



# 2024 SPRING CONVENTION

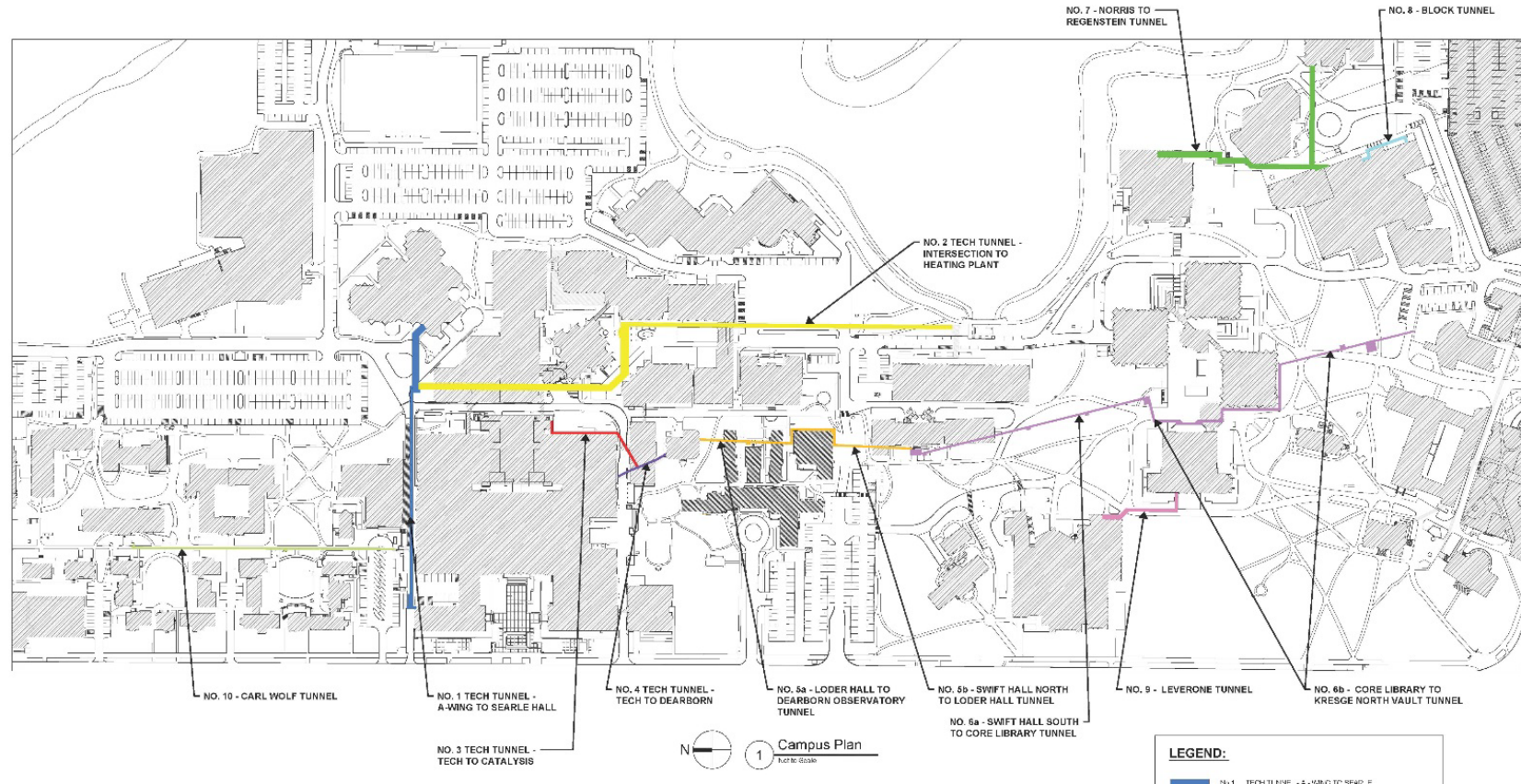


APRIL 21-24, 2024  
[ICRI.ORG](http://ICRI.ORG)

