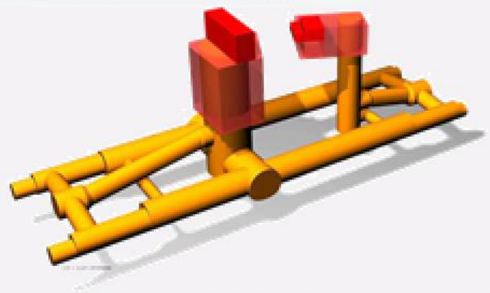
"Benchmark for the Future:

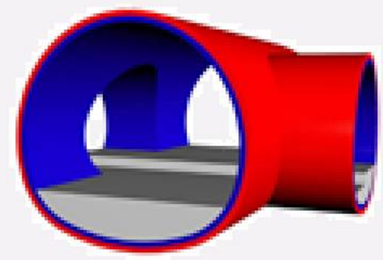


The largest SEM Soft Ground Tunnels in the United Stated for the Beacon Hill Station in Seattle, WA"

Juergen Laubbichler, Dr. G. Sauer Corporation
Gerhard Urschitz, PE, Dr. G. Sauer Corporation
Thomas Schwind, Dr. G. Sauer Corporation

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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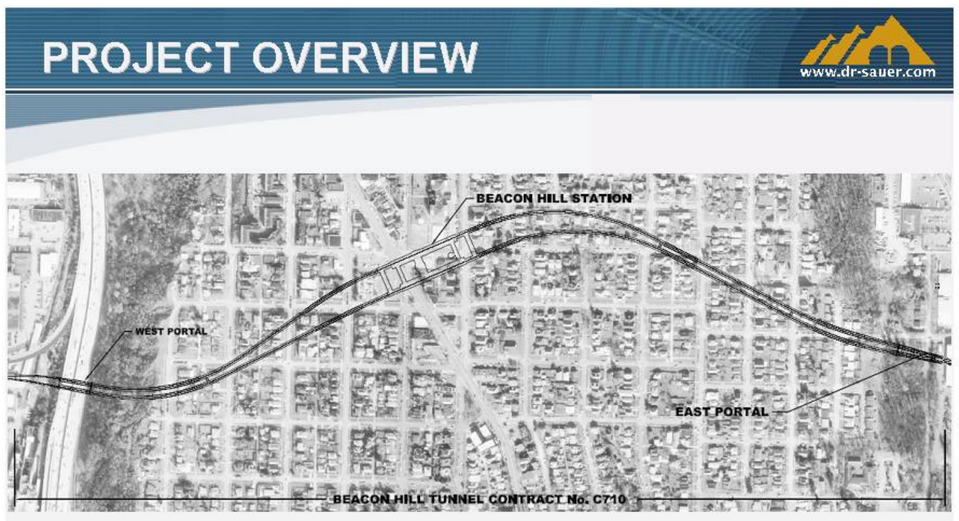
PROJECT OVERVIEW



- 4,300 ft Running Tunnels
- Deep Mined Station

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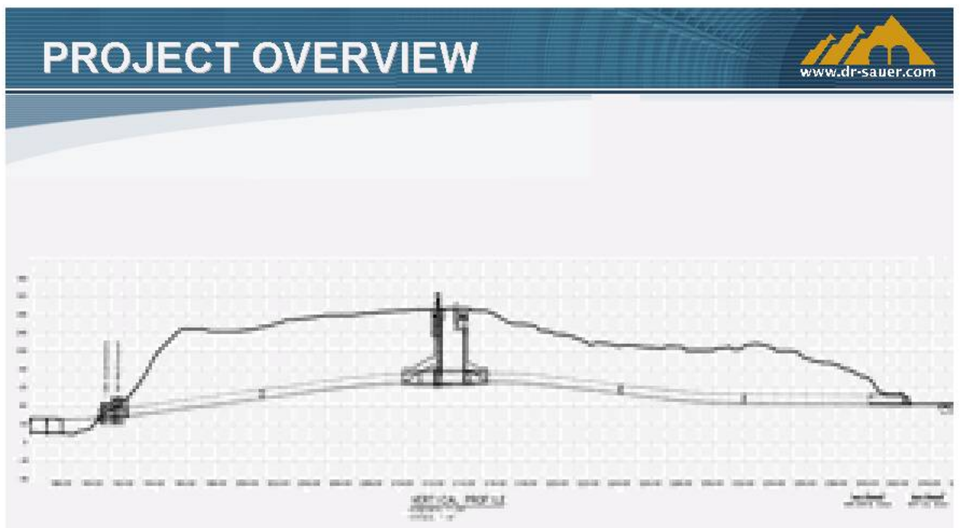
PROJECT OVERVIEW



