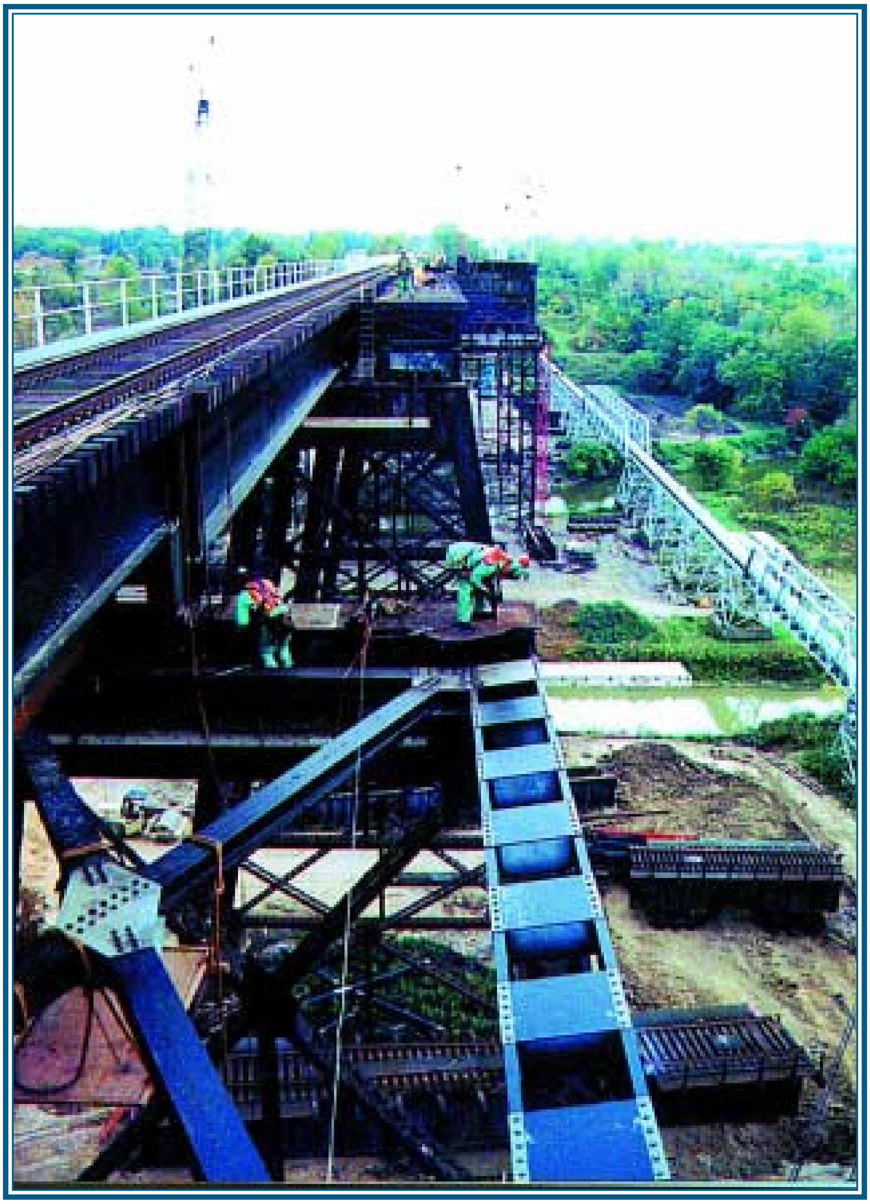
Site, Time Restraints Complicate Bridge Rehabilitation

A 180' double-track truss had to be replaced with only a 54-hour track closure



Shown above is the bridge under construction with some of the girder spans removed.

By Thomas J. Westerman, P.E.

While Bridge 11.09 on the Conrail Short Line has been servicing trains in Cleveland for almost 90 years, deterioration during the past few years had caused the shutdown of the south tracks. If service was going to be restored to both tracks, a thorough rehabilitation was needed.

