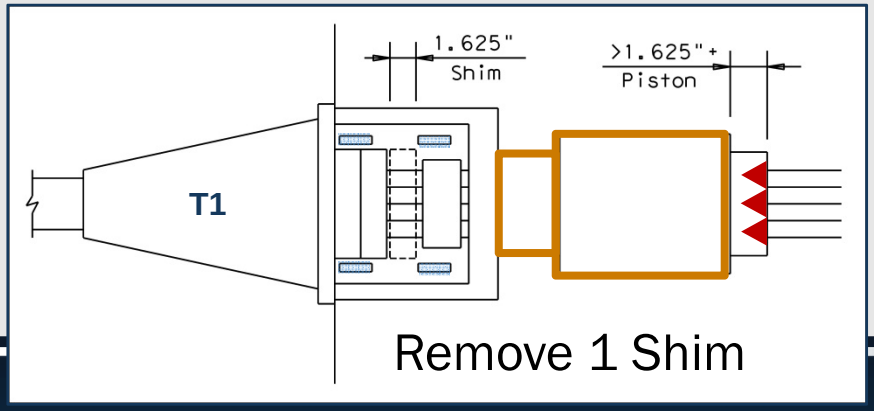
1 Shim ~ 26ksi



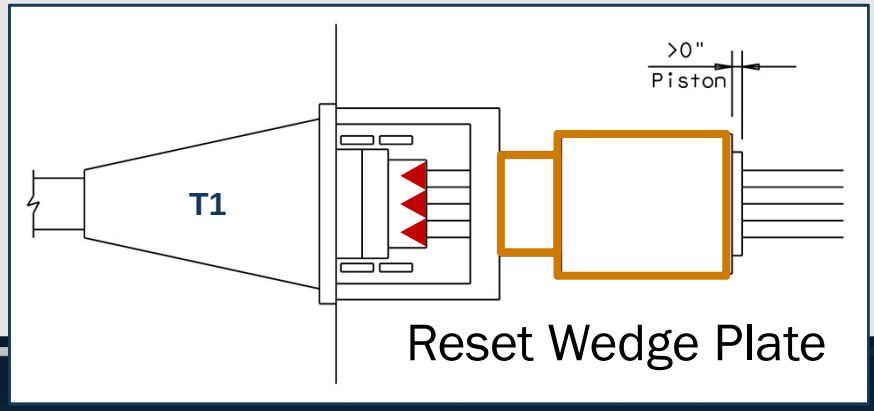
Extend Ram >1.625”



Loosen Wedge Plate

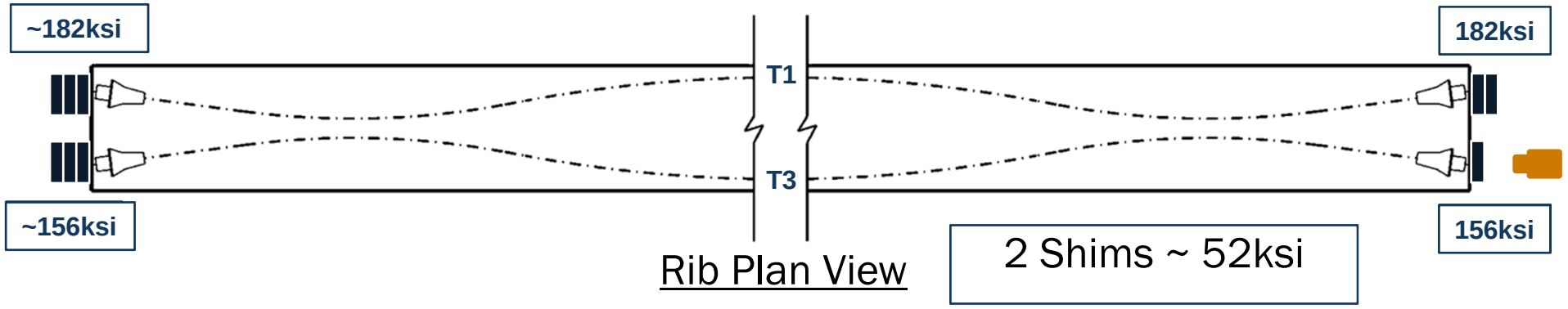


Remove 1 Shim



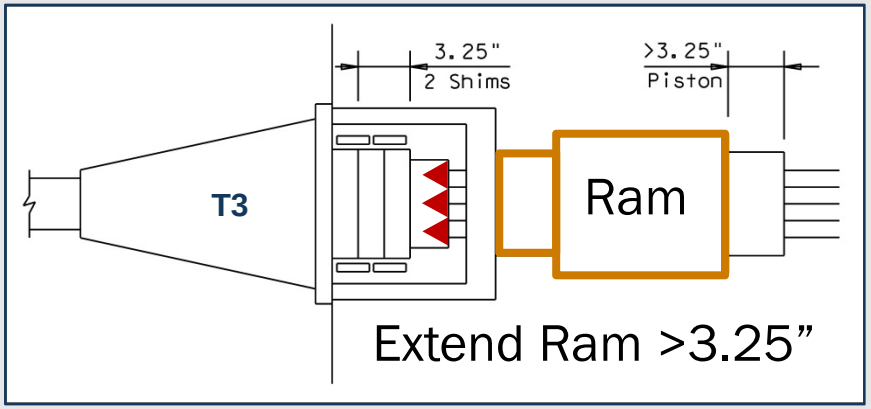
Reset Wedge Plate

De-stressing Rib Tendons

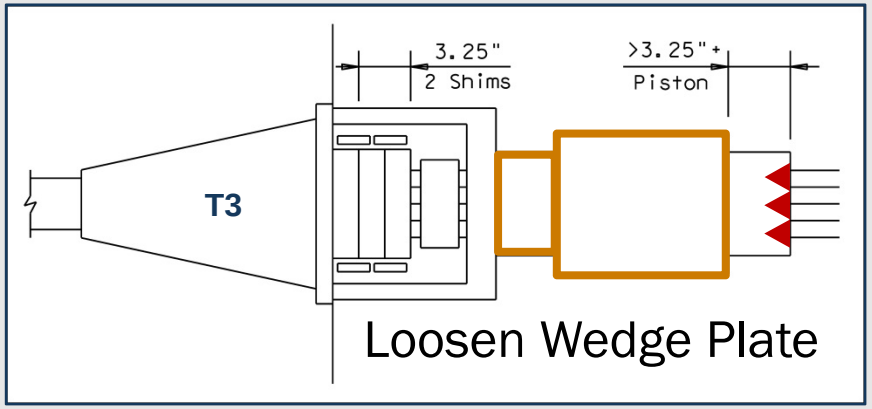


Rib Plan View

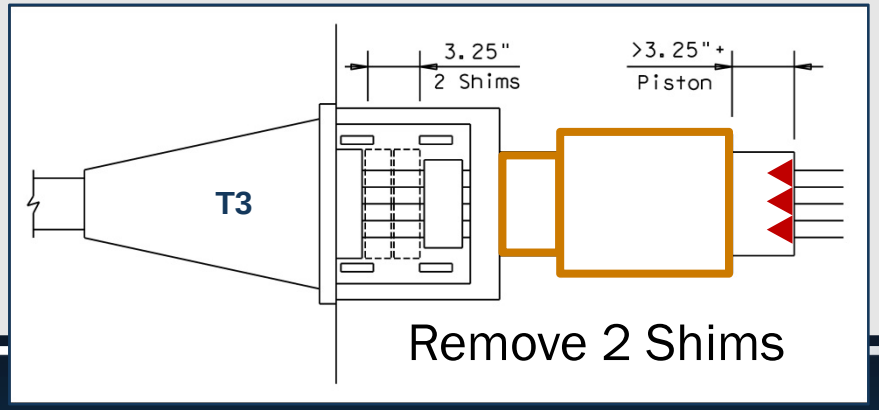
2 Shims ~ 52ksi



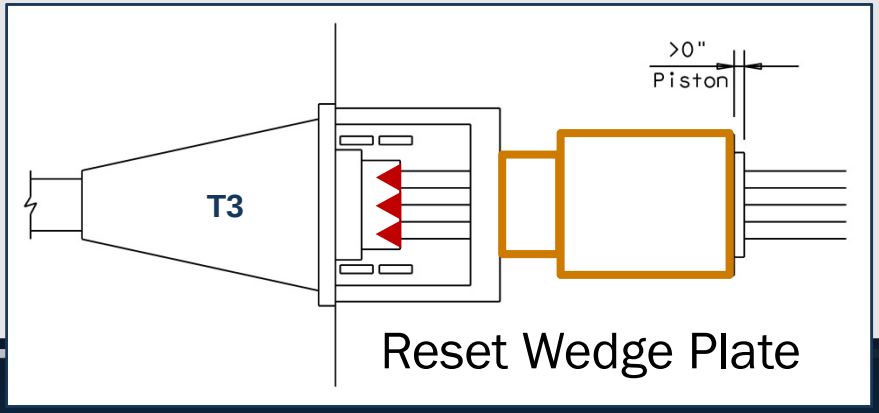
Extend Ram >3.25”



