



American Underground Construction Association **NAT 2004**
Atlanta, GA

**NATM Tunneling Through Frozen Ground at Russia Wharf –
The Designers' & the Contractors' View**

Gerhard Urschitz – Dr. G. Sauer Corporation
Christian Neumann – Beton- und Monierbau
Stephen DeGrosso – Modern Continental


MODERN CONTINENTAL
Beton- und Monierbau

Agenda

- Introduction of the Team
- Project Description
- Design Development
- Instrumentation and Monitoring
- Contractor's VECPs
- Challenges during Construction
- Summary

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Key Members

Key Members of the Project Team:

- DMJM+Harris – Lead Designer
- GEI Consultants - Geotech
- Mueser Rutledge – Underpinning, Ground Freezing
- Jenny Engineering – Immersed Tubes


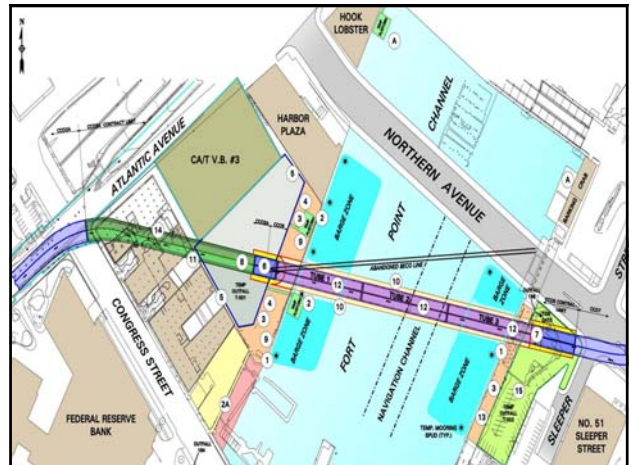
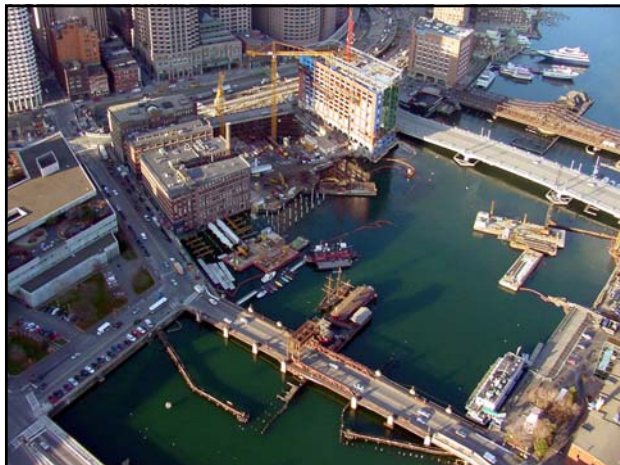
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Short Overall Project Presentation

Contractors View
Steve DeGrosso

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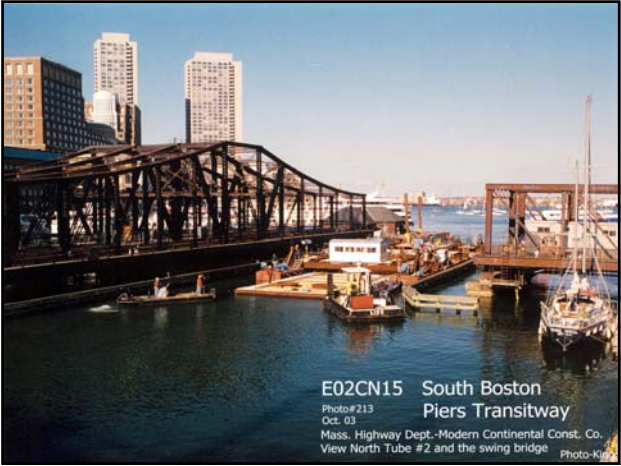
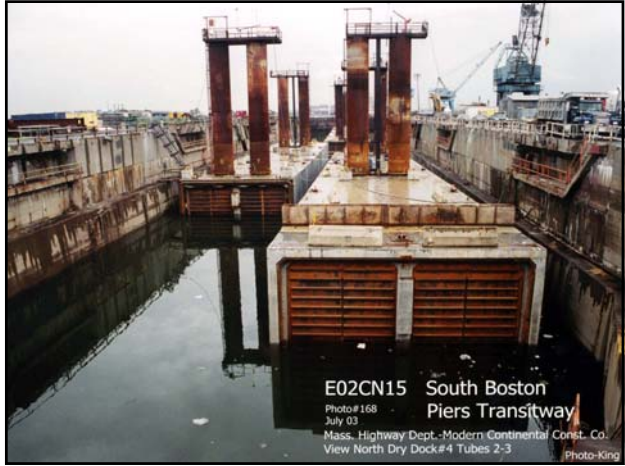
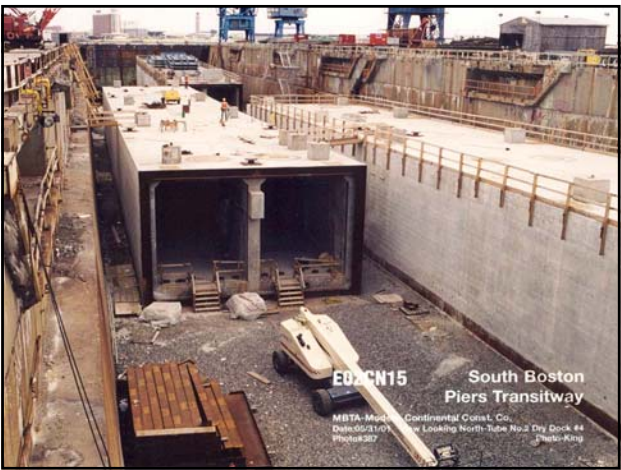




