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	FILE	

El Paso, Texas
November 1, 1963

Bridge Repairs Project
El Paso County

Mr. D. C. Greer
State Highway Engineer
Austin, Texas

Attention: File D-16

Dear Sir:

The attached story of the repairs of our P & SF Bridge is for your information and use as you see fit. Please feel free to edit this in any way you wish. Mr. Ferrari can give first-hand information.

A complete set of photographs have been supplied to D-18 so you may select other photographs if you desire. Some color slides have been made. These are on hand in the district.

Very truly yours,

E. W. Mars
District Engineer

By:

Leroy J. Wallen
Sr. Resident Engineer

LJW/lg
cc: File D-18 (Mr. Ferrari)

Bridge Deck Repairs

El Paso County has a bridge problem similar to many others in the State. The concrete on the deck was deteriorating to such an extent that general deck repairs were required. While other bridges in the district show symptoms of similar stress, the P & SF Overpass on US 80A in El Paso started serious spalling and investigations were started to find the cause and correct it.

This structure is of standard steel and concrete design consisting of 9 continuous I beam units of three, five, and six spans. There are two 24-foot roadways with sidewalks and a four-foot raised median. There is a construction joint down the center of the median and no connections from the steel stringers to the deck. The concrete deck has a 6½" thickness with 1½" from center of reinforcing bars to surface.

The three span units have steel H piling and normal caps. The five and six span units have random spaced steel H piling to fit between railroad tracks and no caps. This structure is on a vertical and horizontal curve and is 1822 feet long. It was built in 1953.

The first problem with this structure was noted by our maintenance crews. Concrete was spalding out to the top steel. These "pot holes" started developing shortly after the legal load limit on Texas highways was raised to 72,000 lbs. Maintenance crews patched these holes with premix, but they continued to grow and new holes developed.

District, Bridge and Maintenance Division personnel, as well as local engineers, examined the bridge and about as many different recommendations were received as there were lookers. First, D-9 took a series of core samples from various parts of the bridge deck. These were broken in the Austin lab and all were in excess of design strength. Next a

research project was established in conjunction with the Bureau of Public Roads to test the stresses, deflections, and vibration on this structure under specified loads.

The bridge was instrumented under the supervision of the bridge division. The Bureau of Public Roads supplied a laboratory trailer and an instrumented truck that was driven at various speeds in specified paths. The results of the many gauges were recorded in the lab trailer.

After much discussion and interpretation the results were given that the steel stringers were operating well within the design limits. No excessive vibration occurred. No report could be given on the reinforcing steel or concrete.

A test patch was decided on using commercial epoxies. A small area, approximately two feet by 30 feet, was chipped out using an air hammer and the edges squared with a concrete saw. The area was then sand blasted and approximately two-thirds was painted with epoxy bonding agent. This area was then patched using a small aggregate concrete. The remaining 2-foot by 10-foot area was patched using epoxy concrete. A solid area, about 10 feet by 10 feet, was sand blasted and sealed using an epoxy glue with sand added to provide a skid proof surface.

All three of these tests have been in place about two years and all appear to be working as desired. The cracks in the bridge deck have appeared in the concrete patch but not in the epoxy concrete patch. Both patches are well bonded.

The Maintenance Division set up a special job to repair this structure using Highway Department formula epoxy bonding agent, Class A concrete to patch the holes, and commercially produced Guard Kote epoxy for a deck sealer.

The deck was "sounded out" by tapping with a hammer. All hollow sounding areas were marked. An air hammer crew followed breaking out the unsound concrete which extended to the top layer of steel. Three small holes were opened through the bridge deck in areas where vibration had been inadequate during construction. This was followed by a sand blast of the area to remove the rust from the reinforcing steel.

During the months of August and September, 1963, concrete patches were poured in the early morning hours to prevent curing cracks in the concrete. Concrete was mixed on the job because of the relatively small volumes needed. A 1-2-3 mix was used with maximum aggregate size of one-half inch and a minimum of water. (The slump averaged about one-fourth inch.) Just prior to pouring concrete the area was painted with epoxy. Curing was accomplished by wet sand for approximately seven days.

An alternate method of repair, using air emplaced concrete (Gunite), was demonstrated by True Gun All Co. The deck was prepared in the manner outlined above. "Albitol" was used to glue the new concrete to the old in the same manner as epoxy. The patch was "gunned" with a mixture of one part cement Type III to four parts sand. A mixture of water and Albitol was added to the cement-sand mixture in the drum and wet concrete at a minimum slump was gunned on the deck. An auxiliary air ring at the nozzle gave the concrete an added push.

