SKID RESISTANCE MANUAL

SUBMITTED TO
FEDERAL HIGHWAY ADMINISTRATION

CONTRACT NO. DTFH61-88-C-00058

Draft — Never published

SEP[illegible] 1990

PENNSTATE

The Pennsylvania Transportation Institute

A new type of portland cement concrete overlay--the thin, bonded overlay was recently investigated.[77] In this technique, a thin (3/8 in [9.1 mm] or less) layer of portland cement mortar is broomed onto the surface of an existing portland cement concrete surface to prolong or restore the pavement's ability to develop high friction. Two fine aggregates, blast furnace slag and lightweight expanded shale, were found to provide the best skid resistance properties. Test strips were successfully placed following this technique on existing pavements without other preparation of the pavement surface. Initial results from this research have shown the thin, bonded overlay to be an effective alternative, especially considering the relatively small amounts of new material required to restore the surface to high skid resistance levels.

GROOVING

Historically, textured portland cement concrete pavements have lost texture in relatively short periods of time under heavy traffic volumes. The skid resistance of these pavements is primarily due to the sandpaper texture left by finishing operations; traffic wears away this finish and the surface becomes smooth. This, coupled with the fact that water cannot penetrate the surface of portland cement concrete, provides an ideal condition for hydroplaning.

In many instances, the solution to correcting a pavement surface of low skid resistance may be modification of the existing surface rather than the application of a new surface. Grooving is a technique of altering an existing pavement surface to greatly increase its texture, facilitating the displacement of water by tires (see figure 21). It is used most often at locations where hydroplaning or wet-skidding accidents at high speeds are a problem.[78,80] Grooves are cut, either transversely or parallel to

