



“Benchmark for the Future:




The largest SEM Soft Ground Tunnels in the United Stated for the Beacon Hill Station in Seattle, WA”

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Gerhard Urschitz, PE, Dr. G. Sauer Corporation
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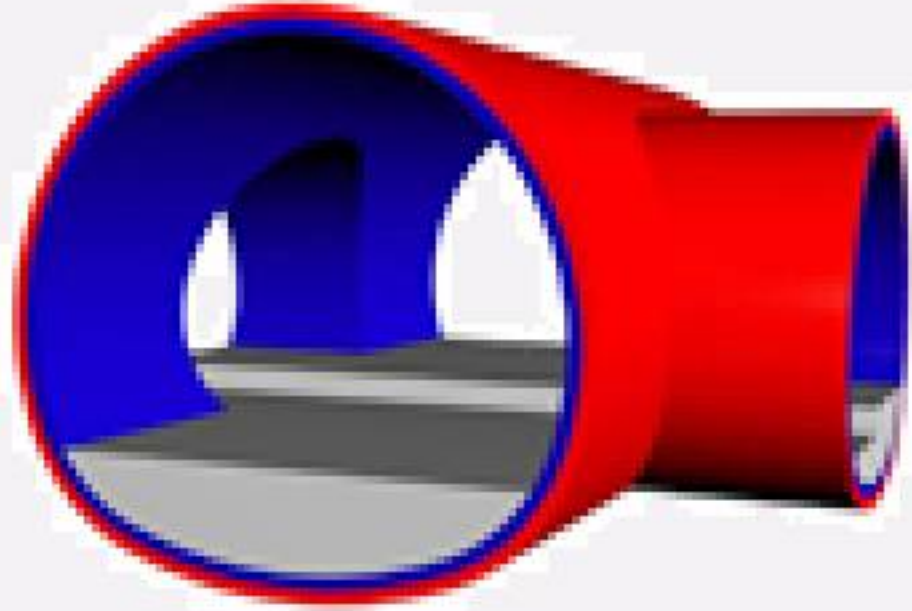
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INTRODUCTION

- Overview
- Design Issues & Solutions
- Test Shaft Program
- Status & Outlook




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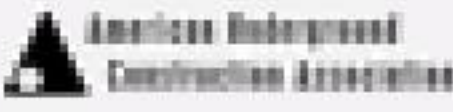



PROJECT OVERVIEW

- Sound Transit’s Central Link Light Rail
- Seattle - Tacoma





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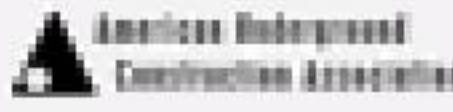



PROJECT OVERVIEW

- Sound Transit’s Central Link Light Rail
- Seattle - Tacoma





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PROJECT OVERVIEW



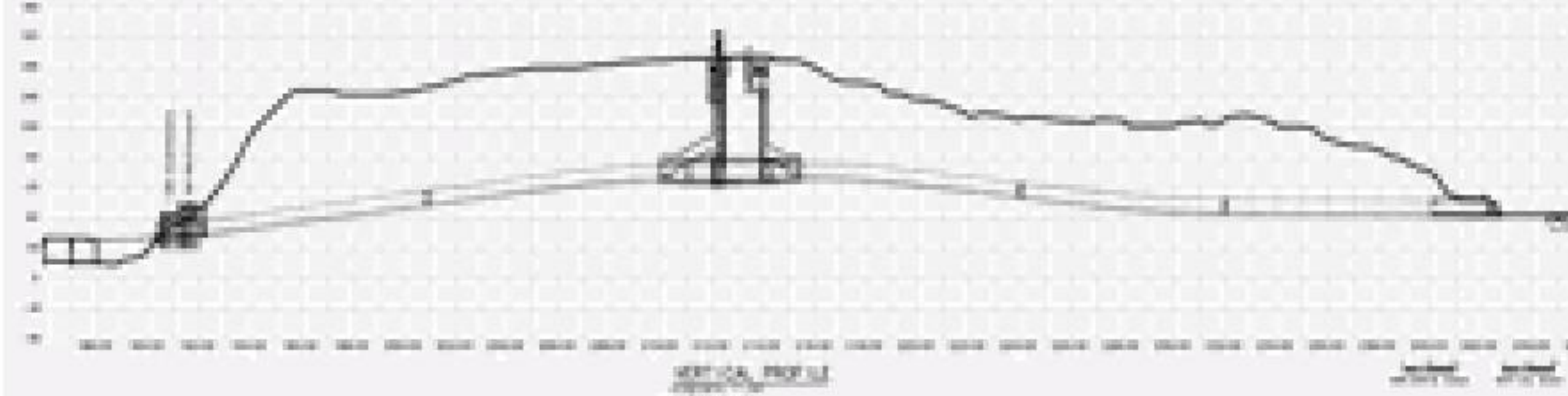
• 4,300 ft Running Tunnels
• Deep Mined Station

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PROJECT OVERVIEW

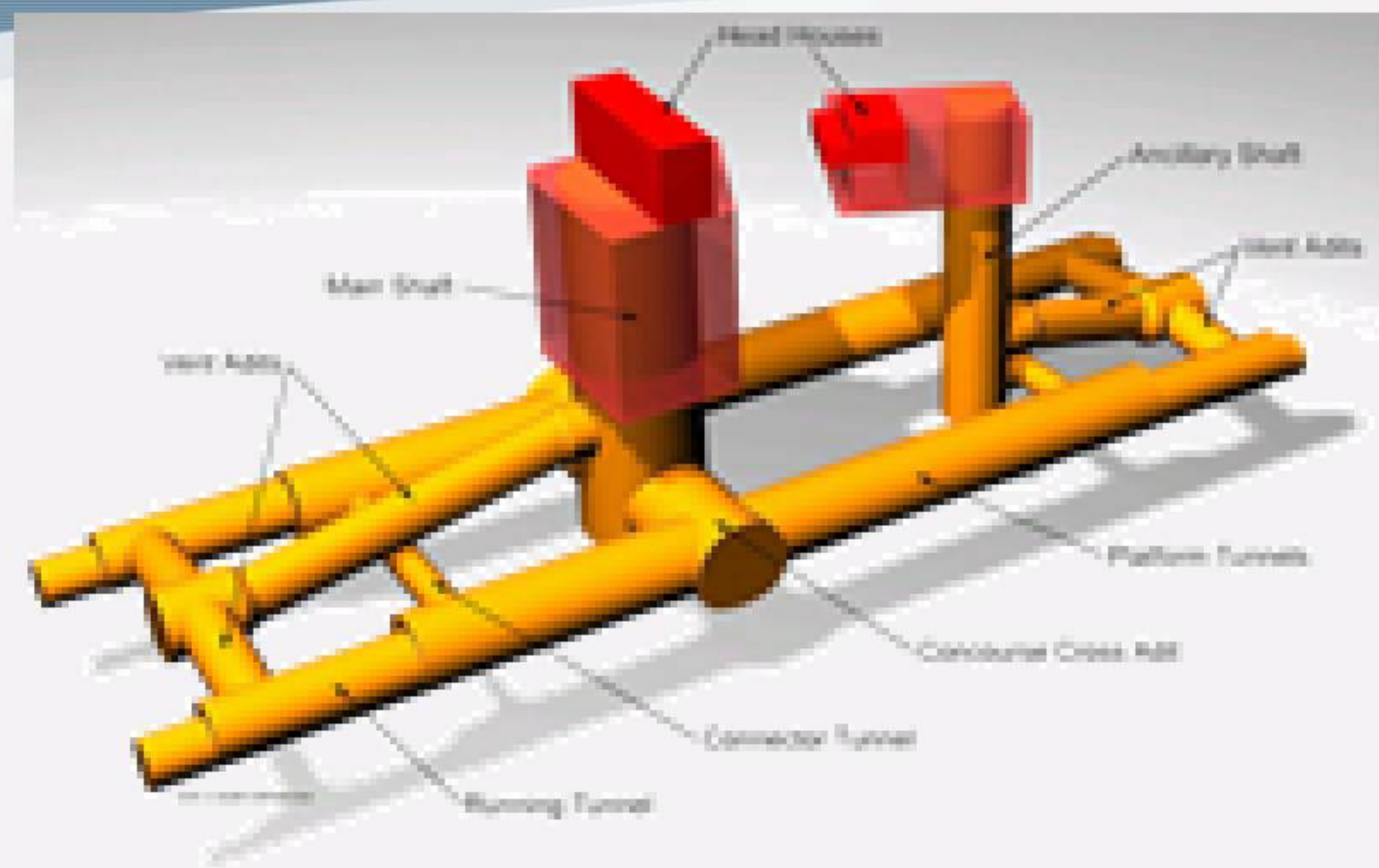


• 4,300 ft Running Tunnels
• Deep Mined Station

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PROJECT OVERVIEW



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DESIGN ISSUES



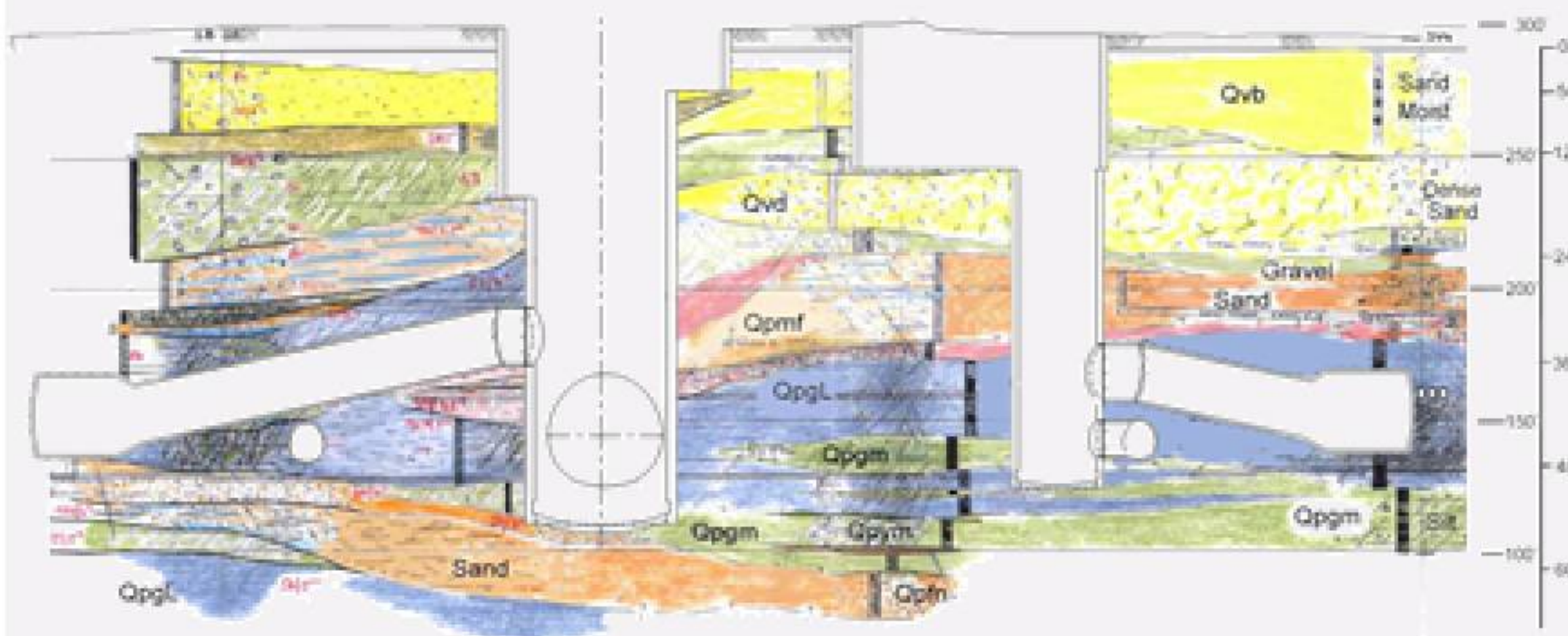
- Geology & Hydrology
- Large Soft Ground Tunnels
- Complex Station Configuration



