THE PENNSYLVANIA RAILROAD SYSTEM

INFORMATION

FOR EMPLOYES AND THE PUBLIC

Broad Street Station
PHILADELPHIA, PA.

October 24, 1914

Pennsylvania Station
PITTSBURGH, PA.

II

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Moving a 720-Foot Bridge Into Its Permanent Abode

WHAT THE 1913 FLOODS DID TO BRIDGE 100

On the morning of March 25th this four-truss steel bridge looked like this picture. Half of it had turned over in the river, and another truss was undermined.

On September 22, 1914, another romantic chapter in the story of the floods of 1913, and how they were met by the Pennsylvania Lines, was completed. On that day a new three-span truss bridge, 720 feet long and weighing 7,000,000 pounds, was "rolled" into place at Tyndall, Ohio, in seven minutes, without interrupting traffic. Eleven minutes after the last train crossed the bridge in its temporary position another moved over it in its permanent place. Between the breaking of the rails and reconnecting them 10 minutes and 17 seconds elapsed.

The bridge is the longest and heaviest ever moved into place by the method employed, and the speed with which the great structure was shifted set new records for engineering work of this kind.

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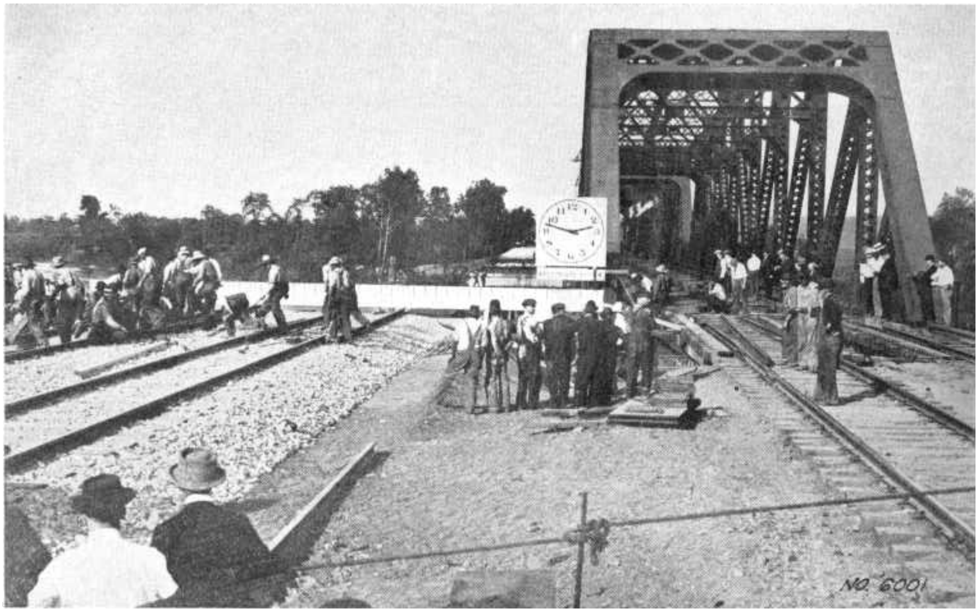
The old Bridge 100 crossed the Muskingum River at Tyndall, Ohio, about four and one-half miles west of Coshocton and about 64 miles east of Columbus. It was erected in 1900—a four-truss bridge, resting on three piers and two abutments. From end to end it was some inches over 614 feet long and it weighed 2,500,000



BRIDGE 100 READY TO BE MOVED
Immediately after a fast mail train had cleared the bridge the rail connections were broken, and this mass of 7,000,000 pounds of steel started on its 47-foot journey to its permanent location.

pounds, which would still be ample for the traffic of today.

The Work of the Floods

The floods of 1913 tore Bridge 100 into pieces. So great was the velocity and so immense the volume of water that scoured out the bed of the Muskingum River and undermined the foundations of the bridge, that the west pier was destroyed and the middle pier was damaged enough to cause it to settle nine feet on the upstream side and five feet on the other. At the height of the flood the water rose to within 1.6 feet of the grade of the rails.

The two trusses at the west end of the bridge fell into the river. The middle east span settled with the middle pier, while the span at the east end of the bridge remained intact. This occurred on March 25, 1913.

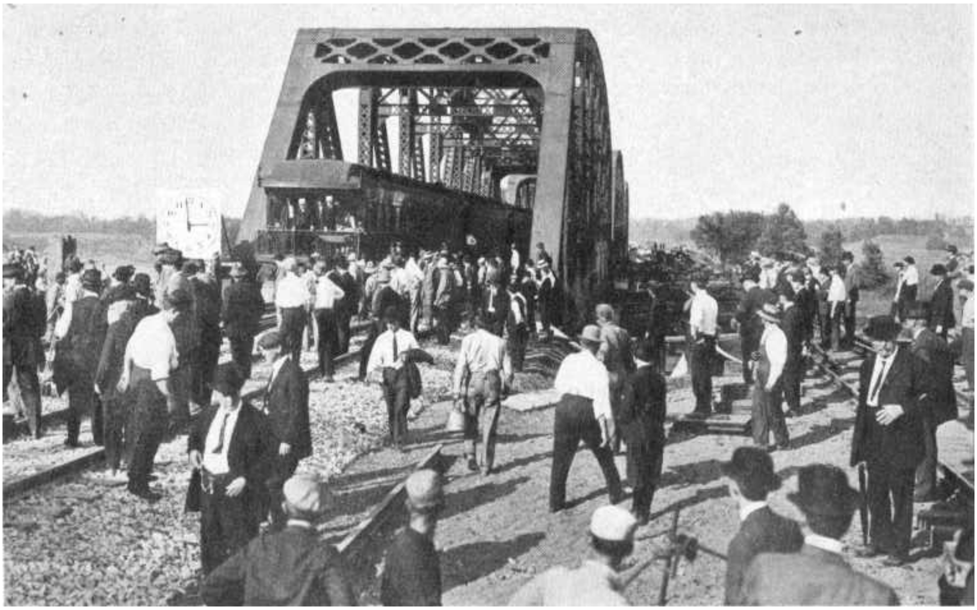
Because of many washouts in both directions, as a result of the great flood, it was April 13th before a temporary bridge could be built.