- 4,300 ft Running Tunnels
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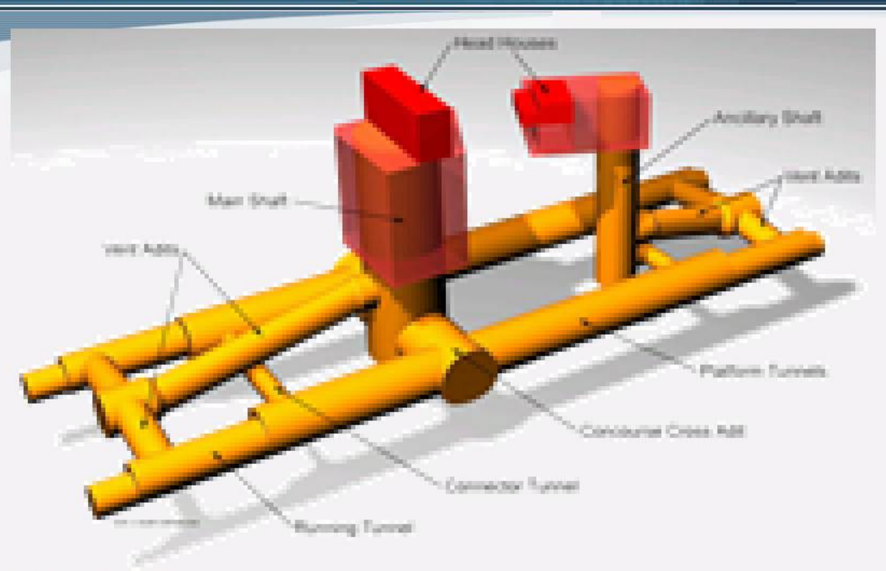
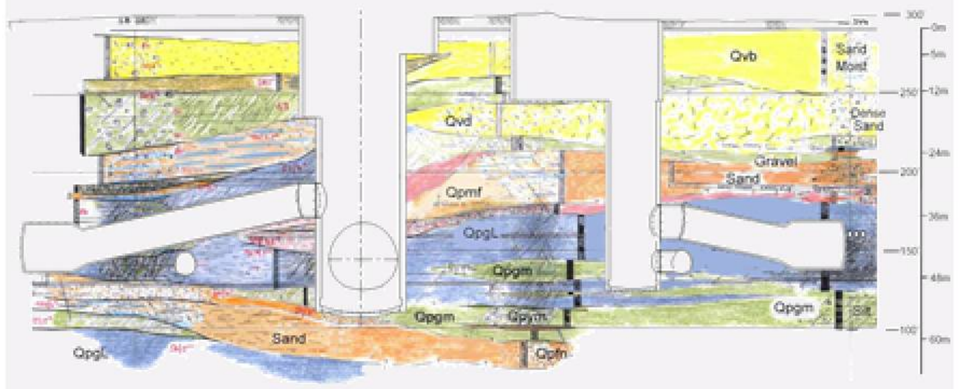
PROJECT OVERVIEW



DESIGN ISSUES

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

GEOLOGY



GEOLOGY

PRESCRIPTIVE DESIGN

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

"SEM TOOLBOX ITEMS"

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

"SEM TOOLBOX ITEMS"

- Pre-Support
- Face Support
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- Excavation