# Restoration of 12 Utility Tunnels at Northwestern University

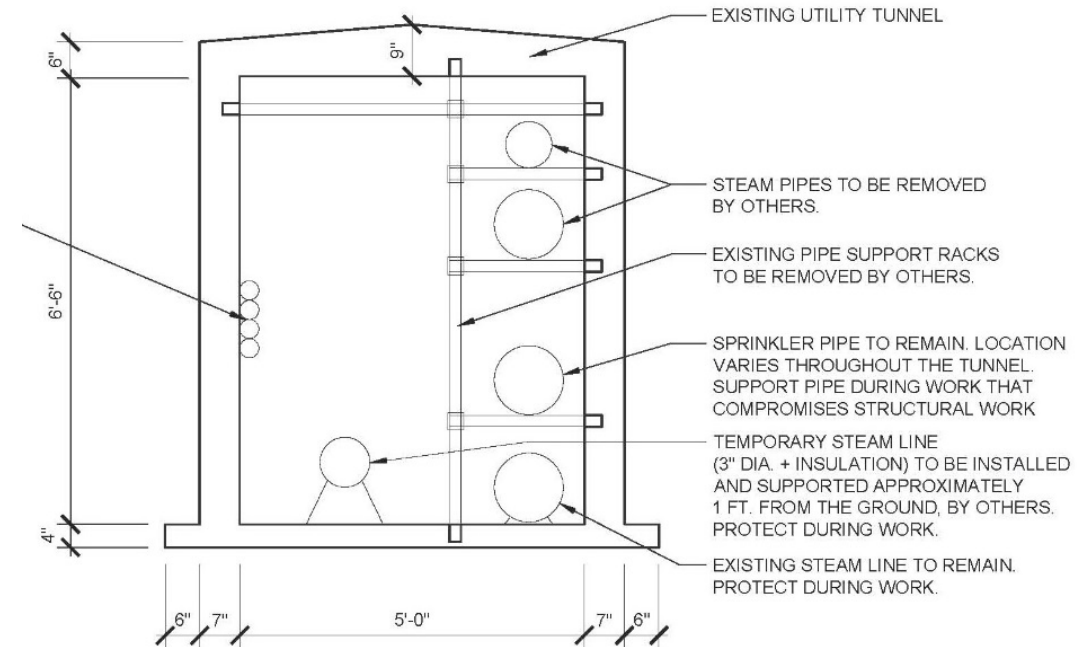
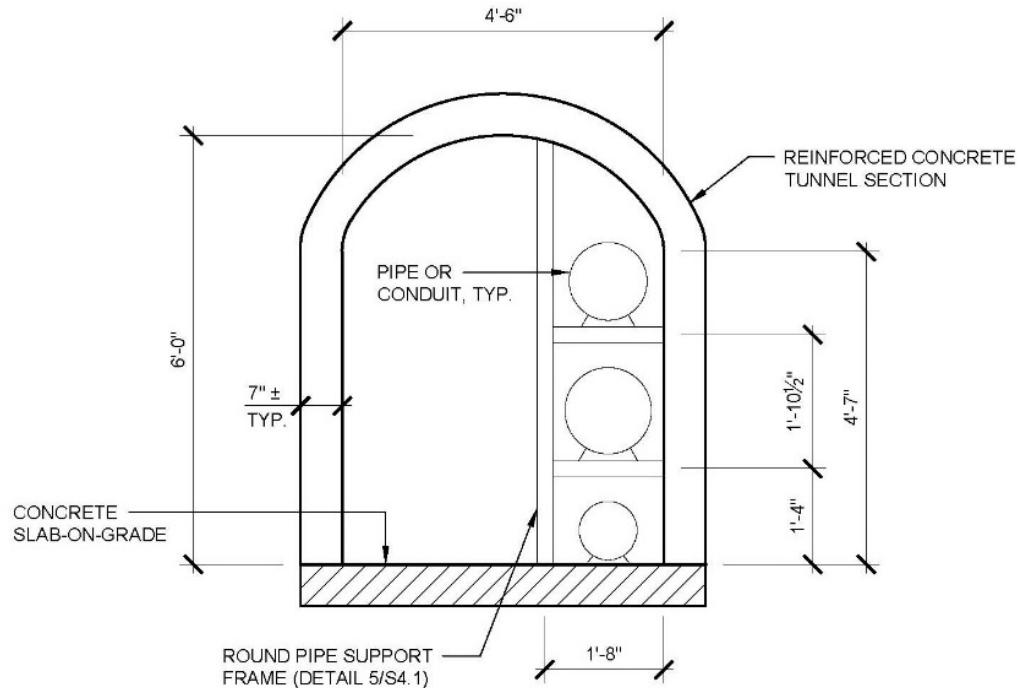
Predrag Popovic, Dunja Vla and Tracy Naso

# Tunnel Locations



- Northwestern University established in 1851, 21,000 students and over 100 buildings
- 12 tunnels about 1.2 miles long, built in 1914 and the 1970s

