Development of Techniques for Applying Resinous Skid-Resistant Surfaces to Highways

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●AT THE 36th Annual Meeting of the Highway Research Board, two papers were presented introducing a new type of resinous material for surfacing portland cement and bituminous concrete highways. (1, 2) This surfacing material, called RELCOTE, (Registered Trade Name, Reliance Steel Products Company) utilizes a modified EPON, (Registered Trade Name, Shell Chemical Corporation) resin binder which, on the addition of a catalyst, sets chemically to a tough thermosetting plastic. While still in the liquid state, the resin is applied to the roadway, and sharp, abrasive grit such as crushed quartz, emery, or alundum is broadcast over the surface. When the resin sets chemically, the grit is permanently fixed in place. The excellent adhesive, physical and chemical properties of the resin produce a surface having outstanding resistance to wear, weather, chemicals, and freeze-thaw cycling, and in addition provide lasting skid resistance.

During the past three years, nearly 200,000 sq ft of experimental coatings have been placed down in forty different locations which embody a wide variety of substrates and surface conditions. Included in this figure is 30,000 sq ft applied to a one-mile portland cement concrete test strip on US 22 in Union, New Jersey, where 140 variables have been studied in triplicate.

During the past year our investigations have been extended to include bituminous concrete substrates in which the variables considered most important from previous work were studied. The knowledge gained from these field studies has played a vital part in advancing technology to the point where large scale commercial applications could be undertaken.

The anticipation of large-scale applications made obvious the necessity of developing equipment which would efficiently and economically apply this material. It was decided to concentrate on developing a large scale portable chemical plant which would proportion, mix, and spray the liquid ingredients onto the roadway.

During January 1957, fabrication of the RELCOTE paver commenced. By May, the machine was ready for trial runs. During the next two months, much time was spent calibrating the pumps to insure proper curing agent to resin ratio, developing experience in maintaining various rates of application of resin binder, and finally, coordinating the work of the RELCOTE paver with a method for distributing grit.

The RELCOTE paver has a capacity of 2,400 gallons. Resin, bituminous extender, and curing agent are proportioned and pumped into a packed mixing column. Once mixed, the resinous binder passes through an open ribbon blender where additives such as thickening agents could be introduced if required. From the ribbon blender the liquid binder is pumped through a spray bar onto the roadway. In order to insure accurate, efficient, uniform operation of the metering system, provision was made to maintain the liquid ingredients within a narrow temperature range—normally between 90 to 95 F.

During August 1957, the RELCOTE paver was used to coat the Wyoming Avenue Bridge in Philadelphia. This bridge has a portland cement concrete deck with a surface area of 30,000 square feet. In this case the purpose of the RELCOTE application was two-fold. First, it was to provide a waterproof membrane for the bridge surface, and secondly, furnish a skid resistant overlay to reduce accidents on the three percent surface grade. Before RELCOTE was applied, the roadway was essentially a porous surface with a large percentage of polished aggregate exposed. The deck is now a water-tight even layer of sharp abrasive aluminum oxide.

The following procedure was used to resurface the bridge:

1. Heavy tar and grease spots were removed with a Tennant machine, Figure 1.
2. The entire surface was etched with hydrochloric acid to insure a lasting bond between the resinous binder and the concrete.

Figure 1. Removal of heavy tar and grease spots.

Figure 2. RELCOTE paver in operation.