It was recommended that one-half the water in the splash (bonding) course be replaced by Albitol. The additional patch should have one-fourth of the water replaced by Albitol. Seven ounces of air entraining agent was added for each sack of cement used. This patch was screeded off by cutting the excess with a specially made screed and floating with a wide paddle cement finisher. A broomed finish was obtained. The patch was

water spray cured for two to three hours; then curing compound was applied. The patch was started at 1 p.m. and completed about 6 p.m., Thursday, October 17, 1963. Traffic was placed over the patch at 6 a.m. the next day.

There is no doubt but that a denser, stronger concrete can be produced by gunning. There is some doubt in my mind as to the need for the added strength in the patch over the original deck. It appears that the entire deck should be sealed in some manner to prevent water and de-icing agents from penetrating to the reinforcing steel.

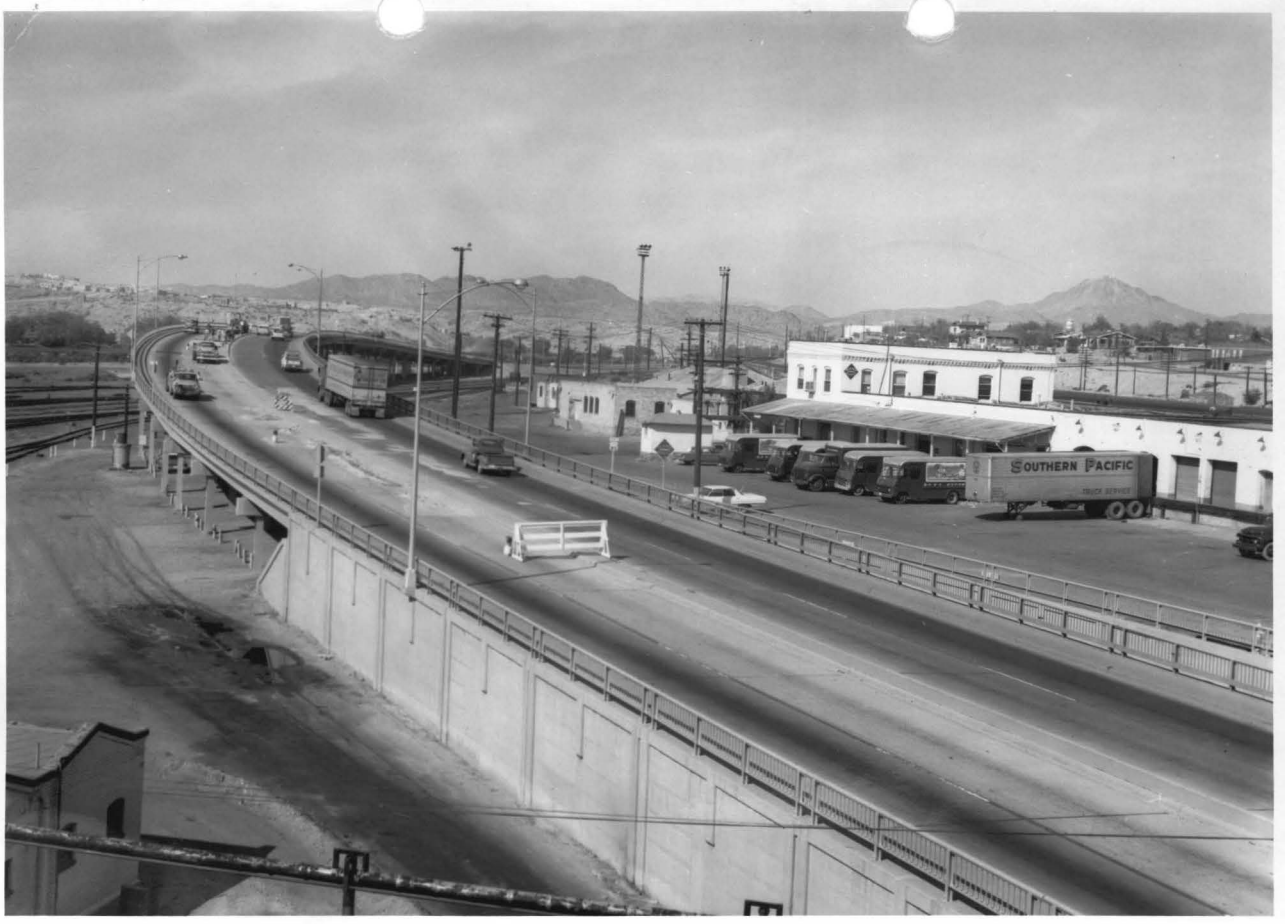
We propose to compare three types of sealers on this bridge deck this winter to determine relative effectiveness. The first is described above as an epoxy seal consisting of approximately 3½ lbs. per square yard (Guardkote) on which is sprinkled approximately 20 lbs. per square yard of uniform sand passing the #8 screen. The second is very similar only using polyester material instead of epoxy. The third is a two-course seal using linseed oil and kerosene.