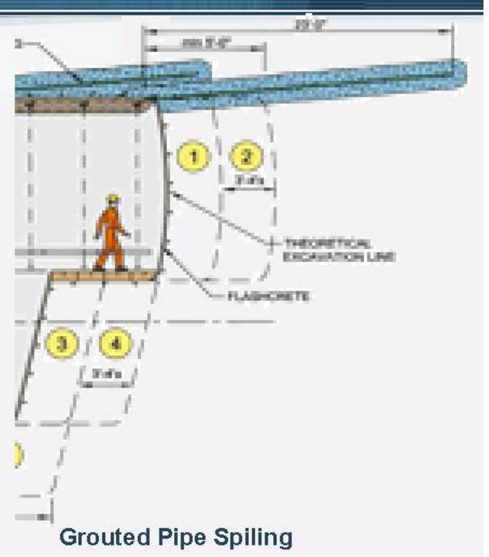
➢ Installation as required

➢ Unit Price

PRE – SUPPORT

Rebar Spiling

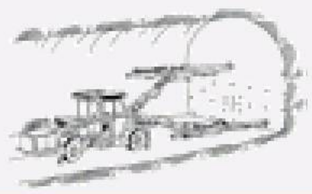
Metal Sheets



Grouted Pipe Spiling

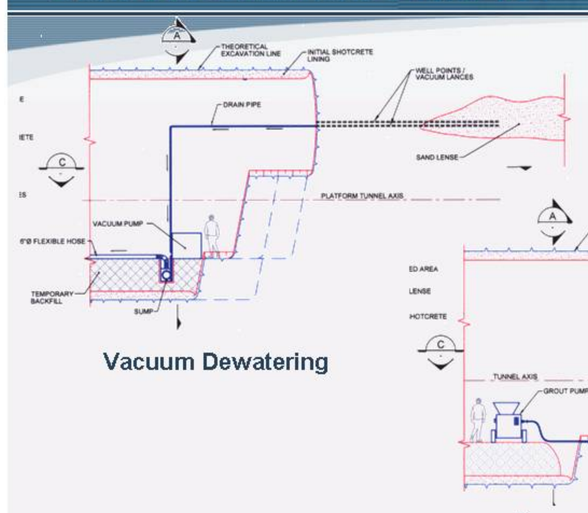
FACE SUPPORT

Face Bolts



Face Support Wedge

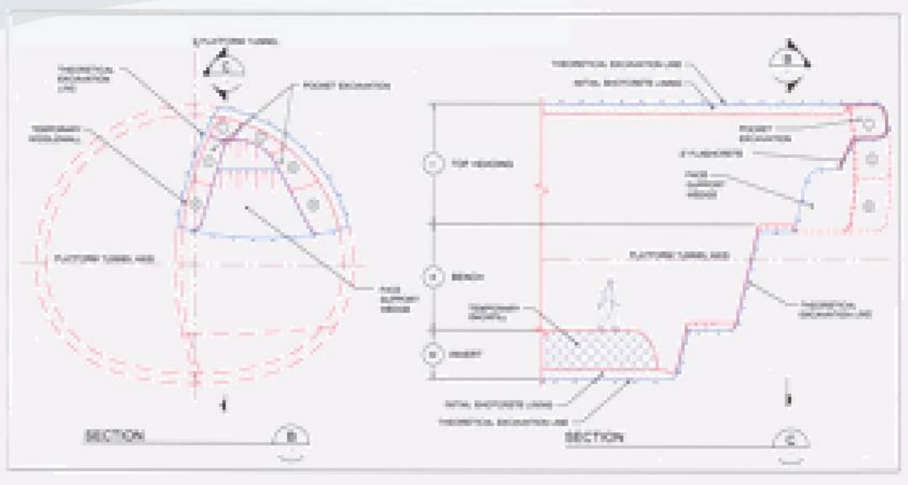
GROUND IMPROVEMENT



Vacuum Dewatering

Permeation Grouting

EXCAVATION SEQUENCE



ANNULAR SUPPORT

Additional Shotcrete

Soil Nails

SURFACE DEWATERING

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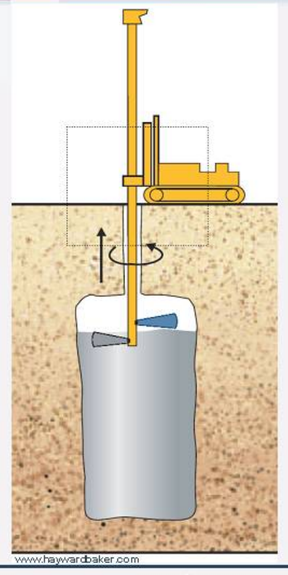
JET GROUTING



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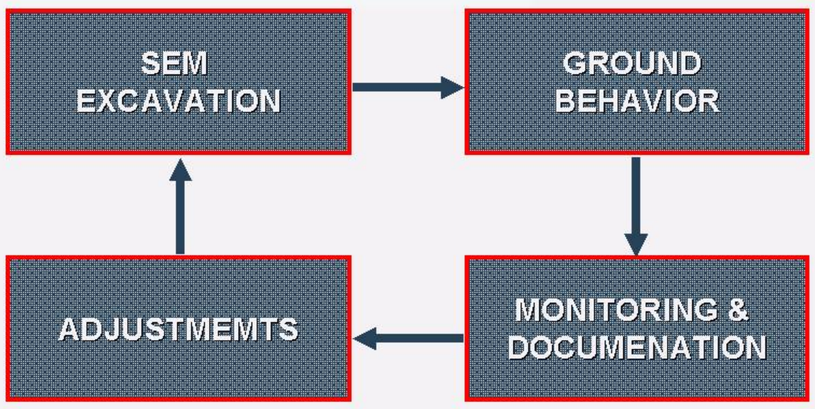
