Federal Highway Administration Project
DTFH61-11-H-0027
Advancing Steel and Concrete Bridge Technology to Improve Infrastructure Performance

Education and Outreach

EIT Workshop

Construction and Field Evaluation of an Electrically Isolated Tendon System in the Coplay Bridge

October 24, 2018
Lehigh University, Bethlehem, PA

Organizers - Clay Naito (Lehigh U.), Reggie Holt (FHWA)
Presenters – L. Franko (Pennoni), S.Islam/C.Aumann (DSI), T. Jenkins (NPP), L. Flournoy (TxDOT)

Workshop Schedule

- 820-830 Introductions and Overview
- 830-850 EIT Overview by Reggie Holt – FHWA
- 850-910 Fabricator Experience by Troy Jenkins – Northeast Prestressed Products
- 910-940 Coplay Bridge Project Overview by Larry Franko – Pennoni
- 940-1000 Break
- 1000-1030 Post Tension Supplier Experience by Shahid Islam – DSI
- 1030-1045 EIT Specification Development by Leon Fourney – TxDOT
- 1045-1110 NDE methods and Long-Term Monitoring by Clay Naito – Lehigh U.
- 1110-1200 Tour of ATLSS Research Center and Lunch
- 1200-230 Site Visit of Coplay Bridge

General Organization

- Parking
- Breakfast/Lunch
- Handouts and Files
- Facilities
- Coffee
- Tour - PPE

Speaker Background

Clay Naito, Ph.D., P.E., is a professor of structural engineering at Lehigh University. His research is focused on experimental and analytical evaluation of reinforced and prestressed concrete structures subjected to extreme dynamic events including earthquakes, impacts, and intentional blast demands. His bridge related research has included development of inspection methods for adjacent box girder bridges, evaluation of nondestructive evaluation methods for concrete bridges, and the development of new bridge systems for PennDOT. He is a member of the Precast/Prestressed Concrete Institute Technical Activities Committee and past chair of the PCI Blast Resistance and Structural Integrity Committee. He also serves as a member of the American Concrete Institute 318 Subcommittee G and ACI 550, and a past associate member of the ASCE 7-16 Subcommittee on Tsunami Loads and Effects.

Reggie Holt is the concrete bridge specialist in the Office of Bridges and Structures for the Federal Highway Administration (FHWA) at FHWA Headquarters in Washington, D.C. He is responsible for national policy and guidance on bridge design and analysis. Mr. Holt's interests include analysis, design and construction of concrete bridges, bridge/infrastructure security, and service life design. Reggie Holt is a registered professional engineer in the state of Maryland and a member of the AASHTO T-10 Technical Committee on Concrete Structures, a professional member of the American Segmental Bridge Institute (ASBI), a member of the Post-tensioning Institute (PTI) Post-tensioned Bridge Committee, PTI Grouting Committee, PTI Cable Stay Bridge Committee. and the PTI/ASBI grouted post-tensioning committee. In addition, Mr. Holts has participated on multiple NCHRP, AASHTO and Industry technical review panels.

Speaker Background

Lawrence P. Franko is the Project Manager for Pennoni Associates and is the P.M. for the Coplay Bridge Project. He has over 30 years of experience in the road and bridge construction. He received his degree in Civil Engineering from Drexel University.

Troy M. Jenkins, P.E. is currently Chief Engineer at Northeast Prestressed Products, LLC, and a registered engineer in the states of Pennsylvania and New York. He graduated from Penn State Harrisburg in Structural Design and Construction Engineering Technology in 2000. Troy is the Chairman of the Precast Concrete Institute's (PCI) Bridge Producer Committee and an active member of the PCI Bridge Committee.

Christain Aumann, Dipl. Ing. is a post-tensioning Systems Engineer at DYWIDAG Systems International. He served as a Structural engineer Keegan Precast in Ireland and at Schletter GmbH. He received his degrees from Technische Universitaet Muenchen and Munich University of Applied Science.