Only time will tell if these repairs will hold. The basic reason that caused the deterioration has not been corrected unless the offender is moisture and salt geting to the reinforcing steel. We feel certain that a good seal will prolong the life of this structure.

Leroy J. Wallen
Sr. Resident Engineer

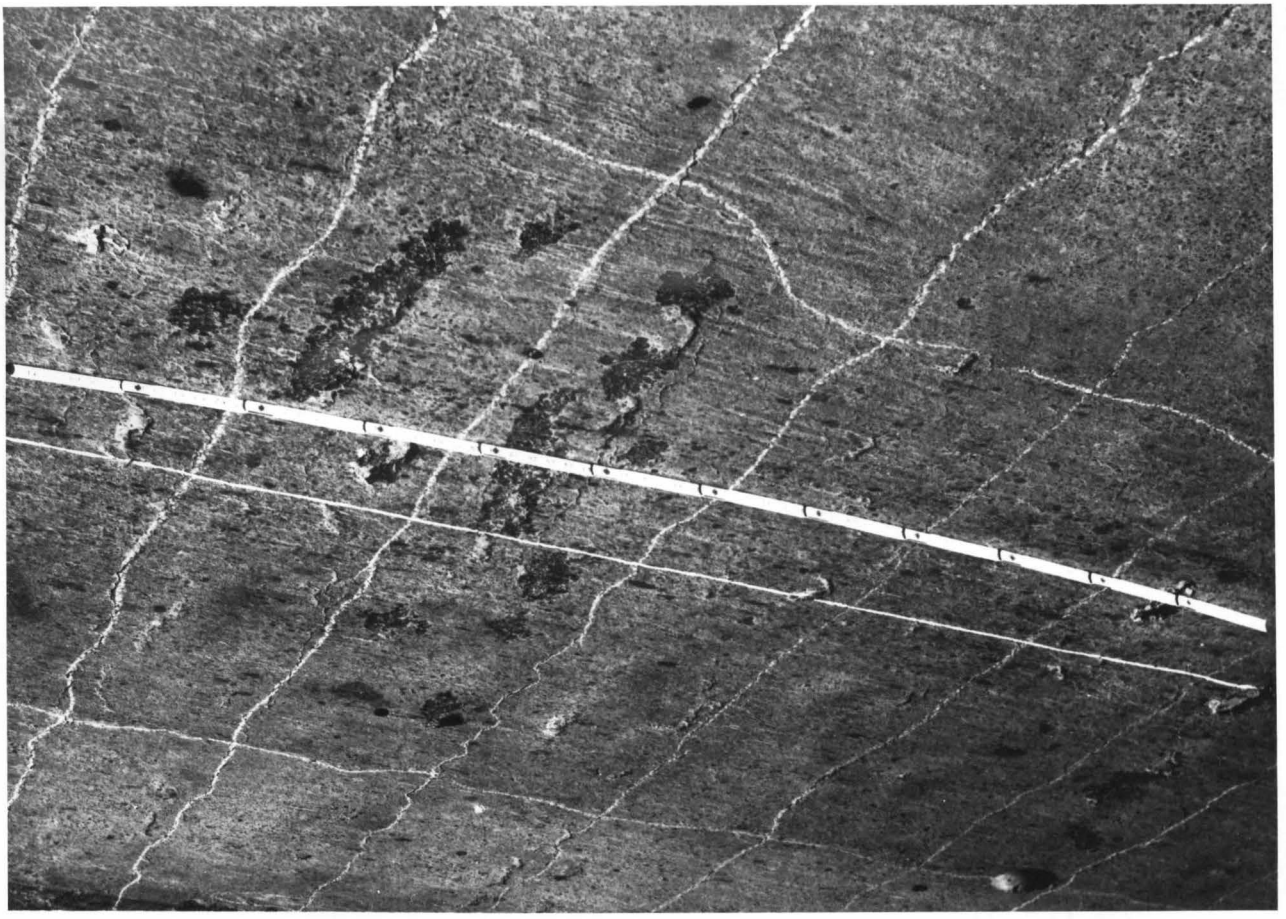
Typical View of Underside of Deck with Cracks Marked