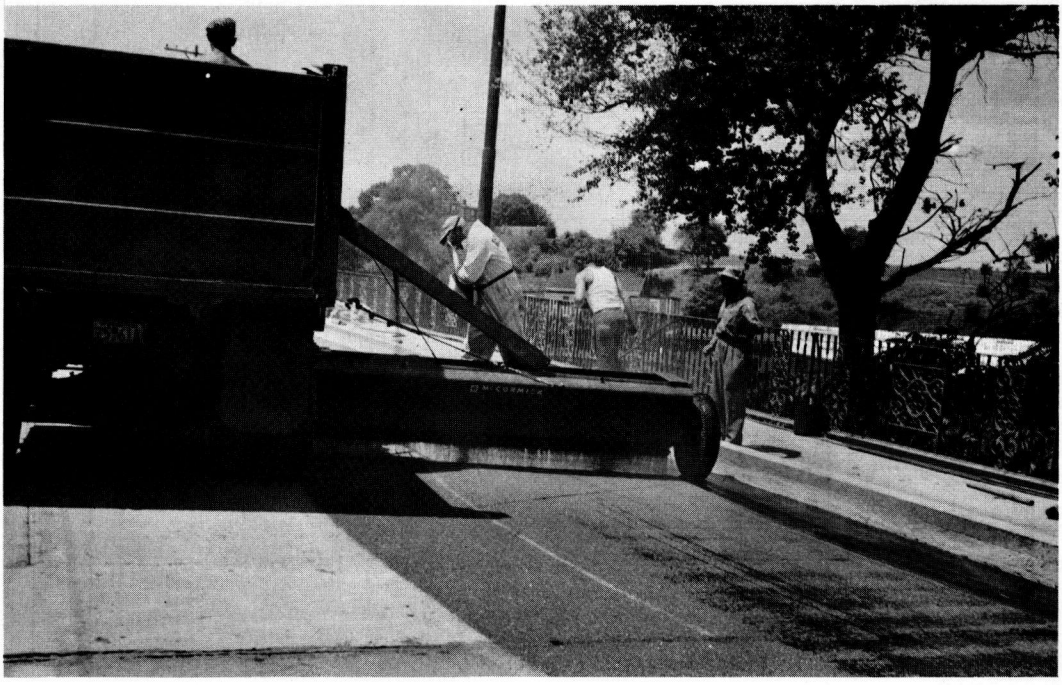

Figure 3. Grit distributor.

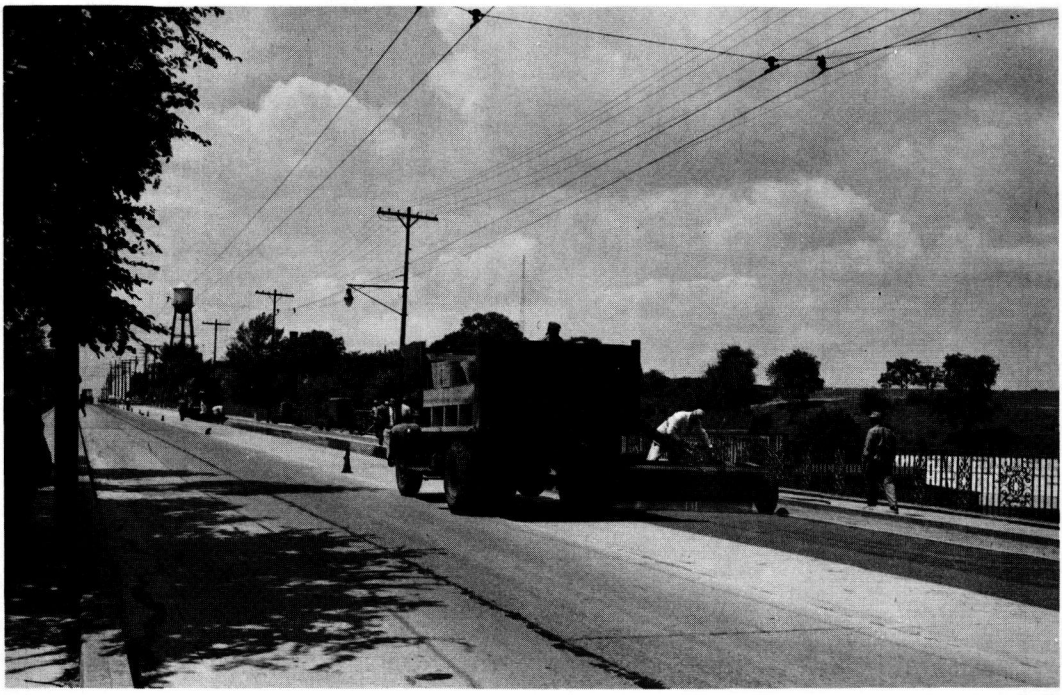

Figure 4. Paving the first lane of the Wyoming Avenue Bridge in Philadelphia.

Figure 5. Rolling to insure optimum filler loading using a 3-5 ton roller.

Figure 6. Tensile test.

Figure 7. Skid test.