Leon Flournoy, P.E. is from the Construction and Maintenance Branch of the Bridge Division of Texas Department of Transportation. He is in the process of implementing EIT into a new project in Texas.

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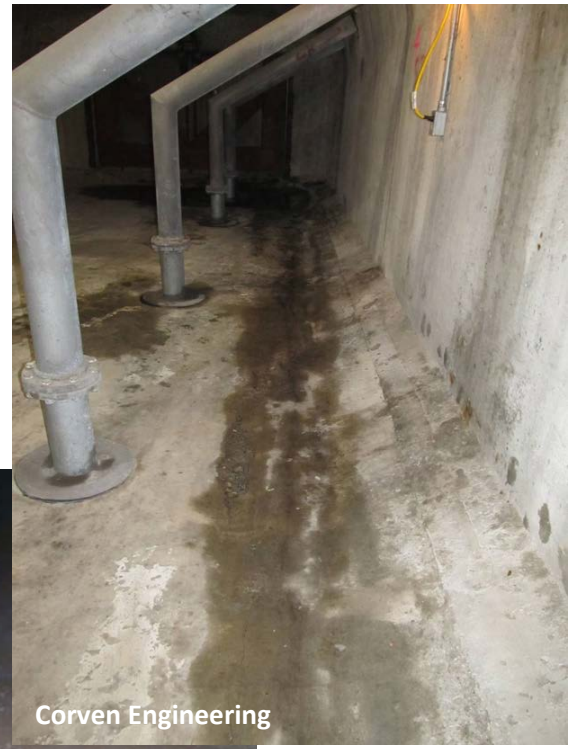
Background on Post-Tensioning Concerns

- Issues with post-tensioning systems
- Grout voids, chlorides, lack of inspection methods



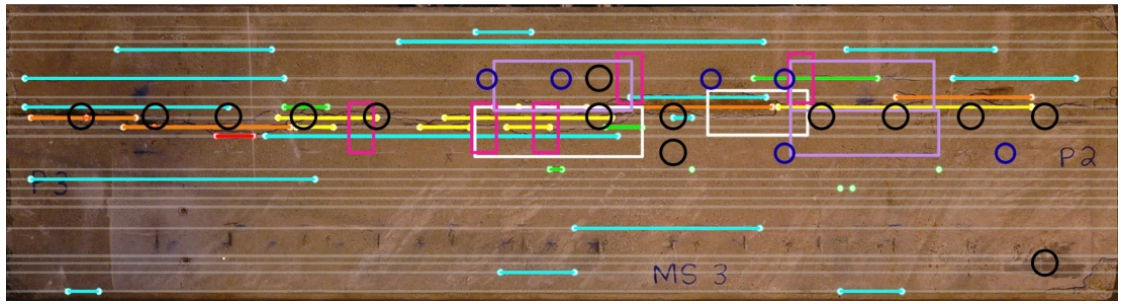
FHWA Task 11 - Designing and Detailing Post Tensioned Bridges to Accommodate Non-Destructive Evaluation

- Corven Eng. / Lehigh U.

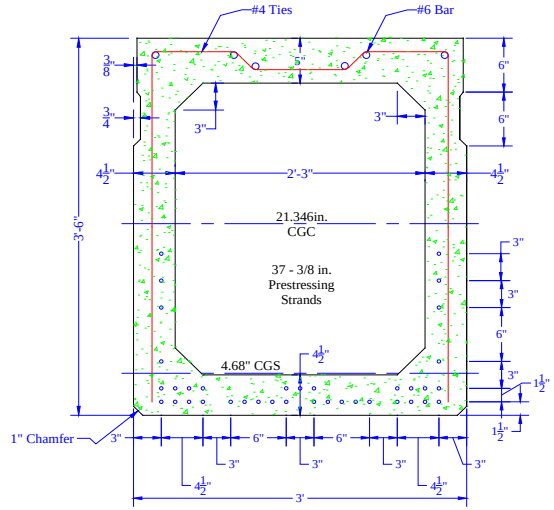
Grout Voids/Condition	Corrosion	Strand Location
• Ground Penetrating Radar Impact Echo • Radiography • Time Domain Reflectometry • Ultrasonic Testing • Visual Inspection	• Acoustic Emission • Electrically Isolated Tendons Half-Cell Potential • Magnetic Flux Leakage • Radiography • Time Domain Reflectometry • Ultrasonic Testing • Visual Inspection	• Ground Penetrating Radar Impact Echo • Thermography • Radiography • Ultrasonic Testing