Contractors View



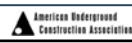
Immersed Tube Tunnel

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Underpinning & Ground Freezing

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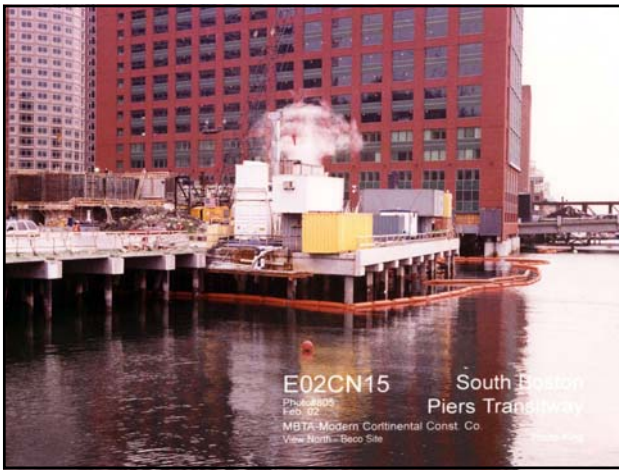
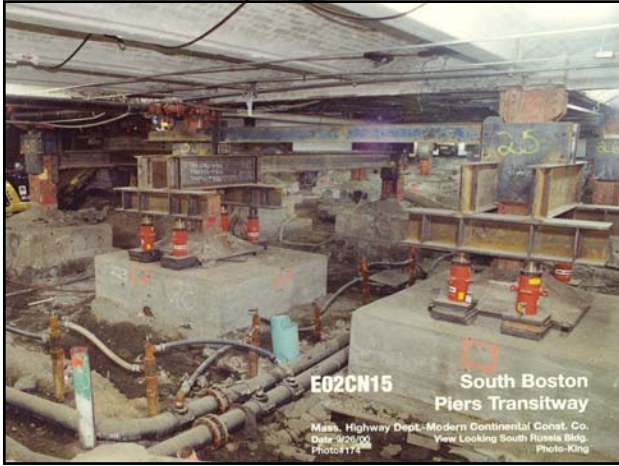


RUSSIA WHARF
BOSTON, MA

Russia Building Foundation

- Granite Blocks
- Timber piles
- Frozen ground
- NATM Tunneling

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Design and Supervision

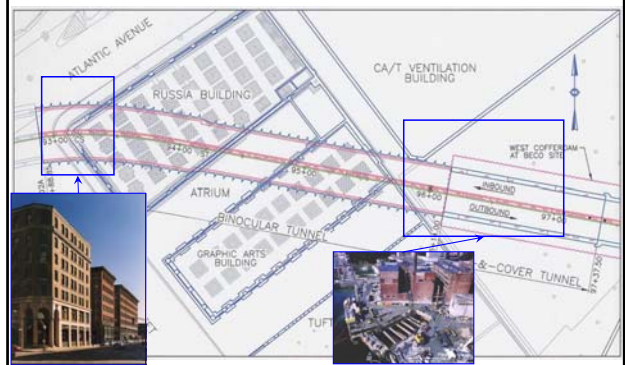
Designer's View

Gerhard Urschitz

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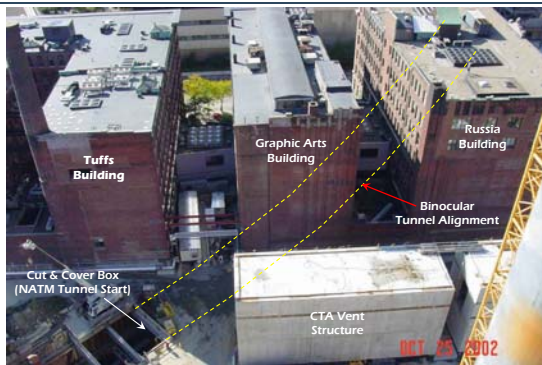
Site Plan