Typical View of Pothole Development



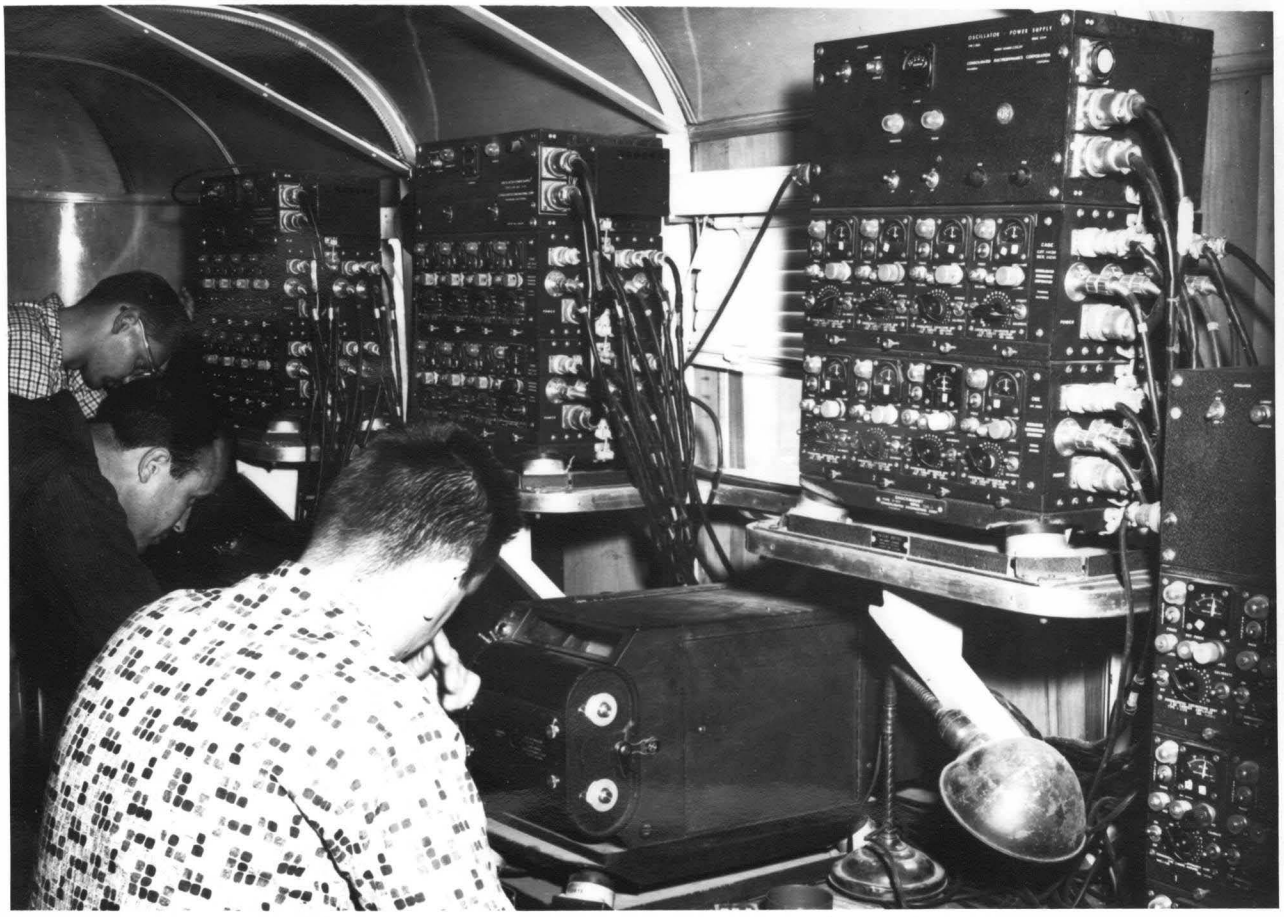
General View of P & SF Overpass Structure