Loosen Wedge Plate

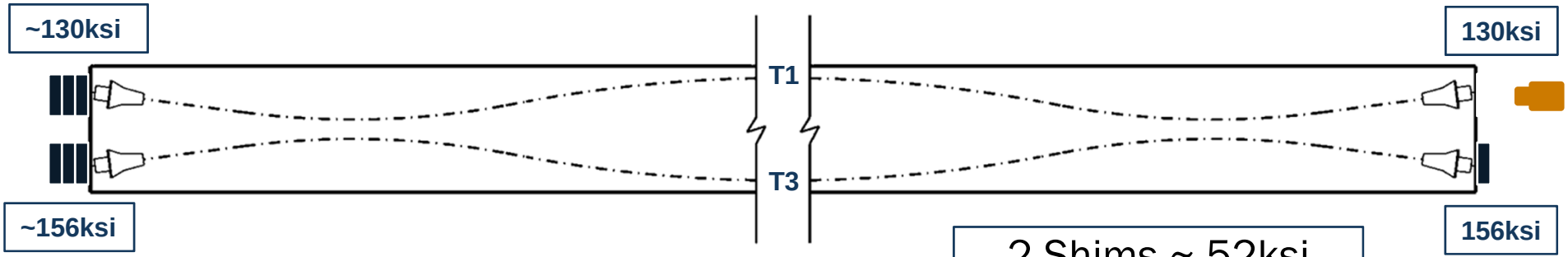


Remove 2 Shims



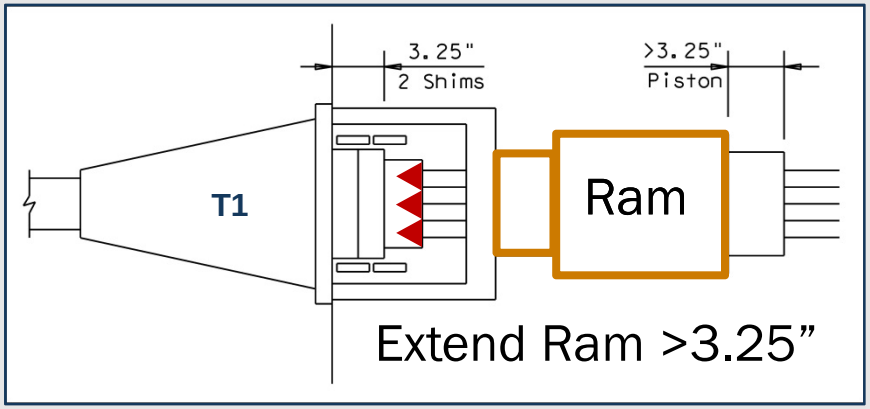
Reset Wedge Plate

De-stressing Rib Tendons

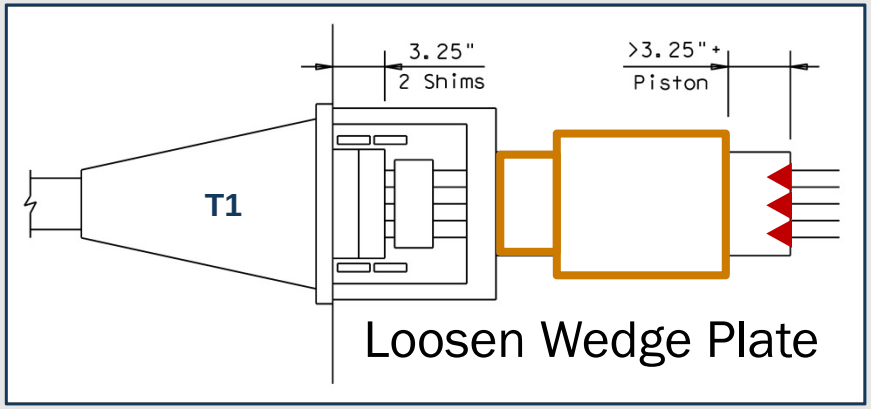


Rib Plan View

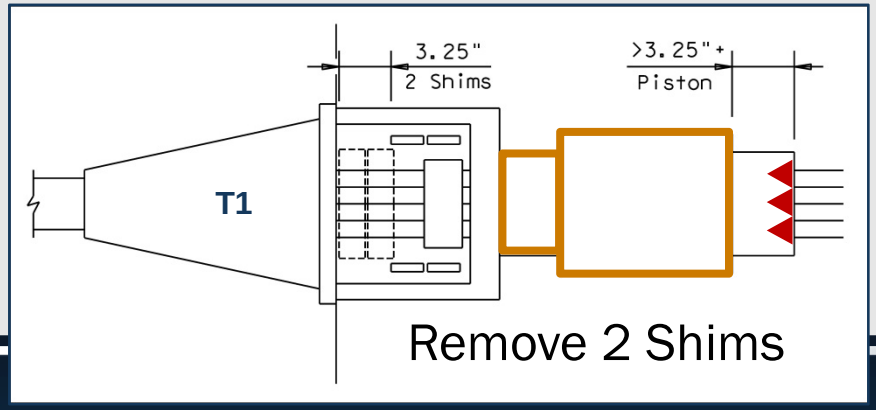
2 Shims ~ 52ksi



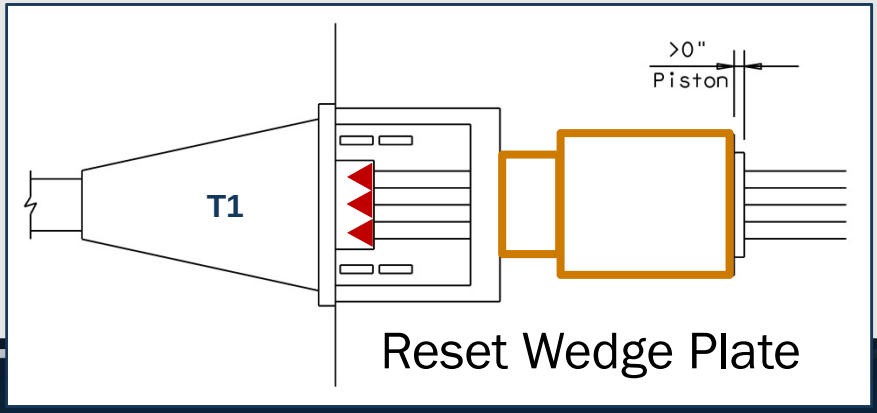
Extend Ram >3.25”



