ABSTRACT

How do you perform $4.5 Million worth of repairs to seven through truss spans over the Connecticut River in Hartford, CT for a $3.6 Million budget? The answer required significant forethought by the railroad and the engineer in the design phase of the project and some creative construction methods by the contractor, along with creative planning by the railroad in the construction phase of the project.

In the design phase of the project the engineer designed repair methods that narrowed the scope of work down to the repair of the individual defects, but left enough room for the contractor to offer alternate repair solutions thus creating cost savings. Also, railroad and engineer decided to create a very detailed scope of work as reflected in the extensive list of bid items. This became very important later as the project developed due to the construction bids received being higher than estimated. The detailed bid effectively provided a method to deduct exact dollar amounts from the project to meet the budget.

The contractor used creative construction processes during the construction phase that minimized the requirement to assemble and tear down scaffolding and allowed multiple crews to work in close proximity to one another, while avoiding interferences. In addition, the railroad was able to adjust train operations to week nights to allow large work windows for the contractor.

In summary, the above coordination between the railroad, engineer and contractor allowed for the structural repairs to a major river crossing to be completed three months ahead of schedule and within 1% of the original budget.

INTRODUCTION

Connecticut Southern’s Manchester Sub Bridge 1.1 crosses the Connecticut River and links Hartford to East Hartford Connecticut. Originally built in 1849 by the Hartford, Providence and Fishkill Railroad, the current single track configuration of a seven span through truss bridge with a fixed two span deck plate girder swing span on the east end was built circa 1918 by the New York, New Haven & Hartford Railroad. The line was absorbed into the Penn Central in 1962. In 1996 the line became the Connecticut Southern Railroad when it was acquired by RailAmerica from Conrail. Today the Connecticut Southern is part of the Genesee & Wyoming family since the acquisition of RailAmerica in 2013.

In 2007 Connecticut Southern started to be concerned with the apparent condition of the bridge. There was significant section loss in the primary and secondary members of the bridge: The through truss top lateral system had upwards of
100% section loss in places; the bottom lateral system gusset plates were extensively holed; the floor system had major section loss on the horizontal surfaces such as flange angles and cover plates.

The Engineer’s estimate of the steel repairs needed to combat the section loss were upwards of four million five hundred thousand dollars ($4.5M). Unfortunately, traffic over the bridge averaged only three thousand (3,000) cars per year. To compound the problem, as the project matured, the initial estimates were shown to be off by at least a factor of two. Clearly the economics of the situation did not favor the needed capital investments. Therefore alternative project approaches and financing were needed.

BUILDING THE CASE

The annual inspections painted a bleak picture for the bridge. In the seven years leading up to the project, two inspection contractors consistently identified some two million dollars ($2M) of high priority conditions noted with wording such as “Condition is unsafe and could cause failure at any time”. However, since these conditions were not new and the bridge was apparently safely handling the traffic, the next logical step was to have the structure rated. Connecticut Southern contacted its current inspection contractor, at the time Osmose Railroad Services now Koppers Railroad Structures, about performing this rating in 2010. Specifically the goal was to rate the bridge for capacity for 263,000 and 286,000 pound traffic (263k and 286k traffic respectively) at speeds of 10, 25 and 60 miles per hour. Koppers teamed with Design Nine to perform those capacity ratings whereby Koppers performed all of the inspections and measurements and Design Nine determined the capacity.

In short, the bridge’s rating showed that the original design was very robust. Despite the section loss, all components of the trusses had significant strength to carry 286k traffic at most speeds while the line speed was fixed at 10 miles per hour.

Constructed of two stringers per rail, the floorsystem rating however had mixed results. Considering corrosion, the stringers had an allowable rating of E72.3 at 10 mph, while the 286k traffic had an equivalent rating of E55.5. From this, it was determined that only 2 of the 4 stringers were necessary to run 286k traffic across the bridge at 10 mph. The end floorbeams had an allowable rating, with the corrosion, of E62.1 at 25 mph, while the 286k traffic had an equivalent rating of E58.1. The interior floorbeam had an allowable rating with the corrosion taken into account of E60.1 at 10 mph, while the 286k traffic had an equivalent rating of E57.1.

