Synopsis:
A 95-m long (310’) skewed Warren truss that carried a “Principle Urban Arterial” over the Seneca River/Barge Canal at Belgium, NY since 1949 was dismantled, shop rehabilitated, and re-erected over the Barge Canal at Plainville, NY. The old Belgium Truss Bridge, which spanned the Historic Barge Canal and was a contributing element to the Historic Canal District, was replaced with a new steel multi-girder bridge with a determination of “No Adverse Effect”. This project was the first to utilize the Canal Bridge Programmatic Agreement developed by SHPO, FHWA, and NYSDOT. Rehabilitation versus replacement alternatives were considered following the established hierarchy of the programmatic agreement. The former Belgium Bridge over the Canal was dismantled, rehabilitated, and re-erected on a “rural collector road” crossing the Canal at Plainville, NY. The rehabilitated truss was constructed on a new alignment and replaced the existing single lane historic truss bridge at Plainville.

The presentation will describe the alternatives investigated; explain why the truss was re-used; the construction processes involved in the relocation; the construction issues associated with a project of this nature; and the real costs of the project realized throughout construction. The project serves as a good litmus test for future bridge replacements over the Historic Canal using the Canal Bridge Programmatic Agreement. The presentation will include a segment comparing the actual cost versus a new bridge replacement. Discussion regarding the overall cost-effectiveness of the project will be pursued. If clear, beyond doubt, that the project was not economically viable (due to actual cost and quality of product) then we might propose to our peers a legislative initiative to get certain preservation laws for historic bridges and bridges determined to be contributing elements to historic district amended.
About the Presenters:

**Kurt Bower** received his ASES from Brome Community College in 1988 and his BSCE from the University at Buffalo in 1990. Kurt has been with the State DOT for 15 years and is a licensed Professional Engineer in New York. Kurt spent 7 years working in a highway design squad and 5 years as a Consultant Design Manager, of which he oversaw the preliminary and final design of the Route 31 project. Kurt started out on this construction project as the Office Engineer and is currently the Engineer-in-Charge.

**Tom Siwula** graduated from Texas A&M University in 1978 with a BSCE and has been involved with track and bridge design, construction, maintenance, and inspection for 27 years. Tom has been a member of AREMA since 1982 and ASCE since 1990. Tom’s past employers include Missouri Pacific Railroad, Union Pacific Railroad, and Konski Engineers. Over the past 6-years, Tom has worked for C&S Engineers providing design services for bridge rehabilitations and replacements. In his current position, Tom enjoys a peer relationship with 12 bridge design engineers on staff at C&S and the flexibility they offer for completing bridge design assignments.

**Tom Horth** received his AAS in from Mohawk Valley Community College in 1996 and a BSCE from Clarkson University in 1998. Tom has been with C&S Engineers for the last seven years, where he has been involved with a variety of bridge rehabilitation and bridge replacement projects. He is a licensed Professional Engineer in New York, and is currently a Project Engineer with C&S. He has been an active board member of ASCE, where he served as President from 2004-2005.
Rehabilitation & Relocation of the Belgium Bridge

A Case Study Using NYSDOT Canal Programmatic Agreement

New York State Department of Transportation

C&S COMPANIES
ENGINEERS
DESIGN BUILD
TECHNICAL RESOURCES
OPERATIONS
Presentation Outline

- Overview of Belgium & Plainville Projects
- Sect. 106 & 14.09 Historic Issues
- Selection of Design Alternative & Programmatic Agreement Hierarchy
- Constructability Issues for Truss Relocation
  - Truss Dismantling at Belgium
  - Shop Cleaning, Repairs, & Painting
  - Truss Erection at Plainville, NY
- Construction Cost Summary
Overview of Belgium & Plainville Projects

- Plainville Truss Historic & Belgium Truss Contributing Element
- Belgium Rd Scope – Capacity Improvements
- Plainville Rd Scope - Rehab or Replace 1-Lane Truss Bridge
- Plainville Rd Project Became Part of Belgium Bridge Project
Plainville Road Alignments