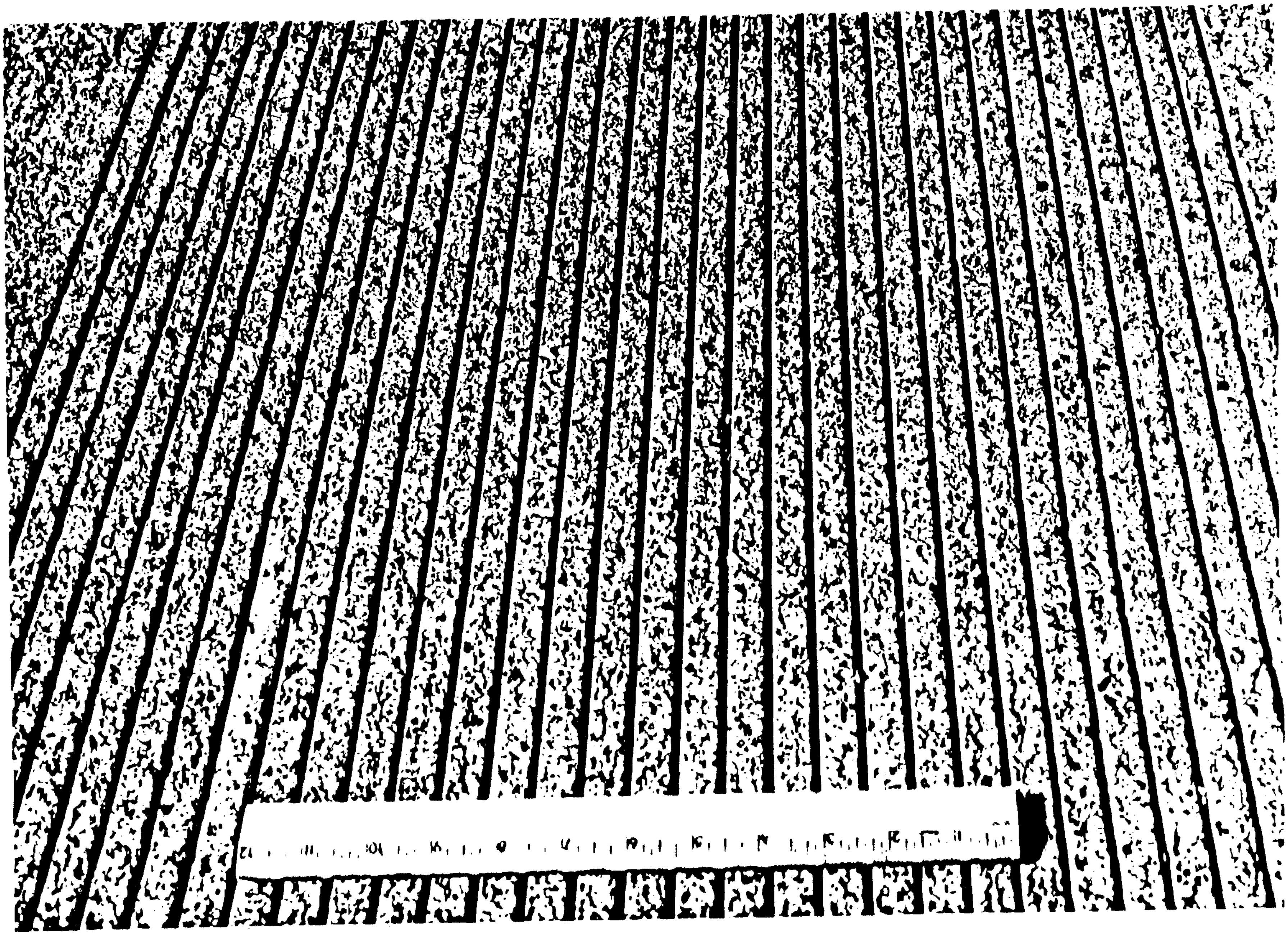

Figure 21. Longitudinally grooved concrete pavement. [37]

..e direction of travel, with a saw that uses a blade impregnated with diamond grit.

Several factors control the success of grooving.[37] The nature of the aggregates plays an important role, particularly their susceptibility to wear. Spalling of the grooves may occur, depending on several factors. Typically, the closer the spacing, the more spalling that is apt to occur.

Several types of groove patterns have been investigated.[80] A minimum depth of 1/8 in (3.2 mm) is preferred. A groove spacing of 3/4 to 1 in (19.1 to 25.4 mm) has been found satisfactory for compatibility between tire tread designs and pavement texture AASHTO recommends the use of 0.095-in-wide (2.4-mm-wide) grooves spaced on 0.75-in (19.1-mm) centers with a depth of 1/8 to 3/16 in (3.2 to 4.8 mm).[88] Closer spacings and shallower depths result in less durability, while wider spacings add significantly to noise .nd loss of directional control in lightweight cars and motorcycles.

Almost all grooving of old concrete pavements is longitudinal (parallel to the direction of travel). Longitudinal grooving assists vehicle control at curves and sites involving lateral movements. However, motorists driving light cars with radial tires and motorcycles have reported that grooves 1/4 in (6.4 mm wide) with 1-in (25.4-mm) spacing reduced directional control. However, by following the AASHTO recommendations for groove spacing and configuration, vehicular handling problems are reduced.

Transverse grooving is the sawing of grooves perpendicular to the direction of travel and across the entire pavement. Early experiments with this type of grooving created noise problems for both nearby residents and motorists.[88] Random spacing of the grooves has alleviated much of the noise problem. Another problem with transverse grooving is traffic control. It is almost essential to close the roadway in order to saw the grooves, since the cutting machine must traverse back and forth across the roadway. This also decreases production and increases costs.

Longitudinal grooving reduces wet weather accidents, although the skid resistance as measured in the conventional manner does not increase significantly. The following mechanisms seem to help prevent accidents:[66]

- Vehicles tend to track in line with the grooves and this reduces skidding.
- The grooves provide an escape for water at the pavement-tire interface, reducing hydroplaning.

Grooving often provides an excellent means for reducing wet-weather skidding accidents, but there are some limitations to their use:[66]

- In areas where studded tires are extensively used, grooves are quickly destroyed.
- Spalling of the grooves occurs rapidly where soft aggregates are used.
- Longitudinal grooving does not actually increase skid resistance, as noted above.
- Longitudinal grooving can create handling problems for small vehicles.
- Grooves may be destroyed by ice formation.

Grooving techniques are typically applied to portland cement concrete pavements but are also applicable to asphaltic concrete surfaces.[37] Under certain conditions, however, grooves in an asphaltic pavement may flow together and lose their effectiveness. This usually occurs on new pavements if the asphalt content is too high. On the other hand, older asphaltic pavements, with high aggregate content, will maintain the groove configuration.