Loosen Wedge Plate

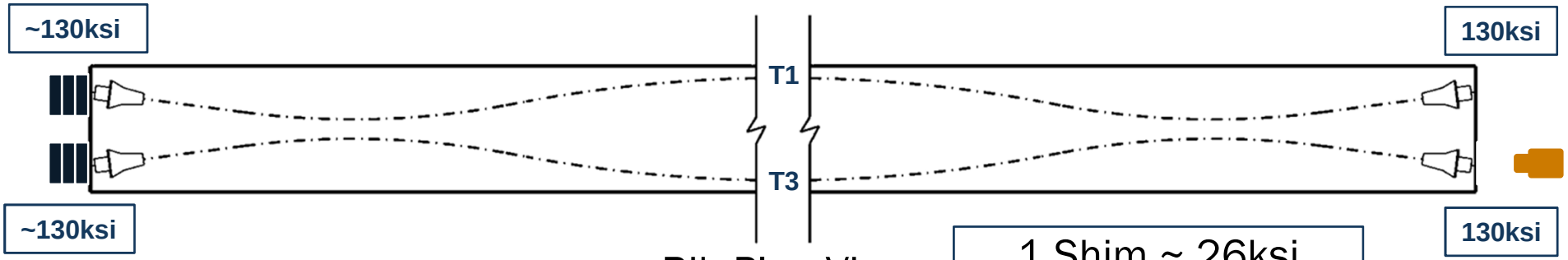


Remove 2 Shims



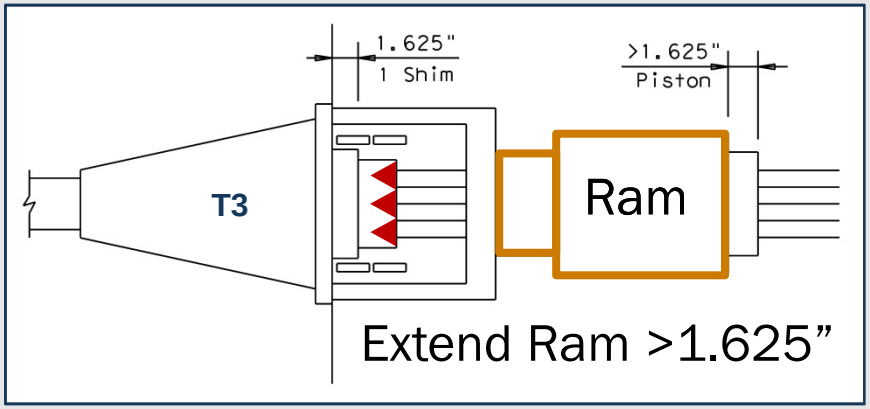
Reset Wedge Plate

De-stressing Rib Tendons

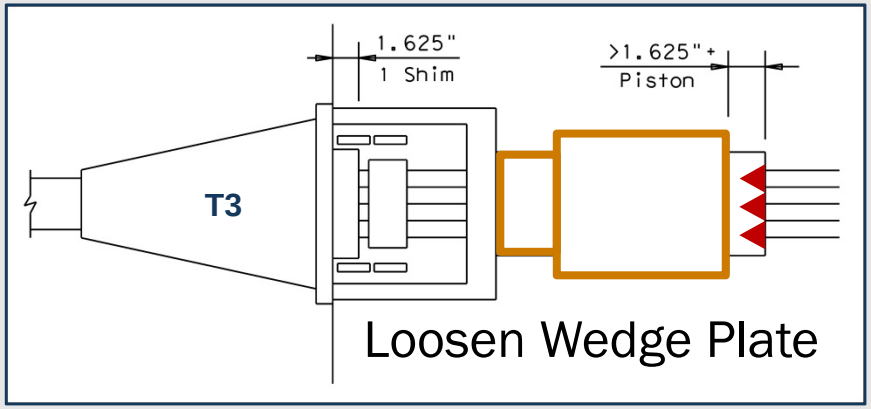


Rib Plan View

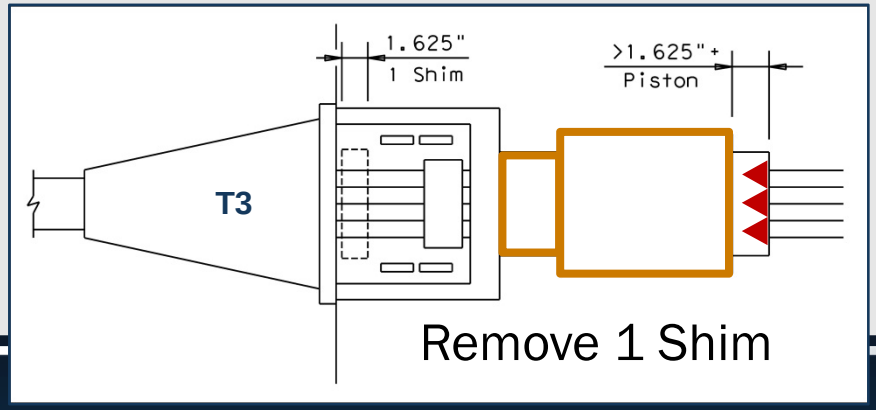
1 Shim ~ 26ksi



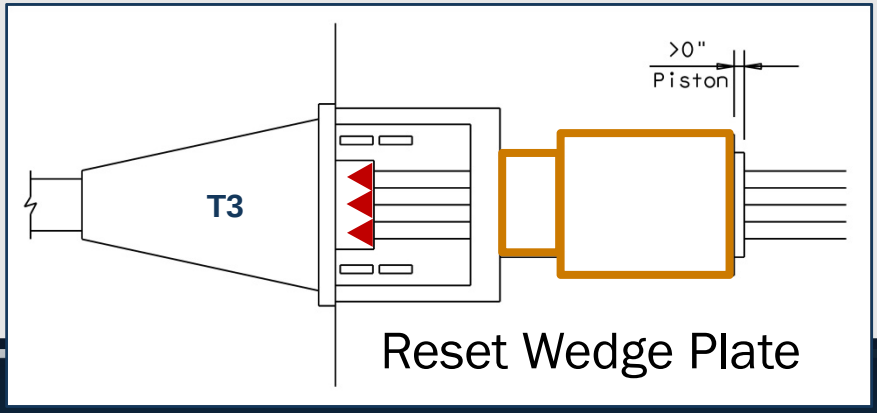
Extend Ram >1.625”