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GEOLOGY



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GEOLOGY



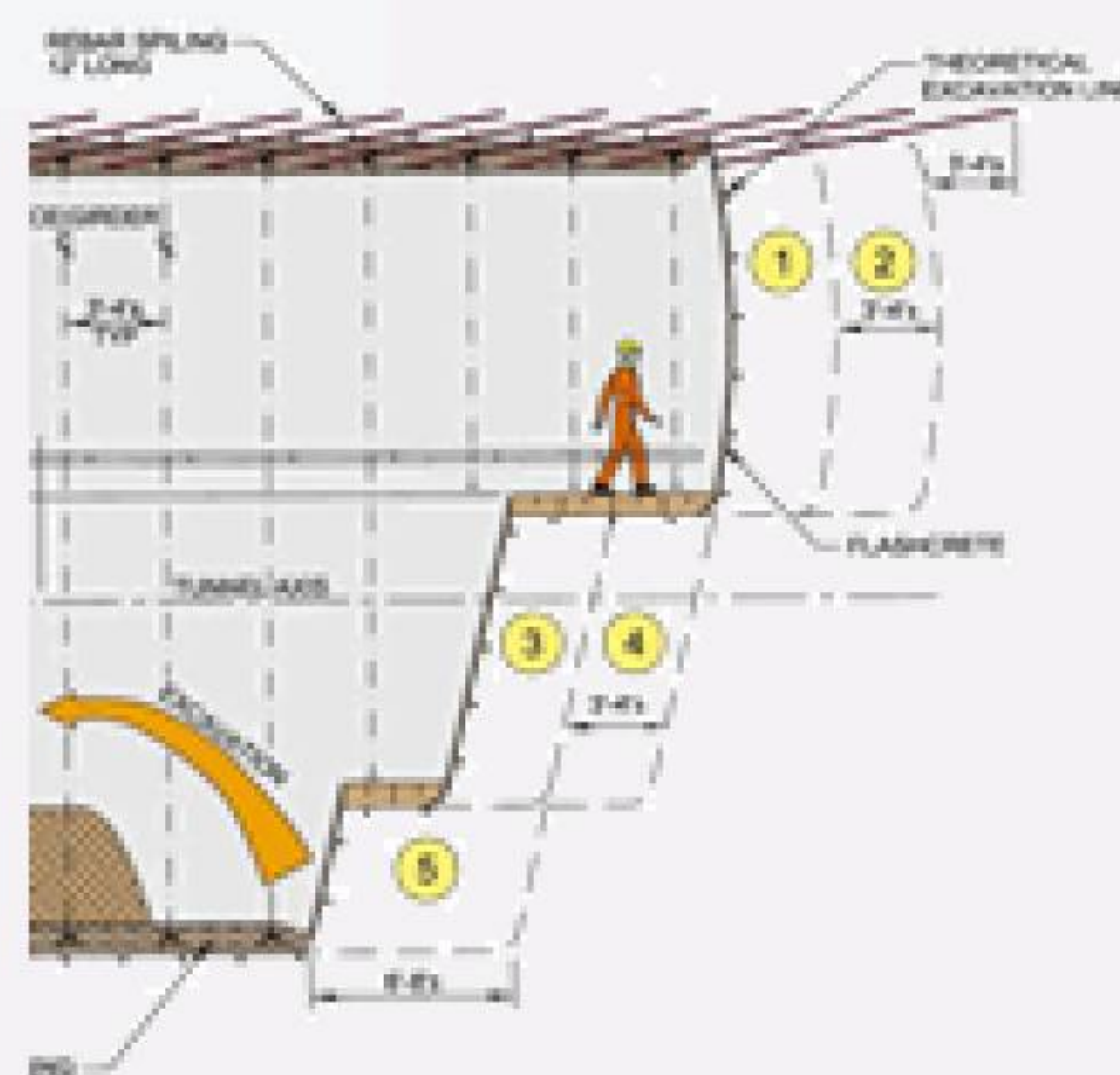
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PRESCRIPTIVE DESIGN



- Excavation Sequence
- Round Length
- Ring Closure
- Shotcrete Thickness
- Probe Drilling



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“SEM TOOLBOX ITEMS”



- Pre-Support
- Face Support
- Ground Improvement
- Annular Support
- Excavation



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"SEM TOOLBOX ITEMS"

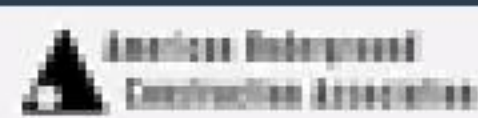


- Pre-Support
- Face Support
- Ground Improvement
- Annular Support
- Excavation

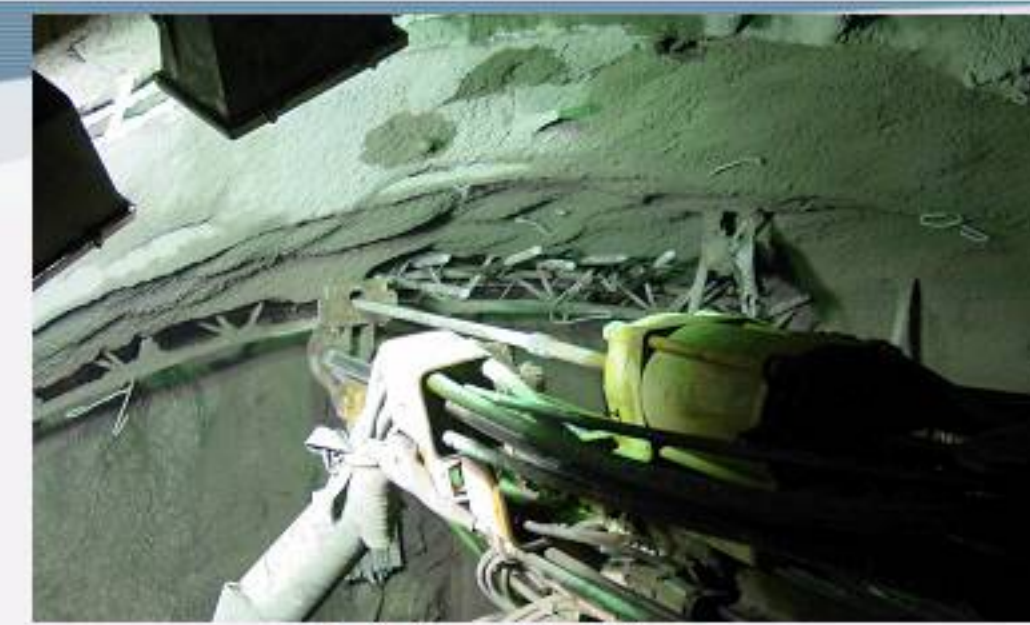


- Installation as required
- Unit Price

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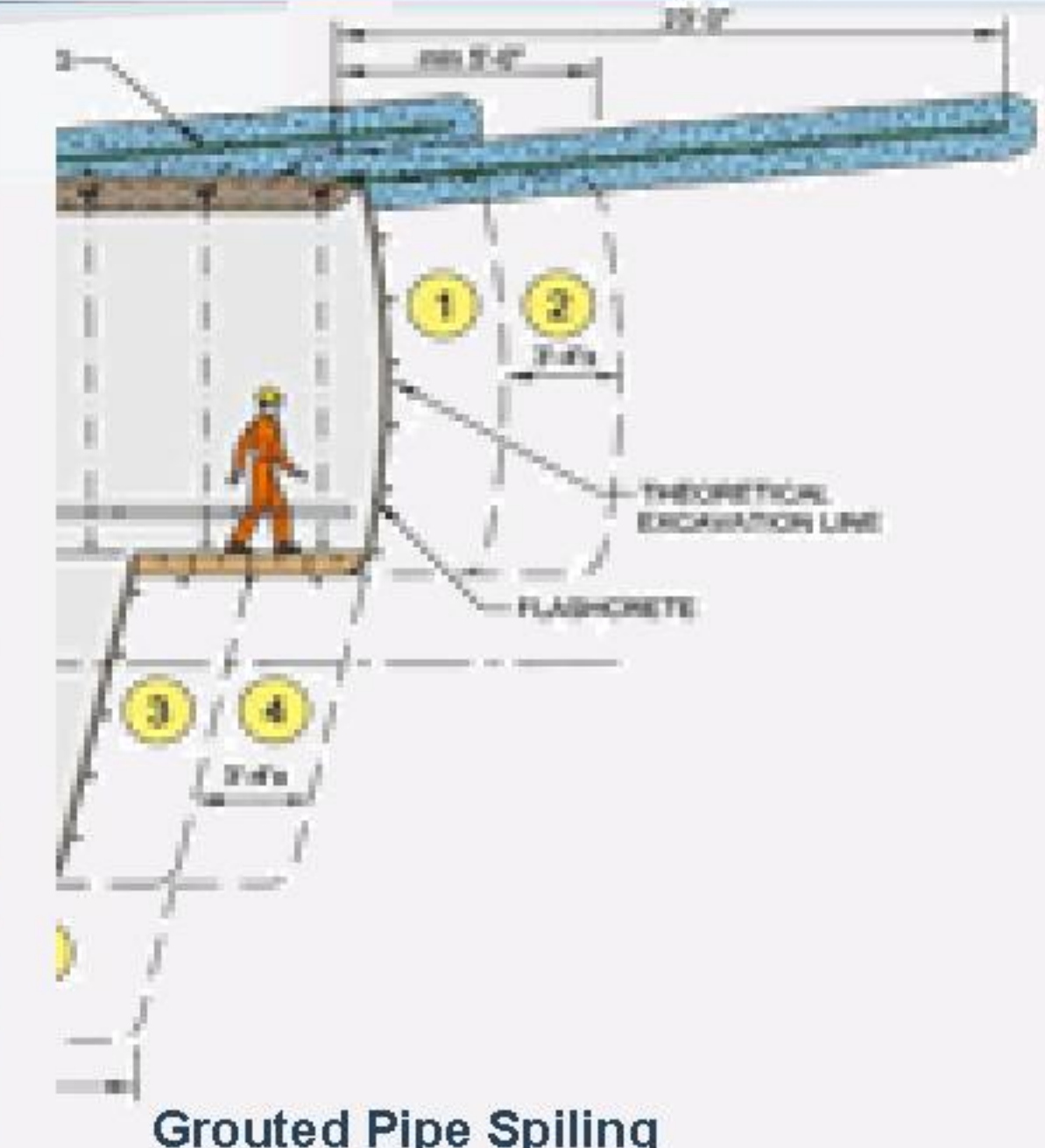
PRE – SUPPORT