For the secondary members, the original design was also very redundant. With respect to the top lateral system, it was determined that only part of the top lateral bracing needed to be intact to adequately transfer lateral loads between the trusses.

With the above being said, many of the members were getting close to the line for design allowable stress. If the section loss was not checked, then individual members could begin to exhibit signs of overstress as the load environment moved from normal stress towards maximum allowable stress. Based on the newly developed capacity ratings and Kopper’s recommendations, it was determined by Genesee and Wyoming that significant individual component level maintenance was needed in lieu of the previous general recommendations of replace floorbeams, replace stringers, etc. A subsequent joint inspection between Genesee and Wyoming, Koppers and Design Nine was undertaken to identify specific defects. After all defects were cataloged, they were then prioritized by the member affected, the severity of defect, the remaining capacity in the member and projected cost to repair the defect.

Also worth noting is that during the inspection it was observed that a majority of the deterioration was in the first two truss spans. These two spans are unique in the amount of overhanging tree cover since these spans are over the river’s flood plain. This tree cover is believed to contribute to the deterioration from the accumulation of debris from the trees on horizontal surfaces of the bridge, which created a continually moist condition and helped promote the creation of pack rust. It was determined that all trees within the railroads right-of-way would be removed. It was also determined that all horizontal surfaces be cleaned of debris and pack rust. This would slow down future deterioration of the steel structure.

Cleaning of the steel would add a new obstacle for the contractor to overcome. The existing paint on the structure contained lead. Needless to say the Environmental Agency would not allow large amounts of pack rust with lead based paint mixed into it to be deposited into the Connecticut River. However, once the horizontal surfaces were cleaned the members could be thoroughly inspected and re-evaluated for repair or replacement to these additional structural components.
This then became the basis for the argument that it was time to act. The bridge was still safe, but it wouldn’t be for long if there was not an infusion of capital.

**FINANCING**

To the industries located on the line in East Hartford and Manchester, this bridge represented a vital link in their supply chain. If these customers were unable to receive by rail, then the majority would need to relocate which could prove detrimental to the East Hartford economy.

As the need for heavy capital investment was socialized within the company it was soon realized it would take a multi-pronged approach to get this project financed. A team representing Government Affairs, Marketing, and Engineering was formed to tackle the challenge.

At the time, the State of Connecticut did not have a program to support rail capital improvement. Therefore the Government affairs team began to work with the Connecticut Department of Transportation Rail Office and the local State Senator representing East Hartford to begin crafting legislation that would create a rail infrastructure bank for the State modelled after successful programs in other states.

Concurrent with this, the marketing department hosted a customer forum where the current state of the bridge and the need for capital investment was explained in detail. This gave the customers an opportunity to evaluate the importance of continued rail service to their business. Specifically, they were asked if they would support a six hundred dollar ($600) per car surcharge to help fund a planned 20% contribution to the project.

Armed with this funding commitment from the customer community, the Public-Private Partnership became a relatively easy sell. The proposed legislation was adopted and the State of Connecticut entered into its first ever rail improvement project. Since it was their first such agreement it was not burdened with many of the requirements typical of such agreements as, prevailing wage, minority/disadvantaged business goals, etc. Essentially, the Connecticut Southern was given the latitude to spend the project funding in the best way possible for the project, and it did.

In the end, the State contributed three million two hundred dollars ($3M) to the project and Connecticut Southern spent three million, two hundred twelve thousand, six hundred seventy three dollars ($3.2M) with Koppers Railroad Structures for the actual work. The balance of the supporting costs such as Engineering, Permitting, Construction Management, Flagging, Tree Removal, etc., were all funded out of the Railroad’s match.

**DEFECTS AND REPAIRS**

Defects found in the primary members consisted of major deterioration in all of the stringer top and bottom flange angle horizontal legs, floorbeam top and bottom coverplates, and floorbeam web plate above the bottom flange angles. All of the expansion bearing roller nests had rolled out between the upper and lower components of the bearing.

For the stringers, since the existing derated condition of the stringer pair was more than sufficient for 286k traffic, the decision was made to only replace the top flange angles in stringers 1 and 4. While not addressing all of the section loss in the stringers, this repair brought stringers 1 and 4 close to original section and ensured excess capacity in the stringer pair for many years to come.