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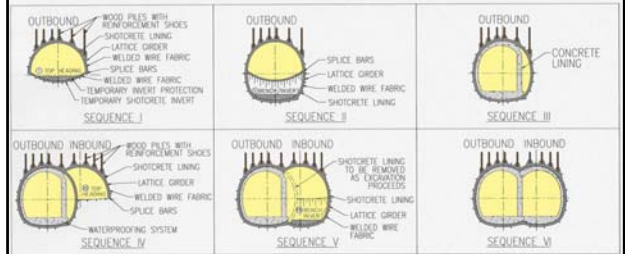
Site Aerial View



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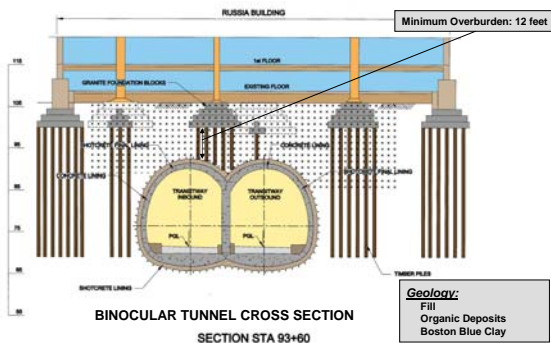
Construction Sequence



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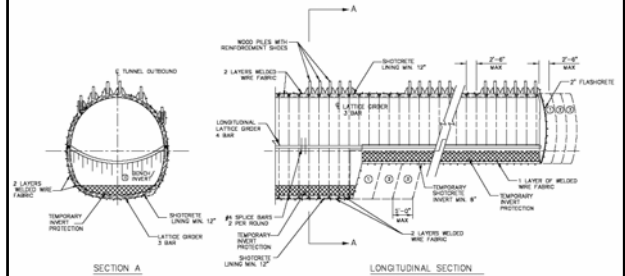
Typical Cross Section



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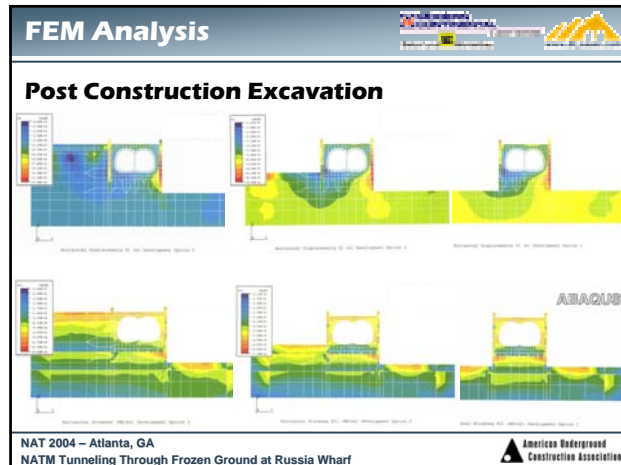
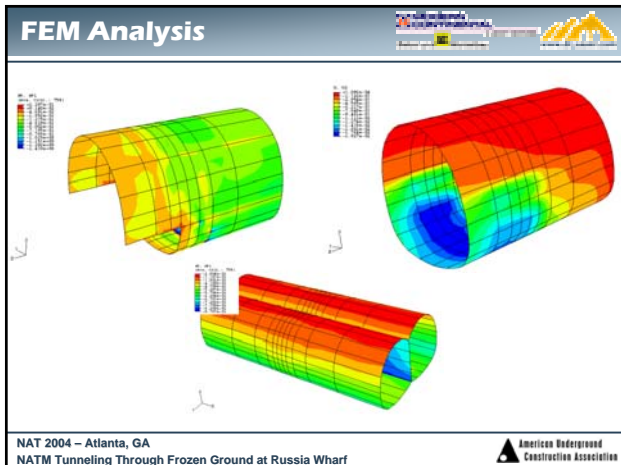