Rebar Spiling



Metal Sheets



Grouted Pipe Spiling

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FACE SUPPORT



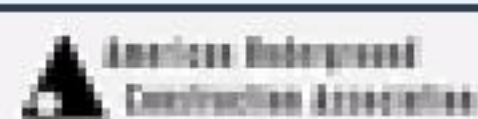
Face Bolts



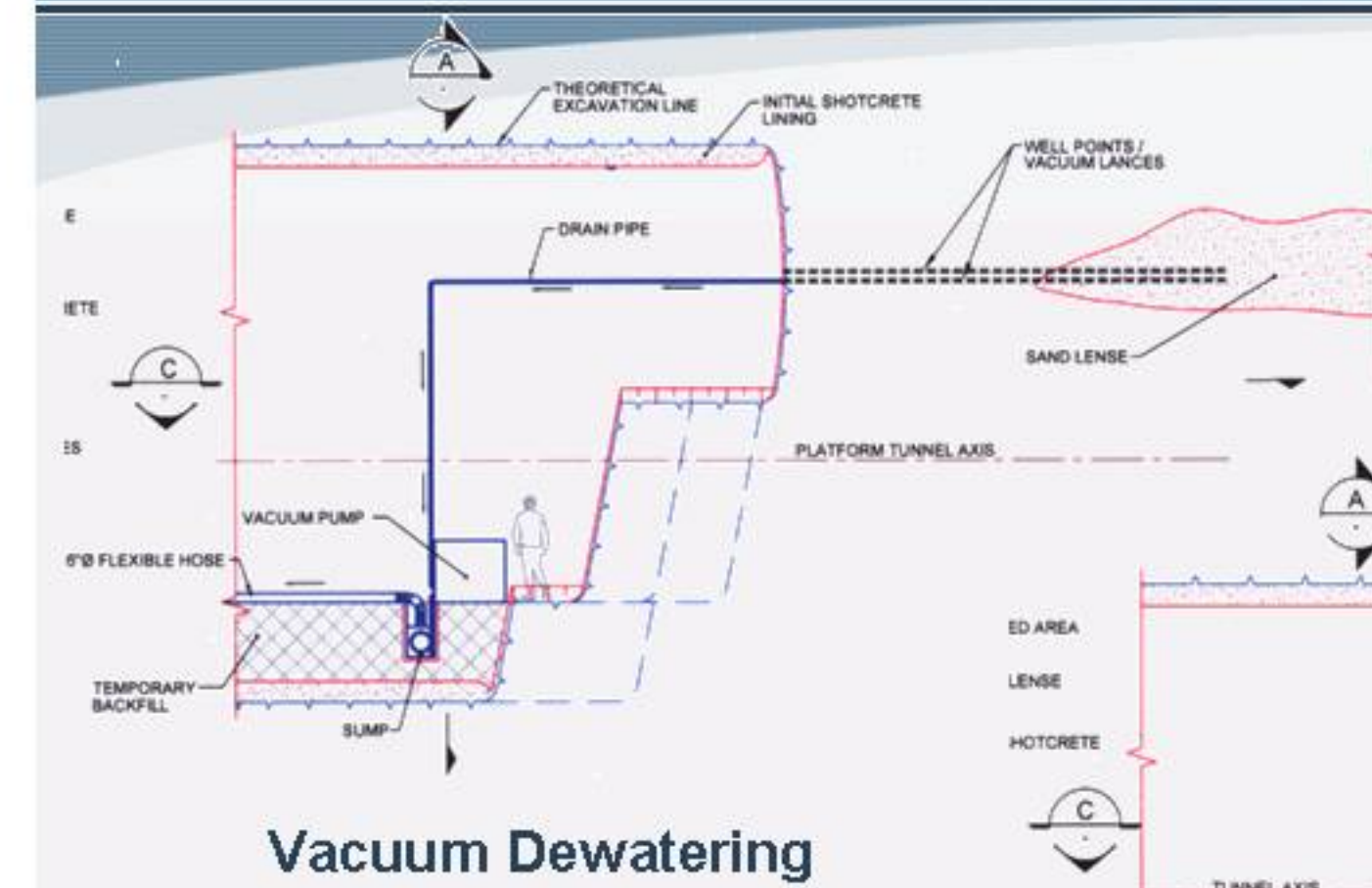
Face Support Wedge



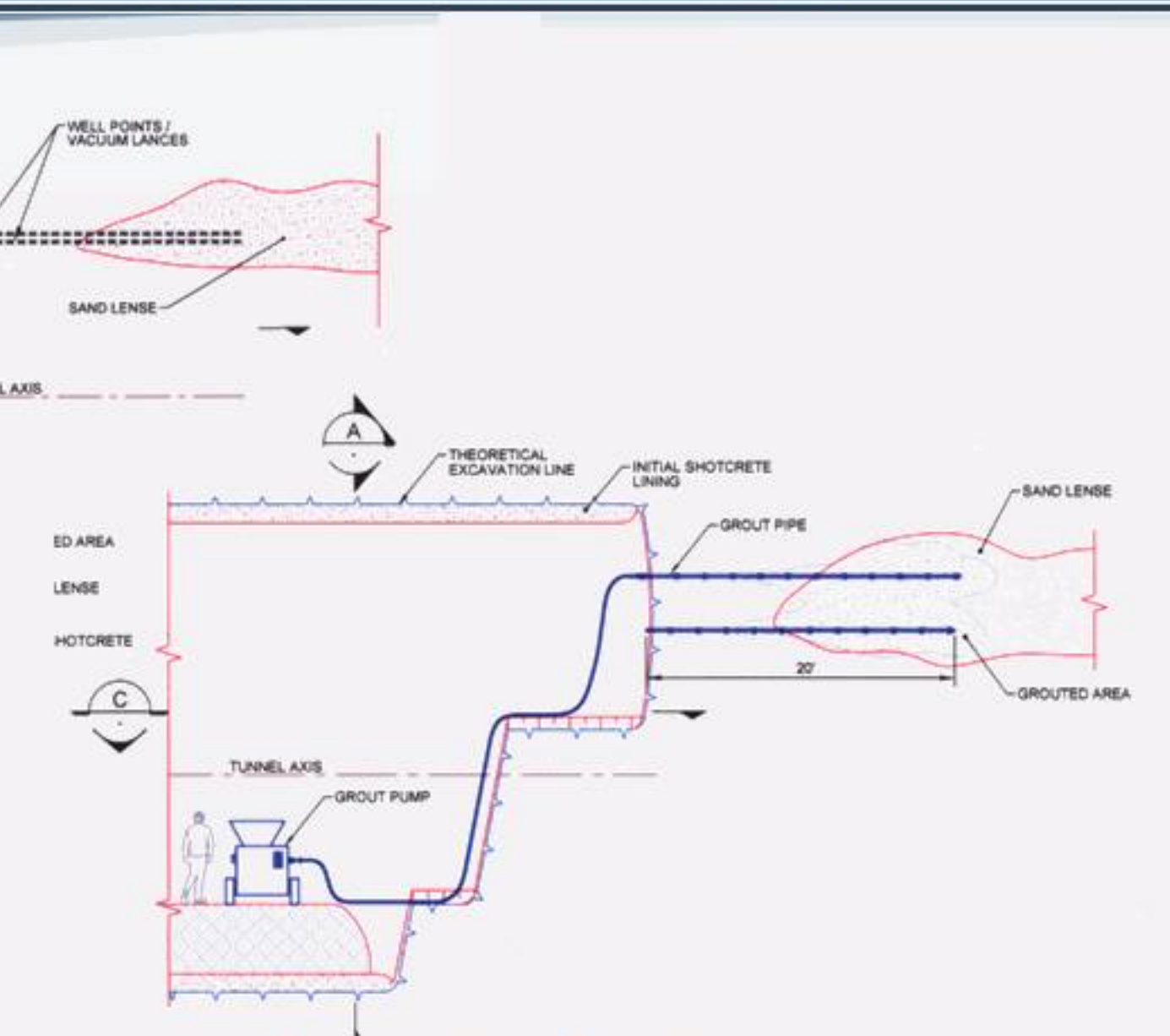
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GROUND IMPROVEMENT