NDT Contractors

- Magnetic Flux Leakage (MFL)
- Ground Penetrating Radar (GPR)
- Remnant Magnetization (RM)
- Line Scanning Thermography (LST)
- Electromagnetic Corrosion Detection (EMCD)
- Galvanostatic Pulse Corrosion Rate (GPCR)
- Ultrasonic Impact Echo (IE) Test Method
- Ultrasonic Shear-Wave Test (UST) Method



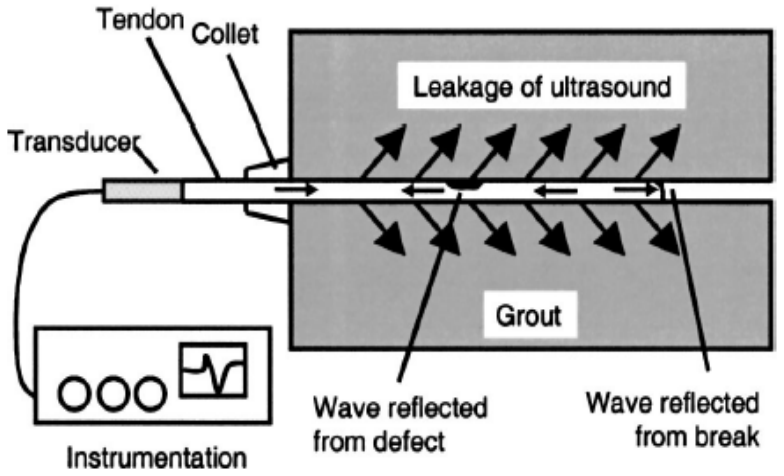
Light Corrosion | Pitting | Heavy Pitting | Wire Loss | Fracture



Ultrasonic Testing

- Ultrasonic guided wave testing (gwt) can detect and locate corrosion in PT strands
- Ultrasonic sound waves are generated at the exposed end of the strand and reflected due to changes in the cross sectional area
- Requires access to the tendon

Not Validated for use in PT Systems

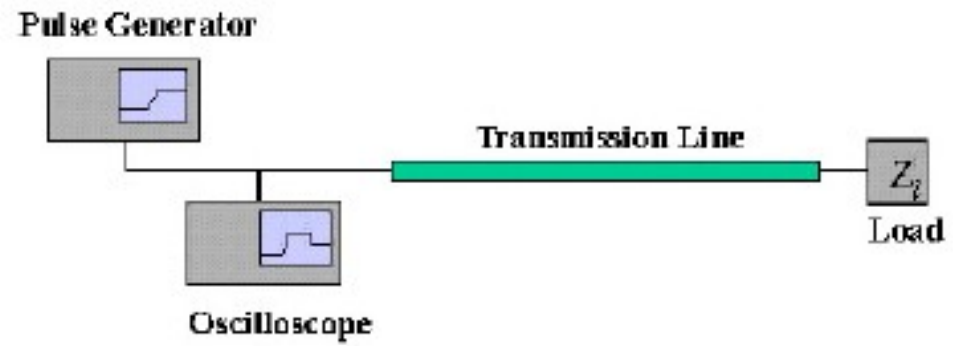


Pulse-echo test configuration for the inspection of post-tensioning steel using guided ultrasonic waves (Beard, Lowe and Cawley, 2003)