Loosen Wedge Plate

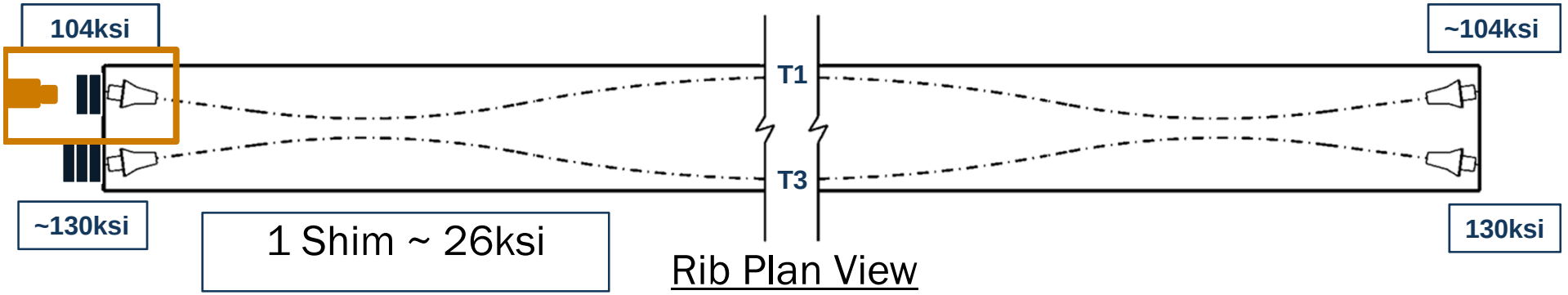


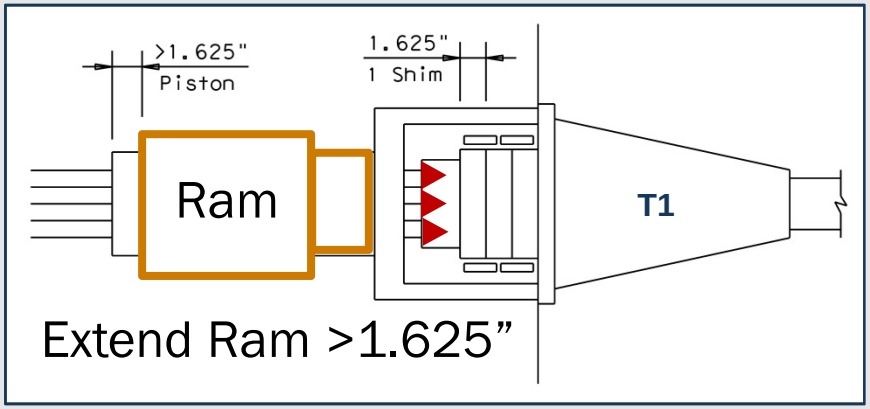
Remove 1 Shim

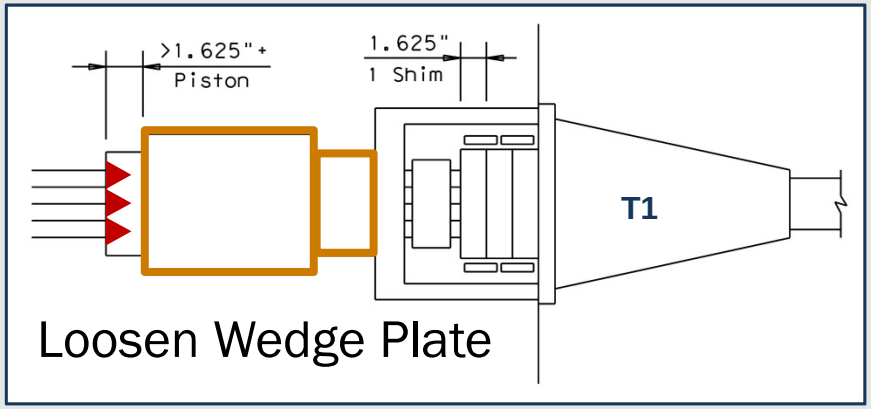


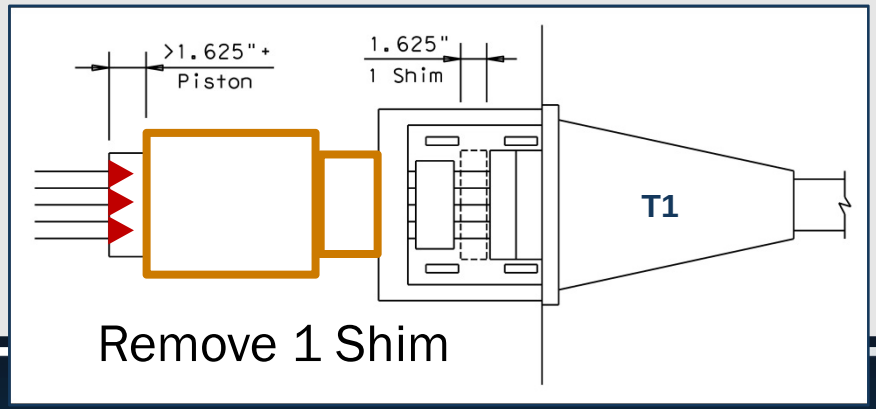
Reset Wedge Plate

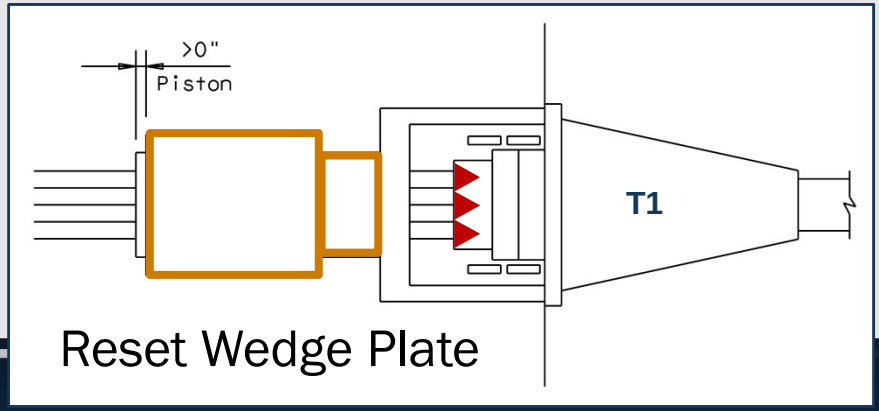
De-stressing Rib Tendons



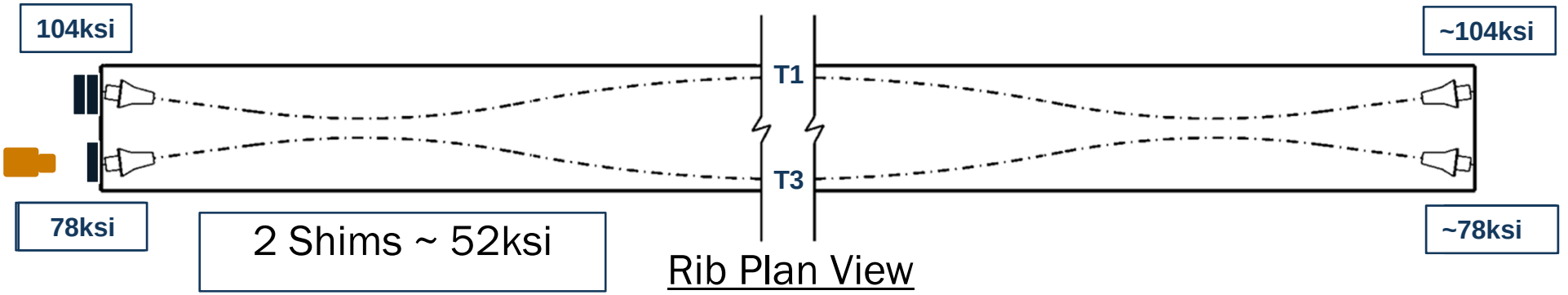


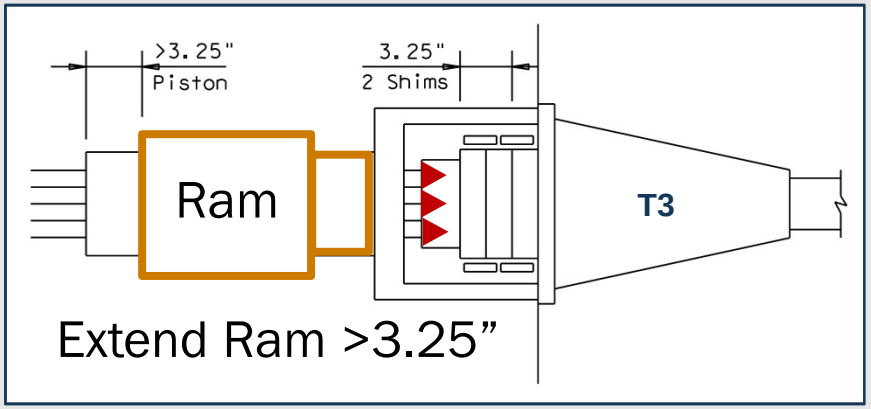


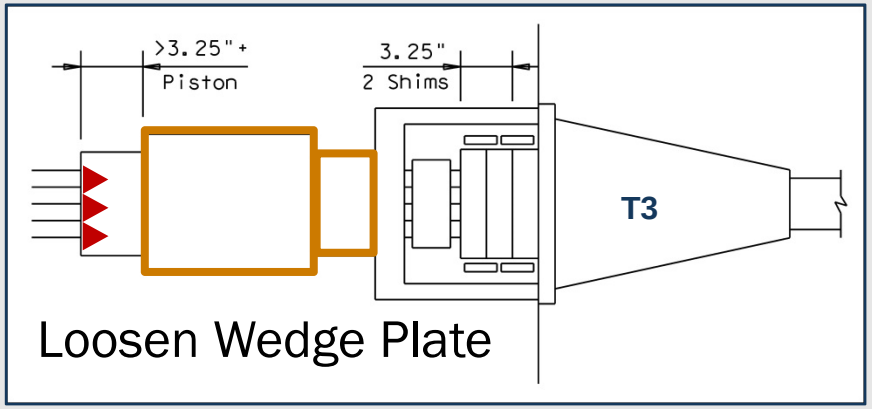


