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TEXTURING
OF
CONCRETE PAVEMENTS

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contractors were informally contacted in an effort to develop methods of obtaining deeper textures. Some of them responded with greatly improved texture using heavier drags or multiple passes with their normal drags. The following season all contractors were informed of the improvements made and requested to make adjustments in equipment and techniques to obtain deeper texture. They were informed of the severity of the problem and the urgency of finding a solution. The result of this request was most gratifying. Several techniques were explored, and the resulting texture was very much improved.

One technique developed was a series of individual brooms mounted on a bridge to impart longitudinal texture in the plastic pavement. A bridge was rigged for ramp pavement for exploration of this type of broom texture. The results were so satisfactory that a full width bridge was later fabricated for 24-foot wide pavement. The finished concrete surface was dragged with the usual burlap before application of the broom. Deep uniform texture was readily obtained with this technique.

A piece of household carpeting was employed by one contractor with satisfactory texture. The bottom side of the rug was placed in contact with the surface of the concrete. Even though good texture was obtained, the contractor reverted back to the burlap drag with equally good results.

Probably the best and most uniform texture seen this past season was imparted by the conventional burlap drag. Several drags were employed in the paving train. One was hung from the rear of the combination float finisher. Another was installed on a traveling bridge following the straightedge operations. The last drag was mounted on a self-propelled machine capable of fast travel in both forward and reverse directions. Four thicknesses of burlap were used, and the machine made three or four passes to obtain deep longitudinal striations. Early observations and tests indicate this type of texture is comparable to the longitudinal brooming discussed earlier.

All contractors in Ohio last year improved their pavement texture. We commend them for their cooperation and challenge them to continue improving texture. We have not seen any texture yet that we would consider to be detrimental or undesirable. Great strides have been made, but greater efforts are mandatory to provide safe new concrete pavements and assure continued use

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TEXTURING OF CONCRETE PAVEMENTS

by

John C. Dixon

Several years ago after rural sections of Portland cement concrete pavement on the Interstate Highway System constructed prior to 1960 had been in service a few years, they became polished. Polishing first appeared in the outside or travel lane of traffic. Loss of friction was apparent when the pavement was wet, and motorists who were aware of the condition reduced their speed, or they operated their vehicles in the passing lane. The inside lane had not been subjected to the same concentration of traffic as the outside lane and, therefore, had better skid resistance. Recent observations indicate that the inside lane is also polishing but not as extensively as the outside lane. This same polishing is in evidence on more recently constructed pavements on urban expressways. It appears in all lanes in urban areas since traffic is more uniformly distributed on all lanes. Severity of polishing, however, is usually greatest in the outside lanes where traffic is heaviest due to ingress and egress from the outside lane.

When this undesirable condition became apparent, action was initiated to correct existing pavements already exhibiting polished surfaces. Before initiating corrective treatment, it was desirable to determine the most effective and most economical method of correction. Therefore, several methods were explored.

One of the more treacherous sections of Interstate Highway 71 pavement from the number of skidding and sliding accidents was treated with muriatic acid to restore fine texture and skid resistance. This method of treatment was found to raise the skid number, using a British Pendulum tester, to that determined

for new pavements. Subsequent tests conducted monthly thereafter indicated a continual reduction in skid number until in six months the benefit from acid etching had diminished.

The following year a two-mile section of this same area, which features both a horizontal and vertical curve over a railroad, was grooved using a Concut Bumpcutter. Grooving was confined to approximately 9 to 10 feet of the outside lanes of both north and south bound roadways. Grooves were sawed in a longitudinal direction and had dimensions of 1/8 inch in width and depth and spaced at 3/4 inch intervals.

During the same season, grooving was installed on two urban interchange ramps that had histories of skidding accidents. The entire width of ramp except for approximately 18 inches at each outside edge was grooved. The Concut Bumpcutter and the Christensen concrete planer were used for these ramps. Here again we encountered a setback. Despite a dramatic reduction in accidents, numerous written complaints were received reporting steering difficulties encountered when driving on the grooved pavements on tangents or slight curves. The number of complaints received has dampened our enthusiasm for this method of correction except for tight ramp curves. No complaints were received pertaining to grooved ramp pavement, and numerous observations at various speeds in several types of vehicles did not indicate any steering problems. Our conclusion was that such grooving would be beneficial on ramp curves in urban areas where polishing is severe and accident frequency is high.

This past construction season another experiment in grooving was conducted on a tangent section of Interstate Highway 75. This time grooving was confined to a three-foot wide strip in each wheelpath of the outside lane. The same groove size and pattern was used as before. This pavement has been reopened to traffic for several months now without complaint from users. The Highway Patrol was apprised of the goals of the experiment and asked to keep records of accidents in the area to determine effectiveness of this style of grooving.

This fall another stretch of Interstate Highway 75, where skidding accidents were frequent and where fatalities had occurred, was surface treated in an effort to remedy this slippery when wet condition. In the southbound lanes, a thin resurfacing was placed using a rubberized sand asphalt mixture. A seal

coating using slag aggregate was used for the northbound lanes. The seal coating consisted of bituminous material and slag coarse aggregate. Traffic was kept off the pavement for a minimum of 72 hours to allow adequate time for curing. Similar conditions and materials were employed about 15 years ago to successfully correct a section of concrete pavement that had polished due to use of manufactured sand. The seal has been providing exceptional performance under heavy traffic without maintenance over the years. Initial observations and preliminary tests indicate exceptional skid resistance on this recently placed section of slag aggregate seal.