Excavation & Support

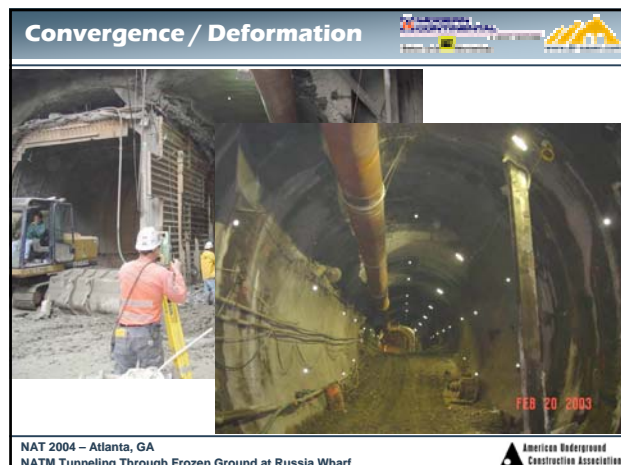
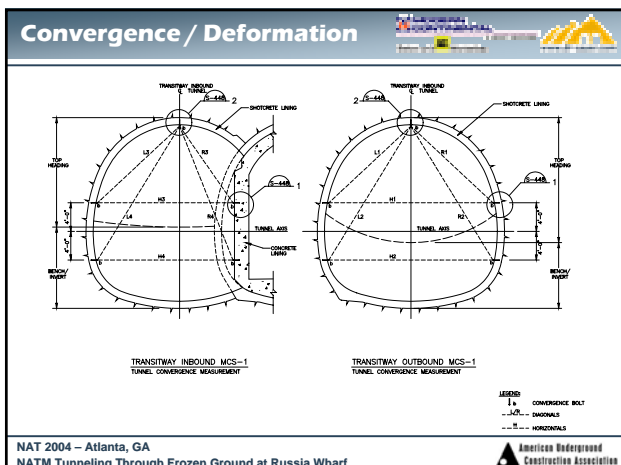
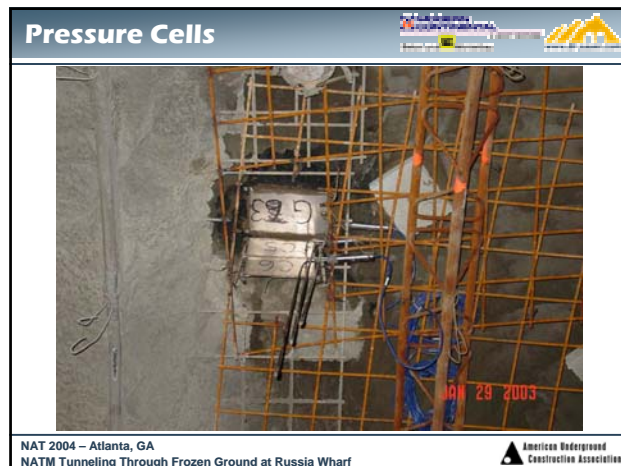