Vacuum Dewatering

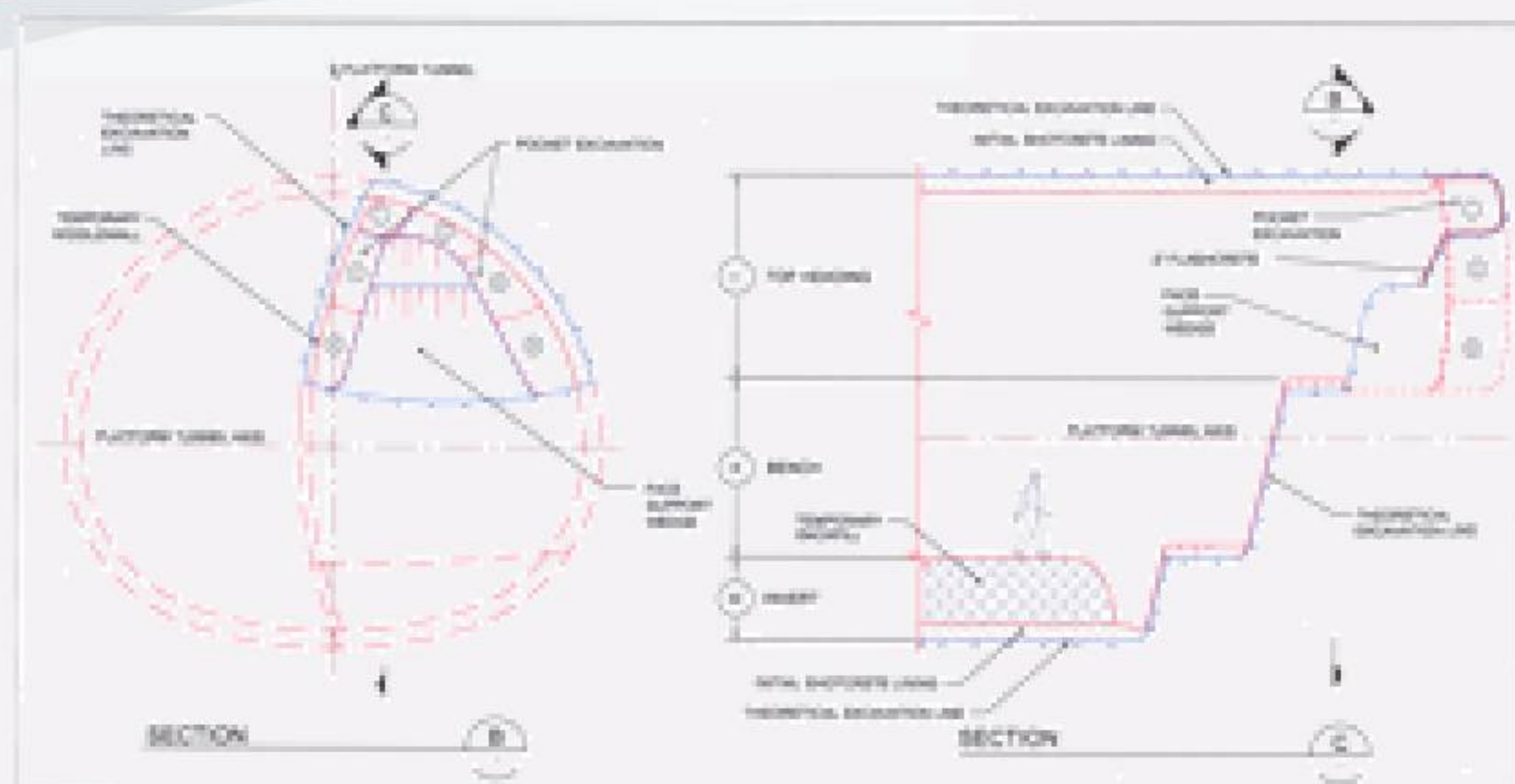


Permeation Grouting

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EXCAVATION SEQUENCE



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ANNULAR SUPPORT



Additional Shotcrete


Soil Nails




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SURFACE DEWATERING




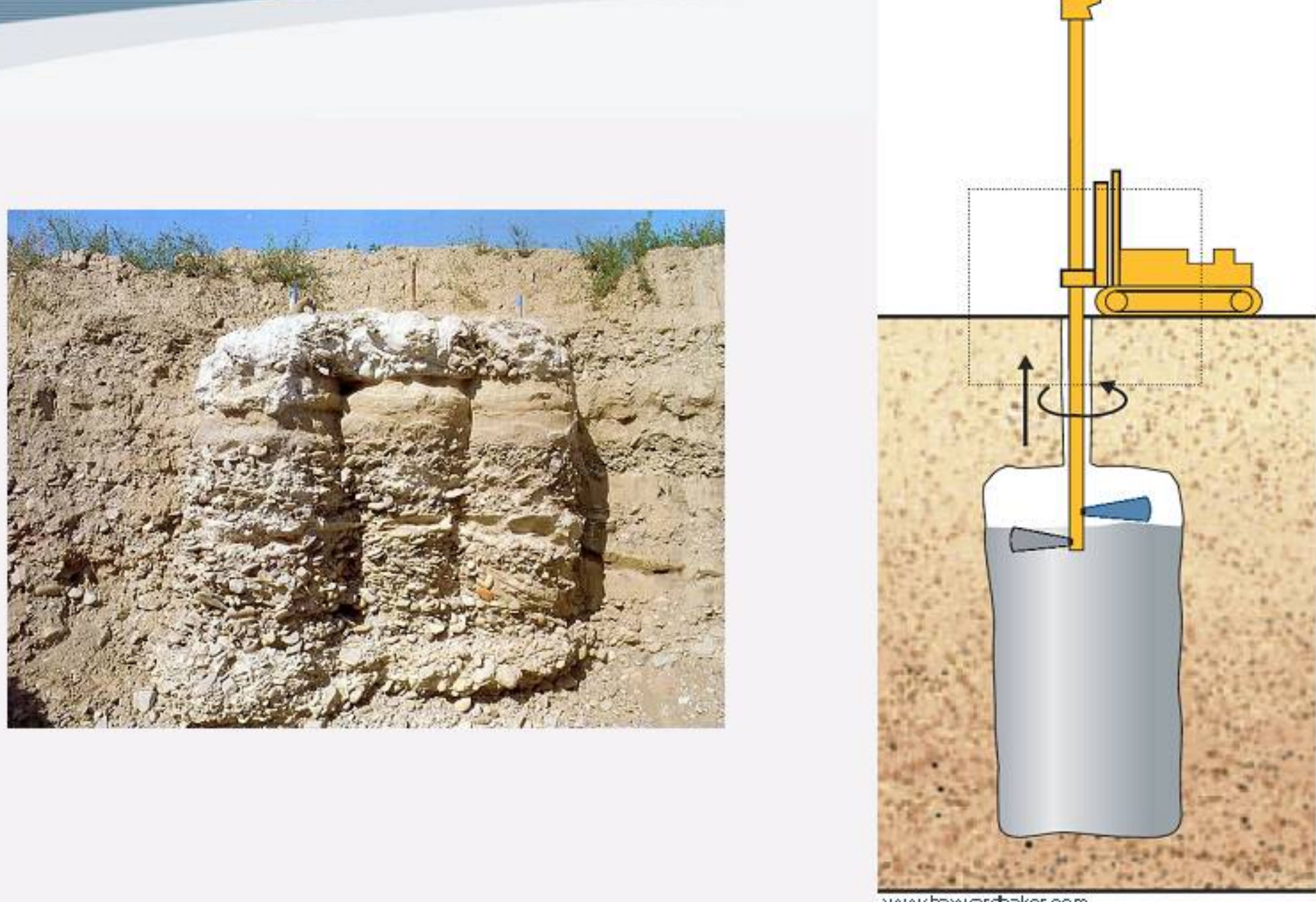


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JET GROUTING




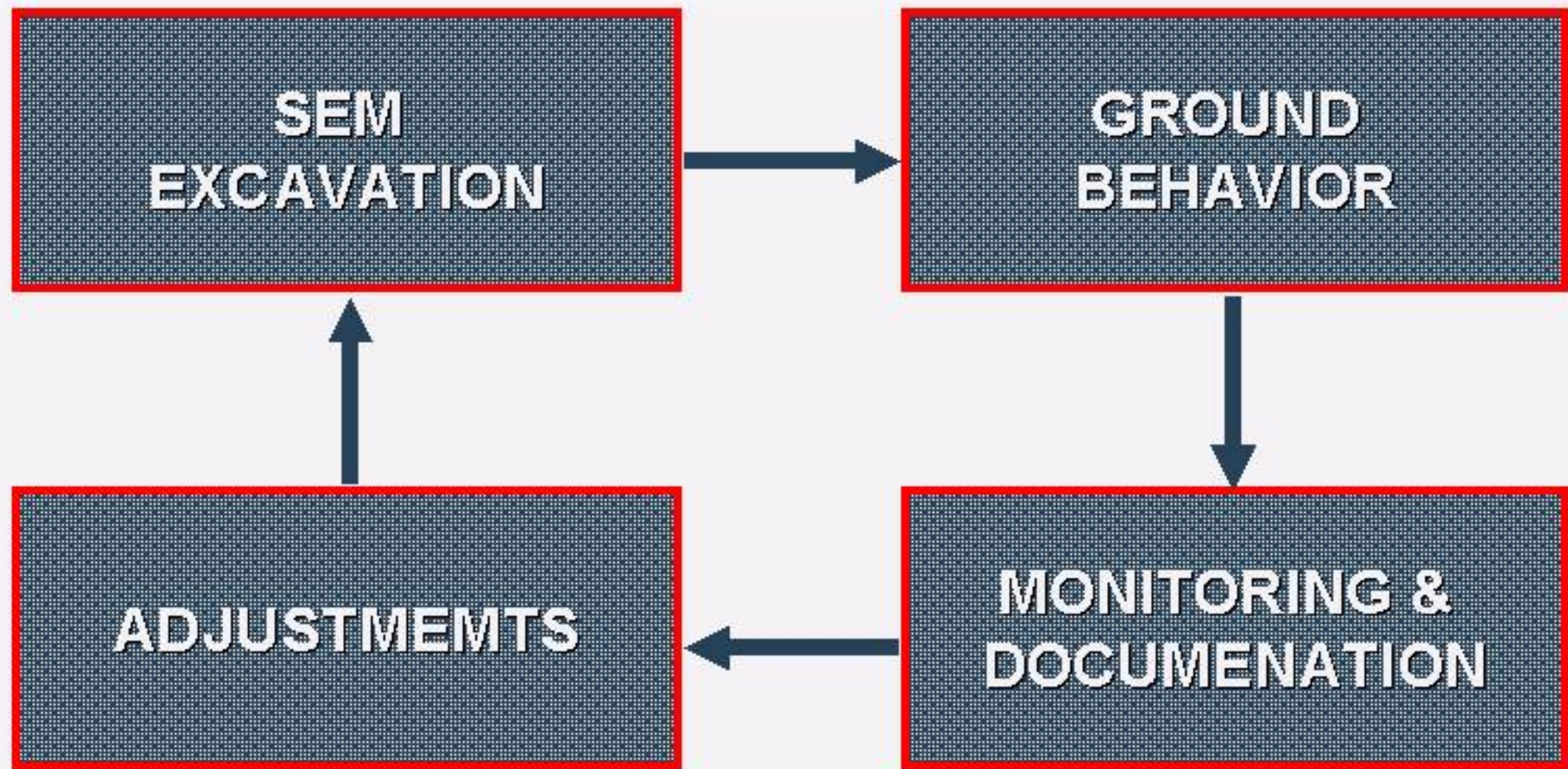


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EXECUTION

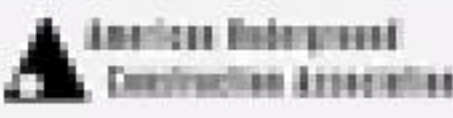




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    graph TD
      SEM[SEM EXCAVATION] --> GB[GROUND BEHAVIOR]
      GB --> MD[MONITORING & DOCUMENTATION]
      MD --> AD[ADJUSTMENTS]
      AD --> SEM
  
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EXECUTION



- Experienced Contractor
- Inspection and Supervision



Russia Wharf, Boston, MA

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EXECUTION



- Experienced Contractor
 - Pre-qualification
- Inspection and Supervision
 - Resident Engineering Services




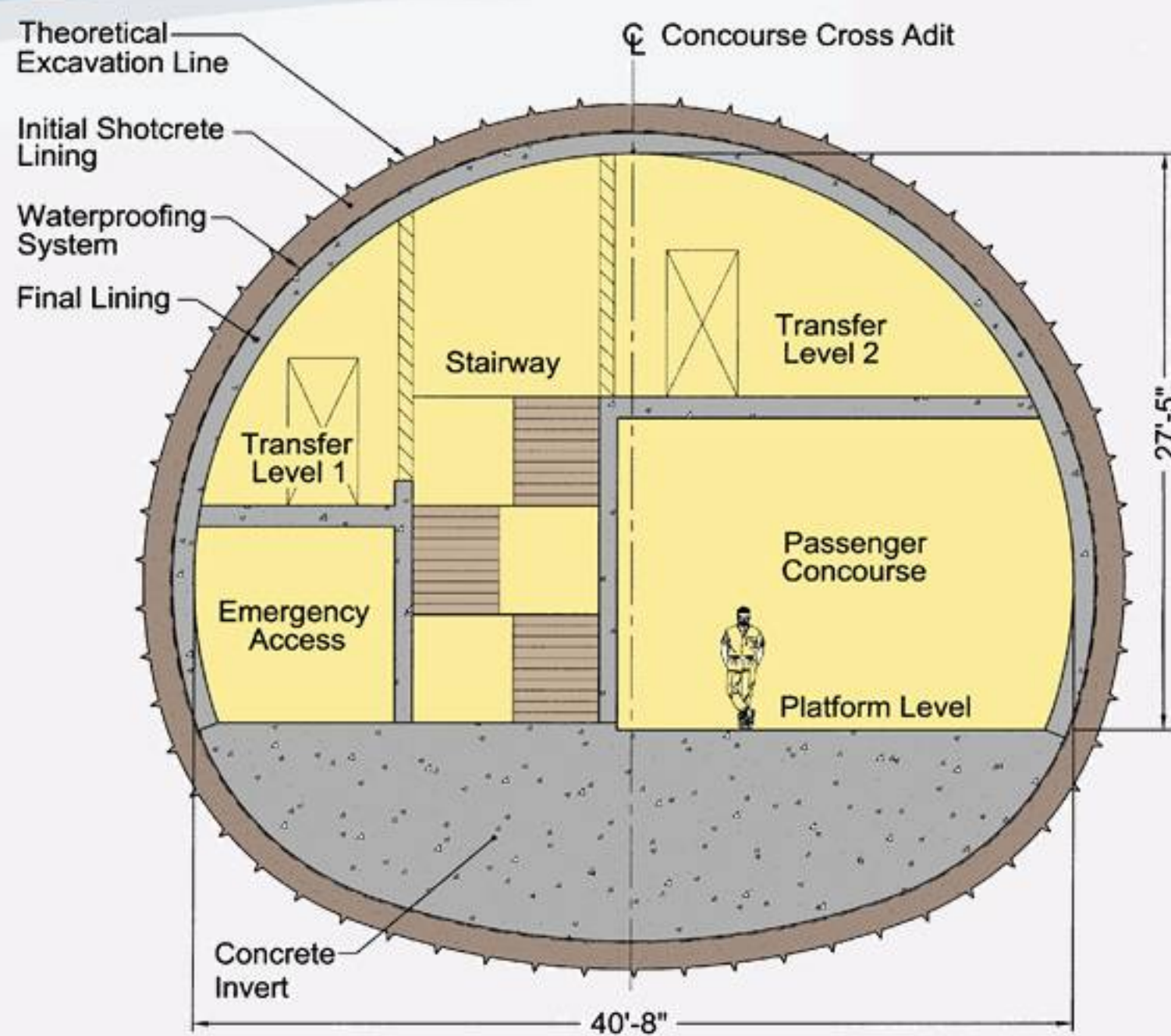
Russia Wharf, Boston, MA

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CONCOURSE CROSS ADIT







The diagram shows a circular cross-section with the following components and dimensions:

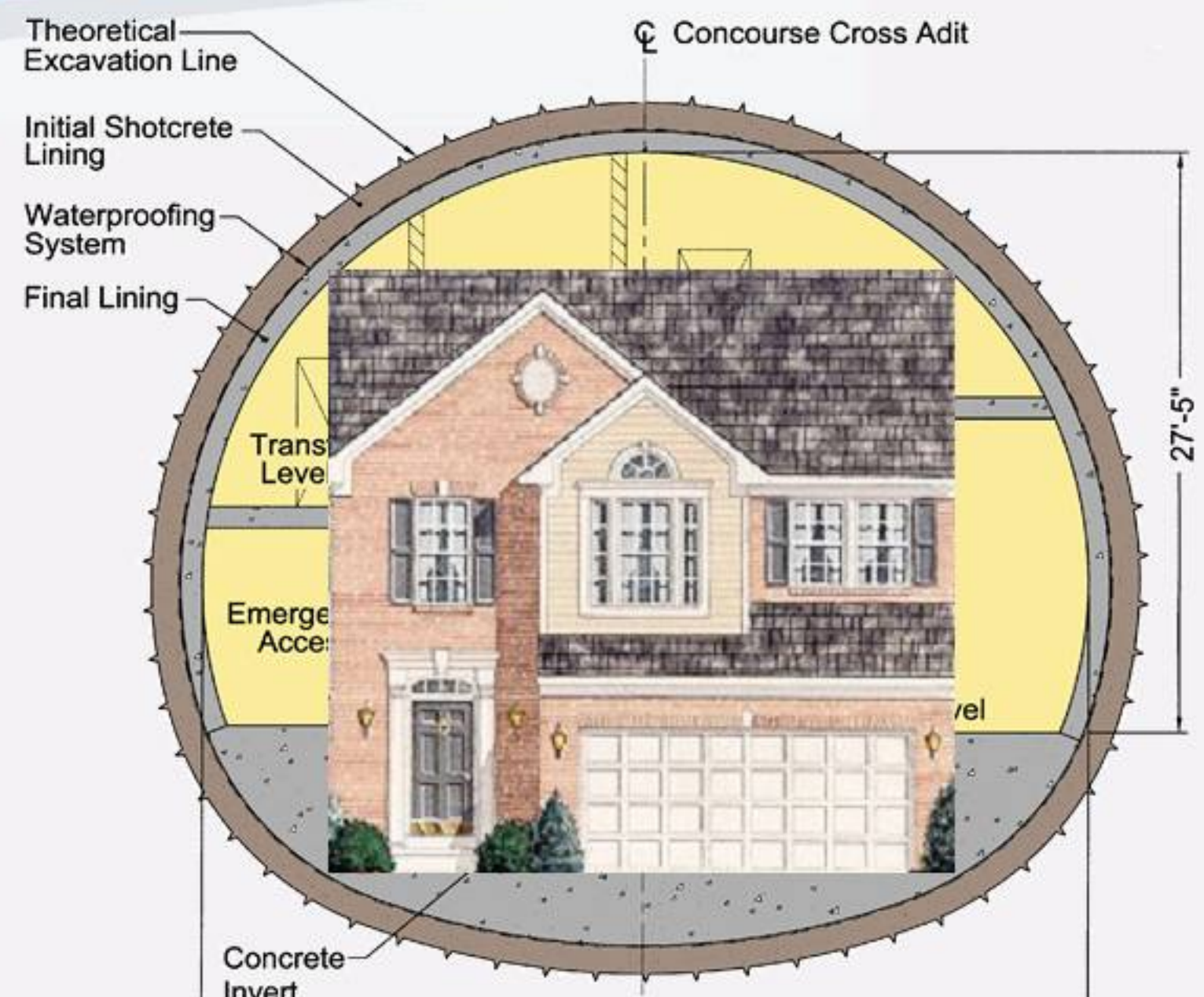
- Theoretical Excavation Line**: The outermost boundary.
- Initial Shotcrete Lining**: The first layer of concrete.
- Waterproofing System**: Applied between the initial and final linings.
- Final Lining**: The innermost concrete layer.
- Concrete Invert**: The base of the structure.
- Transfer Level 1** and **Transfer Level 2**: Horizontal levels for structural transfer.
- Stairway**: Vertical access between levels.
- Emergency Access**: A designated entry point.
- Passenger Concourse** and **Platform Level**: The main functional areas.
- Dimensions**: 40'-8" diameter and 27'-5" height.