EXECUTION



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EXECUTION

- **Experienced Contractor**
- **Inspection and Supervision**

Russia Wharf, Boston, MA

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Beacon Hill Station, Seattle, WA

EXECUTION

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

Russia Wharf, Boston, MA

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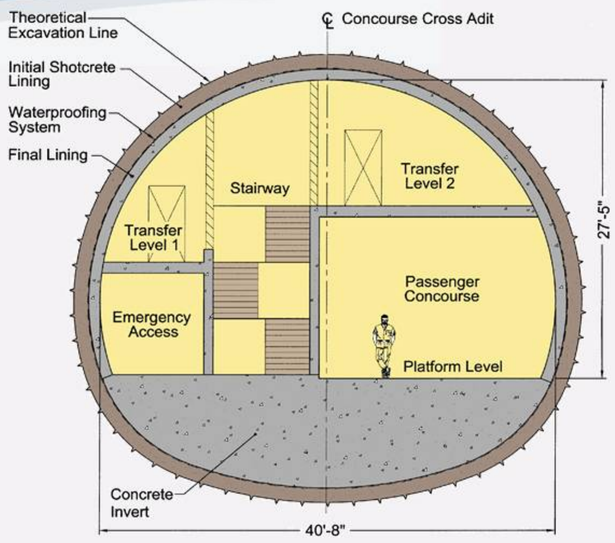
Beacon Hill Station, Seattle, WA

CONCOURSE CROSS ADIT



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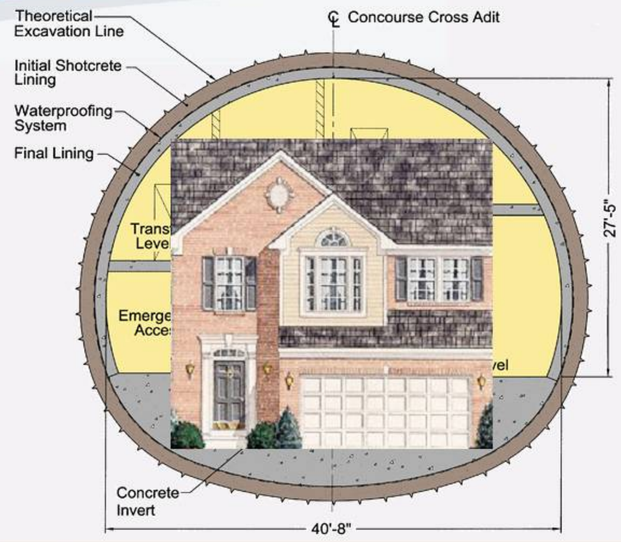
CONCOURSE CROSS ADIT