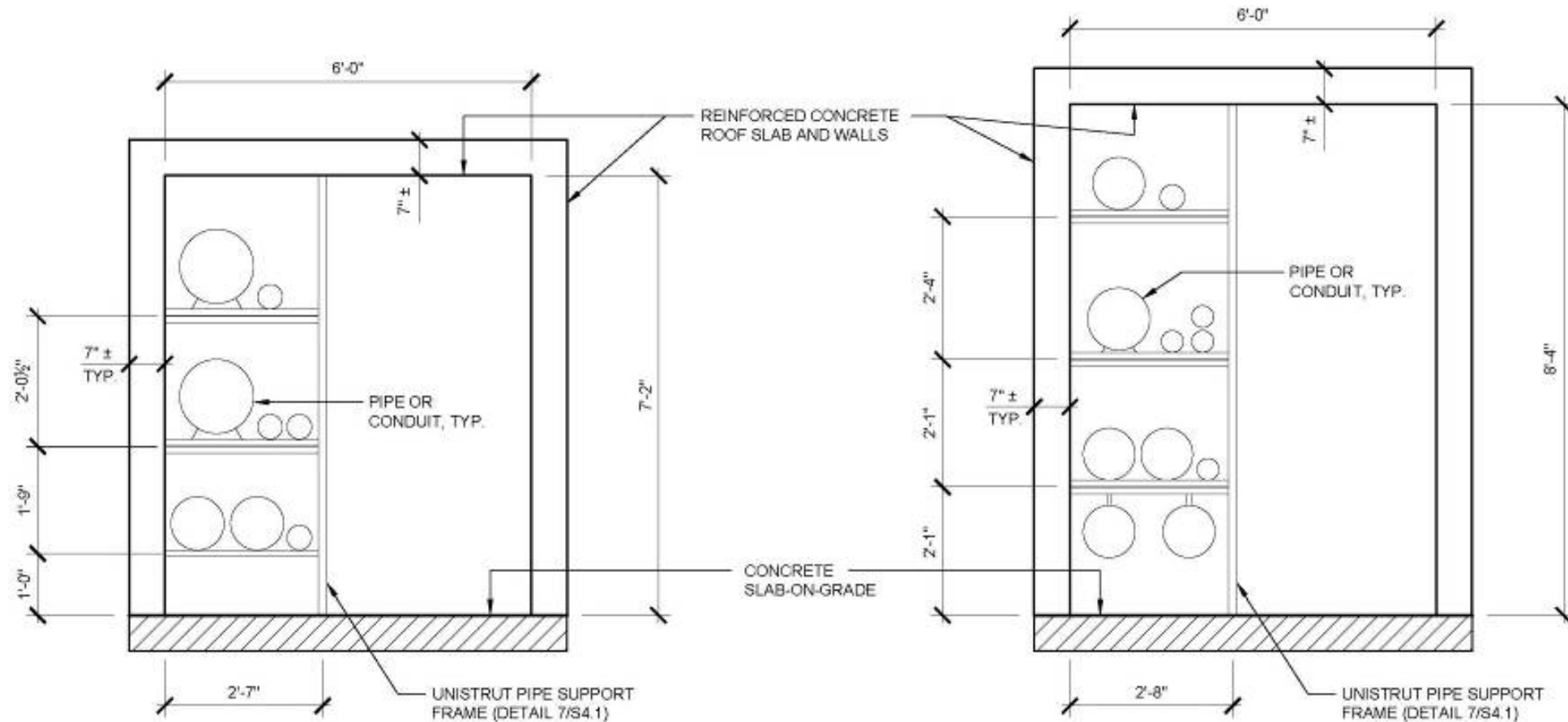
# Tunnels Built in 1914



- Interior height 6.0 to 6.5 ft, width 4.5 to 5.0 ft., walls 7 in. thick, roof slab average thickness 7.5 in.



# Tunnels Built in the 1970s



- Interior height 7.17 to 8.33 ft., width 6.0 to 12.0 ft., walls 7.0 to 9 in. thick, roof slab 7.0 in. thick



# Tunnels Pass Beneath Different Surface Conditions



- Building basements
- Front stairs at building entrances
- Asphalt paved parking lots
- Concrete sidewalks
- Roadways
- Lawns and planter beds



- **2010-2012 WJE investigated the whole tunnel system.**
- **Every tunnel had marked stations every 25 ft.**
- **All distressed areas were recorded with notes and photographs using in-house software Plannotate.**
- **Investigation determined that tunnels are serviceable but require significant amount of repair.**