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CONCOURSE CROSS ADIT






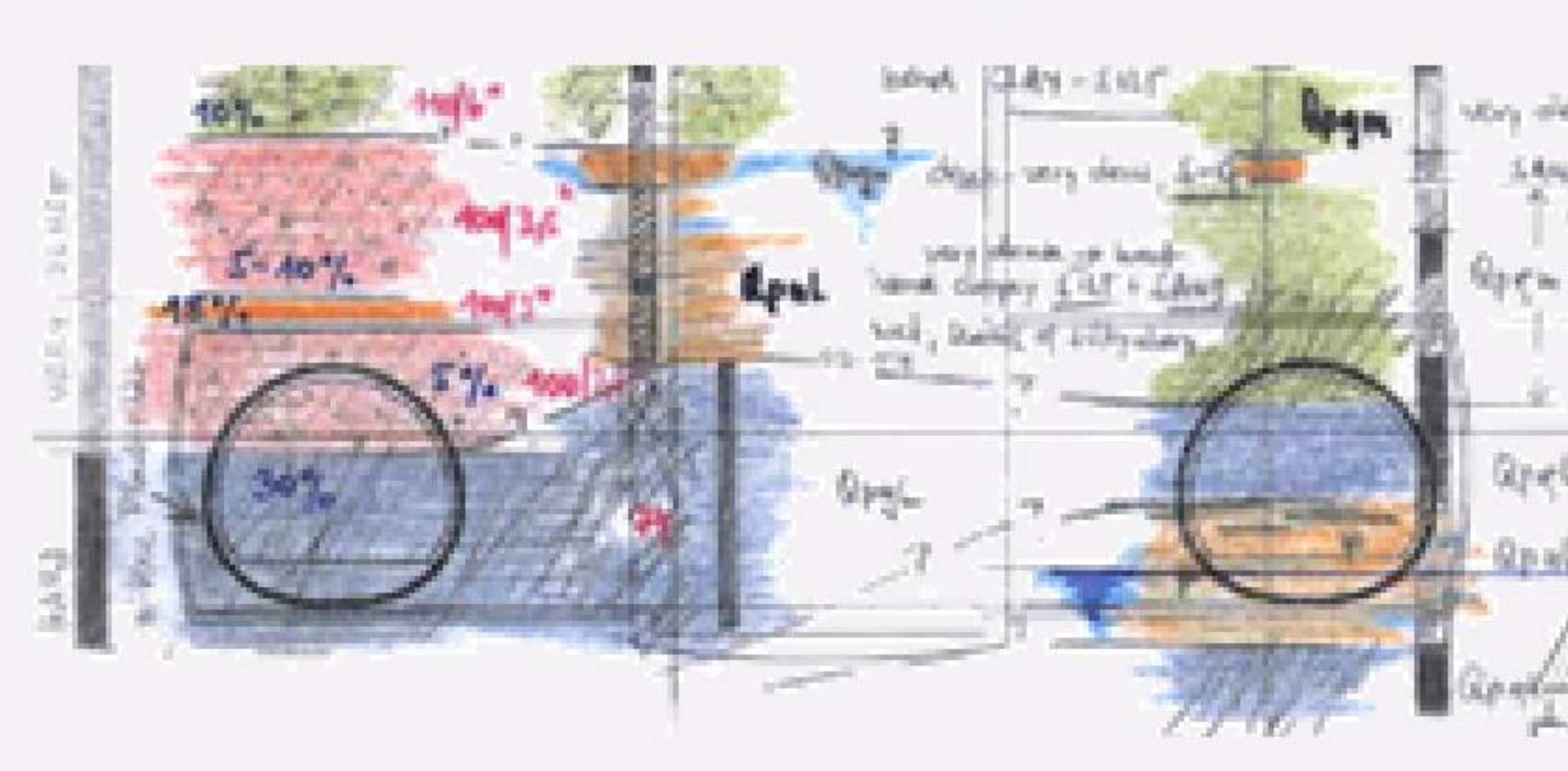
The diagram illustrates the construction layers of a circular tunnel. From the outside in, the layers are: Theoretical Excavation Line, Initial Shotcrete Lining, Waterproofing System, and Final Lining. The interior of the tunnel is divided into a Trans Level (top) and an Emerge Access level (bottom). A concrete invert is shown at the base of the tunnel. The overall diameter is labeled as 40'-8\" data-bbox="160 150 400 300"/>

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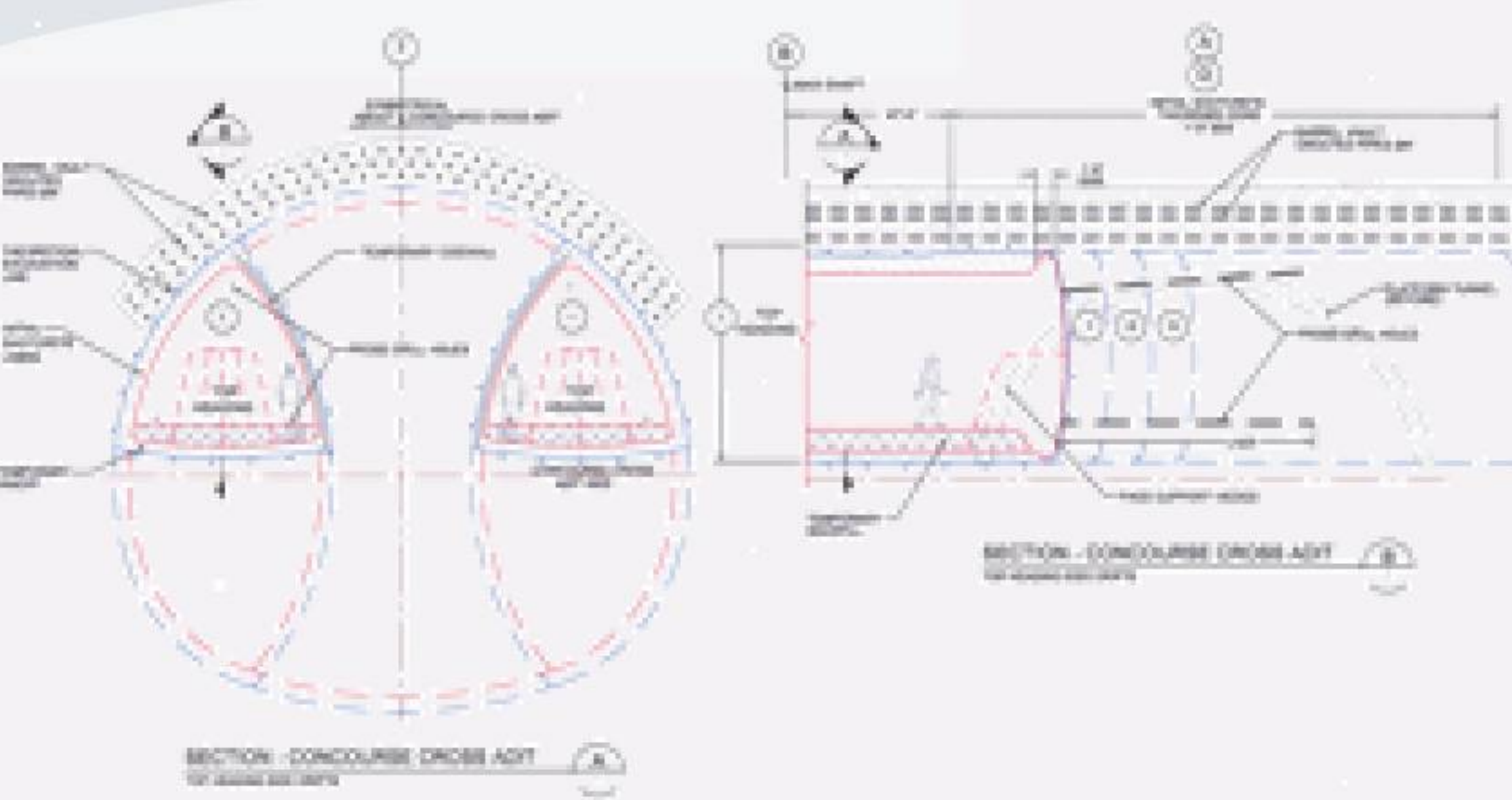


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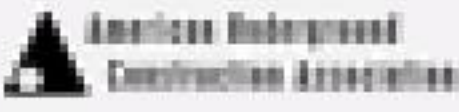


DUAL SIDE WALL DRIFTS




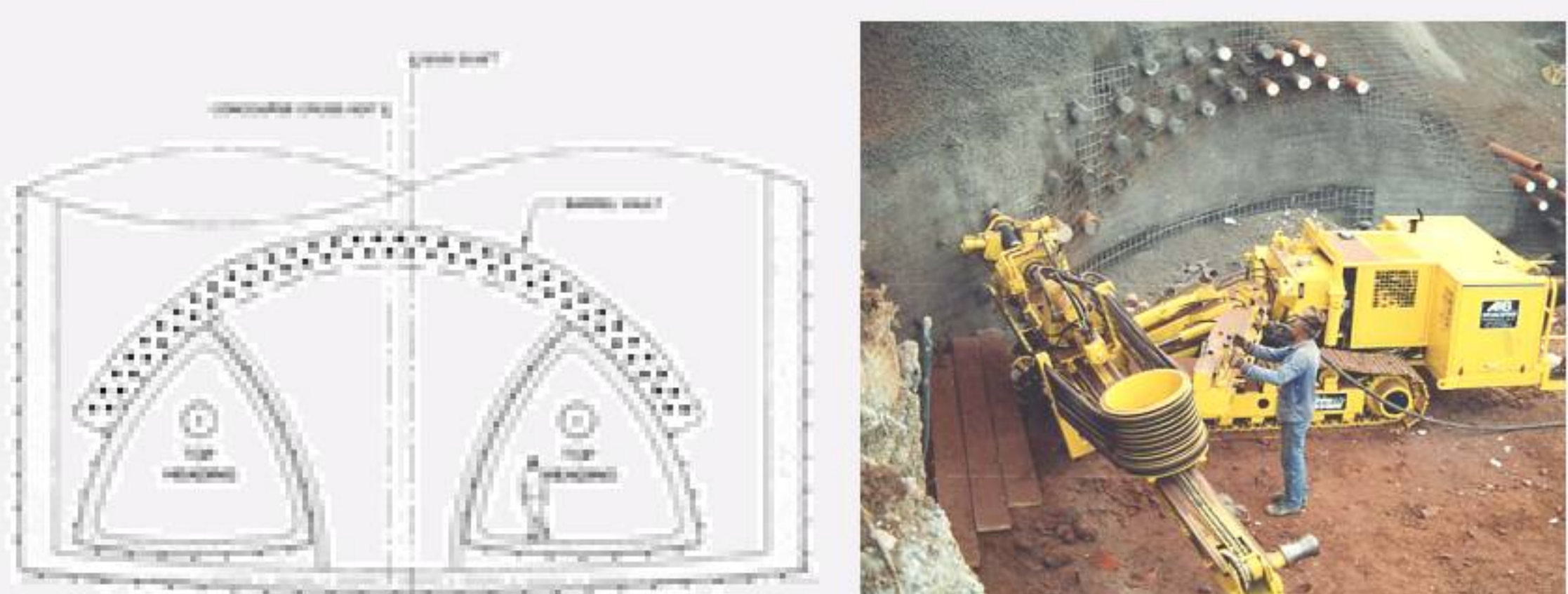


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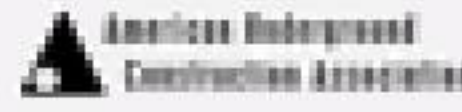