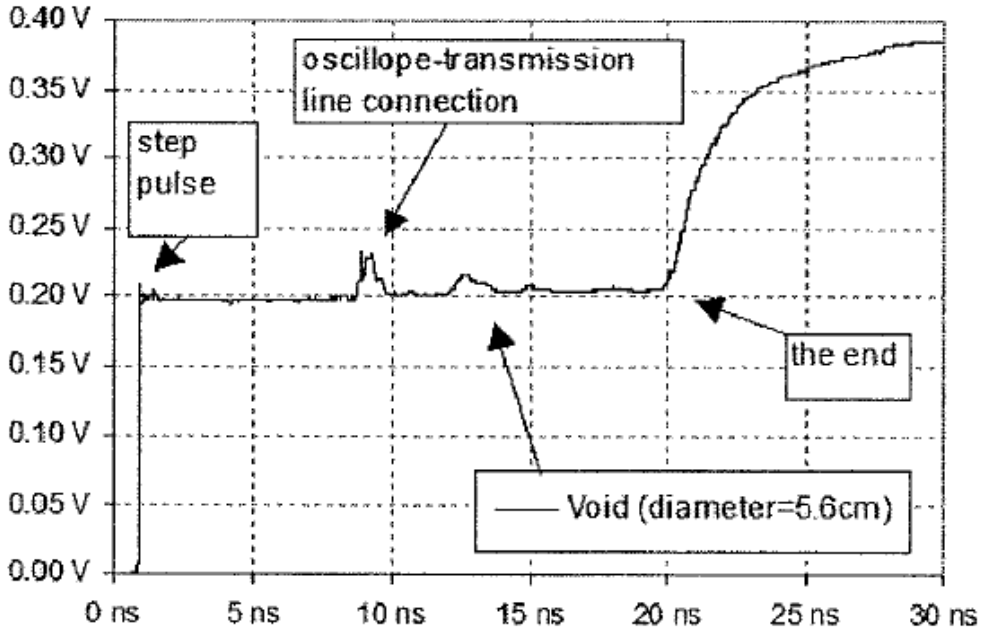
Time Domain Reflectometry

- Can detect strand corrosion/ grout condition
- Involves sending a signal created by a step-pulse generator through a transmission line and using the reflection of the signal to determine any discontinuities
- Electrical and optical TDR applications exist

Not Validated for use in PT Systems



Reflected Voltage Wave Signal

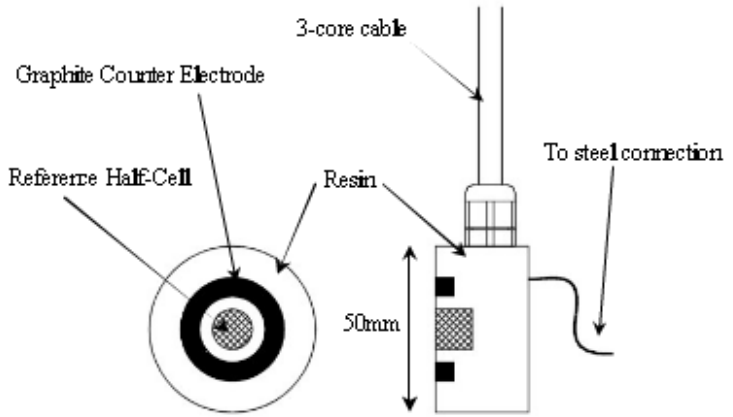


Hunsperger, R. & Chajes, M. (2006) " Void Detection in Post-Tensioning Ducts Using Time Domain Reflectometry" Highway IDEA Project 98

Internal Half-Cell Probes

- Half-cell is a well established method that has proven to be a powerful tool
- Voltage readings are used to determine probability of corrosion
- Probes can be embedded in to the duct system