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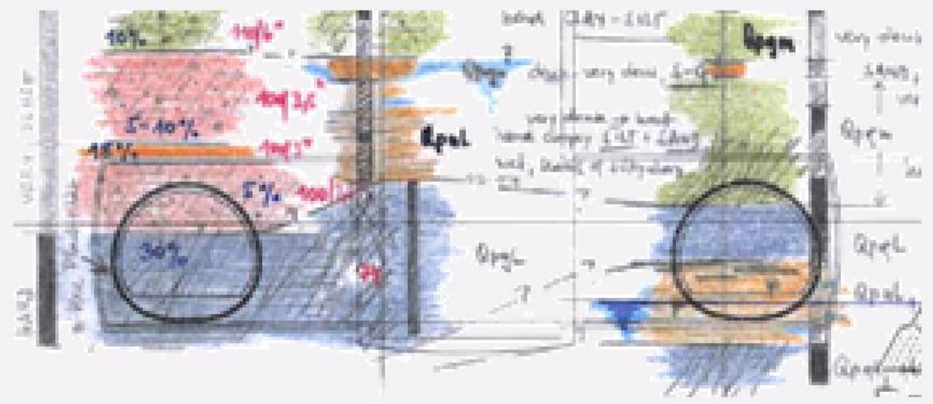
CONCOURSE CROSS ADIT



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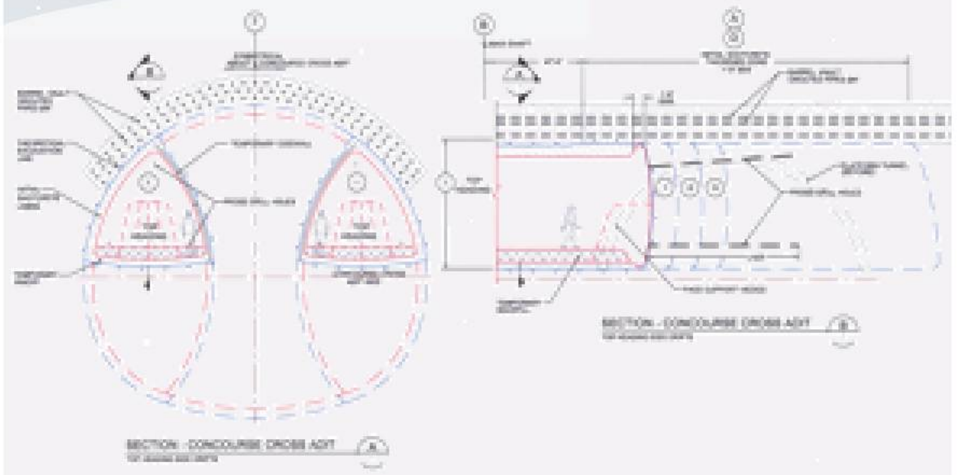
DUAL SIDE WALL DRIFTS



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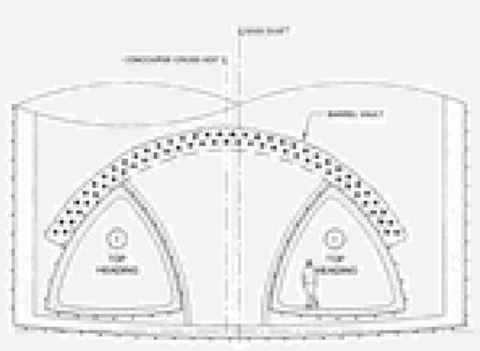
BARREL VAULT METHOD