- **Alt 1:** “Rehab 1-Lane Truss on Existing Alignment” - Cost $1.9m
  ➔ Rejected Due to Traffic Volume and Accident Rate

- **Alt 2 & 3:** New 2-Lane Truss on New Alignment
  ➔ Cost $2.1m to $3.2m

- Public Proposed Alternative
  ➔ Cost > $3.2m
Plainville Historic Preservation

- Project Required to Address Safety Concerns
- Demolition of Truss is an “Adverse Effect”
- Mitigation in MOA (w/ SHPO & FHWA)
  - Provide New Truss Similar to Existing
  - HAER Documentation of Existing Truss
Belgium Historic Preservation

- Rte. 31 – Principal Urban Arterial, Capacity Improvement Project
- Need to Replace 2-Lane Structure with a 5-Lane Structure
- Demolition of Truss is an “Adverse Effect”
- Adverse Effect Could Add 24 Months to Process
- Mitigation Would Involve:
  - Providing New Truss Similar to Existing
  - Provide a Signature Bridge
  - HAER Documentation of Existing Truss
Canal Bridge Programmatic Agreement

- 180 Canal Bridges are Historic, Eligible, or Contributing Element
- SHPO, EAB, Region 3 Completed Work on Draft Agreement on 2/2000
- Rehab/Replace Hierarchy is spelled out
- Committee Looking for Candidates to Test Procedures in Agreement
- Region 3 Volunteered the Belgium Bridge Project
Why Volunteer the Belgium Project?

- DOT Wants a SMG Bridge at Belgium But Will Be Delayed 2-yrs With Adverse Effect & SHPO Will Want a Signature Bridge

- Belgium Bridge Has Had Several “Punch-Through’s”. A Quick Deck Replacement Is A Priority

- The Programmatic “Rewards” With a NAE If The 95 Meter Belgium Truss Can Be Re-used On Canal
Why Volunteer the Belgium Project?

• State Has To Install a New Truss Bridge at Plainville
• What About Public’s Proposed Alternative On Plainville Rd. Project (Belgium Bridge Fits Within Inches)
• Moving The Truss Is The Right Thing To Do

• Estimated Project Costs Are Less If Belgium Truss is Relocated to Plainville
SHPO Concurrence

- Using Canal Bridge Programmatic Agreement Methodology – Asked For “NAE” Using Belgium Truss at Plainville
- 3 Days Later SHPO Agreed With “NAE”
- Design Approval Received Within 3-Months
- Cost For Both Projects Combined - $23 Million
- A 4(f) Evaluation Would Have Been Required For Belgium, Adding 2-Years of Delay
Dismantling of Belgium Truss

Alternatives Considered:

1. Launch Truss to East Shore and Dismantle
2. Dismantle Over River – 2\textsuperscript{nd} Premium For Longshoreman
3. Partial Dismantle & Transport Down Canal to Plainville Site

19 Miles By Canal

Belgium Bridge Site

Plainville Bridge Site
Dismantling & Transport Information Provided in Bid Documents

- Described Suggested Dismantling Methods
  1. Launch Truss to Approach Roadway & Dismantle
  2. Float Truss To Plainville
     - Dismantle Into Triangular Sections
     - Remove Lock 24 Guard Gate
     - Install New Gate (Poor Condition)

Lock 24 Baldwinsville, NY
Cianbro Construction Completes Phase 1 Construction
Truss Dismantling Begins With Launching Truss to Shore
Sessler Wrecking (Subcontractor)

- Approach Spans & Deck Removed
Temp Support Bent Erected On Floating Barge Beneath West Pier

250-Tons of Water Pumped Out of Barge To Lift Steel Truss
East Pier & Abut Used To Run Girders For A Trolley System Onto The Approach Roadway
Trolley System Rollers
The "Winch System"

Rollers
An Excavator Winch!
Close Clearance, 1m From Stage-1 of New Bridge & The Truss
1.5 Hours To Float Truss To East Pier

Barge Nears East Pier, Now What?
The Last Lift From Barge To Trolley Girder System
Ready for Stage-2 Construction at Belgium