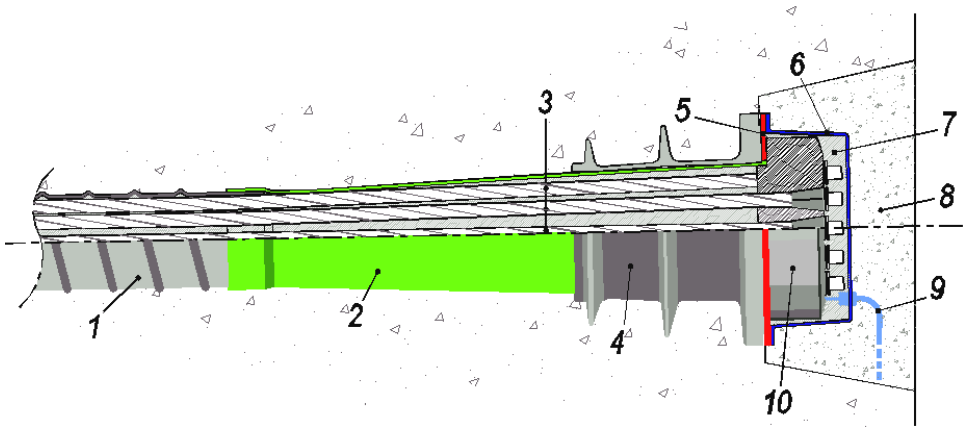
Not Utilized to Date in PT Systems



Corrosion potential and corrosion rate probe (C-Probe, Model CP101)

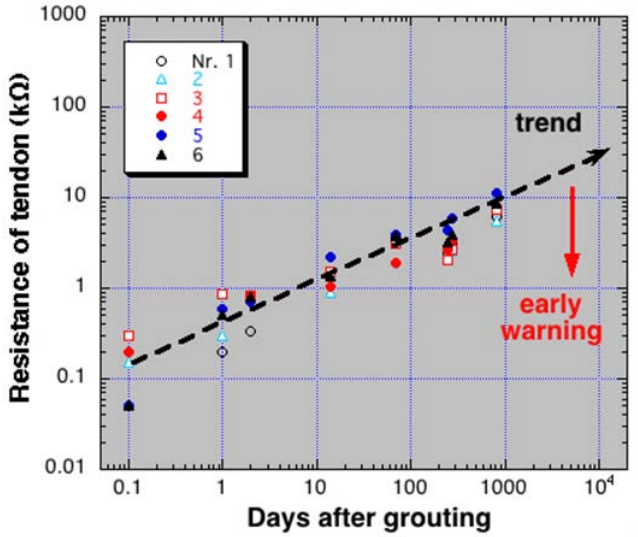
Electrically Isolated Tendons

- Can be used for quality control at time of construction and long term monitoring
- Monitors for breeches in the corrosion protection system indicative of the on set of corrosion.



1. duct
2. plastic trumpet
3. wedges that block the strands
4. cast iron bearing plate
5. mechanically resistant isolation plate
6. plastic grouting caps
7. fully grouted resistant insulation plate
8. non-shrinkage reinforced concrete
9. electrical terminal
10. anchor head

Long Term Monitoring



Vedova, D. & Elsener, B. (2006). "Enhanced Durability, Quality Control and Monitoring of Electrically Isolated Tendons" Proceedings of the 2nd International Congress


SGK

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Schweizerische Gesellschaft für Korrosionsschutz
Société Suisse de Protection contre la Corrosion
Swiss Society for Corrosion Protection

Monitorable post-tensioning systems

Sub task 2 – State-of-the-art report

Bericht Nr.: 14148
Auftraggeber: FHWA
Verfasst: Dr. Ueli Angst
Geprüft: Dr. Markus Büchler
Datum: 21. September 2015

