From the library of Chris Zynda

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Fire-Damaged Bridge Repaired with Gunite

Lake Springfield Structure Spalled by Gasoline Fire Is Completely Restored by Contract in Two Months

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✦ THE 1,700-foot reinforced-concrete bridge over Lake Springfield, Ill., damaged by gasoline fire, was speedily repaired by the use of Gunite. Built in 1933 of reinforced concrete throughout, the bridge has thirty-four 50-foot spans carrying a 40-foot roadway with two 5-foot sidewalks, the weight of which is spread over nine beams supported on five-column bents resting on concrete piers.

Fire Envelops Span

The fire started when a 4,000-gallon truck-trailer gasoline carrier overturned on the bridge which is located 7 miles south of Springfield on U. S. 66. The resultant explosion killed the driver, and set on fire the gasoline which poured over the concrete bridge deck and ran through the row of scupper holes placed in the roadway alongside each curb for drainage. The flaming gasoline soon enveloped the concrete girders, columns, and piers under the deck slab.

The accident occurred near the southern end of the bridge on span 27 which suffered the greatest damage, although the two adjoining spans were also somewhat spalled by the heat. Strangely enough, the fire did less damage on the deck where the truck cracked up than it did to the beams, columns, and piers below. As the liquid fuel ran down the scuppers, it spread out over the bottom of the bridge superstructure, covering the bents and foundation above the water line. A brisk breeze aided the flames in generating a terrific heat which caused the reinforcing steel in the structure to expand, cracking and spalling the concrete around it. When the fire ceased and the smoke finally cleared away, an inspection of the concrete, once clean and white but now blackened from the fire, clearly indicated that the bridge would have to be repaired at once before the beams were further weakened by exposure.

Repairs Start

Restoration work was begun in September, 1944, by the Gunite Concrete & Construction Co. of Kansas City, Mo. The under side of the bridge could be worked on only from boats so the City of Springfield granted to the contractor the use of four steel barges, 40 feet long x 12 feet wide x 6 feet deep. These barges were lashed together and then moored lengthwise beneath the bridge, occupying the entire area beneath span 27. The steel decks of the barges were flush with the sides, making a smooth platform for the easy movement of men, construction material, and equipment. Scaffolds consisting of wooden horses and boards were set up on the barge decks. Two men then chipped off the loose concrete with Ingersoll-Rand pneumatic drills operated by a Sullivan 227-cfm portable air compressor driven by a Buda gas engine. This unit was placed on the roadway of the bridge immediately over the span being repaired, so that no more than 75 feet of hose line was needed to bring air to the drills which operated at 100-pounds pressure. The drillers, wearing transparent shields over their faces as

protection from flying fragments, removed the crumbly concrete for an average depth of 3 inches. On the two outside curved beams, however, which were gutted more than the others, the concrete was removed for an average of 18 inches upward on the sides from the bottom of the beam and for a depth of 4 inches, exposing the steel reinforcing.

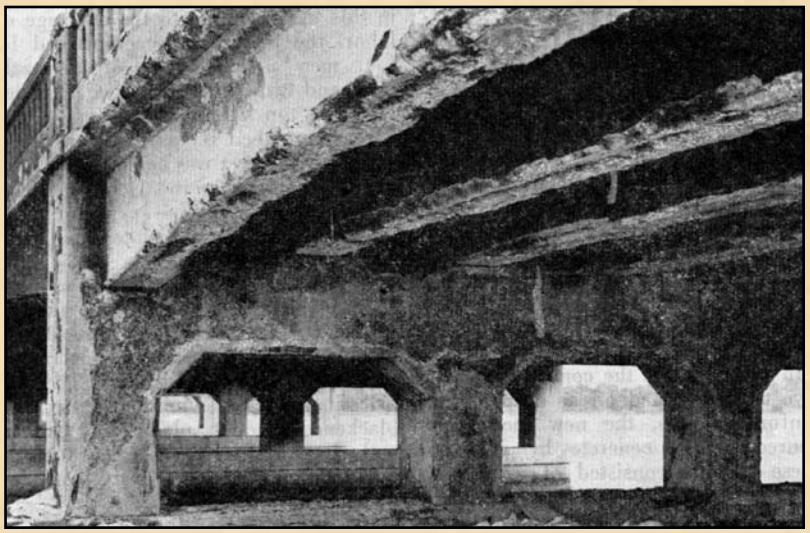
New Reinforcing

The beams were then faced with a 3-inch mesh of No. 10 wire which came in 30-inch rolls. As the beams are 18 inches wide, a 6-inch strip was turned up on each side of the mesh so that the section could be wired to the reinforcing rods. For ease of handling, the mesh was cut with nippers into 5-foot lengths and when placed along the bottom of the beam had a 6-inch lap at each junction. The wire was light enough so that it could be bent by hand to the shape of the beam.

