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

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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
- 88 ft Overall Width
- 2 Lanes Each Direction
- 10.5 ft Sidewalk Width
- 4’-9 ¾” Hanger Spacing
- 4’-6” Arch Width
Tie PT Ducts and Embeds

- Duct for Future Tendon
- Floor Beam Tube
- Duct for Future Tendon
- Hanger Tube
- Light Fixture
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

2 @ 0.77 f_{pu}

4 @ 0.39 f_{pu}
Curves in Tie PT Duct
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
Instrumentation of the Arch

- University of Texas at Austin
- Vibrating Wire Gages
2 @ 0.39 f_{pu}

4 @ 0.77 f_{pu}
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

- 6 Shims per tendon
- 3 Shims on each tendon end
  - 1 Shim = 1.625” Theoretical Elongation \(\approx 26\text{ksi} \left(\frac{1}{8}\right)\text{ of } 0.77f_{pu}\)
  - 2 Shims = 3.25” Theoretical Elongation \(\approx 52\text{ksi} \left(\frac{1}{4}\right)\text{ of } 0.77f_{pu}\)
  - 3 Shims = 4.875” Theoretical Elongation \(\approx 78\text{ksi} \left(\frac{3}{8}\right)\text{ of } 0.77f_{pu}\)
  - 6 Shims = 9.75” Theoretical Elongation \(\approx 156\text{ksi} \left(\frac{3}{4}\right)\text{ of } 0.77f_{pu}\)
- Leaving ~52ksi in Rib Tendons at the end of de-stressing (208ksi – 156ksi = 52ksi)
De-stressing Rib Tendons

Ribbon Plan View

1 Shim ~ 26ksi

208ksi

~182ksi

182ksi

208ksi

Arch

T1

Ram

Extend Ram >1.625”

Loosen Wedge Plate

Remove 1 Shim

Reset Wedge Plate
De-stressing Rib Tendons

Rib Plan View

- Extend Ram >3.25"
- Loosen Wedge Plate
- Remove 2 Shims
- Reset Wedge Plate

2 Shims ~ 52ksi

~182ksi

182ksi

~156ksi

156ksi
De-stressing Rib Tendons

Rib Plan View

2 Shims ~ 52ksi

Ram

T1

Extend Ram >3.25"

Remove 2 Shims

130ksi

156ksi

182ksi

130ksi

156ksi
De-stressing Rib Tendons

Rib Plan View

1 Shim ~ 26ksi

~130ksi  130ksi  ~130ksi

T1

T3

T3

T3

Ram

Ram

1.625” 1 Shim

1.625” 1 Shim

0” Piston

Piston

Piston

>1.625”

>1.625”

Extend Ram >1.625”

Loosen Wedge Plate

Remove 1 Shim

Reset Wedge Plate
De-stressing Rib Tendons

1 Shim ~ 26ksi

Rib Plan View

104ksi

~130ksi

130ksi

Ram

T1

Extend Ram >1.625”

Loosen Wedge Plate

Remove 1 Shim

Reset Wedge Plate
De-stressing Rib Tendons

Rib Plan View

Extend Ram >3.25”

Loosen Wedge Plate

Remove 2 Shims

Reset Wedge Plate

104ksi

2 Shims ~ 52ksi

~104ksi

78ksi

~78ksi
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

1 Shim ~ 26ksi

Rib Plan View

Extend Ram >1.625”

Loosen Wedge Plate

Remove 1 Shim

Reset Wedge Plate
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

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Hanger Tensioning

17 Kip Jacking at Floor Beams
Arch Transportation
Arch on Columns
Floor Beam to Arch Connection
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West 7th Street Bridge

Photo Courtesy of Liam Frederick
Arch Transport Video