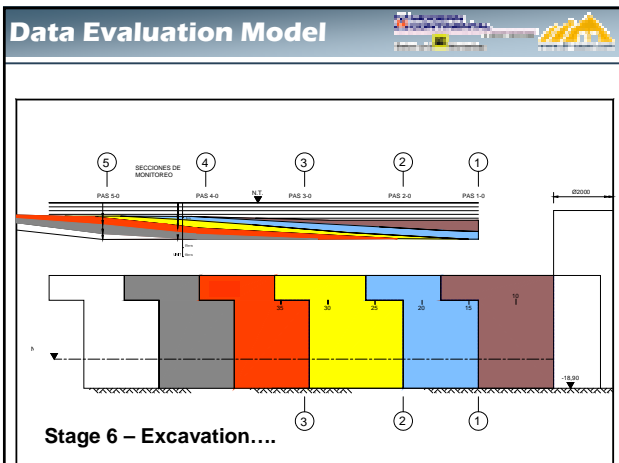
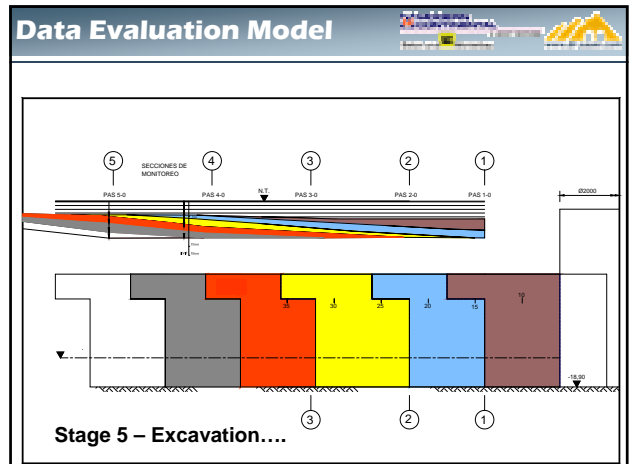
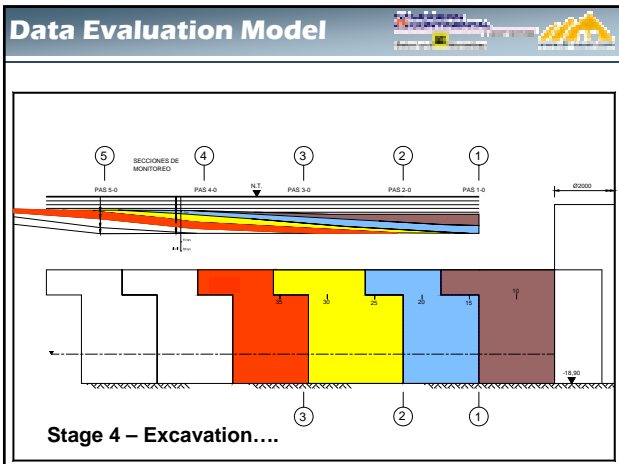
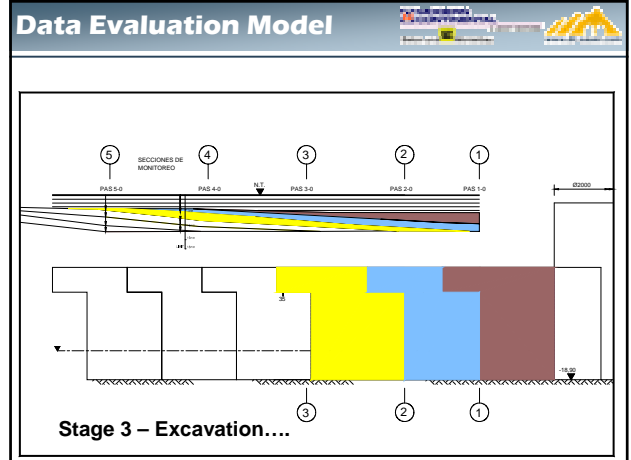
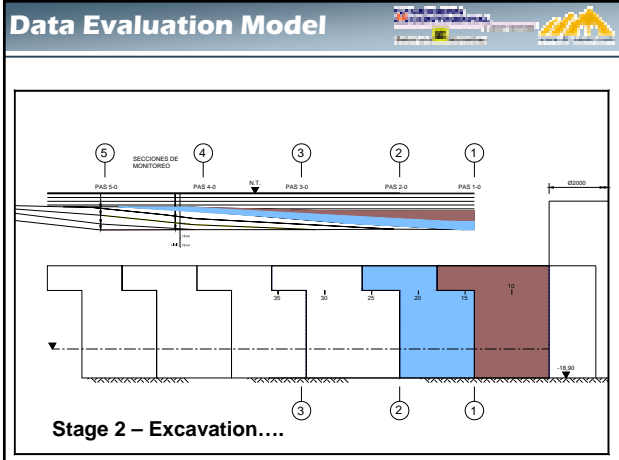
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- ### Instrumentation & Monitoring
- Instruments used at Russia Wharf :**
- Surface / Building Monitoring Points**
 - Tiltmeters**
 - Probe Extensometers**
 - Deformation Points (DMP's)**
 - Convergence Points**
 - Pressure Cells (ground, shotcrete, pile load)**
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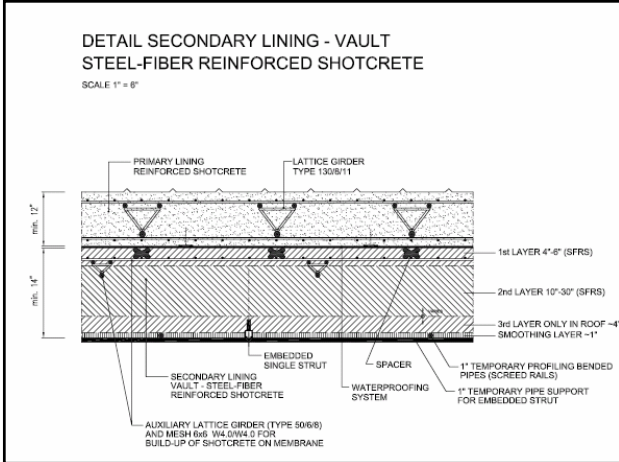
Construction Supervision

- Designer retained for Inspection Services – Team Approach
- Quickly responded to RFIs & Changed Conditions
- Efficiently supported VECPs

The figure contains two images. On the left is a line graph titled 'Thickness of Structure, Ring #4 to #10 Top Reading Section 8, Truss Bay'. The graph shows multiple data series over time, with a legend on the right. On the right is a photograph of two construction workers in safety gear standing in a tunnel, with a date stamp 'July 11, 2004'.

