Bellows Falls Tunnel

Track Lowering Project for Modified Double Stack Container Cars and Auto-Racks

ECI Rail Constructors, Inc.
Kenneth A Pidgeon, PE
Circa 1913 during flood
Project Background

• Project Costs:
  - $2.5M Construction
  - Funded by VTrans/FHWA/Rail America

• Objectives for State/Fed:
  – Reduce I-89 and I-91 Heavy Truck Traffic
  – Enhance VT’s Transportation System
Project Team

• Owner: New England Central Railroad - Rail America

• Engineer: VTrans (Rail & Structures Divisions)
  Parsons Brinckerhoff

• Contractor: ECI Rail Constructors, Inc.
  – Thomas Drilling & Blasting (Rock Removal)
  – Acme Waterproofing (Shotcrete)
  – Bazin Brothers (Local Excavation Company)
About the Tunnel

• Stone Arch – Cut & Cover Construction
• 280 ft long x 12 ft narrow
• Constructed in 1850s
• Invert Lowered Twice Previously (1950s and 1970s)
• Overlying Hotel & City Street
• Crossing at South Portal is only access to Municipal Sewer Treatment Plant
South Portal – June 2006
North Portal – August 2005
Here first Canal in United States was built in 1802

The British-owned Company, which was chartered to render the Conn. River navigable here in 1791, was 10 years building the 9 locks and dam around the Great Falls, 52 ft. high. After the railroad came in 1849, river traffic declined and the canal was used for water power only.
Stone Arch Construction
Built in 1850s
Historic Hotel and City Street above the Tunnel
Project Criteria

• Lower Track about 2.5 feet to provide a minimum 19’8” clearance
• Maintain a horizontal clearance envelope of 11’8”
• Maintain Train Traffic with an allowance for:
  – A 1-day shutdown for the grade crossing work
  – A 3-day shut down for final profiling
• Minimize Closure of Mill Street
Illustrative Profile

- Commercial Building
- City Street
- Hotel
- TUNNEL
- New Clearance of 19'8" min.
- Mill St.
- Existing 2% grade
- Original Track Elev.
- New Track Profile
- Canal
Railroad Coordination

- ECI Served as RR Flagger
- ECI Set out Derails & Removed
- Amtrak Passed through at 12:00 and 5:30
- Freight Traffic at Night
- ECI work Windows:
  - 4:00 am to 11:45 am
  - 12:00 noon to 5:30 pm
ECI’s Foreman Strobel Sets out the Derail
Construction Hardships

- Restricted Working Times & Long Days
- Poor Lighting: Better Light = Better Work Quality
- Unexpected Subsurface Conditions
- Limited Access: Tunnel work is a linear chain process (no equipment movements around internal activities)
- Limited number of activities could occur at once
Early 4:30 am Shift Starts Required Working in Dark Conditions
Working Room Was Limited, Operations are Linear, & Poor Lighting
Obstructions & Unexpected Conditions
Construction Phases

1. Mobilize: Tunnel Lighting, Office Trailer, Security Cam, Staging Areas, Access (9/06)

2. Relocate Sprint & RR Comm Lines

3. Relocate UG Utilities at Crossing

4. Rebuild Crossing Area (Tracks & Street)
Construction Phases (cont.)

6. Shotcrete Work: Crash Wall Repairs, Ceiling Joints, New Retaining Wall (NW)

7. Dap Bridge Ties

8. Cut rail in 13 ft sections, drill, add joint bars

9. Line Drill Rock Areas

10. Rock Removal (2,077 cubic feet)
Construction Phases (cont.)

11. Underpinning (551 linear ft)

12. Cast-in-Place Retaining Wall (NE)

13. Lower Track to New Profile about 2 ½ ft (8/07)

14. Install Continuous Welded Rail

15. Final Paving/Reset Communication Lines/Demobilization (9/07)
Sprint & RR Communication Lines Were Relocated and Moved Back After Construction
Repaired Crash Wall – by Shotcrete
13 ft Track Sections Removed in Work Areas Twice Daily
Grade Cross Replacement at Mill Street
Amtrak Passes at 12:00 noon and 5:30 pm
Subcontractor DL Thomas
Drilling & Blasting Rock in Tunnel
Hydraulic Splitting and Hammering also Used
Rock is Removed After Blast
Hydraulic Rock Splitting Required where Tunnel was Supported on Soil with Shallow Rock
Shotcrete was used for Crash Wall Repairs, Ceiling Joint Fill, and Retaining Walls
Dapping Bridge Ties to Lower Rail
Underpinning

• Traditional Underpinning:
  - Typically a series cast-in-place concrete units below an existing foundation serving to extend the depth of the footing

• At Bellows Falls Tunnel:
  – Underpinning consist of soldier piles, steel plate lagging, and steel cross bracing
  – More accurately called permanent excavation support
BELLOWS FALLS TUNNEL
UNDERPINNING DETAIL

TYPE I - SOIL PILE

1840'S GRANITE BLOCK TUNNEL
1950'S CONCRETE UNDER PINNING
1970'S CONCRETE UNDER PINNING

1/2 LAGGING PLATE IN 1 1/2 SLOT (TYP)
6'-0" TIE
GREASED GUIDE SLOT
BALLAST
GREASED GUIDE SLOT

STRUT 1SS 4X4

GRANULAR SOIL
TOP OF ROCK
GROUT
2-H14 REBAR PINS GROUTED INTO ROCK AND STEEL TUBE WELDED TO SOLDIERS

TYPE II - ROCK PILE

W1O SOLDIER PILE @ 4'-4" D.C. (TYP)
16" DIA. CONCRETE
GRANULAR SOIL

11'-8" CLR
TRAIN ENVELOPE
5'-10"
5'-10"
3'-6"

Courtesy of PB
Soldier Piles: Coped End, Lagging Guide Plate, Stiffeners, Strut Bracket, Innerduct Holes

# Piles = 148
Length = 6’0”
Spacing = 4’4”
Underpinning

1. Insert Piles (vacuum excav) & Grout
2. Insert Cross Struts
3. Insert ¾” Steel Lagging Plates & Grout
Grout Plant  Installation

Approximately 2,000 bags of grout
Labor-Intensive Chipping of Existing Granite Blocks Was Required to Maintain Clearances
Amtrak Passed at Mid-Day Which Interrupted All Tunnel Work
Strut Bearing Against Rock Face
Installing Steel Laggings
The Blitz

• 3 Days Continuous (Aug 18\textsuperscript{th} – 20\textsuperscript{th})
  – Removed Track
  – Excavated to new Subgrade
  – Installed conduit
  – Trimmed Rock
  – Installed Ballast Stone
  – Installed Track
  – Surfaced, Aligned, Tamped
Excavation for Track Lowering was done with a Pavement Cold Planer.
First Train Passes Through Lowered Tunnel: 
August 20th
Installing CWR
Double Stack Test
Circa 1913,
Flood with Stop Logs in Place
Approx 14 ft vertical clearance

August 29, 2007
After Lowering Track
Min 19’8” Vertical Clearance
Questions?