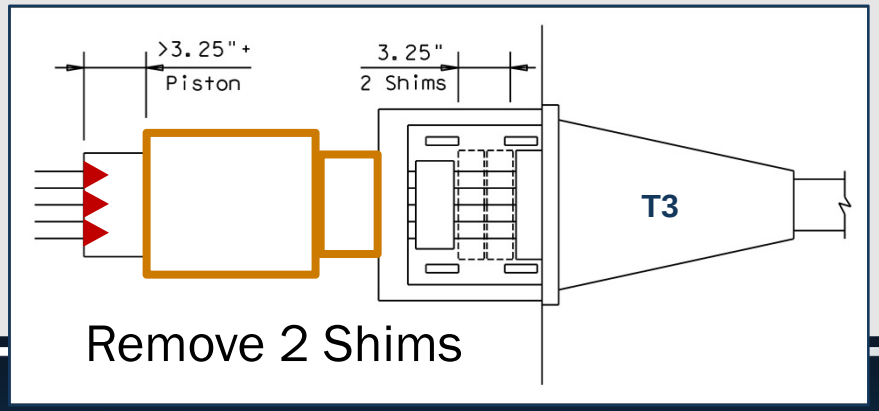


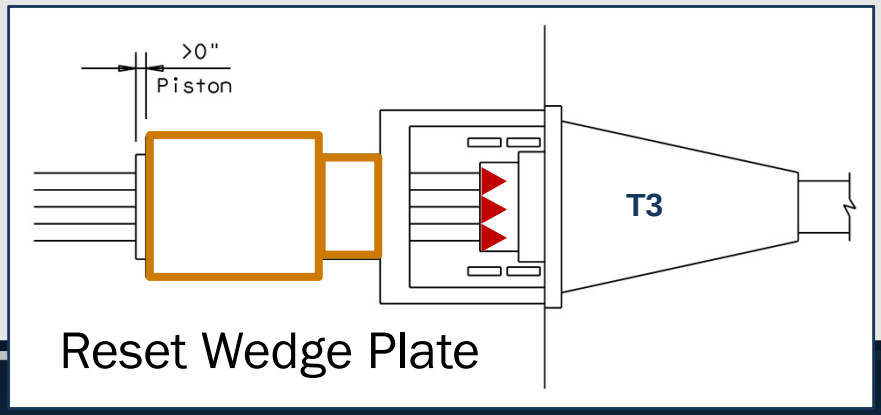
De-stressing Rib Tendons



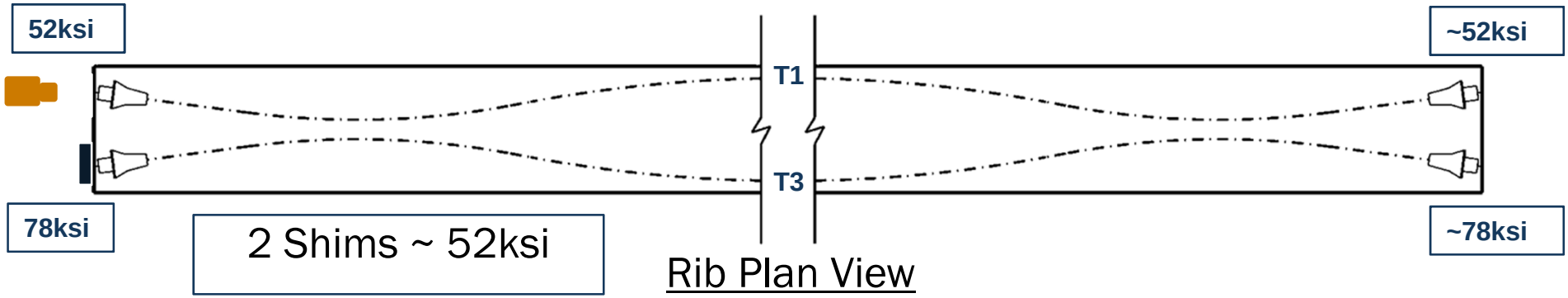


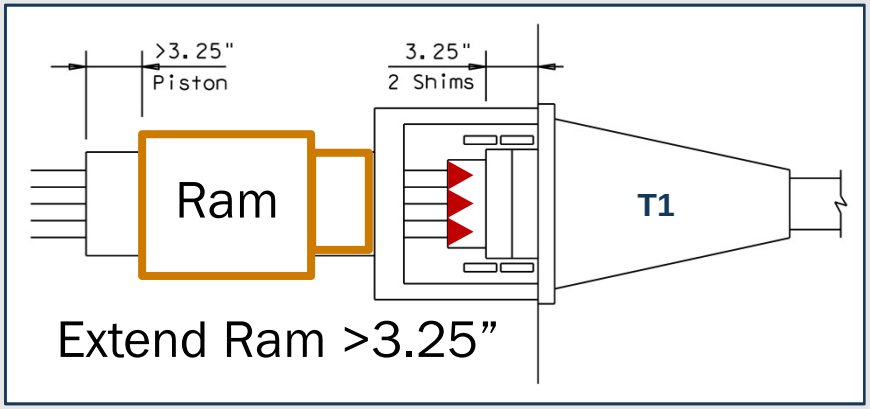


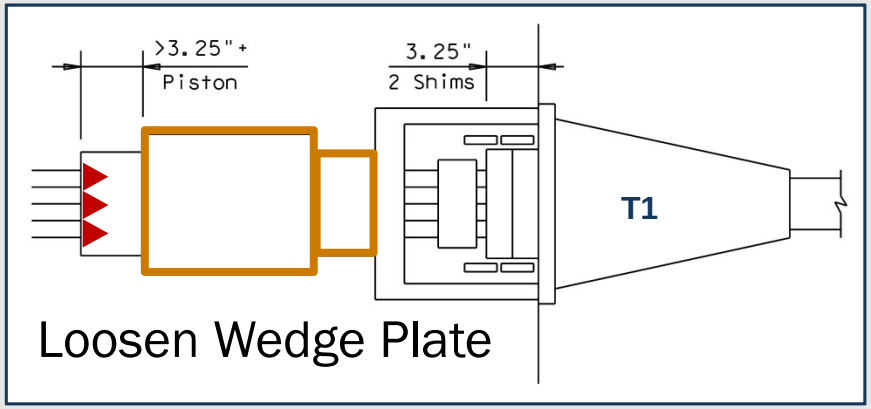


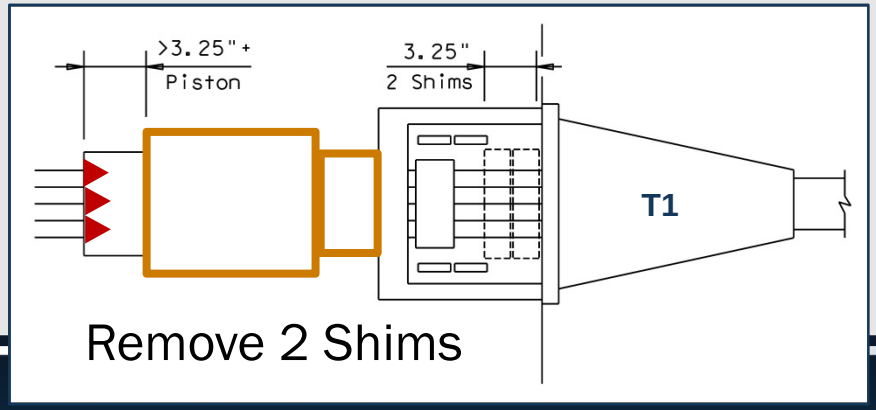


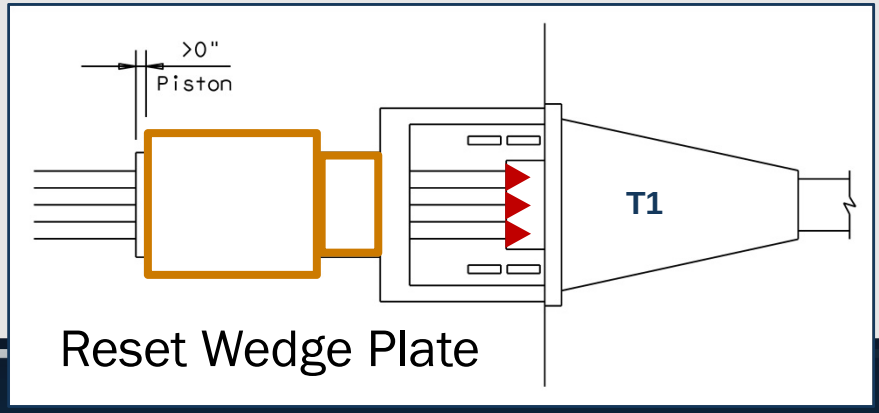
De-stressing Rib Tendons



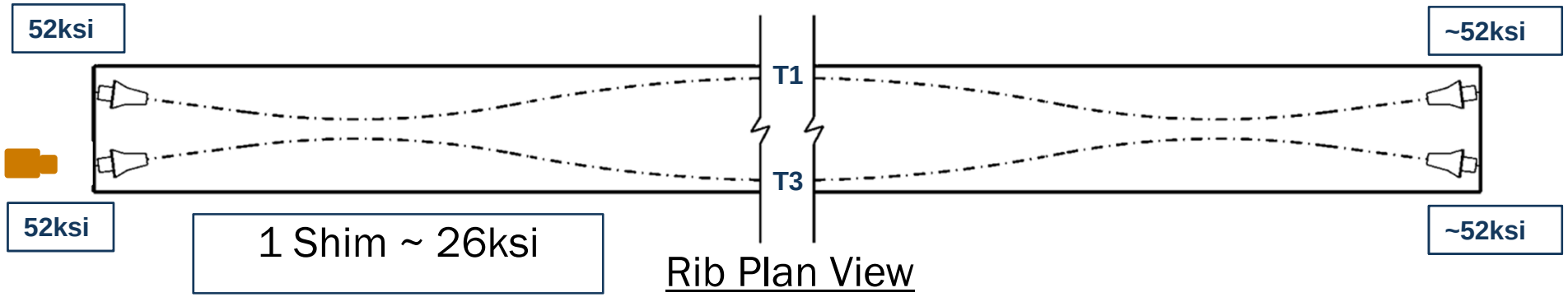