Ready for Truss Disassembly & Transport for Shop Cleaning/Repair
Dismantling The Truss, Piece By Piece

Getting Ready In Plainville
Existing Truss Condition

- 94.5m (310’) Long By 16.8m (55’) High Riveted Warren Thru Truss with Verticals
- Originally Constructed in 1950
- Minor Section Loss (5%)
- 1999 In-Depth Inspection Gave Bridge a “3” Rating Due To Floor System
Replacement Truss Members

Controls Rating (MS 19)

Replace in Kind

Replace in Kind

Add Retrofit to Gusset PI
Additional Truss Repairs

- Additional Work As Part of Truss Rehabilitation:
  - Replace Entire Floor System (Composite Stringers)
  - Replace Bottom Lateral Bracing In Kind
  - Rivet Replacement (Three Conditions Identified)
  - New Bearings
Shop Inspection

- Palmer Industrial Coating & Jasper Fabricating
  - Williamsport, PA

- Key Members Identified For In-Depth Inspection:
  - All Lower Truss Chord Members & Splices
  - Diagonals With Section Loss Over 5%
  - Rivets Not Meeting Acceptance Criteria

Pack Rust
Shop Inspection, Cont’d

- Objective of In-Depth Inspection (C&S Engineers):
  - Confirm Section Loss Readings From 2001 Load Rating (Primary Members)
  - Identify Rivets To Be Replaced With H.S. Bolts
  - Inspect, Document Section Loss At Splices, Gusset Plates
  - Document Fatigue Details & Recommend Repairs
Truss Cleaning & Painting

The Blast Cabinet
How to Disassemble A Truss

- Pneumatic Removal Methods Proved Very Time Consuming
Rivet Removal

- Slice Torching Is The Answer…Or Is It?
Additional Repairs

- Needed To Develop Criteria For Repair Procedures:
  - Mis-Aligned Rivet Holes (Fit-Up Condition)
  - Pneumatic Chisel Gouge Damage
  - Damage From “Slice Torch” Operations
  - Corrosion
Rivet Hole Repairs

Treatment Methods (Slip Critical Connections):
- Grind Out Any Surface Irregularities
- Test Surface Discontinuities (NDT) As Needed
- Drill Oversized Holes & Add Plate Washers
Results Of Shop Inspection

- Three Diagonals Had > 5% Section Loss (No Effect on Overall Rating)
- L14A-L16A Bottom Outside Angle Replaced
- One Inside Gusset Plate Replaced
- Over 2100 Rivets Marked For Replacement
Re-Assembling The Truss

- Truss Assembled From West to East
Re-Establishing Truss Profile:

- Truss Profile Documented By Survey At Belgium Had To Be Re-Established At Plainville
- Reconstructed Truss Set To Theoretical No Load Camber Profile (Supported Condition)
Re-Assembling The Truss

- Truss Consists of Over 300-Members
- Total Truss Steel Weight = 500 Tons
Re-Assembling The Truss

- Rehabilitated Truss Will Deflect 13mm (1/2") More than Original Truss
- Net Camber 180mm (7")
The Plainville Truss(es)

Looking East
The Rehabilitated Truss

Open For Business…Well, Almost!
Cost Comparison

- New Truss Alternative: $3.2M
  (94m Span On Same Alignment)
  ➔ 2005 Steel Price Increase: 80%
- Design Approval Construction Estimate: $2.93M
- PS&E Construction Estimate: $2.91M
- Actual Construction Costs:
  ➔ $1.275M For Truss Disassembly, Relocation, and Re-erection *(Bid)*
  ➔ $0.28M For Truss Cleaning & Painting *(Bid)*
  ➔ $17k in Change Orders For Rivet Replacements
Summary

- Programmatic Eliminated The Need Of A 4(f) Evaluation At Belgium
- State Got The Steel Multi-Girder Bridge They Wanted At Belgium
- State Accepted Greater Risk Associated With Rehab & Relocation Of The Truss To Plainville
- Useful Service Life Of Rehabilitated Truss Is 30-Yrs Versus 50-Yrs For New Bridge