- **Extensive corrosion of reinforcing steel was present at walls and roof slabs, resulting in delaminations and spalling.**
- **Depth of spalls in some areas reduced the load-carrying capacity of the tunnel, including some under roadways.**
- **The challenge of the restoration project was that utility tunnels has to remain operable with all piping systems in place. The work had to be coordinated in one of the tunnels with a separate project for replacement of steam and fire protection pipes.**
- **Repair of tunnels was phased over several years, starting in 2012.**

# Damage at Roof Slabs



# Damage at Tunnel Walls



# Damage at Steel Framing





# Water Infiltration in Tunnels



# Water Infiltration and Ponding



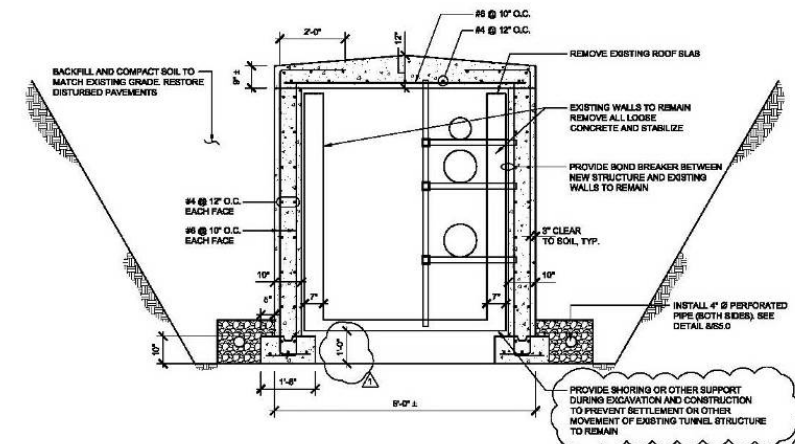
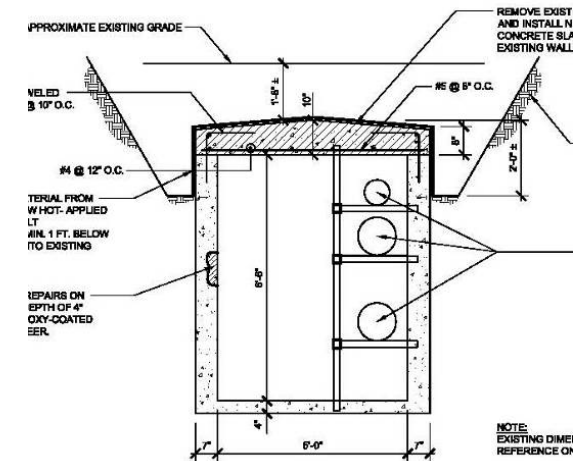
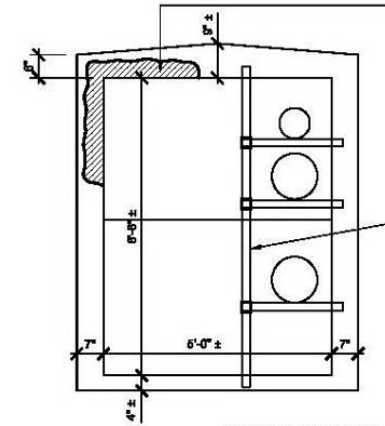