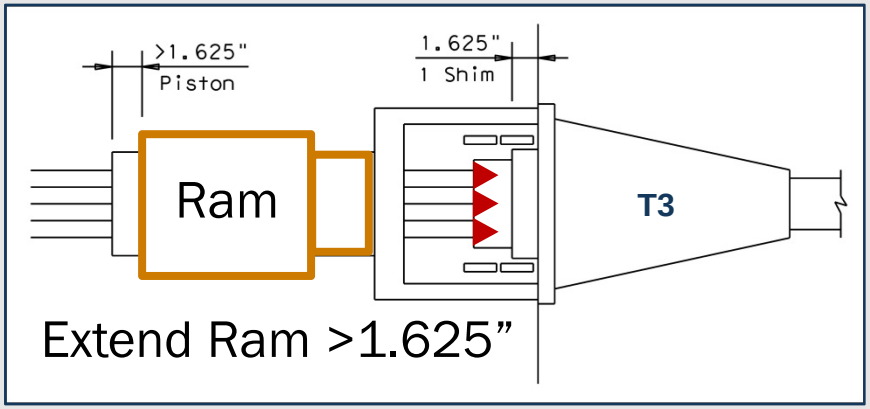


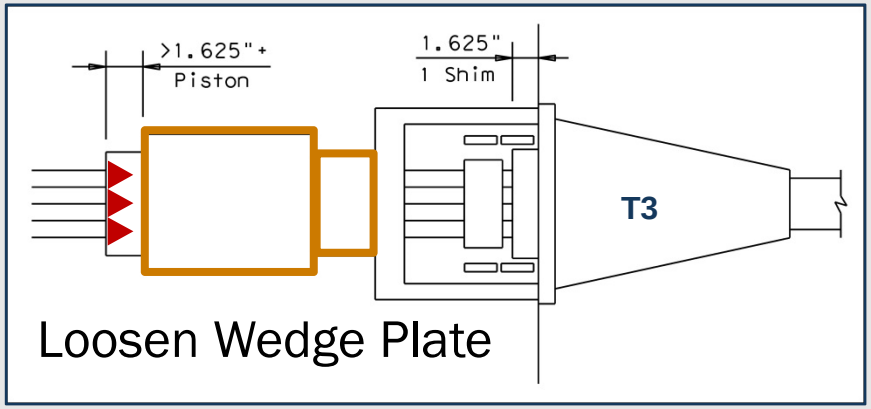


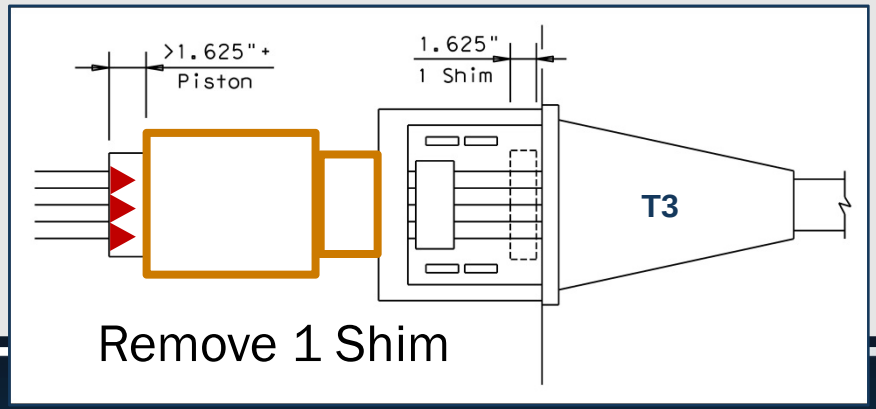


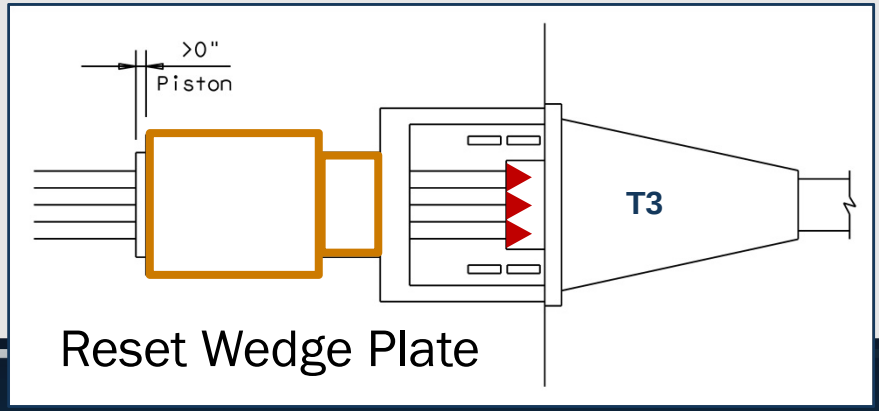
De-stressing Rib Tendons



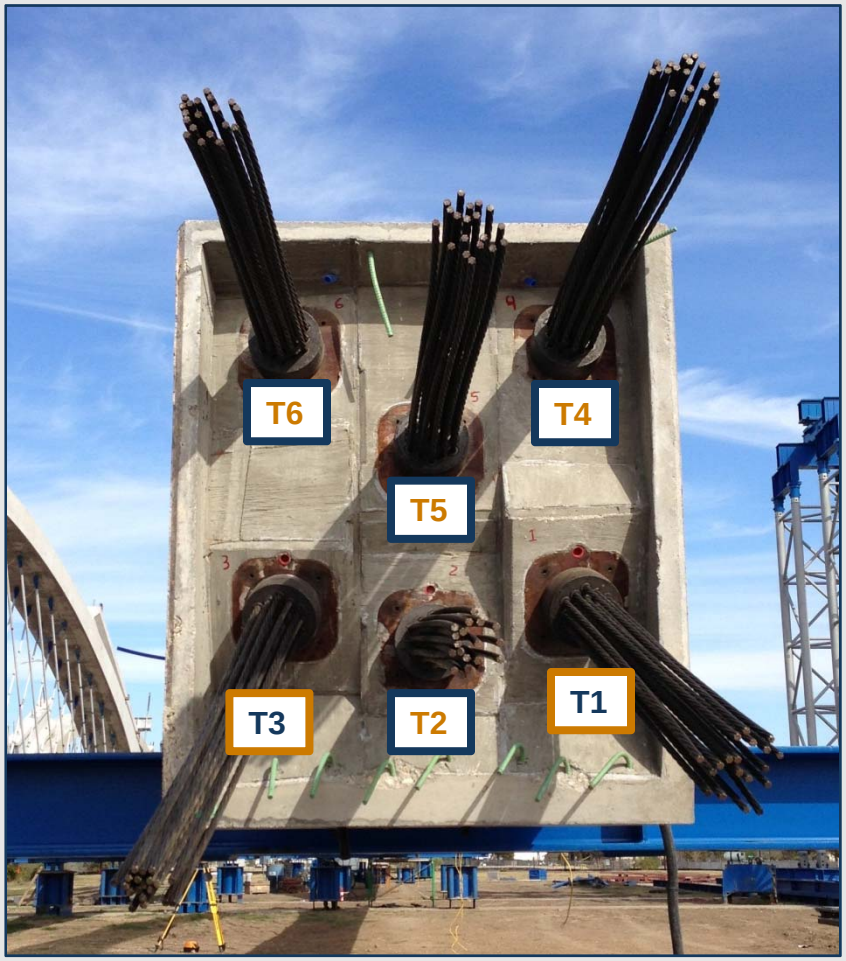








PT – Stage II

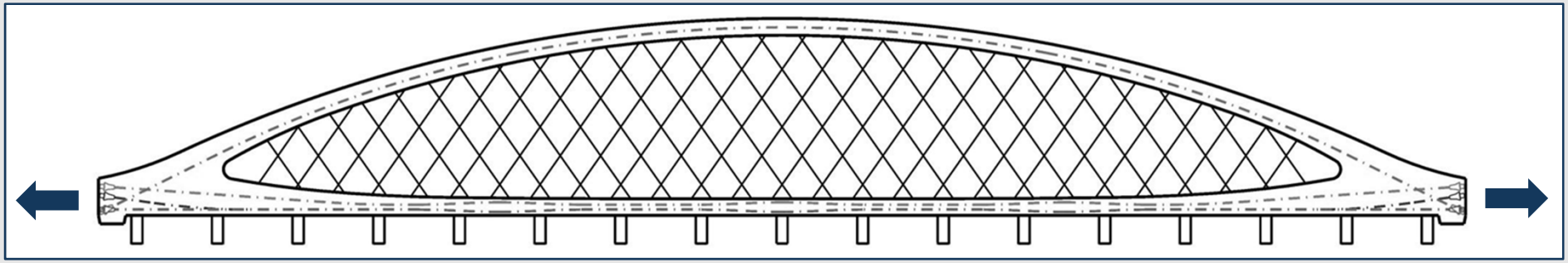


Stressing Order

- T2, T4, T5, T6: 156ksi, 208ksi
- T1,T3: 52ksi (De-stressing)
  - Shims Removed from Both Ends
- T1, T3: 104ksi