For the bottom flange angles of the stringer, once the debris was removed from the horizontal leg it was determined that select bottom flanges needed to be replaced. These were replaced in kind with a fracture critical Grade 50 flange angle.

The floorbeam bottom coverplates were replaced in kind but with grade 50 steel. For the floorbeam top cover plates it was decided that the primary deterioration consistent with dripping brine did not have a significant impact on floorbeam capacity and no repairs were made.

The web of several floorbeams above the top of the vertical leg of the bottom flange angle had significant section loss and holing. To repair these floorbeam webs a coverplate was selected as the best repair. A fill plate and lap plate were placed over the deteriorated web area on both sides. This increased the sectional area of the web and more than adequately replaced the section loss.

The expansion bearing roller nests were removed and replaced with Teflon/stainless steel bearings with similar depth. These units were installed on the existing grillage of the bearings and no pier top work was needed. During this
changeout the trusses were shimmed to achieve a best fit surface across the spans. To achieve a better surface would have required shimming the fixed bearings as well and it decided to save the project funds for other steel repairs.

Defects found in the secondary members consisted of section loss ranging from minor pitting to 100% in the top and bottom lateral systems, the gusset plates connecting these lateral systems to the truss had deterioration ranging from minor pitting to 100% section loss in some cases. Repairs to the secondary members were prioritized by location, defect and percent of section loss. The highest priority defects were selectively replaced at the individual component level.

At the west abutment, significant scour existed under the front face of the abutment. Additionally, the concrete surfaces were spalling and the wingwalls were beginning to divorce from the abutment and lean outward. It was determined that the west abutment needed to be wrapped in a concrete encasement with all loose stone and concrete removed prior to the new work. The existing wingwalls were pinned back in place and pressure grouted with no-shrink grout to eliminate any voids.

At pier number 6 it was found that prior to Genesee & Wyoming, previous work had been done to partially correct a settlement issue. In 1998 pier number 6 suffered a scour failure, and sunk enough into the Connecticut River that it required shoring to be installed around the entire pier and the interior of the shoring filled with concrete. This stopped the movement of pier, however the damage was done. The trusses resting on pier number 6 would remain racked and tapered ties would be installed in 1998 to restore the track to service. For this project, the first priority for pier number 6 was to ensure that it was no longer moving and/or sinking. TEC and Associates was contacted to provide an underwater inspection and determine whether the pier was stable. After determining that no further movement was occurring the selected repair was to restore the bearings to the proper elevation and eliminate the tapered ties. To achieve this a series of concrete riser blocks and shims would be used to bring the bearings level and remove the racking that had occurred on the truss when the pier initially sank. This also allowed for standard sized ties to be installed across those spans, instead of the tapered that were previously installed. Prior to jacking the trusses there was a discussion about whether the trusses members had gone beyond plastic deformation threshold and how the truss would react when it was subjected to the jacking forces. It was decided that levelling the trusses was still the best course of action. The trusses were leveled up at pier number 6 and no signs of distress were noted.

At pier number 8 it was found that the deck plate girders resting on the pier had punched into the bridge seat. Originally pier number 8 was the pivot pier for a turn span, so it was designed to carry the load on the outside stones and not on the interior of the pier top. Initially the owner and engineer decided on a precast concrete riser block solution which would be set in place with cast-in-place concrete for the balance of the pier top to transfer the load to the exterior stones. This would minimize the necessary work window curfew. However, the contractor suggested the center of the pier first needed to be solidified. This would be accomplished by pumping the rubble inside the center of the pier with no-shrink grout. Then a polymer concrete pad was placed to provide a good bearing surface for the deck plate girder spans. Next, the exterior stones were pinned and grouted to the polymer pad and grout to transfer the load to the exterior stones. Further inspection of the deck plate girder bottom flanges at the bearings determined that the punching into the bridge seat had severely distorted the horizontal legs. Therefore, new bottom flange angles would need to be spliced in at the bearing.