# High Temperature in Tunnels

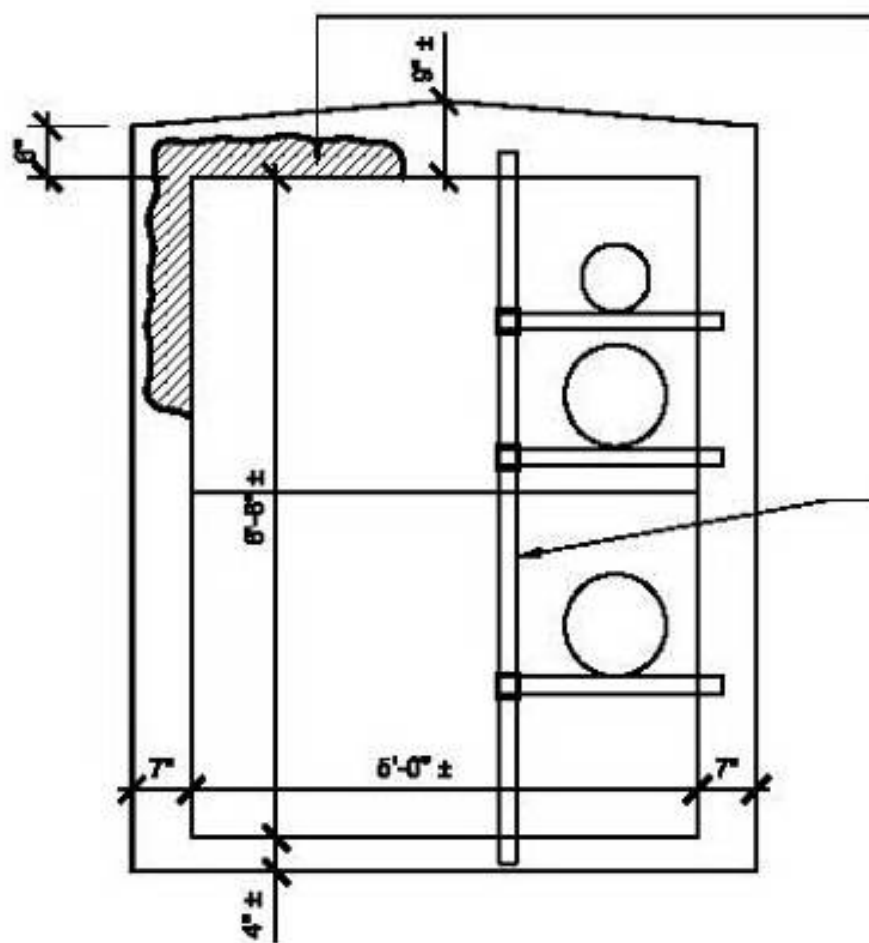


# Repair Options

- Option 1 – Localized repairs of concrete inside the tunnel and inject leaking cracks and joints.
- Option 2 – Excavate tunnels, replace roof slab, install exterior waterproofing, localized concrete repairs inside, and inject leaking cracks and joints.
- Option 3 – Tunnel replacement, with encasement of existing walls.



# Localized Repairs



PERFORM PARTIAL - DEPTH CONCRETE REPAIRS ON WALLS AND ROOF SLAB FOR AVERAGE DEPTH OF 4" PER SHEET S4.0 ADD SUPPLEMENTAL EPOXY-COATED STEEL AT THE DIRECTION OF THE ENGINEER.

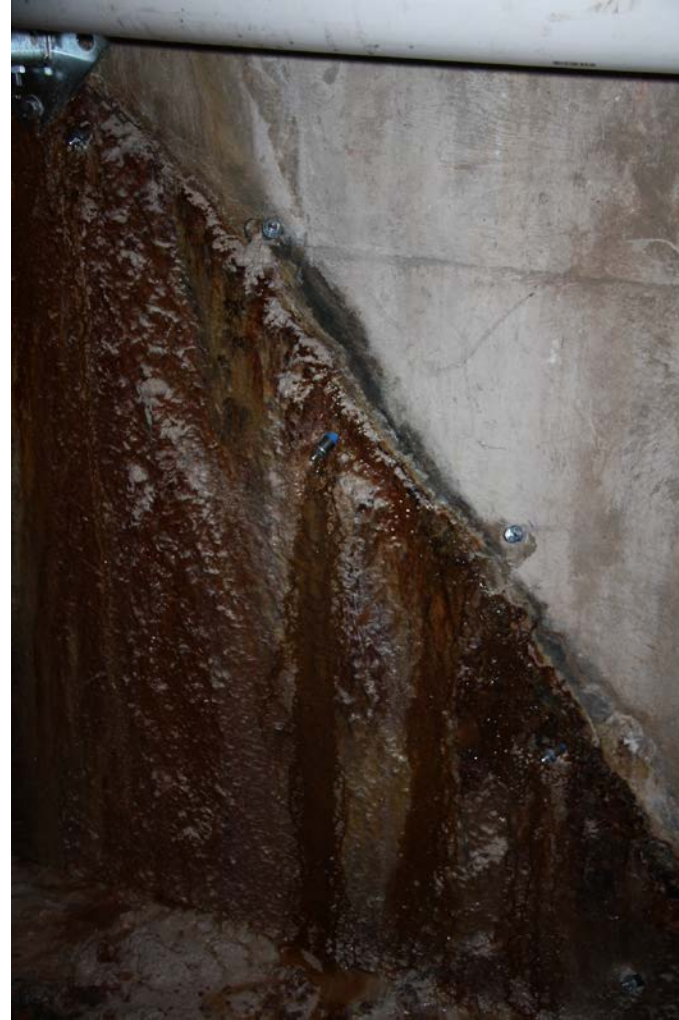
PROTECT EXISTING PIPE SUPPORT RACK (UTILITY LINES NOT SHOWN FOR CLARITY)