Elongations

- Arch 1 – Tie tendons were stressed from both sides
  - 0.25” elongation on 2nd side
  - Arches 2 thru 12 – Stressed from one side only
- Tie Elongations
  - Stage II stressing elongations within 6% of theoretical
- Rib Elongations
  - Stage I stressing (from 104ksi to 208ksi) elongations averaged 9% over theoretical



Rib Grouting

- Masterflow 1341 Grout
  - For vertical duct placement

- Rib tendons
  - grouted from both ends
  - grouted up to the rise of the arch

Tie Grouting

- Tie tendons
  - grouted from one end

Construction Sequence

Arch Cast Horizontally

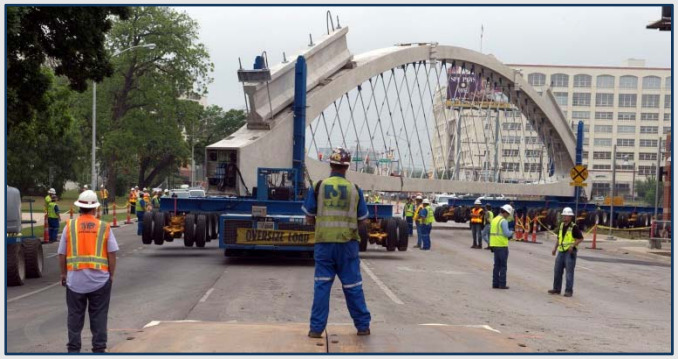
PT – Stage I