BARREL VAULT METHOD







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SEQUENCE






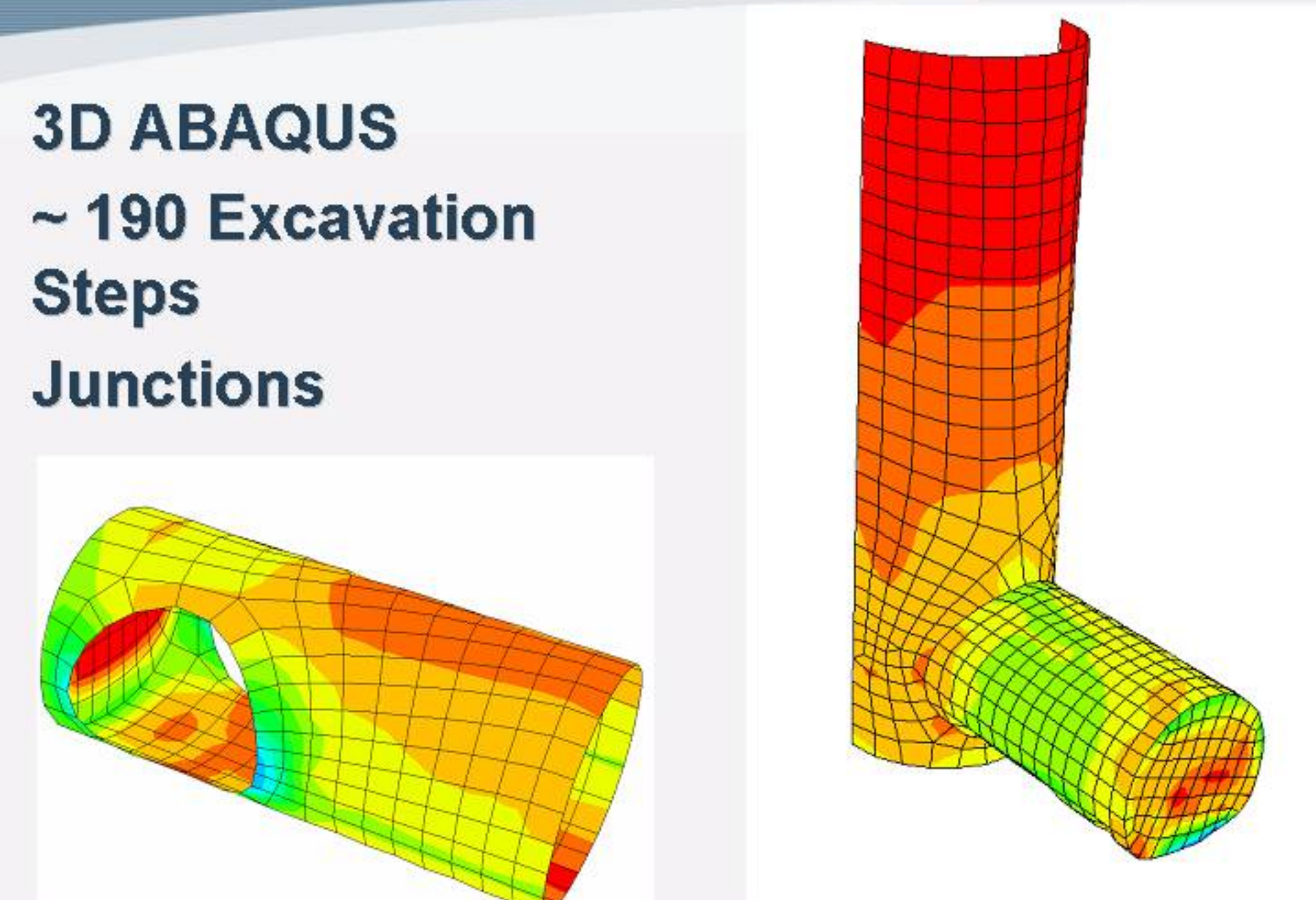
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FE ANALYSIS



- 3D ABAQUS
- ~ 190 Excavation Steps
- Junctions



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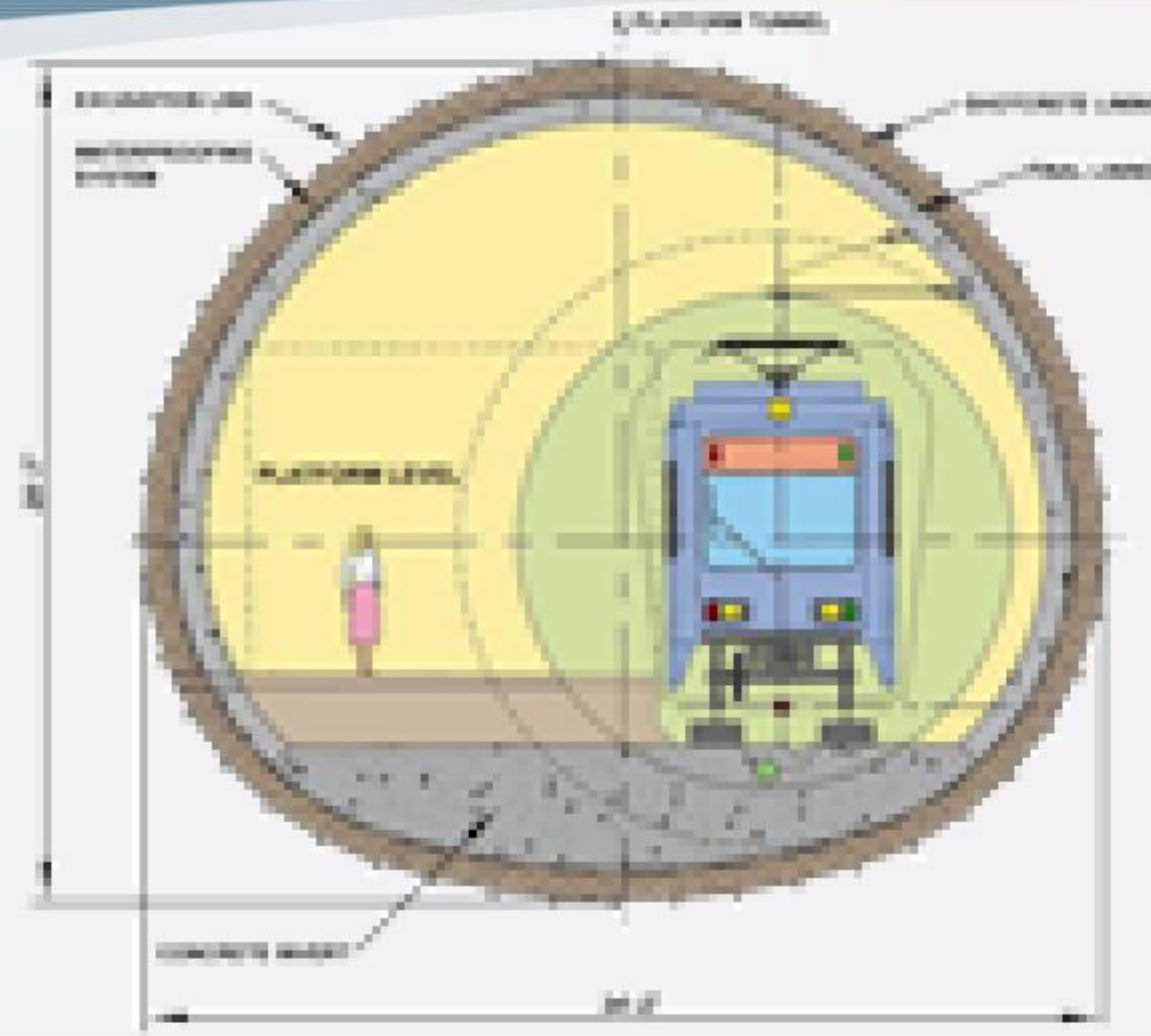
"UNDER CONSTRUCTION"



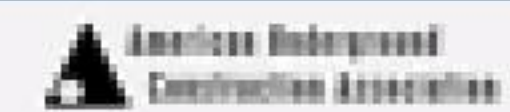
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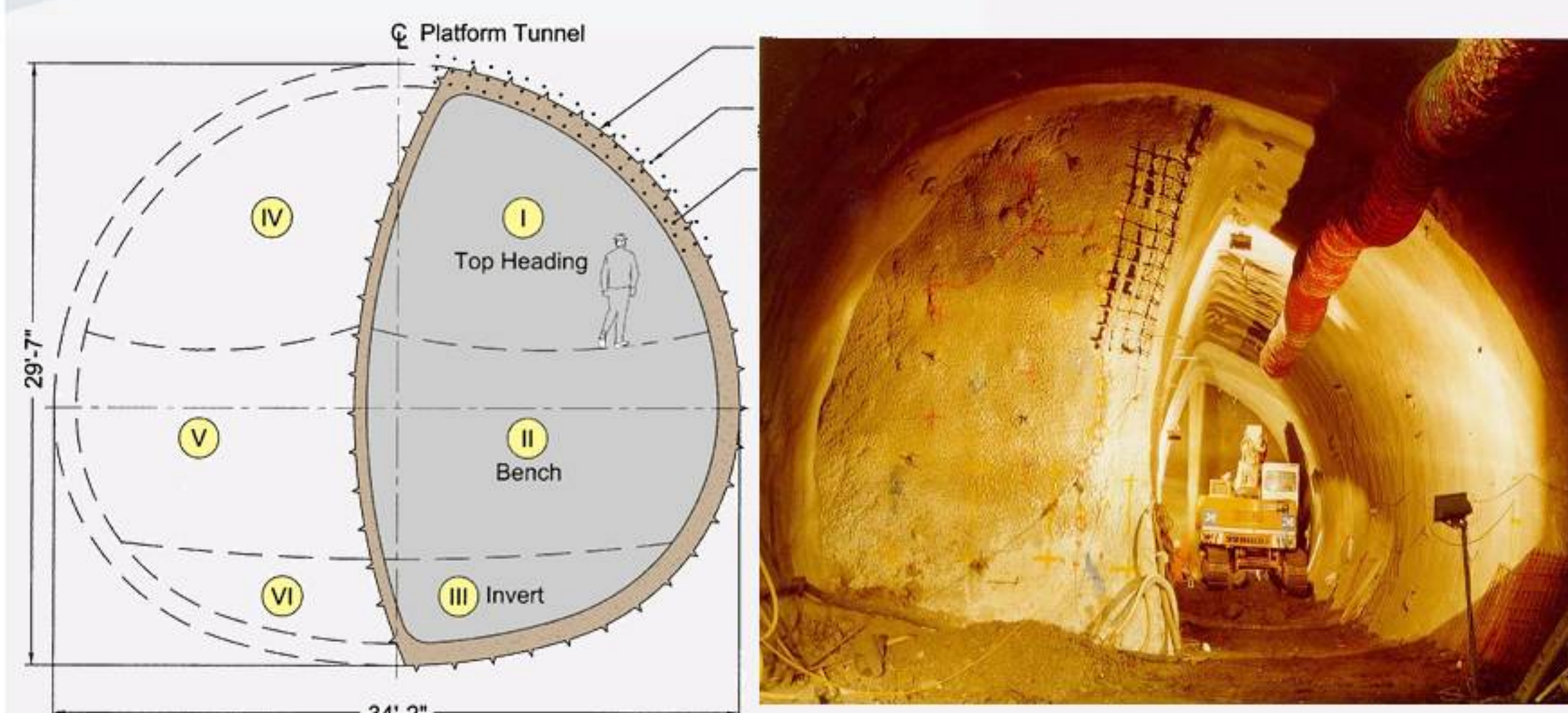
PLATFORM TUNNELS