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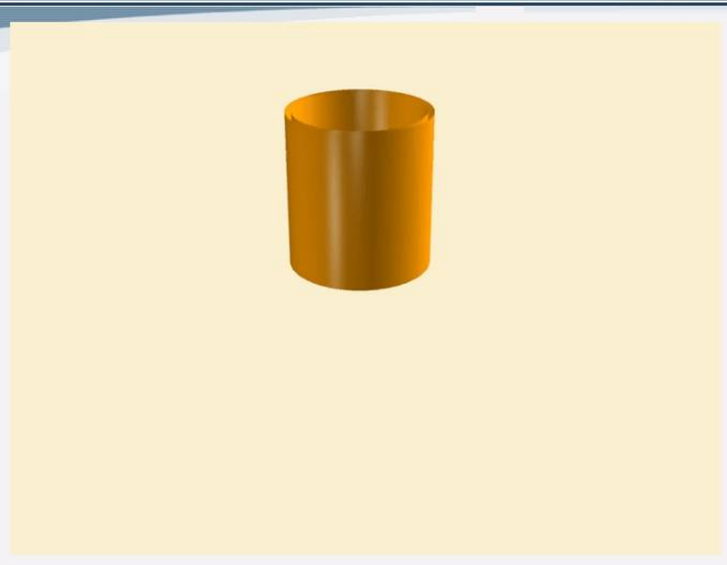
SEQUENCE



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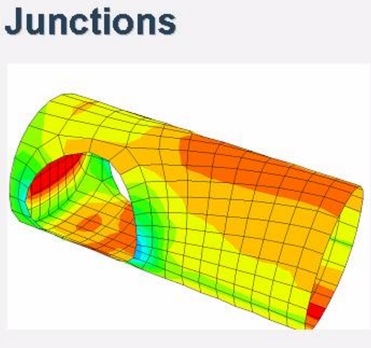
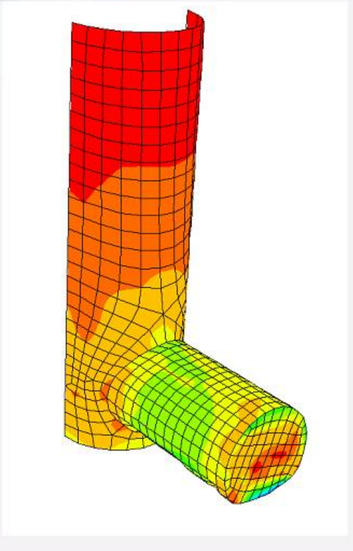
FE ANALYSIS