At the east abutment multiple stone courses were beginning to separate from each other because of settlement. A couple stones were cracked vertically because of the transfer of the load through the separated layers. The bearings of the deck plate girder had punched through the bridge seat causing the alignment to dip on the southern rail. To repair the east abutment, a pin and grout repair was selected to pin the top three layers of stone together. Then a polymer concrete pad would be installed to repair the bridge seat and better support the bearings of the deck plate girder bearings.

Due to the deferred maintenance, the timber tie deck was also in need of maintenance. Among the defects found were a significant number of spot tie defects, poor timber walkway planks which removed the walkway from service, substandard handrail clearance on the deck plate girder spans, and the clearance envelope was shifted upstream. In addition, the prior movement of pier number 6 and the subsequent jacking of the trusses at pier number 6 had moved the pier and truss ends downstream. This shifted the clearance envelope opposite of everywhere else. It was determined that difference between the track shift and the truss shift be split and the centerline of the rail approaching pier 6 be feathered into that proposed clearance. The existing tie deck was replaced with a new tie deck, handrails and bar grate walkway. This provided current handrail clearance standards where possible. At the same time the centerline of the track was moved more centrally between the trusses. In order to determine the best course of action for the proposed tie deck, shots were taken across the bridge on the top of rail, top of tie, top stringer, top of floorbeam and top of bridge seat to determine what the easiest course of action was to be able to use standards tie depths across the bridge. It was determined that some shimming was necessary at piers 4 and 5, as well as the riser blocks and shims which were already necessary to level the top of steel at pier 6.
SCOPE OF WORK, CONSTRUCTION DRAWINGS AND SPECIFICATIONS

It was decided early in the engineering phase of the project that minimal construction drawings would be prepared for the work but there would be a comprehensive set of specifications which were in line with Genesee and Wyoming's Standards. This approach was taken to allow the contractor the freedom to develop true best ways and means for the project while still meeting the requirements of the engineer and the railroad. In addition to a comprehensive set of specifications, the bid items and scope of work were very specific and comprehensive in order to give an exact scope of work for the project. Each repair, on each span, in each panel point was given an individual bid item. This simple concept helped in multiple facets of the project to control cost and allow the railroad to get the most bang for its buck so to speak. It allowed the contractor to know exactly what was being repaired in each span to better setup construction phasing. It also allowed for the engineer to get a pretty good handle on the engineers estimate. When the contractor bids came in higher than the engineers estimate anticipated, it allowed the engineer and railroad to easily remove lower priority items from the scope of work in order to bring the cost down to within the budget. Finally, as the contractor was clearing debris from the horizontal surfaces and identified additional priority repairs, the detailed bid list provided a simple change order process and the unit pricing was already established for mode defect encountered.

WORK WINDOWS

Thanks to the light traffic density of the line, and flexibility of Transportation and the customers, Connecticut Southern was able to commit to large track work windows during the daylight hours and long weekend outages. This gave the contractor basically an uninterrupted daily work window from 0700 to 1700, Tuesday through Friday and a three day outage from 0700 on Saturday through 1700 on Monday. This allowed the contractor to cut additional cost off the mobilization and demobilization bid item, since they were able to minimize the movement of on-track construction equipment on and off the bridge to allow for train movements.

For this non-controlled track, on-track safety was established by derails placed on either side of the bridge and beyond the staging areas for the project. With a temporary crossing established within these working limits, the contractor had unimpeded ability to move men and equipment as needed between the construction staging zones and the bridge. As local maintenance of way personnel were responsible for establishing the on track safety, this provided for a 49CFR217.7(a) qualified employee to see the track through the working limits before the derails were removed at the close of the work window. Conversely, the contractor's superintendent was designated as the 49CFR237.55 railroad bridge supervisor responsible for the bridge work itself.

ENVIRONMENTAL PERMITTING

As the original engineering design progressed it was determined that several permits from the State of Connecticut – Department of Energy & Environmental Protection (CT-DEEP) were needed for the project to move forward. It was determined that the best way to satisfy the permitting process as well as minimize construction delays was to stage all construction from on top of the railroad structure or at the abutments from the ground. This minimized the amount of impact to the environment while still accommodating the need to perform these maintenance repairs. The permitting was progressed as though no debris from the maintenance repairs would pollute the river running into the Long Island Sound. Contractors were instructed that if they deemed other construction methods necessary they would be responsible for the modifications to the permitting with the CT-DEEP.