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Contractors View

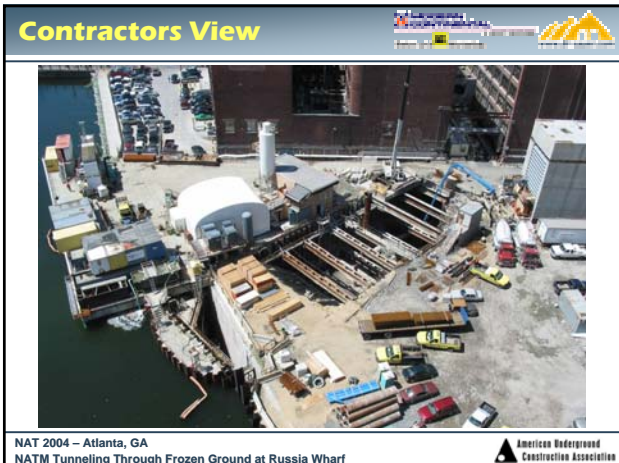
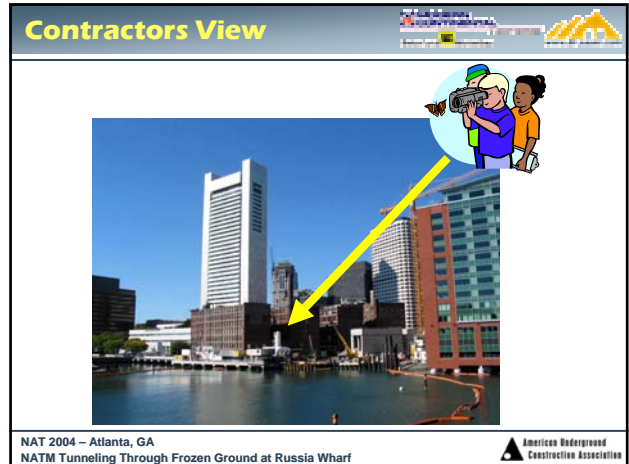
NATM Tunneling

Contractors View

Christian Neumann

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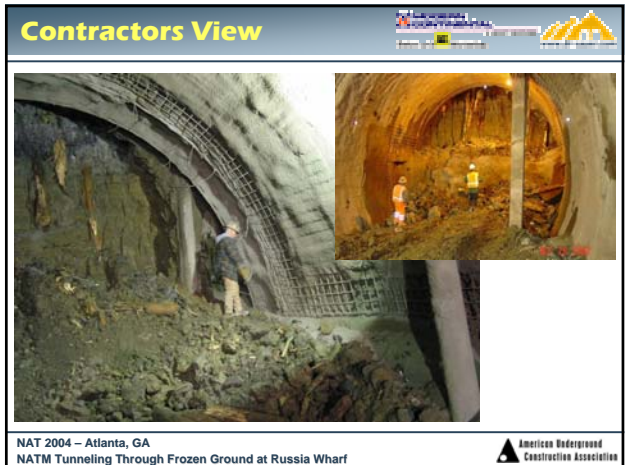
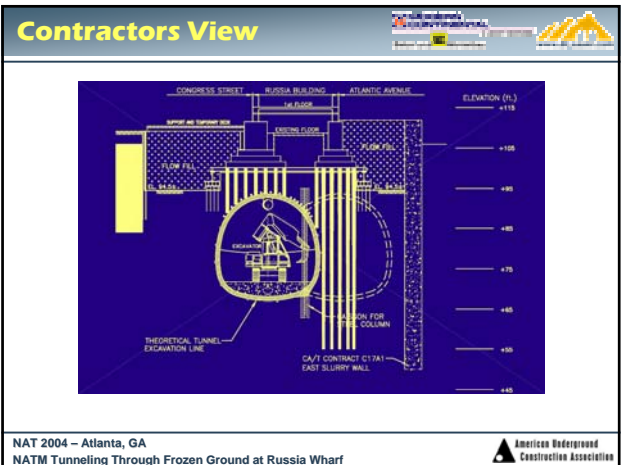
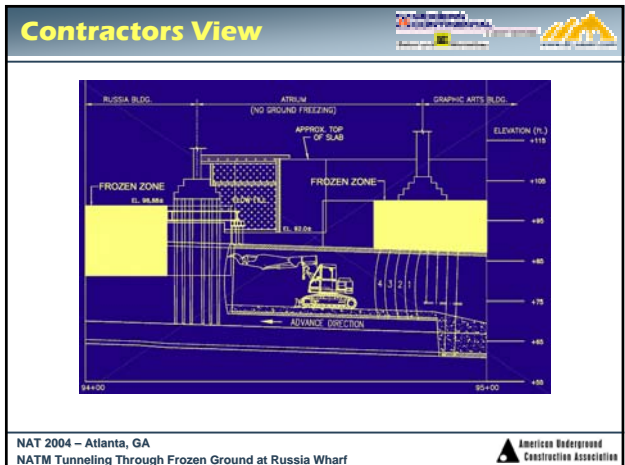