- 3D ABAQUS
- ~ 190 Excavation Steps
- Junctions





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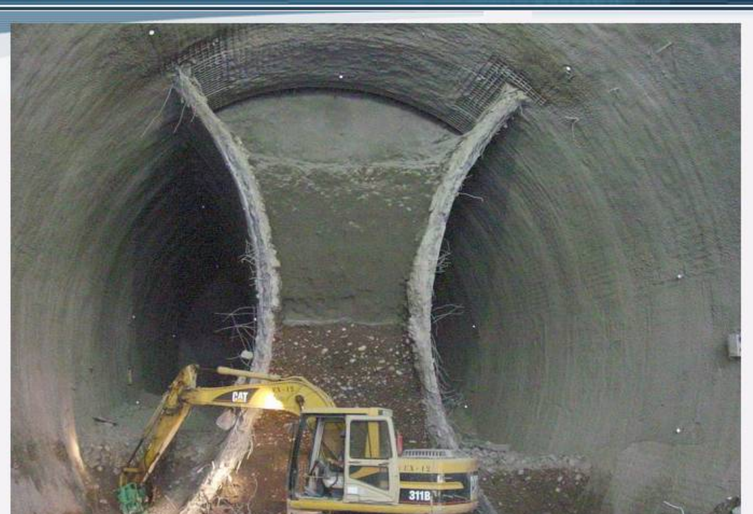
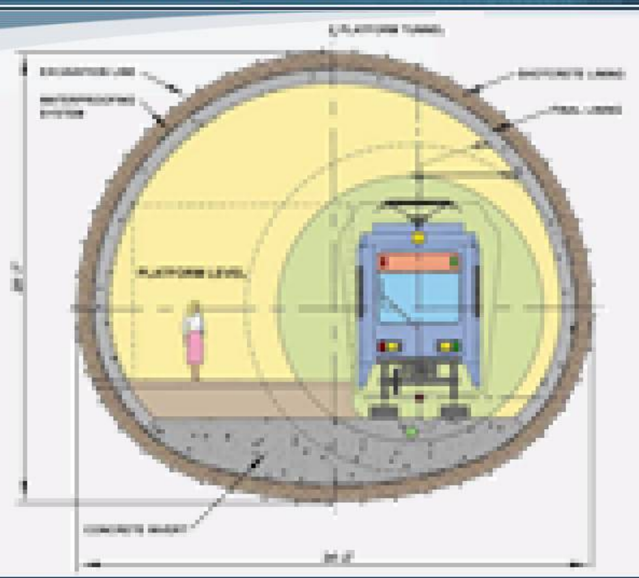
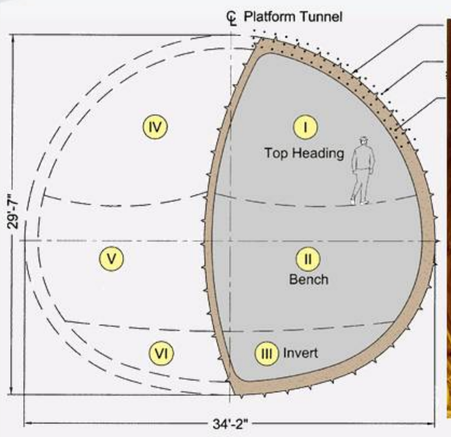
“UNDER CONSTRUCTION”



PLATFORM TUNNELS



SINGLE SIDE WALL DRIFT



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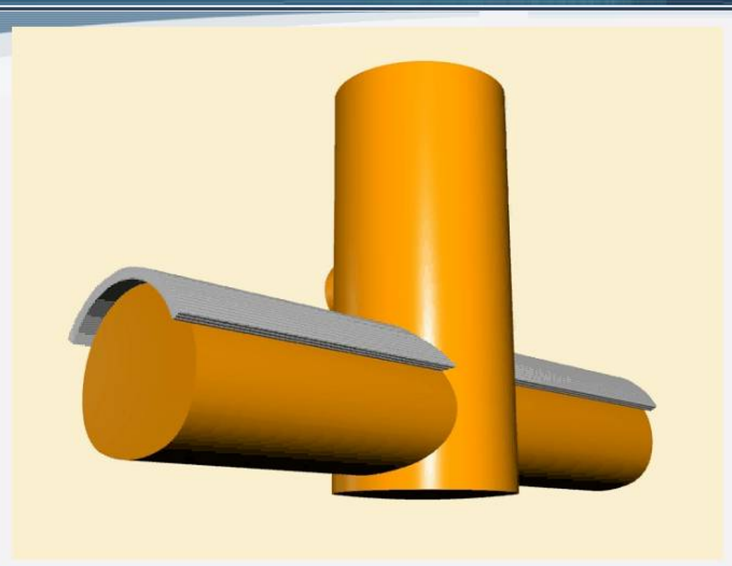
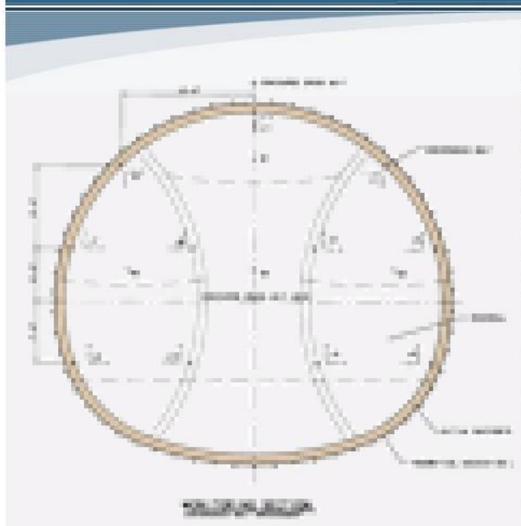
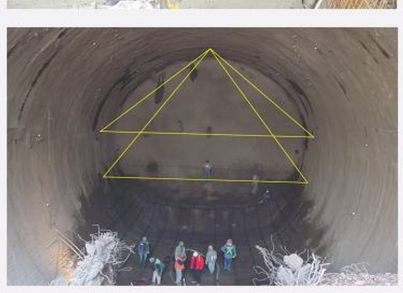