Last year a committee was appointed by the Highway Director to study the problem of slippery pavements. Some of the action of the committee has already been discussed which was acid treatment, grooving of wheelpaths, slag aggregate seal coat, and rubberized sand asphalt overlay. It was recommended by the committee that sand for use in concrete wearing surfaces contain a minimum of 25 percent silicon dioxide to prevent or delay polishing of concrete pavement surfaces. This recommendation has not been adopted but will be thoroughly explored next season. When the sand proposed for use has less than 25 percent silica, change orders will be considered to change the specifications to require this minimum silica content. Skid data will be collected and studied before a specification change is considered.

The committee will continue to experiment with various corrective and preventive measures next year. The recent acquisition of a General Motors type skid trailer is expected to provide valuable skid data from the various experimental treatments for evaluation by the committee. A year hence sufficient data may be available to permit more specific recommendations from the committee.

We've discussed corrective treatments; now let's consider preventive measures. Our first effort in this area was to obtain more effective texture. We were aware that concrete pavement texture was not uniform, and we felt that deeper, more uniform texture would improve the slippery condition that develops after a few years' use. Longitudinal deep texture would provide striations that would tend to overcome hydroplaning and also cause vehicles to track and remain in their direction of travel even when skidding. Similar benefits are anticipated from longitudinal grooving of existing pavements. Initially several

contractors were informally contacted in an effort to develop methods of obtaining deeper textures. Some of them responded with greatly improved texture using heavier drags or multiple passes with their normal drags. The following season all contractors were informed of the improvements made and requested to make adjustments in equipment and techniques to obtain deeper texture. They were informed of the severity of the problem and the urgency of finding a solution. The result of this request was most gratifying. Several techniques were explored, and the resulting texture was very much improved.

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of concrete for pavement surfaces.

There was one other change which should prevent early polishing of new pavements. This was a redesign of pavement concrete to provide more sand in the mix. This increased sand, coupled with deeper texture, should provide safer concrete pavement surfaces than obtained in the past.

A machine developed by the Barton Company was used experimentally a few months ago to explore various combinations of texture. Sections of pavement were textured longitudinally and transversely with a broom in addition to a combination of transverse grooves and longitudinal burlap. Further experimentation is anticipated next season to impart other combinations of grooves, brooming, and burlap. Skid trailer tests will be conducted next year to evaluate these various textures.

Equipment and material was provided for trial and evaluation of the sand patch method of measuring depth of texture. Tests were conducted on various types of texture considered to be effective. It may be helpful to point out that texture considered to be effective is noticeable when driving at speeds of 60 and 70 miles per hour. A tabulation of sand patch results is shown in Table No. 1. This method of determining texture depth appears to be a useful tool and may be further explored and compared with skid trailer results in the future.

Based on past experience the January 1, 1969, edition of the Construction and Material Specifications will specify that the pavement contain striations in the longitudinal direction not less than 1/16 inch in depth. No reference is made of the method of texture. It is anticipated that contractors will select a method that produces deep uniform texture in compliance with the specified dimensions and is economical.

Whenever skid resistance is discussed, the conversation usually gets around to the question of longitudinal versus transverse texture. It is suspected that on high speed highways, longitudinal texture if effectively applied will cause vehicles to track in the longitudinal direction and prevent skidding out of control. It is realized that skid resistance will not be as great as for transverse texture. However, with deep longitudinal striations water can escape fore and aft from under vehicle tires and overcome the tendency to hydroplane. Transverse texture

MEASUREMENT OF PAVEMENT TEXTURE BY SAND PATCH TEST

<u>Method of Texture</u>	<u>No. of Tests</u>	<u>Depth Range</u>	<u>Average Depth</u>
Burlap Drag (Long.)	6	.023" - .032"	.028"
Rug-Backing (Long.)	5	.016 - .026	.021
Longitudinal Broom (Light)	10	.015 - .023	.019
Longitudinal Broom (Heavy)	6	.023 - .026	.024
Transverse Broom	6	.016 - .023	.017
Transverse Groove - Long. Broom	6	.032 - .046	.037

Table I

channels the water quickly from the pavement and, therefore, minimizes hydroplaning. It is also effective in decreasing stopping distances in addition to having greater skid resistance. Research is needed to determine the effect of vehicle control on transversely textured pavements as compared to longitudinal texture. Complete or panic stops generally are not necessary on high speed Interstate Routes. Therefore, why provide texture for that purpose? Texturing the pavement to keep vehicles in their direction of travel and to avoid head-on or abrupt collisions with oncoming traffic or roadside appurtenances should do much to reduce fatalities on our highways. Transverse texture could be used effectively at the terminus of ramps, and at intersections where vehicles must come to a stop. It may also be practical in areas where traffic must reduce speed in preparation for directional changes.

Skid trailers are effective tools in providing the highway engineer with data necessary to design safe highway surfaces. However, it should be recognized that texture pattern is also an important aspect and should be given consideration in addition to skid numbers. Further work is needed to correlate these features to determine the most effective combination which would provide safe pavement surfaces.

Gentlemen, it is a pleasure to participate in your Annual Meeting. I am always happy to attend your meetings and to discuss these problems that confront the concrete paving industry. Only by recognition of these problems and diligent search for solutions can we expect to overcome these serious obstacles in our quest for better concrete highways.