Contractors View

Contractors Task

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Contractors View

NATM Tunneling:

- Think Design and Cycle in Cross Section + Longitudinal Section

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TBM Tunneling:

- Everything is **Driven by the Machine**
- Decisions to be made mainly before you ever start driving the Tunnel

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Contractors View

NATM Tunneling:

- Everything is **Driven by Decisions at the Tunnel-Face**
- Decisions to be made mainly short before you excavate
- **Experienced Manpower** is the key to success

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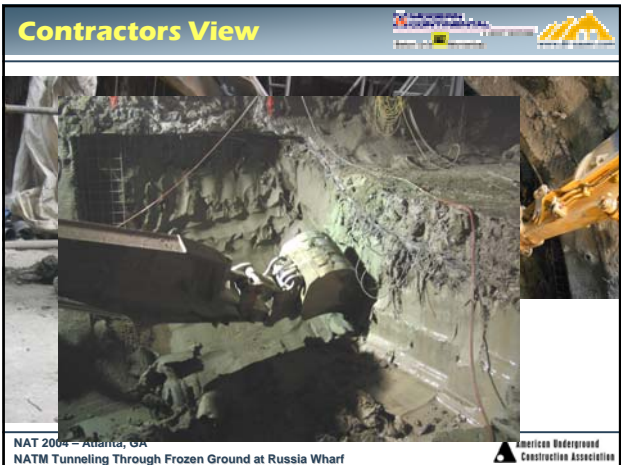
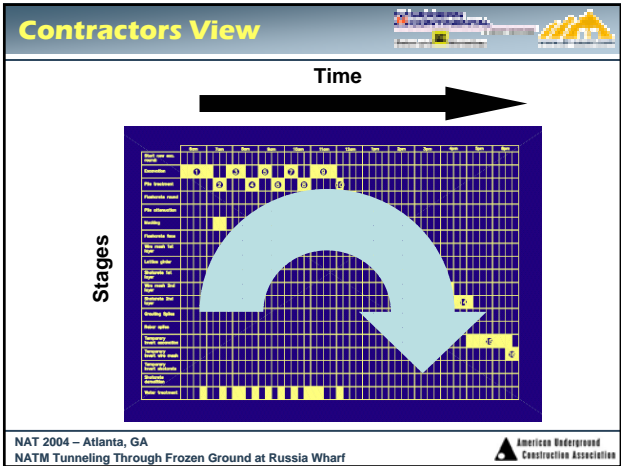
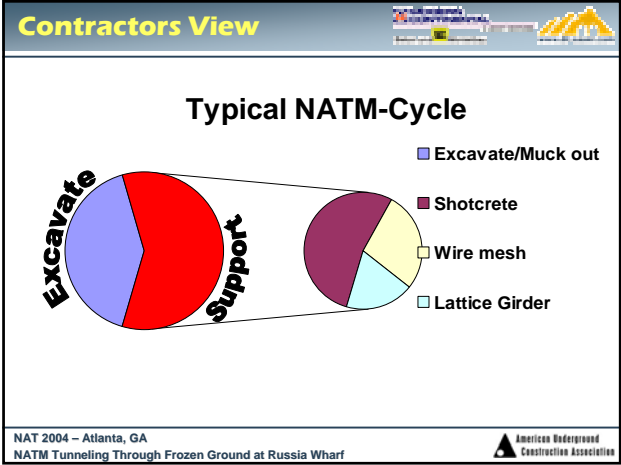
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NATM Tunneling with Local Labor:

- NATM requires Experience and Training
- Try to **limit decision-making at the face** to the absolute minimum!!