Planning the New Bridge

Once traffic was moving again over Bridge 100—moving very slowly, it is true—the railroad engineers devoted themselves to the task of designing a bridge that would defy the force of another flood such as that of March, 1913.

Soundings taken in the Muskingum River, under Bridge 100, after the flood, showed that the bed of the river had been washed out in some places 18 feet below its former level and in other places 15 feet. The area of the waterway beneath the bridge—that is, the space between the bed of the river and the floor of the bridge, through which water could flow—had been 16,328 square feet. With the passing of the flood it was found that this had been increased to 18,990 square feet by the cutting away of the river bottom.

The engineers decided to plan a structure which, in addition to withstanding the floods, would provide extra strength to meet the



BRIDGE 100 IN SERVICE AGAIN

Eleven minutes later Bridge 100 was resting on its permanent foundation, and another passenger train was passing over it.

growth of traffic for many years to come. Hence the new bridge was designed not only to be higher and longer than the old, but also of more than twice as heavy construction.

A greater waterway area was one of the first features decided upon. The flood, itself, had accomplished something in this direction by scouring out the river bed, but the plans for the new structure provided a further increase to 21,672 square feet, to give a larger opening for the free passage of swollen waters. The grade of the rails was raised three feet, and the total length of the bridge, from face to face of the abutments at either end, was increased to 721 feet. The new bridge was planned to be built in three spans, instead of four, so that only two piers would oppose the flow of water, where there had been three under the old structure.

Depth of the Foundations

As the river bed was found to consist of sand and gravel to a depth of 100 feet, the engineers provided for pier foundations 43 feet below low water, about 75 feet under the tracks. The foundations for the abutments were carried to a depth of 31 feet below low water.

In laying the new foundations, the workers in the pneumatic caissons found a curious relic of the flood, a little child's wagon in the sand 58 feet below the tracks.

The three 240-foot truss spans which form the superstructure of the new Bridge 100 were erected on temporary, but very strong, supports 45 feet down stream from the location of the old bridge. As soon as the new spans were put together, traffic was diverted to the new bridge in its temporary position. The old repaired structure was then demolished.

The masonry work on the new piers and abutments was finished, except for some details which awaited the moving of the superstructure into place, in December, 1913. The work of putting together the three trusses was started in the same month. All of the material had been delivered by the following March and the spans were complete to the last rivet on September 22d. They were immediately moved to their permanent places.

How the Bridge Was "Rolled" into Place

The three spans were shifted as one structure, with ties and rails in place. So fine was the calculation that, despite the rapidity of the operation and the great length of the bridge, nothing was disturbed in the slightest degree and the rails on the spans made strikingly perfect alignment with the tracks of the approaches at either end.

The spans were moved from their temporary supports to the adjacent piers and abutments on 2½-inch steel rollers, resting on rows of 85-pound steel rails laid for that purpose. Each span was carried on "sand jacks," small steel boxes filled with fine dry sand. The purpose of the "sand jacks" was to hold the spans, during the rolling operation, somewhat higher than their final positions, so that, when the bridge was in place, the sand could be allowed to run out and the trusses would settle gently into their permanent "shoes."

The motive power was supplied by two derrick cars, equipped with hoisting engines. The cars were placed end to end on the middle span, and anchored. From each of the four drums of the hoisting engines steel wire cables were led through a series of many-sheaved steel blocks, attached to various points on the spans and to wooden "deadmen" built at the upstream ends of the new piers and abutments. In effect, the spans and their permanent foundations were pulled together, but, of course, only the spans moved.

Little Power Required to Move 7,000,000 Pounds

Owing to the very careful arrangements, the power required to roll the heavy spans was surprisingly small. The greatest pull on any one of the three trusses was calculated at not over 15,000 pounds, although the entire structure, with rails, equipment, and the moving machinery, weighed more than 7,000,000 pounds. The steel cables were not even pulled taut.

An ingenious "telltale" arrangement, constructed on piano wire, pulleys, weights and a scale graduated in feet and inches, in plain sight of the person directing operations, guarded against one span moving faster than another, which would disturb the alignment.

A huge clock was erected at the west end of the bridge, over a scale, with a pointer, showing the number of feet the structure had to be moved. This not only graphically illustrated the progress of the work, but rendered possible photographic records of the various stages of the operation.

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The last train to cross the bridge in its temporary position was a fast westbound mail. As soon as it cleared the bridge, the tracks were broken and within two minutes the bridge began to move. The actual rolling required between six and three-quarters and seven minutes. The time during which the tracks were disconnected, 10 minutes and 17 seconds, was half what had been counted upon.

So swiftly and smoothly did the great bridge glide into its permanent place that the several thousand persons who had come from miles around to witness a rare engineering feat, for a moment hardly realized that the work was done. Then the first train crossed and the spectators burst into enthusiastic cheers.

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To the railroad men, who were responsible for the success of a delicate task, the joining of the rails brought a quiet relief. It meant that the line was open again and permanently. Otherwise, the shifting of Bridge 100 was but part of the day's work in efficiently serving the public.