**NOTE:**  
EXISTING DIMENSIONS ARE APPROXIMATE AND FOR REFERENCE ONLY. VERIFY ALL DIMENSIONS IN FIELD.

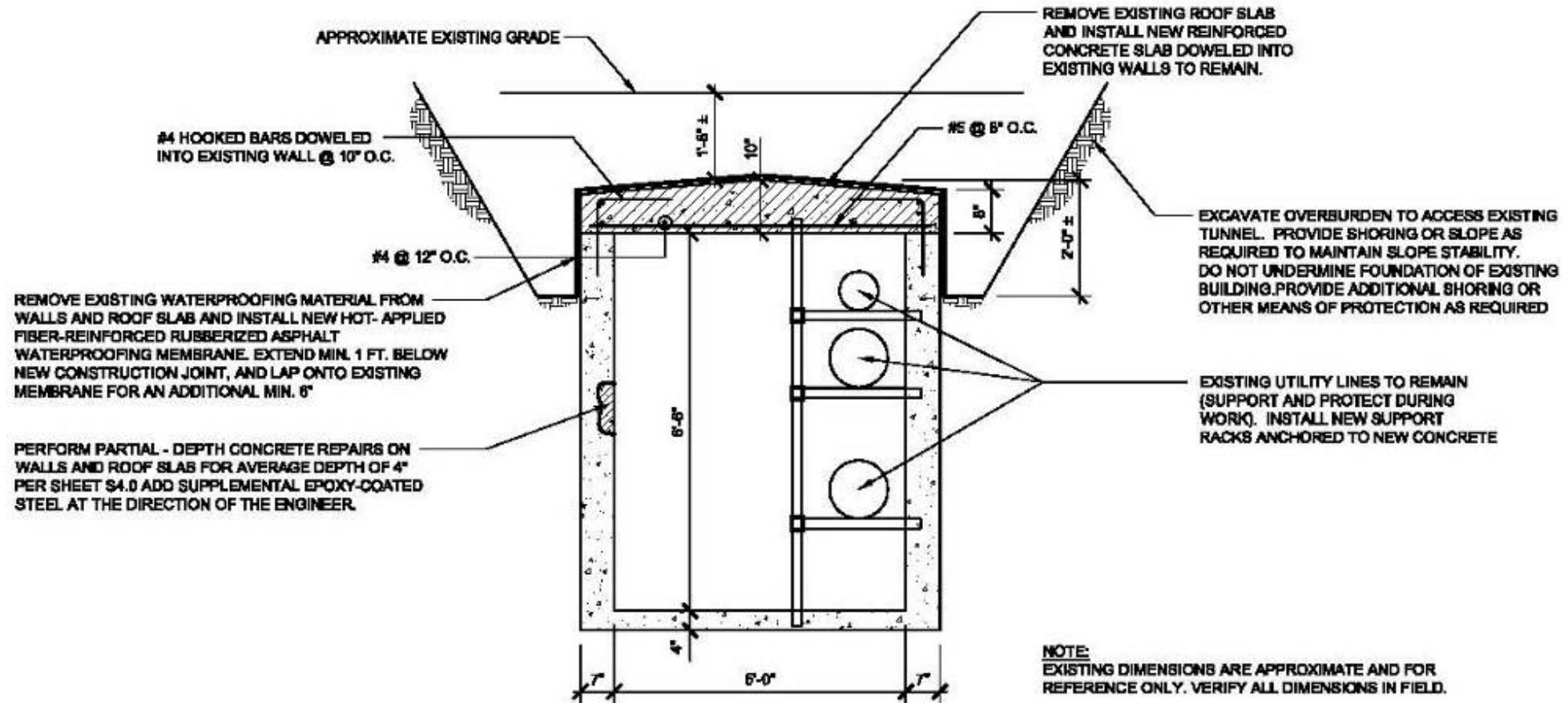




# Injection of Leaking Cracks and Joints



# New Roof Slab











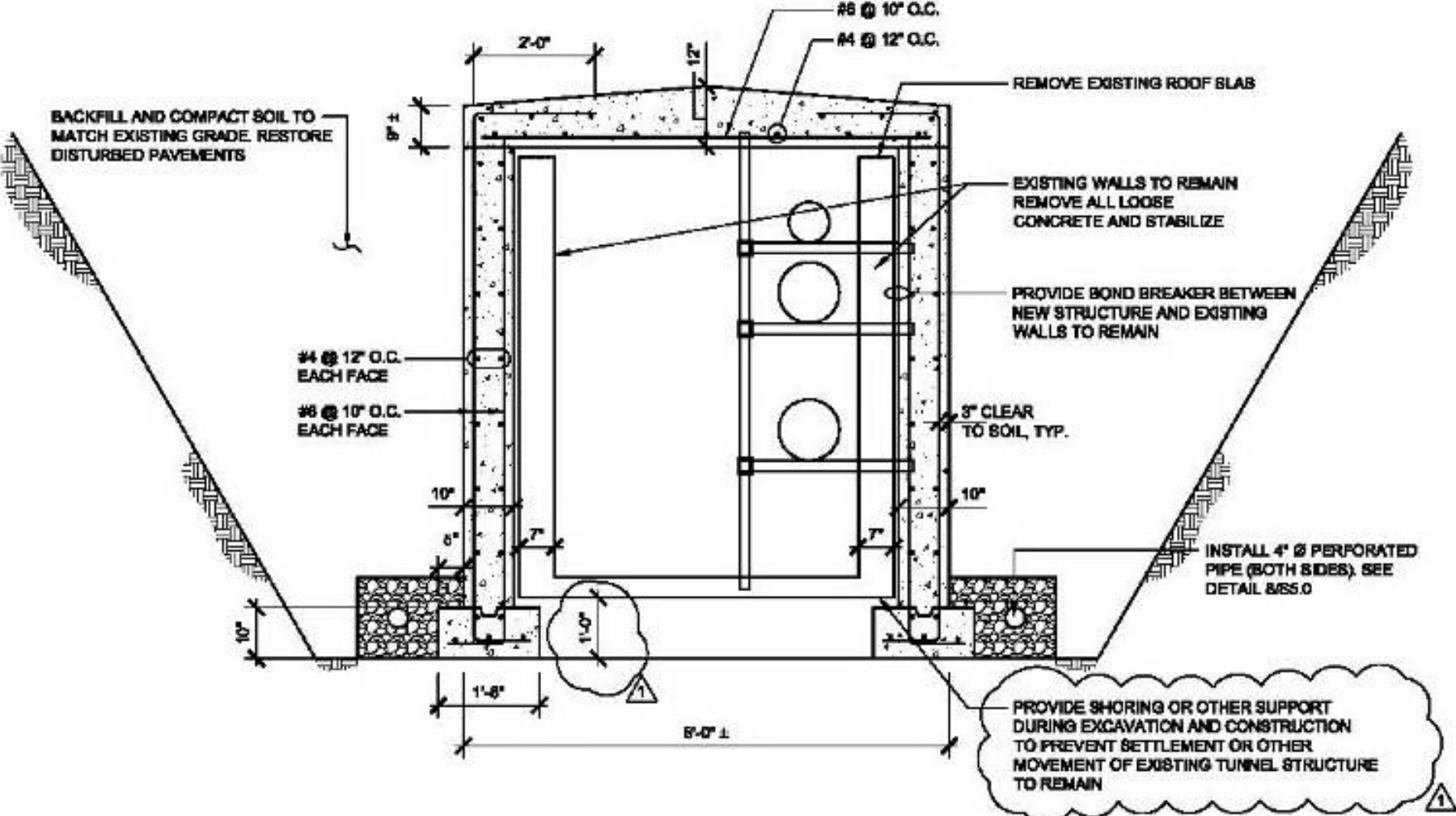




APRIL 21-24, 2024

ICRI.ORG

# Encasement of Existing Walls







# Conclusions



- **Considering various types and extent of concrete damage and reduction of load-carrying capacity, a separate approach was required for each tunnel.**
- **All repair options restored the required load capacity and extended the useful life of the tunnels for another 50 years.**
- **All repair and replacement work was completed while the infrastructure systems inside them remained fully functioning. There were no damages to the existing pipes and no injuries during these restoration projects.**