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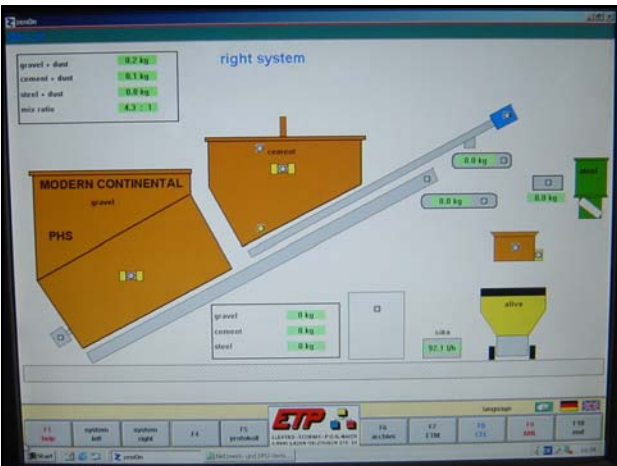
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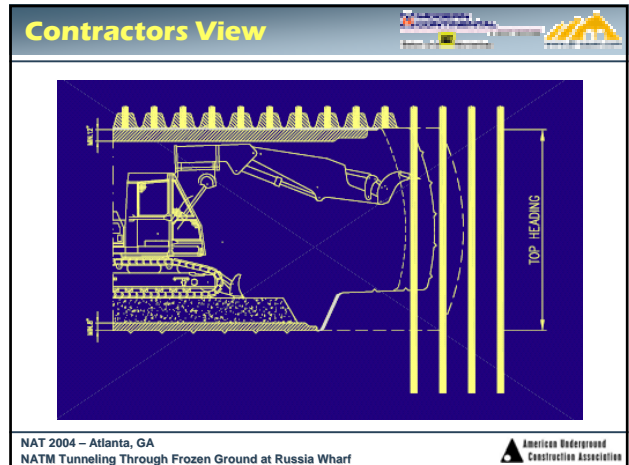
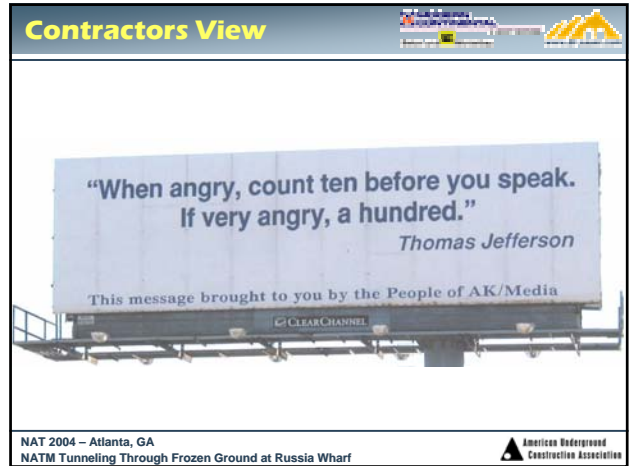
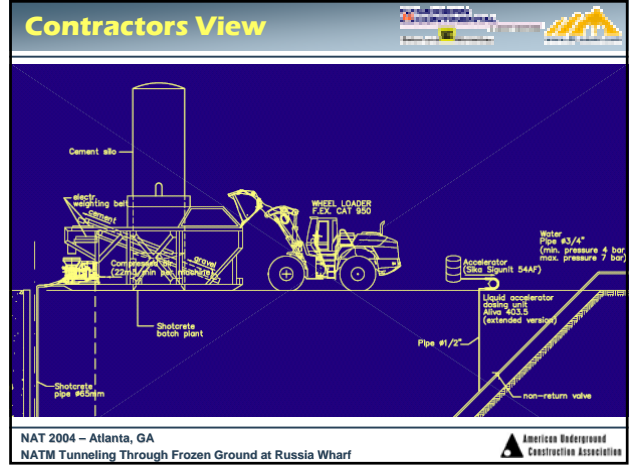
Support

- PHS Shotcrete Plant – PHS, Austria
- (2) Aliva AL 262 Shotcrete Guns – Aliva, Switzerland



Contractors View





Contractors View

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WOOD PILE IN TUNNEL SHOULDER DETAIL FOR GRAPHIC ARTS BUILDING

SCALE: 1/2" = 1'

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- 1) SURROUND BACKFILL OF THE CRACKS/JOINTS WITH GROUT TO PREVENT CLAY FROM MOVING INTO THE TUNNEL.
- 2) SURROUND THE PERMANENT PILE WITH A REINFORCEMENT LAYER (200G MESH).
- 3) METAL FIRST LAYER OF WELDED WIRE FABRIC IN BACKFILL AND OVERLAP THE REINFORCEMENT WITH THE REINFORCEMENT BOX-OUTS.
- 4) INSTALL LATTICE GIRDER IN BACKFILL AND SPRAY FIRST LAYER OF SHOTCRETE.

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Contractors View

Conclusions:

- Boston's Russia Wharf was a very difficult project for the both the Designers and Contractors.
- Although it was a unique small project when considering total tunnel length, but
- It was a **Laboratory** for a lot of challenging situations, surely to be encountered in the future.
- Almost everything what is technically possible with NATM was done at this project!

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How this can be achieved?

- **JOINTLY** between experienced Designer and experienced Contractor
- **New Partnership with Tunnel Labor**

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Thank You

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