The bridge is a 30-span, 1,988', open deck, double track, steel railroad bridge. It spans the Cuyahoga River Valley, and is part of the Conrail system. It will become part of CSXT's railway system in early 1999. The thirty spans include seven 80', fourteen 40', and four 67' deck girder spans along with five truss spans. There are also four riveted deck trusses and one pin connected deck truss. The riveted trusses include two 100', one 106' and one 114' spans. The pin connected deck truss is 180' long. Steel tower bents and concrete abutments support the spans. The steel tower bents rest on concrete pedestals. At the highest point, the top of rail is about 160' above ground.

Rehabilitation was required on all components of the bridge. The deck girders, pin connected truss and north track stringers in the riveted trusses were replaced. Deteriorated steel in the riveted truss spans and steel tower bents was repaired or replaced. Both abutments were repaired and modified to accommodate the new girders. The concrete pedestals, which support the steel tower bents, were also repaired. New bearing devices were installed on the expansion ends of the four riveted trusses.

This was a substantial project and several constraints made it more challenging. Rehabilitation jobs in general are full of surprises since additional repairs are usually discovered once the contractor removes portions of the bridge. This job was no exception. An inspection by a consultant had been completed in the fall of 1997. The inspection included a report that tabulated the deterioration of the bridge and included recommendations for repairs.

Detailed Verification

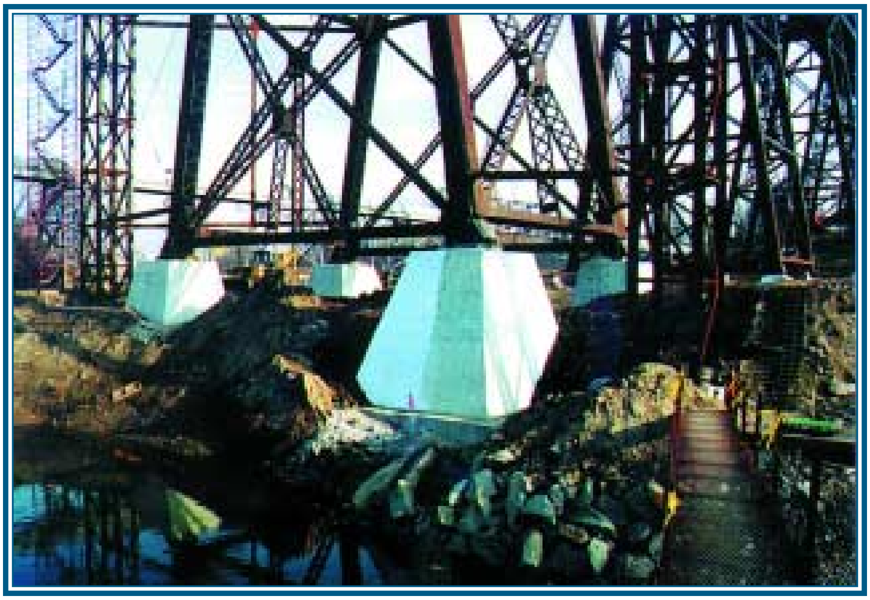
Unfortunately the inspection was only visual and not in-depth. Verification of deterioration to the towers and trusses was required before repair plans could be completed. The initial intent was to make a quick verification of the deterioration and jump into preparation of repair plans. It became apparent after the verification inspection started that numerous areas of deterioration were overlooked. At this time, it was decided to complete an in-depth inspection of the four-riveted truss spans and all of the steel towers.

It was difficult to reach many portions of the bridge since the structure is so high. The contractor helped considerably with this task by allowing the use of their manlifts to complete the inspection. Some last minute repairs to the floorbeams of the riveted trusses were required when additional deterioration to the flanges was discovered once the stringers were removed. After the in-depth inspection was completed, the number of truss and bent repairs was three times the repairs tabulated in the original inspection report.

Pictured above and at top is the 180' truss during roll-in.