MONITORING





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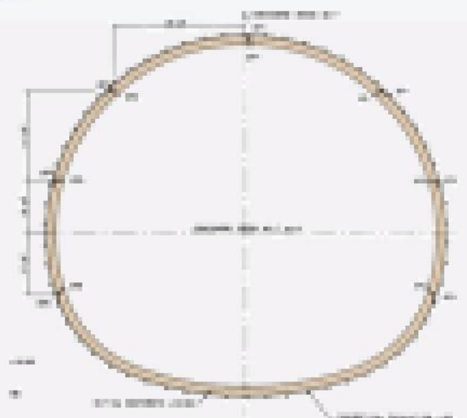
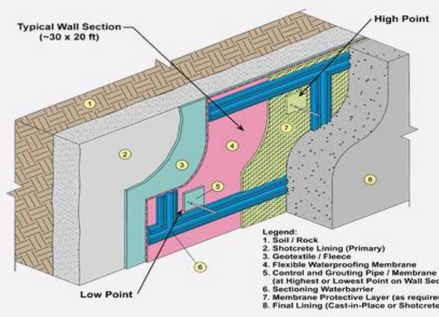
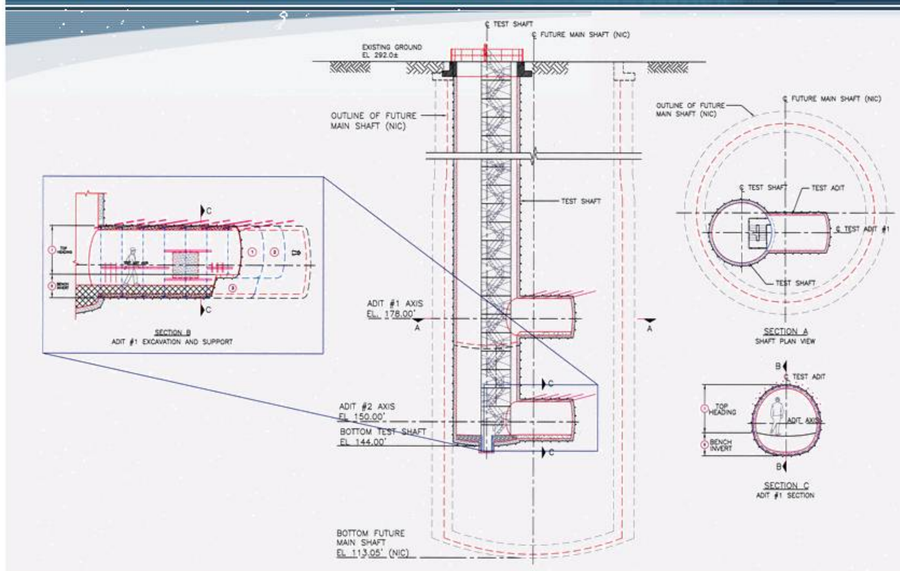


WATERPROOFING



TEST SHAFT PROGRAM



TEST SHAFT CONSTRUCTION

PROJECT STATUS

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

"Excitement is Building!"

PROJECT STATUS

THANK YOU !