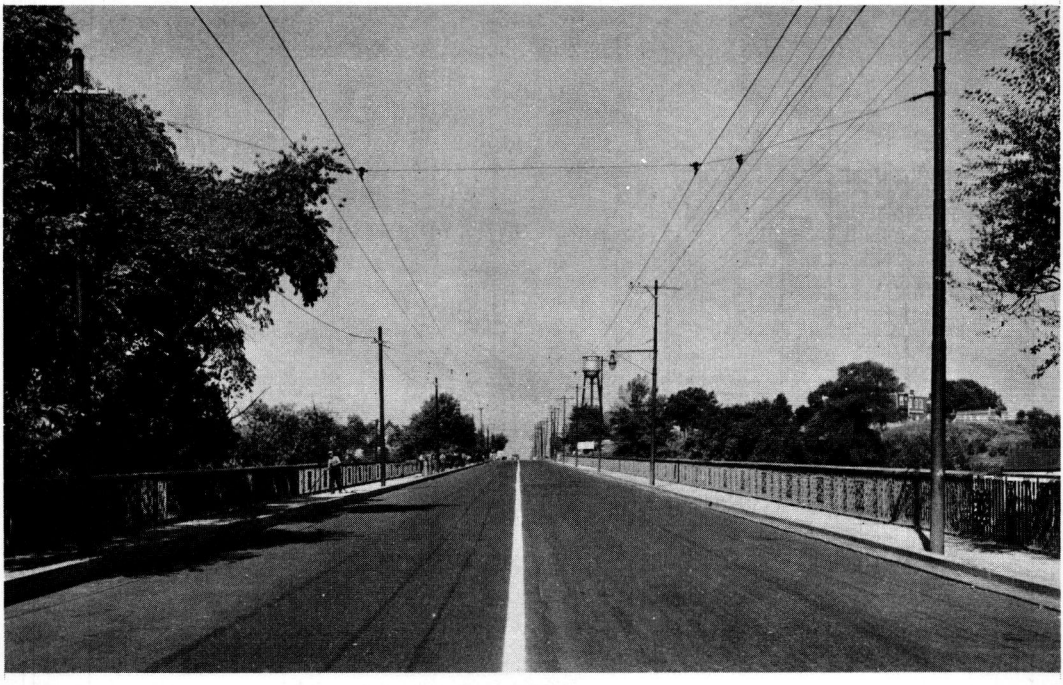

Figure 8. Finished job.

3. Figure 2 shows the RELCOTE paver making its first pass on the bridge. The rate of application of resin binder was 2.7 lb per sq yd. The paver is traveling at a speed of 3½ mph.

4. A 50-50 mixture of coarse garnet and 20-26 mesh alundum was used as the abrasive medium. The grit dispenser shown in Figure 3 is a make-shift device. Due to the inefficiency of this spreader, several passes had to be made to completely fill the liquid binder. In such applications, the grit is applied in excess of what is actually retained in the coating.

5. Figure 5 shows the coating being rolled using a 3-5 ton roller immediately after the excess grit was placed on the surface. The surface is rolled to insure optimum filler loading. After the coating had hardened, which in this case took approximately two hours, the excess grit was removed by means of a mechanical sweeper.

Figure 6 shows a tensile test being performed on the coating. In essence this test consists of drilling an annular groove 2 in. in diameter through the coating just down to the surface of the concrete. A 2-in. standard pipe cap is then bonded to the isolated coating using a fast setting, high strength EPON resin based adhesive. The plug is then placed in tension, using the simple jack arrangement pictured in Figure 6, in such a way that the stress required to separate the coating from the surface is indicated by a Dillon Dynamometer. Properly prepared surfaces invariably result in concrete failure indicating that the bonding strength of the coating is greater than the tensile strength of the concrete surface to which it is applied. In this case the concrete broke at a value of 300 psi. This indicated that the surface preparation had been adequate and that an optimum bond had been obtained between the coating and the concrete surface.

Figure 7 shows a skid test being performed for city officials and other persons interested in the skid resistant qualities of this coating. The test was performed on a freshly wet surface. The stopping distance was approximately cut in half by RELCOTE. This test merely illustrates the effectiveness of the sandpaper-like finish of the RELCOTE surface and should not be used as a quantitative measure of skid resistance since the controls to equalize braking and regulation of speed were poor.

Figure 8 is a view of the completed RELCOTE application.

The primary objectives, that of providing a water-tight membrane and a skid resistant coating, have been satisfactorily achieved. Perhaps more important is the fact that a practical means has been developed for efficiently applying this two component thermosetting resin system, thus providing another useful tool for highway maintenance.

REFERENCES

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2. Creamer, Warren M., and Brown, R. E., "Application of a New Non-Skid Surface Treatment on Connecticut State Highways." HRB Bulletin 184, p. 9 - 16 (1958).