BID PROCESS / STRUCTURE

During the bidding process it was generally recognized that it was highly likely not all items could be completed within the budget allocated. The bid was therefore structured to allow flexibility in awarding specific line items. In the case of Kopper's winning bid, staging and access for each of the 7 through truss spans as well as the deck plate girder swing span was incorporated in the bid item for mobilization. While this resulted in a large mobilization cost, it was agreed to invoice these costs incrementally as work was completed on individual spans.

A specific bid item for access and staging on a span by span basis is another good way to ensure these costs will not be buried in individual bid items. This also ensures the unit costs for repairs does not get weighted with significant additional access time.

STAGING
In addition, convenient access is critical to allow for proper fall protection, proper employee body positioning and containment of debris generated by construction activities. Much of this goes without saying, but it cannot be overstated. An employee must be in a proper work position to safely and effectively do his job. A solid staging system can provide for the collection of falling construction debris without the need for secondary containment. The staging system must also allow for work outside the train envelope to minimize construction delays while trains pass. As with any railroad related work, first and foremost the Railroad must remain in service.

Staging and access were designed based on the work to be completed. A major task in this project was rivet busting, an estimated 20,000 rivets required removal. Per American Railway Engineering and Maintenance of Way Association (AREMA) recommendations, the rivets were removed mechanically, a very labor intensive and hazardous endeavor. The rivet head is first sheared off with a chisel bit on a thirty pound pneumatic chipping hammer. Once the head is sheared off, a knock out bit is installed and the rivet is driven out with the same hammer. Needless to say, there is ample opportunity for the head of the rivet or the rivet shank to become a projectile.

On this project several methods of staging were utilized. The floor system and bottom chord truss repairs were staged using Quikdeck, a full platform suspended below the truss bottom chord. This platform allowed for proper body positioning while busting rivets and installing high strength bolts and still allowing space for removal and replacement of twenty feet (20') long steel members. The platform included a full handrail and toe board. Employees were also tied off to further practice fall protection while on the staging.

Suspended scaffolding, sometimes referred to as swing staging, was also used to allow for vertical movement along abutment and pier faces for tuckpointing and pinning and grouting work. Swing staging is much like the staging used by window washers on high rise buildings but of course customized to meet the requirements of a turn of the century bridge structure. Of primary concern is attachment of the staging to the bridge structure maintaining the required factor of safety for suspended scaffolding while not impeding the clearance envelope.

High rail boom trucks and bucket trucks were utilized to make select repairs to the truss top chord and top chord bracing system. These trucks were also used for the initial set up the other types of staging.

**STEEL WORK**

A major portion of the project was the steel repairs. Initially, the original drawings were thought to be lost and not available. As it turned out, the original drawings were found and greatly aided developing shop drawings for the replacement steel. Field verification of all details were required prior to fabrication. The fact all seven truss spans were fabricated in much the same manner also aided field verification.

Shop drawings, field verification, steel procurement and finally shop fabrication began in January of 2014 to allow for steel repairs to begin in May 2014. Significant lead time is often required to obtain the structural shapes required for these type repairs in the desired grade of steel. In the case of this project the majority of the steel needed was Grade 50 weathering plate, wide flange shapes and angles. The outboard stringer flange angles required 6” x 6” flange angles. The lateral bracing required 6” x 4” bracing angles, a variety of plate and wide flange top chord bracing members. Floor beam flanges and webs were strengthened with plate steel. All of the common shapes selected maintained the necessary section properties of individual elements.

An experienced steel repair crew was used for the repairs. This eight man crew using a high rail boom truck as well as high rail bucket truck focused strictly on the steel repairs. Efficiencies were gained as the crew moved through the seven truss spans. The crew was divided into smaller work groups to allow for prepping of work which included installation and advancing staging as well as the aforementioned rivet busting. A second group focused on the actual steel changeouts.