In places where the concrete did not have to be chipped off as deep as the reinforcing rods, the new mesh was secured to the concrete by anchors. These anchors consisted of a ¼-inch rod, 3 inches long, which threaded through two cone-shaped washers, one of iron and the other of lead. These washers were secured at one end of the anchor, and could be driven into the concrete by placing a hollow tube over the rod and driving the anchor into a drilled hole. The iron washer was thus forced into the lead washer which consequently expanded, securely locking the anchor into the concrete. The mesh was then wired to the anchors set along the sides of the beams.

Placing New Concrete

A Model N-O Cement Gun, requiring a minimum of 125 cubic feet of actual free air at 60-pounds pressure per minute, was set up on the bridge deck near the air compressor to apply the new concrete surface. Portland cement in bags was stored on one side of the gun while a load of clean, sharp, fine sand with from 4 to 8 per cent water content was stockpiled on the other side. Dry-mixed cement and sand in the ratio of 1 to 3 was placed in the upper chamber of the two-compartment cement machine where the pressure is alternately off and on. The mix then passed into the lower chamber which is always under pressure from the air compressor. The dry mixed sand and cement was next forced through a stout rubber hose, 1-inch inside and 1¾-inch outside diameter, at the end of which was a nozzle where water was added from a connecting line.



Beams, columns, and piers of the reinforced-concrete bridge over Lake Springfield, IL, damaged by fire, were repaired with gunite

The nozzle pressure of the dry material averaged between 45 and 60 pounds, according to the moisture of the sand; the drier the material the less pressure was needed. Pressure on the water line was around 10 pounds more than that of the material line. Water for the operation was pumped directly from the 14-foot-deep lake by a double-cylinder air pump located on the barge deck. The nozzle man increased the pressure on the water line as needed by stepping up this small air pump without having to adjust the compressor itself.

On the two arched outside beams, wooden "shooting" or guide strips were wired to the reinforcing in order to secure true lines and camber. Sixteen-foot strips of 3 x ⅞-inch board were used, along one edge of which a 1¼-inch chamfer strip was nailed. With the strips in place, shooting began, with the nozzle man directing the stream of sand, cement and water against the bottom of the beam first and then moving towards the top. The Gunite was built up in layers until the concrete conformed with the original outline. Encasing the beams with reinforced Gunite restored the design to the structure.

Sand Blasting

When the bridge had been structurally repaired, the Cement Gun was used to remove smoke and oil stains from the remaining affected parts of the span. The dirty concrete was cleaned by sand

blasting, dry sand being forced through the machine and out the nozzle.

Personnel

Ordinarily Gunite work of this type requires an average crew of eight, but in this instance, due to the shortage of labor, the work was accomplished by four men, a superintendent, a nozzle man, and two drill operators. A ladder from the top side of the bridge to the barges furnished access to the working area. The project was completed in two months, September and October, 1944, with about half the time spent in removing the burned and disintegrated concrete and the remainder in placing the new mix. The job was paid for on a contract basis according to the number of sack batches of Gunite that were used with a bid price per sack batch; 800 sack batches were required. The bid price included removing the spalled and blackened concrete, placing the Gunite, and sand blasting the blackened areas, but additional payments were made for the wire-mesh reinforcing.

This contract for the restoration of fire-damaged spans of the Lake Springfield Bridge on U. S. 66 south of Springfield, Ill., was awarded by the Illinois Division of Highways, Wesley W. Polk, Chief Highway Engineer, to the Gunite Concrete & Construction Co. of Kansas City, Mo., for whom W. J. Gregory was Superintendent. The work was in District 6 of which Carl M. Wahl is District Engineer, with headquarters at Springfield. Resident Engineer on the bridge was Edward Warren.