Another challenging aspect of the project was that the owner and client were two different entities. Conrail was still operating the bridge when the rehabilitation was being completed. CSXT would begin operation on the structure in early 1999. CSXT wanted to operate double track service as soon as possible; therefore, they agreed to pay for the repairs before they were operating trains on the structure. For this bridge project, Conrail was the owner and CSXT was the client. Design plans and construction procedures had to be approved by Conrail and CSXT, since both had an interest with this bridge.

It was also challenging maintaining rail service on one track during construction. Once a week, one eight-hour track outage was allowed for repairs to the trusses and towers that required no live load on the bridge. Conrail provided a full time flagman to coordinate track outages and notify the contractor when trains needed to cross the



Pictured above and on the opposite page are the piers and abutments of the bridge after construction.

structure. A couple of extended outages were granted to assist the contractor, including one 54-hour continuous outage in order to roll out the old truss and roll in the new truss.

Installing the new 180' truss was also cumbersome. The truss had to be assembled on falsework and rolled into its final position. The following conditions had to be met for installing the new truss and designing the falsework.

- The falsework had to support the old and new 180' double-track deck trusses, both weighing approximately 1.4 million pounds.
- The new truss would have to be erected on the falsework at the level of the top of the existing steel towers, 130' above the ground line.
- The truss change out must be completed within a 54-hour track closure.
- The elements of the falsework had to be transportable on standard trucks without special permits for weight or width.

The falsework configuration selected required two bents. Each bent consisted of two new towers, the existing towers, and two runway beams. The runway beams supported the trusses when they rolled over them. The new and existing towers supported the runway beams. All of the falsework was fabricated from steel rolled sections and plates.

The existing tower columns are battered transversely at 2:12 and required a weldment to be bolted to the battered face to support the runway beam. The new towers were constructed 56' north and 56' south of the existing bridge centerline, for a total of four new towers. Each tower had four legs and a 36" diameter concrete drilled shaft supported each leg. The drilled shafts were approximately 40' long. The towers were made up of 15' and 20' segments that were bolted together. The segments were fabricated from 4-HP10X42 sections at 6'-6" centers. The runway beams were cover plated W36X245 sections spaced to match the tower legs. The runway beams were staggered vertically approximately seven feet to clear the lower truss chord and the existing tower bracing.

After the falsework was constructed, the new truss was assembled on the falsework. Both the existing and new trusses had custom designed lifting devices attached to them.

The lifting devices allowed the trusses to be jacked up using four 100-ton capacity jacks under each of the four corners of the trusses. Four 50-ton capacity rollers were then installed under each of the four corners of the trusses. The rollers allowed movement of the trusses when they were pulled. The trusses were then pulled into final position.

Roll-In

The trusses were rolled into position by attaching an air driven winch to each end of the truss. Each air winch was capable of developing a 10 kip pull. They were anchored at the base of the north falsework towers. A wire rope extended up the north falsework tower to a four-to-one block and tackle that was attached to the bottom members of the trusses. At a verbal command, both air winches were started and the truss slowly moved along the runway beams. If the truss became skewed to the runway beams, each air winch could be operated independently to re-align the truss. The same procedure was used to roll out the existing truss and roll-in the new truss.

The following is a condensed time line and sequence of construction tasks required to install the new 180' truss.

- Prior to the track closure, the new 180' truss was assembled on the falsework with the rollers attached.
- At about 8 a.m. on Sunday September 20th, the bridge was taken out of service and the rail was cut. The two 40'girder spans that rest on the truss and the four truss stringer spans that rested on the girder spans were removed.
- After the spans were removed, the existing truss was jacked up and the rollers were installed.
- At 6:30 p.m., the rolling out of the existing truss began. It

was in its final position by 7:30 p.m., about 30 minutes ahead of schedule.