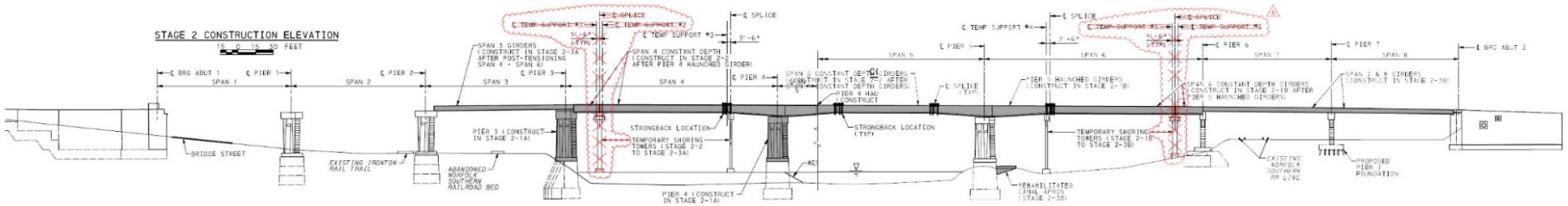
Revised Draft

Swiss Society for Corrosion Protection 1/63

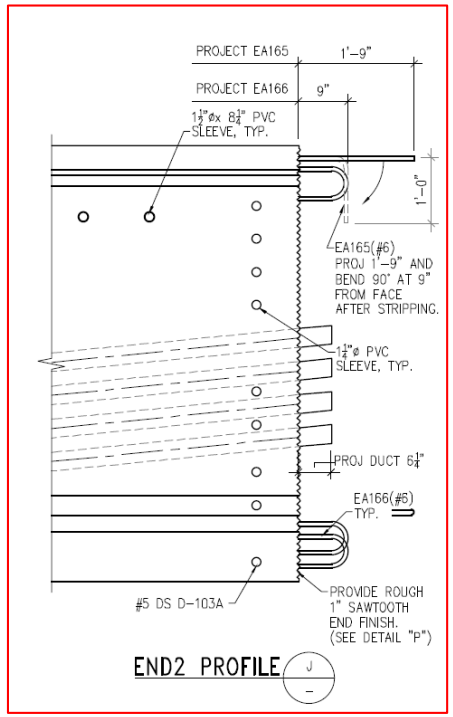
Coplay Bridge Demonstration Project

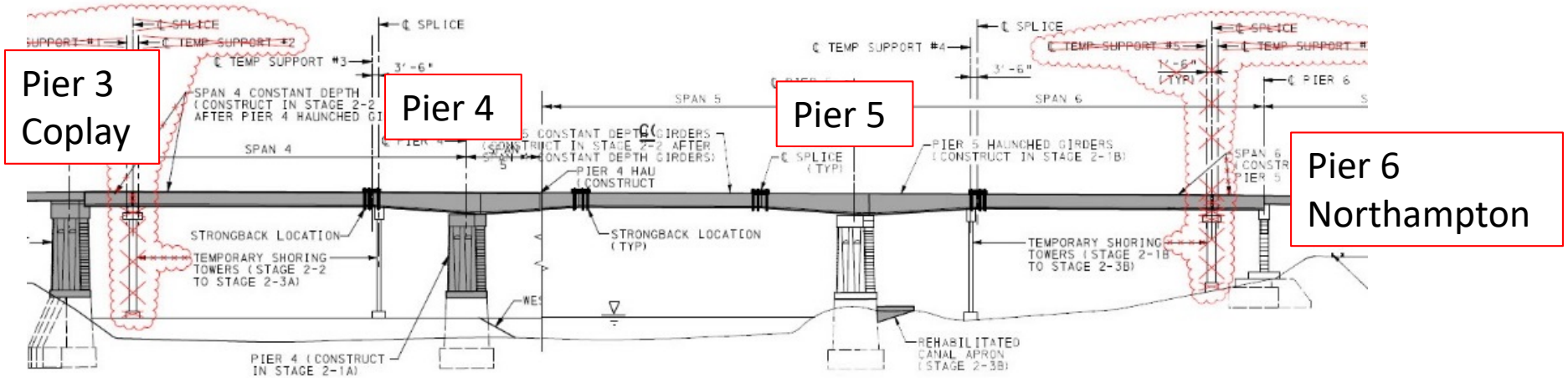
- Trial Project in Coplay/Northampton, PA
- Measurements at:
  - After Tensioning Prior to Grout
  - After Grouting
  - 28 days after grouting
  - Long term