# Inspection 10 Years after Restoration



New spalls observed at small number of locations



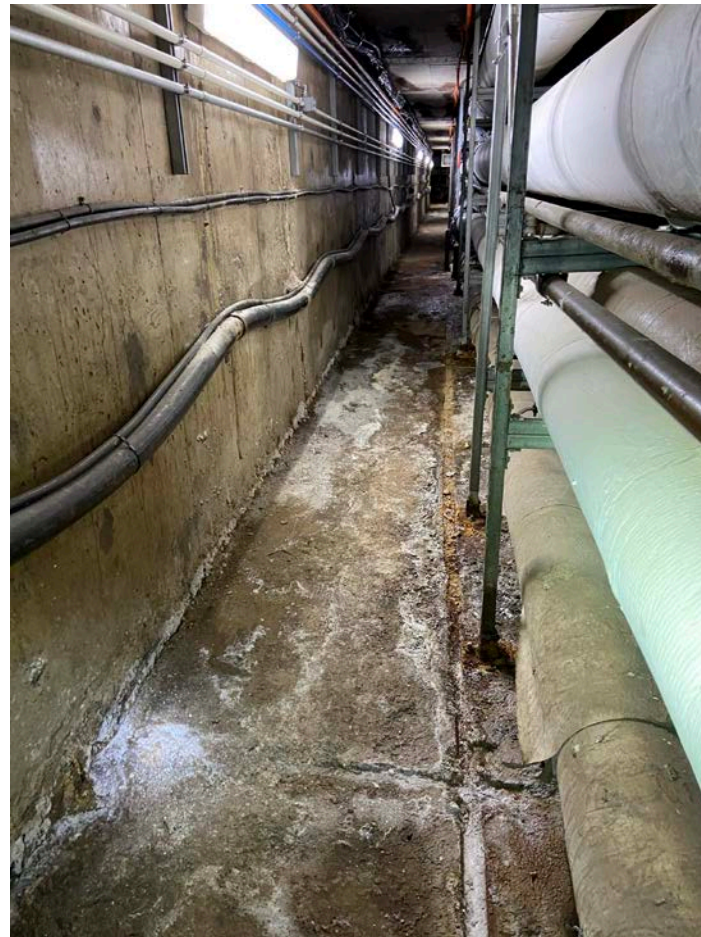
Small overhead repaired areas with leaking cracks but sound



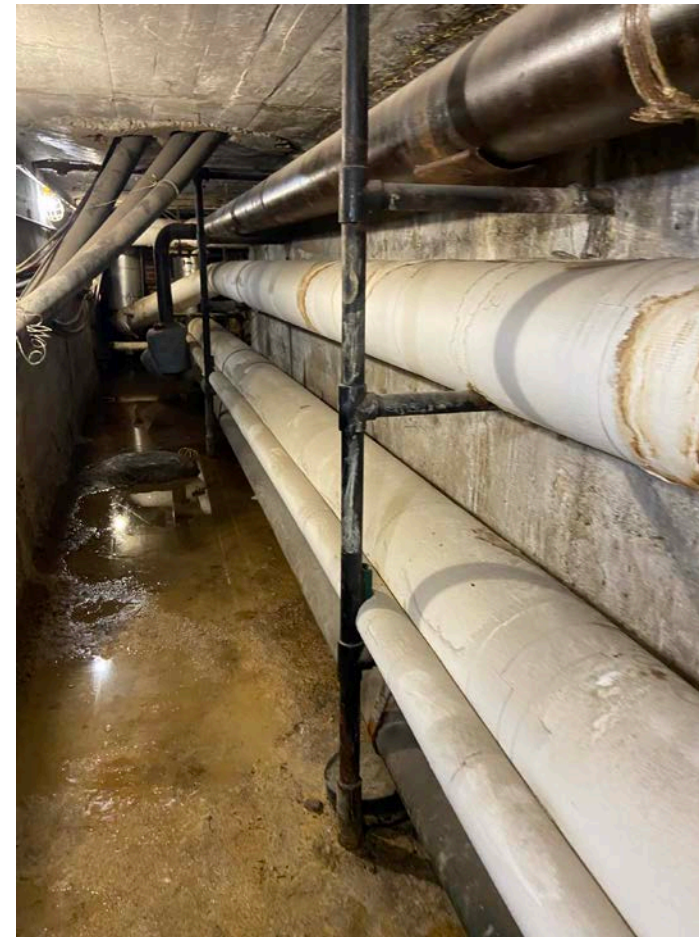
Larger overhead repaired areas with leaking cracks but sound



Injected cracks in good condition, new ones have formed



Created trenches created in a floor help with infiltrating water, but lack maintenance



Water is infiltrating select tunnels' sections



No change in the level of corrosion was observed at corrugated metal ceilings

# Questions?

Predrag Popovic

[ppopovic@wje.com](mailto:ppopovic@wje.com)

Dunja Vla

[dvla@wje.com](mailto:dvla@wje.com)

Tracy Naso

[tnaso@wje.com](mailto:tnaso@wje.com)

**WJE** **Wiss, Janney, Elstner Associates, Inc.**