**CONCRETE WORK**

As mentioned there was significant concrete repairs to the river piers, swing span drum pier and abutments. Again an experienced six man concrete crew was used for these repairs to allow for increased productivity and quality. As detailed above, the concrete repairs included reinforced cast in place encasement, pressure grouting, pinning with 1” diameter reinforcing steel, tuckpointing and high strength polymer concrete bearing pads.

**BEARING WORK**
The original roller nest expansion bearings were replaced with a new Teflon bearing system. The Teflon system top and bottom plates were sized to match original roller nests and required minimal work on the existing cast upper and lower bearing shoes. The concrete crew completed the bearing work which required jacking the trusses to proper elevation. The new bearings were installed and shimmed as required.

**DECK WORK**

Design Nine developed a detailed deck plan for replacement of all ties, walkway and handrail across the bridge. The detailed deck plan allowed for ordering of timber essentially as soon as the contract was executed. Treated structural timber lead times often approach 100 days and therefore time was of the essence. While the timber was being fabricated survey work identified significant line and surface issues with the bridge. In fact the deck prior to repairs was not centered in the truss spans and had significant surface problems due to previous river pier settlement. The bearing work set top of steel elevation and horizontal alignment. The new deck was installed with a dedicated seven man deck crew with high rail boom truck.

**OVERALL**

The project was put out for bid in the summer of 2013 with a required completion date in the fall of 2014. This duration allowed ample time for Contractors to submit very competitive bids and ensured the Owner received the best price possible. The timing also allowed for the proper engineering, project planning and material procurement. The use of 3 different repair crew types allowed the Contractor to expedite repairs working in many different areas along the length of the bridge while not creating logistical delays or safety concerns. Several changes were encountered as the project progressed, but essentially unit costs for different types of repairs as well as excellent communication between Owner, Engineer and Contractor allowed for completing the additional work within the allotted time and original budget. Good communication also ensured minimal disruption to train traffic and maximum production by the different repair crews.

The project was completed 4 months ahead of the required schedule set for funding and at a cost that was right at 1% over the originally funded construction cost, which included all change orders and additional work which was required after all horizontal surfaces were cleaned.

**CONCLUSION**

In conclusion a few things can be taken away from this project. First and foremost Connecticut Southern found itself in a very difficult financial position due to decades of deferred maintenance by the various owners. Ignoring maintenance needs does not make them go away, typically it only adds additional cost to the project. The work that was done in this project could have been easily handled in small, manageable chunks over the preceding decade and avoided the “do or die” drama of this project.

A strong Public-Private partnership is always a key to a successful publicly funded project. In the case of this project, the business community supported the project and provided capital. This made the project very attractive to the Connecticut legislature for funding. Without consensus among the stakeholders, the project never would have moved forward.

Finding the right balance of preliminary engineering and what is pushed to the contractor can save project costs in the long run. Too little engineering forces the contractor to assume risk in his bid. Too much engineering can result in higher design fees and remove contractor means and methods flexibility. In the case of this project, much of the work was component changeout. Therefore, the project team did not find it necessary to produce detail component drawings for the items being replaced especially since the contractor was required to produce detailed shop drawings. This approach allowed the preliminary engineering to focus on surgical component changeout to support the desired outcome of twenty plus more years of safe service life and let the bidders find the most efficient means to achieve this goal.

When building the bid list for a major project, make sure the list includes prospective bidders who value the owner as a client and are interested in a successful project. In addition to the usual mix of active Genesee and Wyoming contractors, this project picked up addition bidders through public advertising. Connecticut Southern invited thirteen contractors to bid on the project and six showed up for the prebid conference. Of these six, two submitted bids and it was clear from the submittals which contractor viewed the work as just another job. Needless to say their proposal was not selected as the most responsive.
Finally, communication is everything on a large project. Early, open, full disclosure, dialog with CT-DEEP about the nature of the work got the project a finding of “no authorization required” within forty five days of submitting the application. Strong communication between the engineering and operating departments to maximize work windows saved the project cost and time in the long run. There were no delay claims by the contractor and there were no delay of train claims against the contractor. Almost daily dialogue between the owner, engineer and contractor addressed issues, questions and changes as they arose and kept the project ahead of schedule and within 1% of the budget.
REHABILITATION OF CONNECTICUT SOUTHERN RAILROAD MANCHESTER SUBDIVISION BRIDGE 1.1 OVER THE CONNECTICUT RIVER
PRESENTED BY:

- WILLIAM S. RIEHL III, P.E.
  - GENESEE & WYOMING RAILROAD SERVICES, INC.
  - ASSISTANT VICE PRESIDENT OF STRUCTURES
- MATTHEW E. CHRAPEK, P.E.
  - THOLVENOT, WADE & MOERCHEN, INC.
  - MANAGER OF RAILWAY ENGINEERING
- MICHAEL J. TWEET, P.E.
  - KOPPERS RAILROAD STRUCTURES
  - VICE PRESIDENT

LOCATION

GENERAL HISTORY

- BUILT IN 1849 BY HARTFORD, PROVIDENCE AND FISHKILL
- RE-BUILT IN 1918 BY NEW YORK, NEW HAVEN & HARTFORD
- 1996 RAILAMERICA ACQUIRED FROM CONRAIL
- 2013 GENESEE & WYOMING ACQUIRED RAILAMERICA

SPAN CONFIGURATION

- SPANS ARE LABELED FROM WEST TO EAST (LMP TO HMP)
- 7 – OPEN DECK RIVETED THROUGH TRUSS SPANS
  - SIMILAR IN LENGTH AND COMPONENT MAKEUP
- 2 – OPEN DECK, DECK PLATE GIRDERS
  - RESTING ON CENTER OF PIER
  - DECK PLATE GIRDERS WERE ONCE TURN SPAN RESTING ON EXTERIOR COURSES OF STONE

INSPECTION AND REPAIR ESTIMATES

- $2M IN HIGH PRIORITY CONDITIONS NOTED
- RATING PERFORMED FOR 286K AT 10, 25 AND 60 MPH
- TRUSSES “OK” FOR 286K @ 25 MPH
- END FLOORBEAMS “OK” FOR 286K @ 25 MPH
- INTERIOR FLOORBEAMS “OK” FOR 286K @ 10 MPH
- STRINGERS “OK” FOR 286K @ 10 MPH
- ENGINEERS ESTIMATED $4.5M TO REPAIR SECTION LOSS:
  - REPLACE FLOOR SYSTEM
  - REPLACE TOP AND BOTTOM LATERALS
  - REPLACE EXPANSION BEARINGS
  - REPLACE TIMBER TIE DECK
- 2ND INSPECTION PERFORMED TO PRIORITIZE ALL DEFECTS

FINANCING

- $4.5M ENGINEERS ESTIMATE
- 3,000 ANNUAL CARLOADS
- PUBLIC/PRIVATE PARTNERSHIP ($3.2 MIL):
  - CUSTOMERS
    - CUSTOMER FORUM SETUP
    - $600 PER CAR SURCHARGE
  - CT GOVERNMENT
    - PRESENTED CUSTOMERS COMMITMENT
    - CT GOVERNMENT COMMITTED $3.2 MIL
  - GENESEE & WYOMING
    - ENGINEERING, PERMITTING, CONSTRUCTION MANAGEMENT, FLAGGING & TREE REMOVAL
STAGING & PREP WORK

- QUIKDECK - FULLY SUSPENDED PLATFORM FOR FLOOR SYSTEM REPAIRS
  - UNHINDERED MOVEMENT ON THE SCAFFOLDING
  - CAPTURED ALL DEBRIS FROM REPAIRS
- SUSPENDED SCAFFOLDING FOR SUBSTRUCTURE REPAIRS
- HI-RAIL BOOM & BUCKET TRUCKS FOR TOP LATERAL REPAIRS
- PREP WORK/ RIVET REMOVAL
  - APPROX 20,000 RIVETS REMOVED
  - REPLACED W/ 7/8" DIA. A325 BOLTS

STEEL DEFECTS / REPAIRS

- SECTION LOSS IN STRINGER TOP & BOTTOM FLANGES
  - ALT. REPAIR - REPLACED FLANGE ANGLES IN KIND ON STRINGERS 1 & 4
- SECTION LOSS IN FLOORBEAM COVERPLATE
  - REPLACED BOTTOM COVERPLATE IN KIND
- SECTION LOSS IN WEB OF FLOORBEAM AT BOTTOM FLANGE
  - PLACED FILL & COVERPLATE BOTH SIDES

STEEL DEFECTS / REPAIRS (CONT.)