Project Overview



- Three Span Continuous Bridge
- Five Pretensioned Bulb Tee Girders (Four Splices) Along Span
- Five Girder Lines
- Post-tensioned and Grouted – Four Tendons Per Line
- Composite Cast-in-Place Concrete Deck





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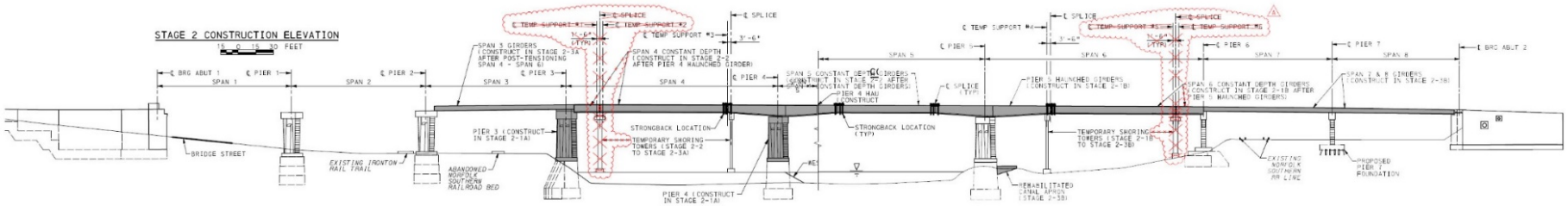
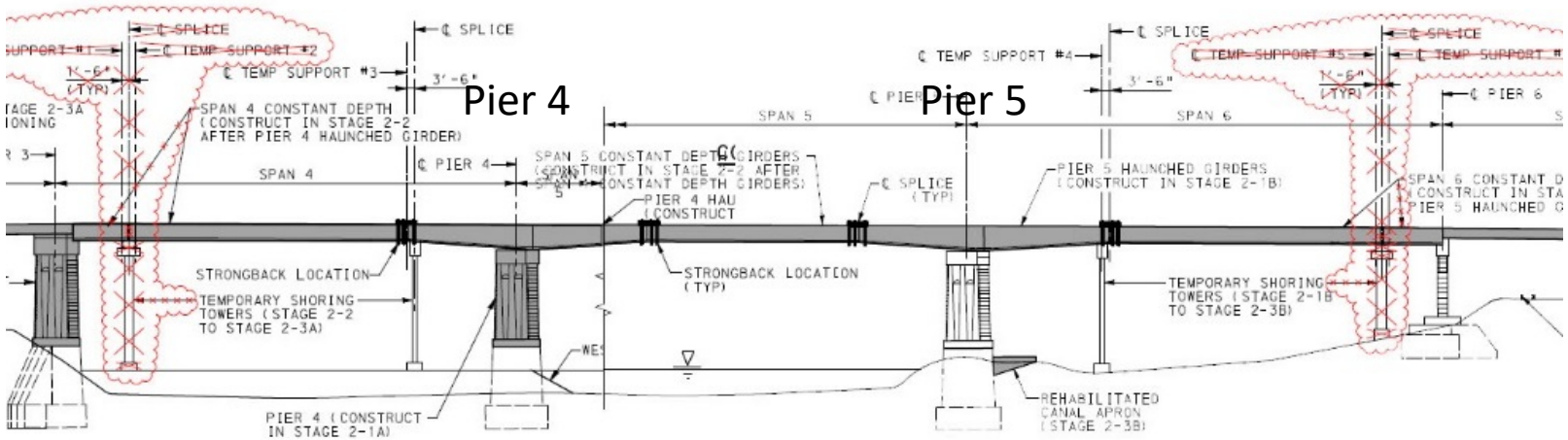


- Owner – Lehigh / Northampton County
- Construction Oversight Project Management – Pennoni*
- Designer - AECOM
- Bridge Beam Producer – Northeast Prestressed Products, Cressona PA*
- Post-Tension Contractor – DSI*
- Bridge Construction – Trumbull Corporation
- Bridge Beam Erector – Structural Services

Pier 3
Coplay



Pier 6
Northampton

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