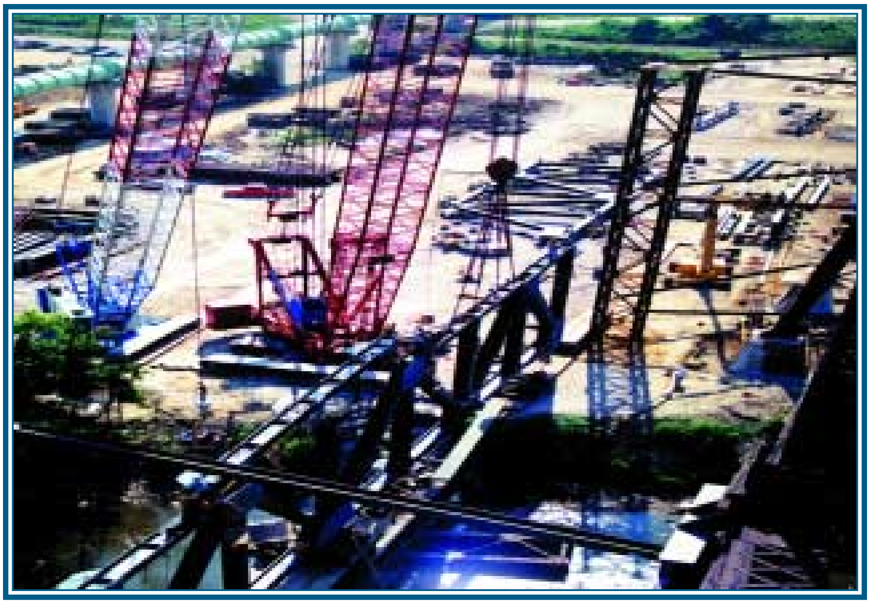
- The existing truss bearings were removed and the tower tops were cleaned and prepared for the new truss bearings.
- At about 12 a.m., the rolling in of the new truss began. It was in its final place at about 5 a.m. Numerous lights were installed and two shifts of ironworkers were utilized to allow around the clock activity.
- The new truss then had the rollers removed and the bearings were welded in place on the existing towers.
- The two new 40' girder spans and the four stringer spans were installed.
- The remaining timber ties, tie plates, walkway and handrails were installed.

All tasks were completed by about 12 noon Tuesday, September 22nd, two hours ahead of schedule.

Scheduling Challenge

The biggest challenge of the project was the schedule. At the beginning of the project, CSXT wanted the bridge opened to double track service in the fall of 1998. Therefore, an enormous amount of work had to be completed before this could be accomplished. Design of the new truss and girders started in February 1998, and partial plans were completed by March 1st. Mill orders to the steel mill were placed by the middle of March and approved shop drawings were completed by the end of March. Construction began at the end of May.

To accommodate the fast pace, the design-build contract was awarded to Dick Corporation, of Linwood, PA, as the contractor, and TranSystems Corporation, of Kansas City, MO, as the consultants. Dick Corporation took the lead by coordinating the fabrication of the long lead time items, namely the truss and girder spans. AISC-Member PDM Bridge, the steel fabricator, agreed that they could meet the deadlines for the fabrication of the truss and girder. AISC-member Tensor Engineering was also brought on board to produce the shop drawings for the steel fabrication. They were aware that this was a fast paced job and they would be working with partial design plans. In many instances, they were detailing from hand drawn sketches that were provided by the design engineers.



Massive Materials

The following is a partial listing of the quantities of materials required for the project.

- 4.2 million pounds of steel were required for the new 180' deck truss and 25 deck girders spans.
- 550,000 pounds of steel were required to construct the falsework towers
- Approximately 765,000 pounds of steel were required for the bent and truss repairs
- 3,500 new oak ties were required for the new track
- 670 cubic yards of concrete were required for the abutment and tower bent pedestal repairs

The project was successful for all parties involved. The bridge was opened to double track traffic in early November, meeting the clients' expectations. The construction did not adversely affect rail traffic. No significant accidents occurred during the accelerated construction schedule. The life of the bridge is now significantly extended as a result of the full rehabilitation.

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