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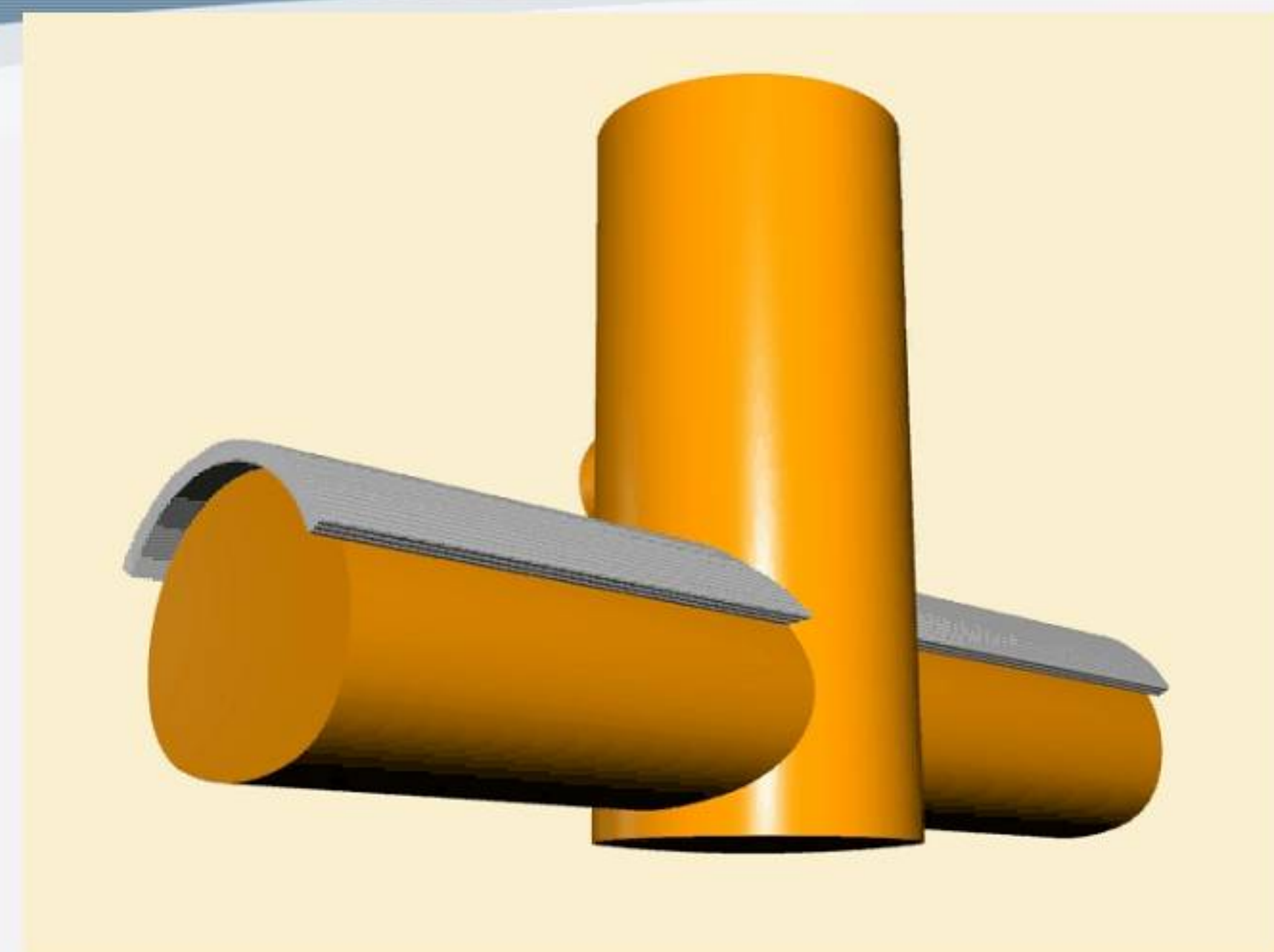
SINGLE SIDE WALL DRIFT



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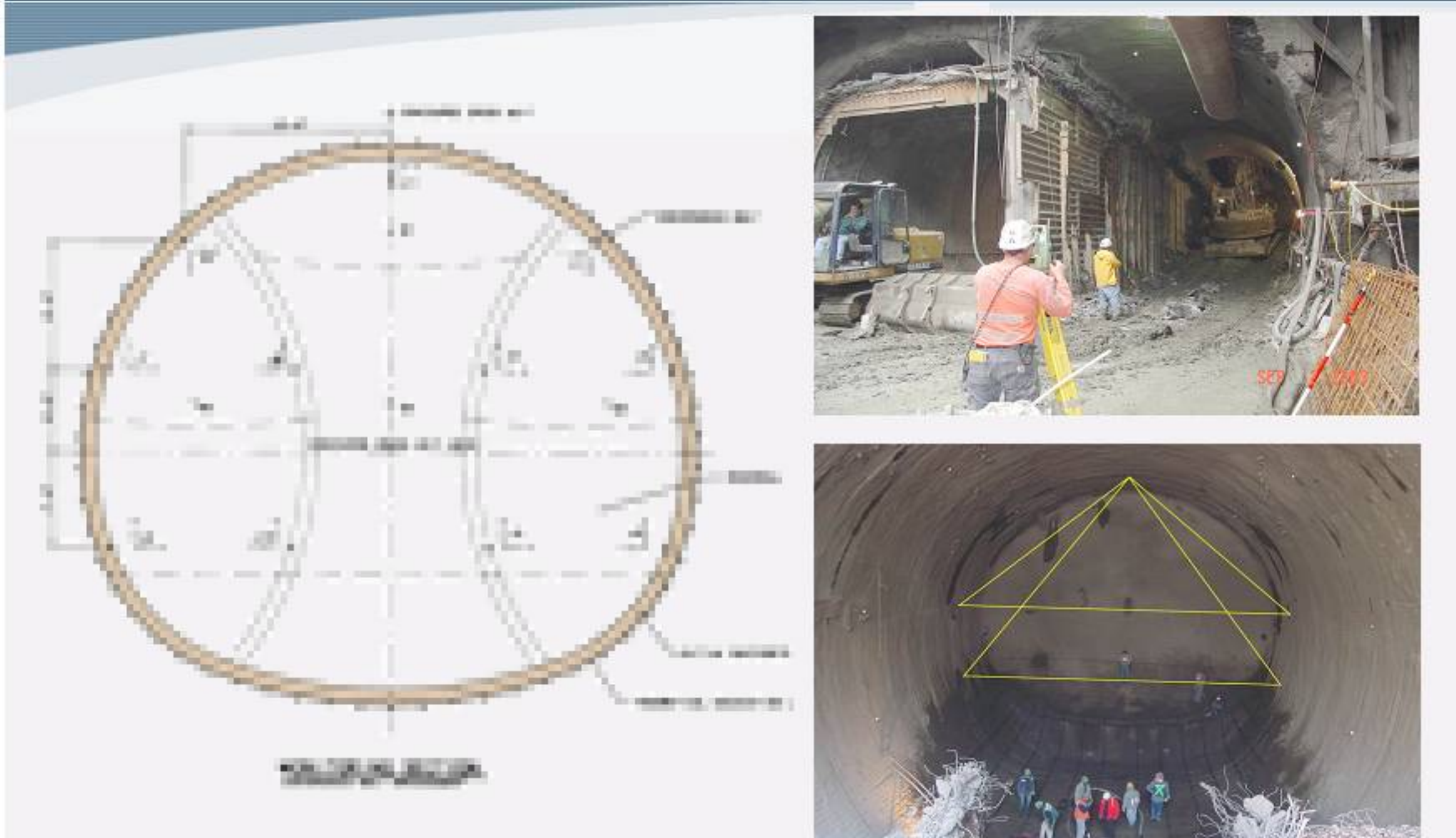
SEQUENCE



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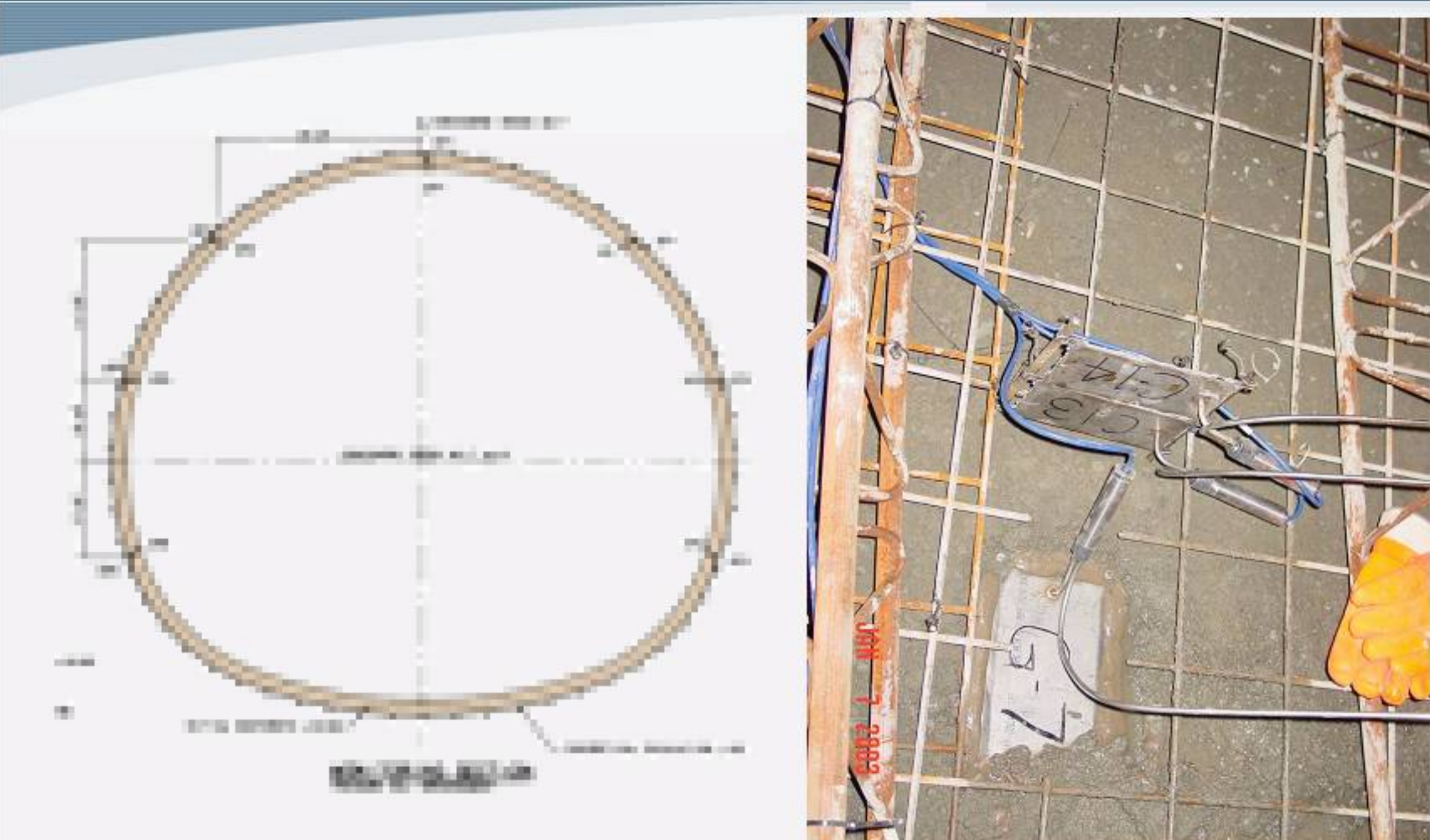
MONITORING



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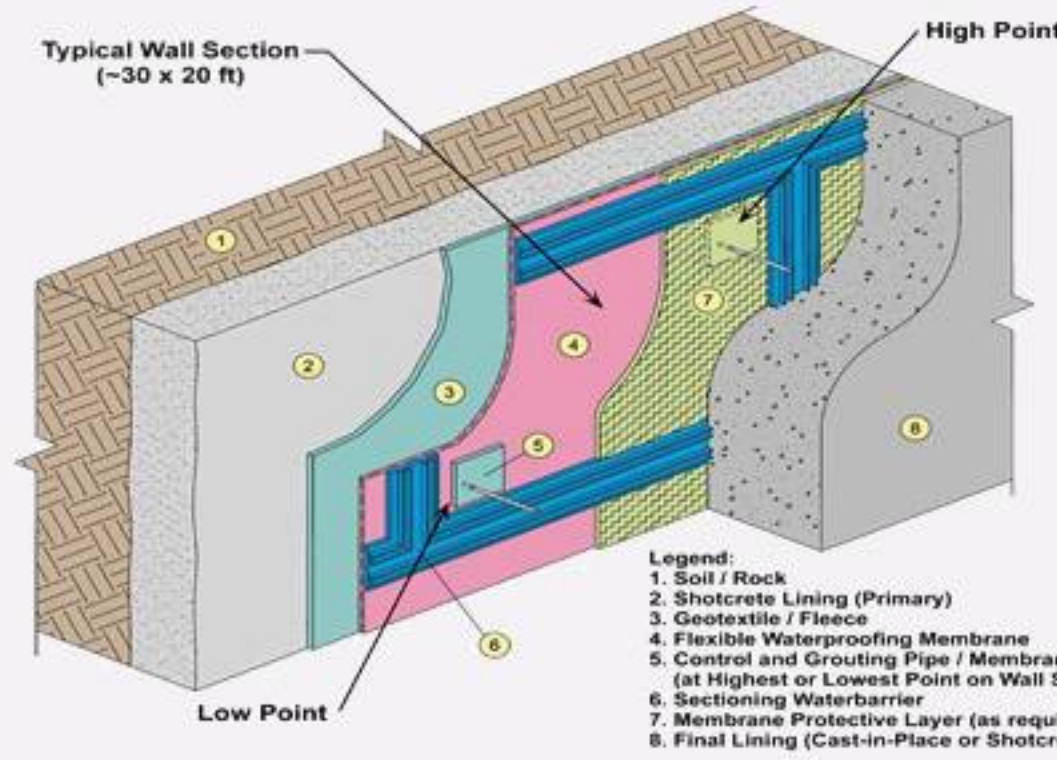
MONITORING