Arch Rotation

PT – Stage II

Hanger Tensioning

Arch Transport

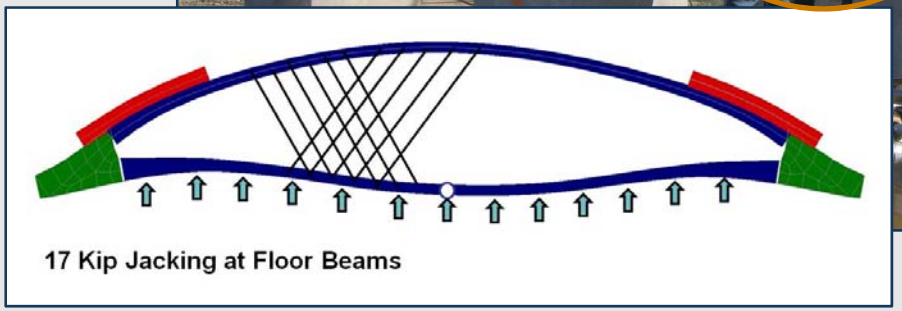


Hanging Floor Beams

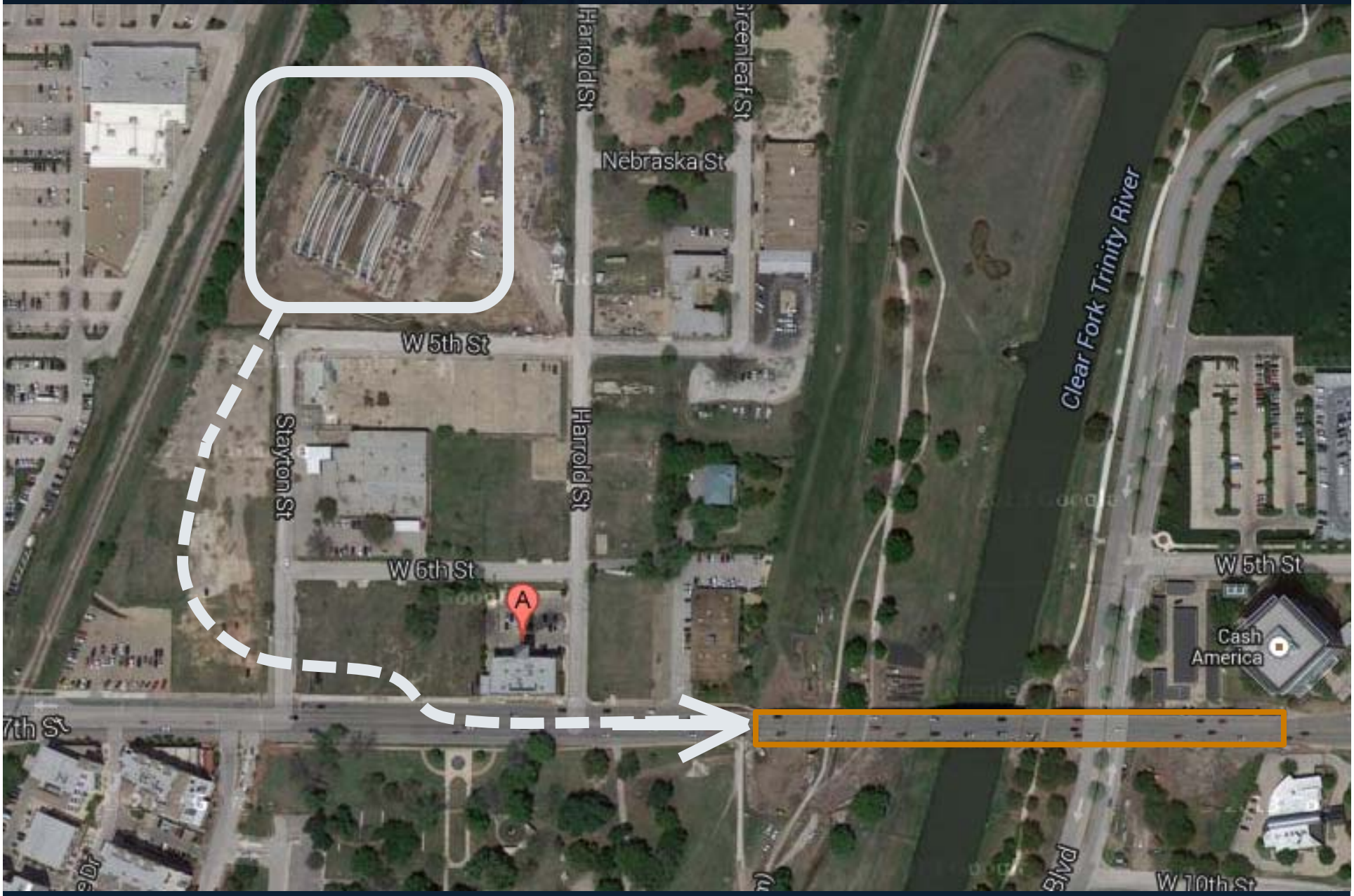
Place Panels

Bridge In Service

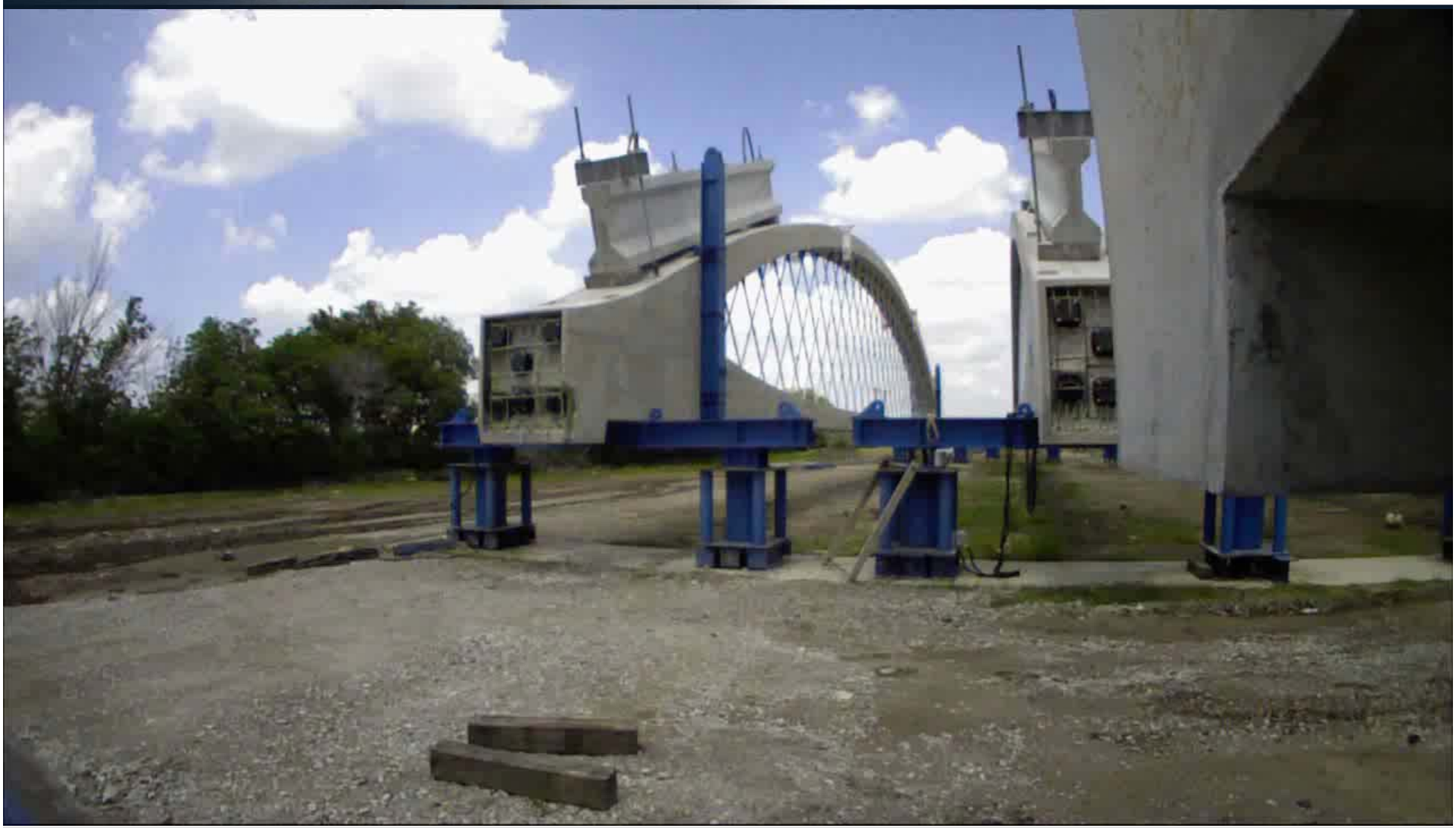
Hanger Tensioning



Arch Transportation



Arch Transportation Video

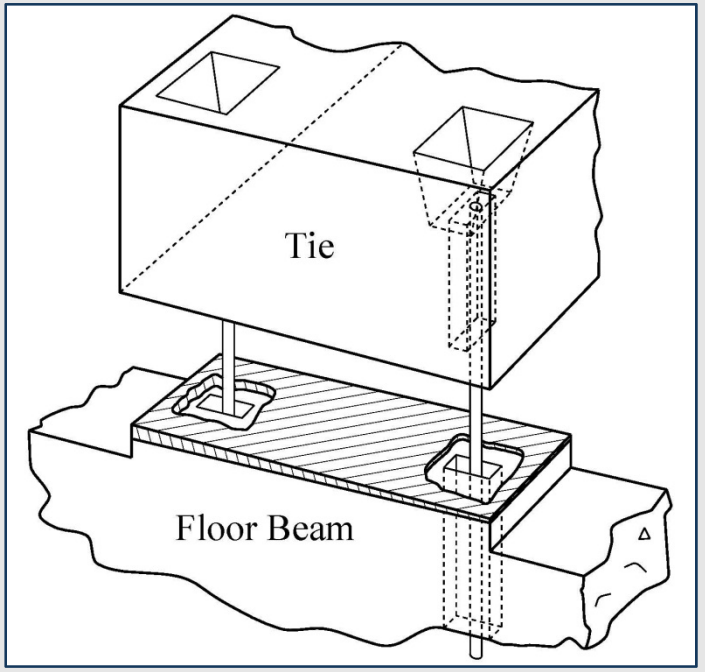


Arch on Columns

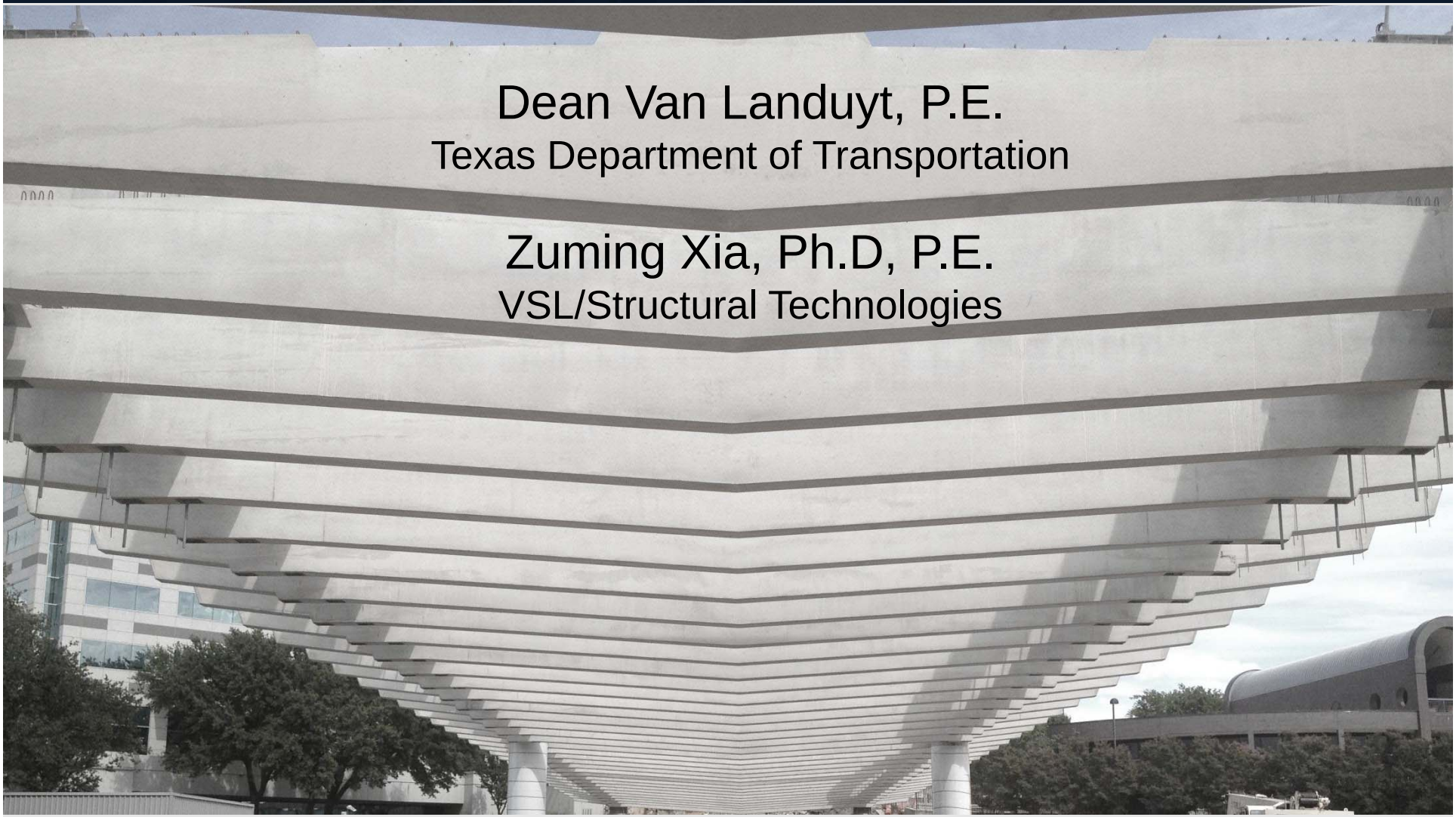
Existing Structure Demolition

Bridge Construction

Floor Beam to Arch Connection



Acknowledgements



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West 7th Street Bridge

Photo Courtesy of Liam Frederick

Arch Transport Video