Typical View of Deck with Major Cracks Marked with Chalk

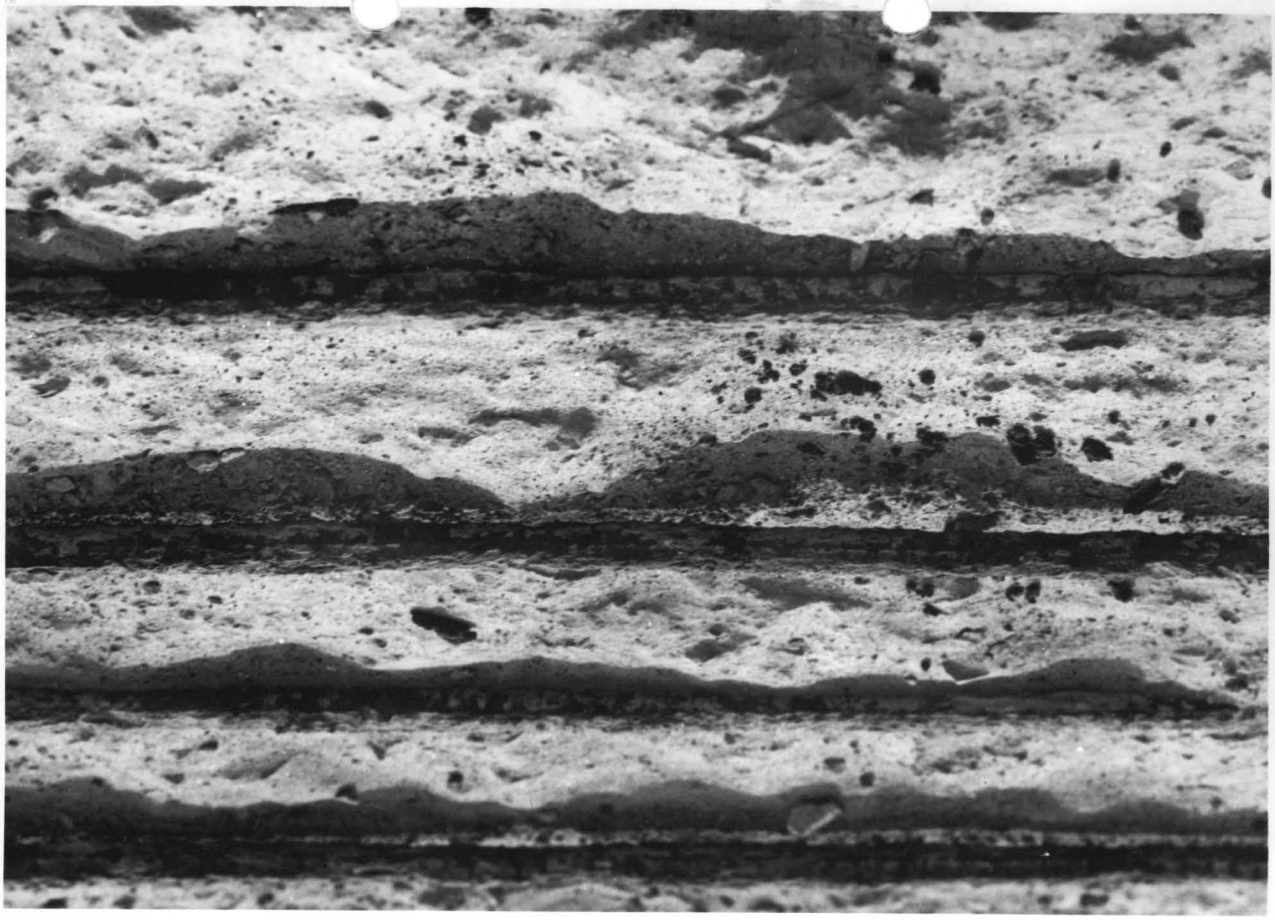


Strain and deflection gauges being placed. Bureau of Public Roads instrument trailer in center. Old Mexico on right.

Ed Payne of District Bridge Division calibrates truck mounted instruments as Bureau of Public Roads' test truck is loaded.



Interior view of Bureau of Public Roads lab trailer showing amplifiers and recorders. Paradee and Ybanez from District Bridge Section assist Christopher of Bureau in recording data.



Typical of deterioration of reinforcing steel

One of three holes opened in deck during operation

Correa spreads Guardkote epoxy with broom and squeege. Aguirre adds sand. Velasco keeps close watch.

Gordon Vernon and Robert Barton of True Gun at the nozzle. Samaniego back up on the line. Medina and Moreno loading machine. Ferrari of D-18 is inspecting equipment. Velasco, Hernandez, Correo and Ramirez stand by to assist.

Mixer in operation on top of bridge. Holguin from the lab makes cylinders. Vejil operates the mixer. Jackson is operating a wheel barrow and "Shorty" Velasco runs the operation.

"Shorty" Velasco, Special Job Foreman, cleans the loose material ahead of Jackson applying epoxy and Samaniego brushing while Aguirre finishes the patch.

Screed operated by Aguirre and Chavira cuts excess material as Correa and Vejil pull. Hernandez stands ready to shovel excess away while Vernon operates finisher. Ramirez directs traffic.

Velasco turns on the air and Aguirre operates the nozzle preparing the deck to receive a Guardkote epoxy seal.

The air hammer is being used by Moreno to chip out unsound area as Barnett stands by to assist. Vejil uses the broom.