- EXPANSION BEARINGS ROLLER NESTS NO LONGER FUNCTIONAL
  - REPLACED W/ TEFLOM & STAINLESS SYSTEM HAVING SAME DEPTH
- SECTION LOSS IN TOP & BOTTOM LATERAL SYSTEM
  - ALT. REPAIR - REPLACED IN KIND HIGHEST PRIORITY COMPONENTS

CONCRETE DEFECTS / REPAIRS

- WEST ABUTMENT - SCOUR AND CONCRETE SPALLING
  - ENCASED W/ CIP CONCRETE BELOW GROUNDLINE
- WEST ABUTMENT - WINGWALLS LEANING
  - PINNED BACK WINGWALLS
- PIER NO. 6 - 1998 SANK DUE TO SCOUR FAILURE: TAPERED TIES & TRUSSES RACKED
  - FOUND NO MOVEMENT IN PIER
  - SHIMMED BEARINGS TO ELEVATION & LINE

CONCRETE DEFECTS / REPAIRS (CONT.)

- PIER NO. 8 - DPG BEARINGS PUNCHING INTO SEAT
  - PINNED EXTERIOR STONES
  - PRESSURE GROUTED INTERIOR
  - PLACED POLYMER PAD FOR BEARINGS
- EAST ABUTMENT - DPG BEARINGS PUNCHING INTO SEAT
  - PLACED POLYMER PAD SET TO ELEVATION

TIMBER DEFECTS / REPAIRS

- SPOT TIE DEFECTS & SPIKEKILLED TAPERED TIES
  - ALT. REPAIR - SHIM BEARINGS INSTALL STANDARD SOLID SAWN TIES
- TIMBER WALKWAY REMOVED FROM SERVICE
  - REPLACED W/ SEPPARATED STEEL GRATING
- SUBSTANDARD CLEARANCE ON DPG SPANS
  - INCREASED CLEARANCE ON DPG TO CONFORM W/ AREMA AND MOVED C/L TRACK TO C/L TRUSSES
MISC. DEFECTS / REPAIRS

- Heavy tree cover over first 2 spans
  - Removed all trees within row
- Approach alignment shifted upstream
  - Track centered back on bridge
- No handrail on west abutment wingwalls
  - Installed handrail on ballast retainers

SCOPE OF WORK, CONSTRUCTION DRAWINGS & SPECIFICATIONS

- Bid item list was clearly defined
  - Each item, each member, each panel point, each truss
  - Clearly defined list of items to bid on
  - Allowed for easy +/- to project
- Construction drawings
  - Minimal details (allowed contractor flexibility)
  - Shop drawings required by contractor
- Specifications
  - Clearly defined what repairs were necessary
  - Means & methods by contractor w/ owner & engineer review

WORK WINDOWS

- Flexibility by transportation department & customers
  - Tuesday thru Friday – 0700 to 1700
  - 0700 on Saturday thru 1700 on Monday
- Non-controlled track, on-track safety was established by derail beyond bridge and staging area

ENVIRONMENTAL PERMITTING

- Connecticut – department of energy & environmental program (CT-DEEP)
  - Natural diversity database (NDDB) review
  - Certificate of permission (COP) application
- Construction staged from on top of bridge
- Bridge painted w/ lead based paint
- No debris in Connecticut River

PROJECT IN REVIEW

- Provided contractor ample time – received better bids
- Contractor used 3 specialized crews – maximized windows
  - Completed 4 months ahead of schedule
- Contractor used creative staging methods – minimized mobilization/demobilization
- Detailed unit costs – easy change orders
- Minimal construction drawings – means and methods by contractor
- 1% over originally funded cost after change orders and additional work

CONCLUSIONS

- Ignoring maintenance does not make it go away
- The right balance of preliminary engineering can save project cost
- Spend time to itemize the bid items
- Open communication with permitting agency avoids permitting set backs
- Strong public-private partnership is critical for publicly funded project