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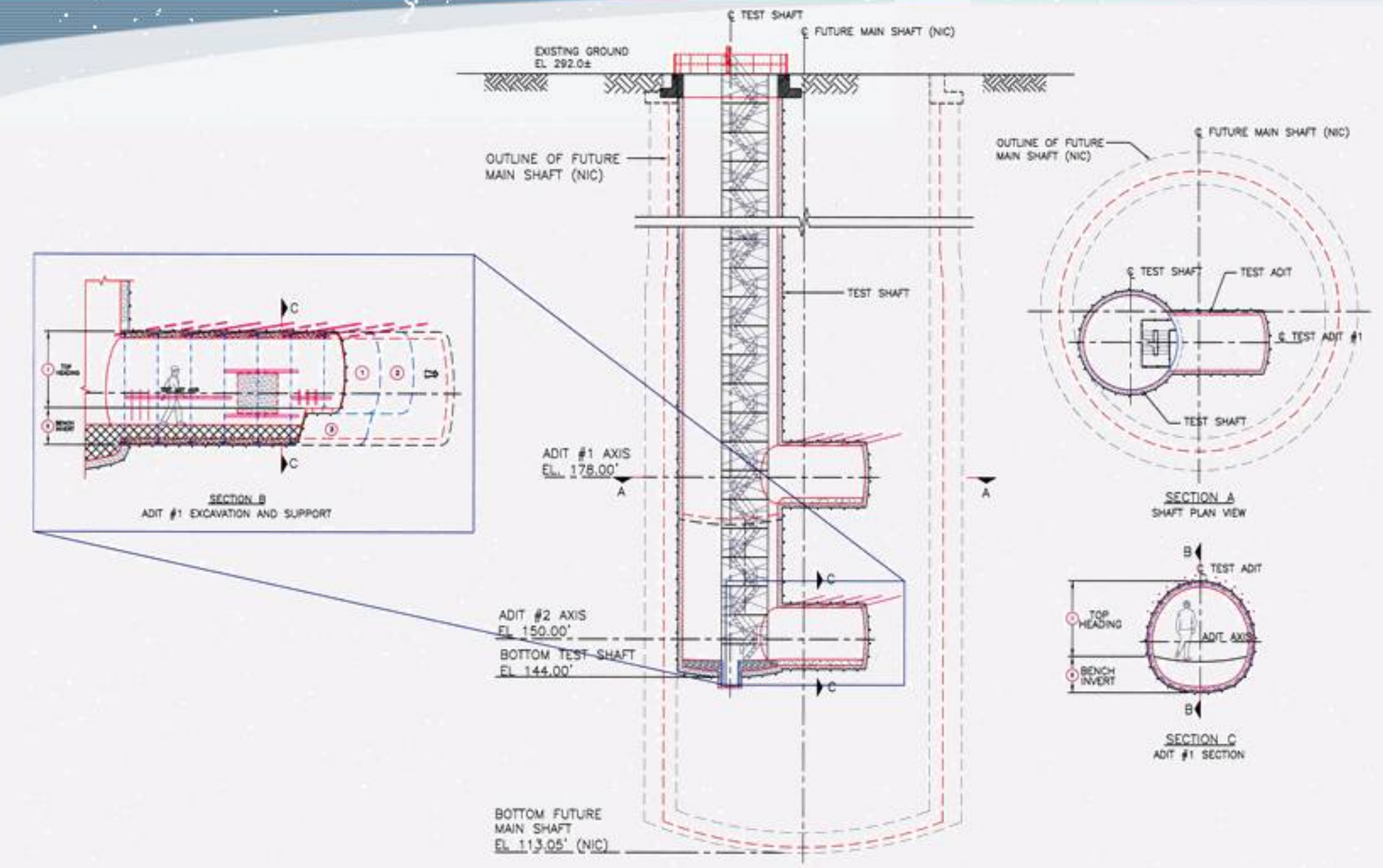
WATERPROOFING



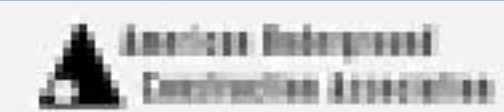
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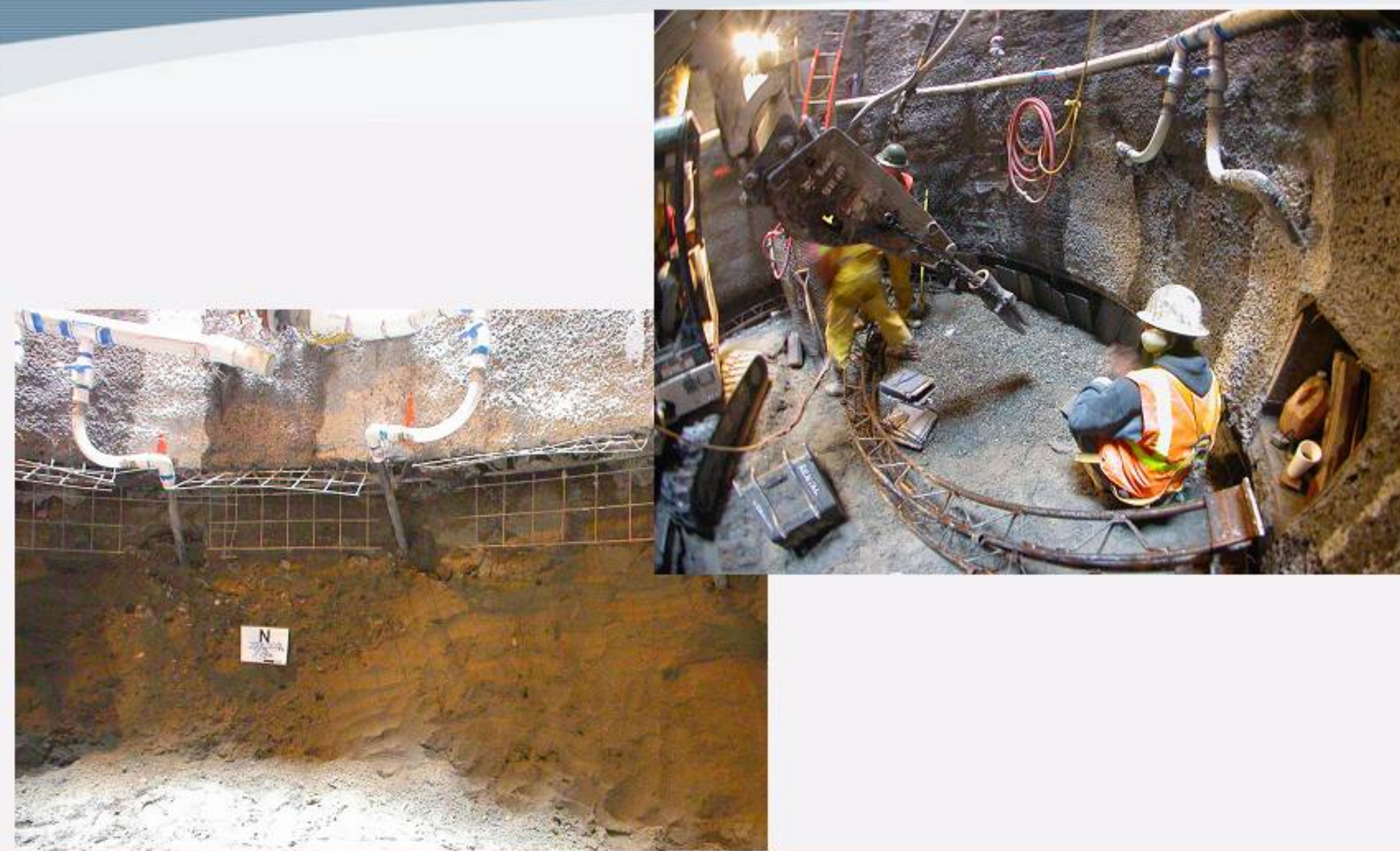
TEST SHAFT PROGRAM



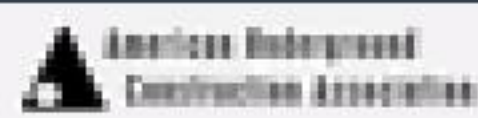
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TEST SHAFT CONSTRUCTION



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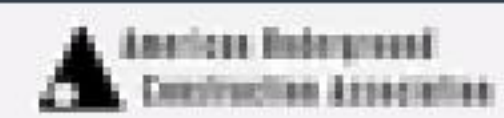
PROJECT STATUS



- Design complete: 12 / 15 / 2003
- Bids due: 05 / 07 / 2004
- Expected NTP: 06 / 2004
- Start Construction: late Summer 2004

“Excitement is Building!”

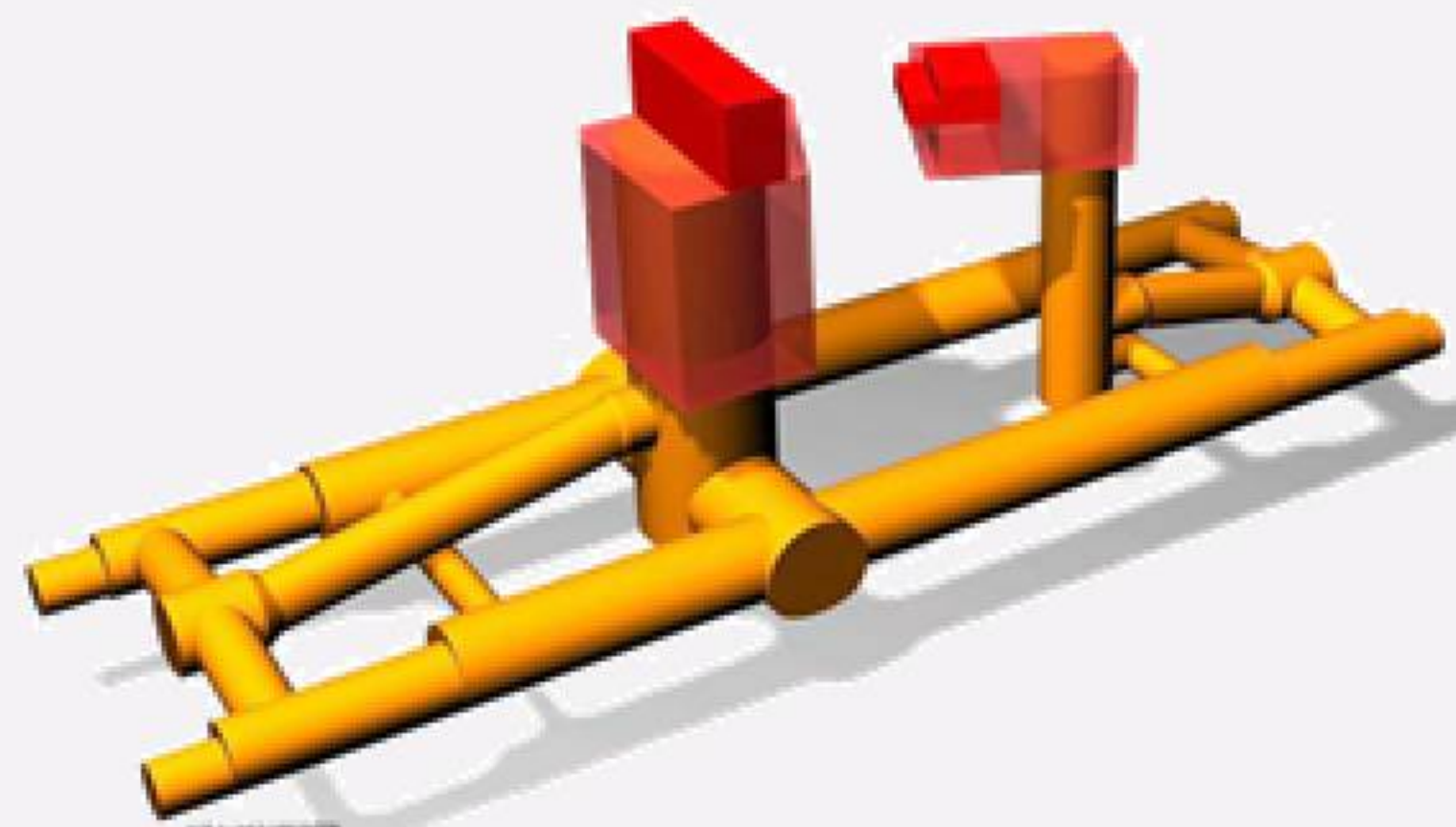
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PROJECT STATUS



THANK YOU !



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