TEXTURING EXISTING CONCRETE PAVEMENT

MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

TEXTURING EXISTING CONCRETE PAVEMENT

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Background

Texturing or profile planing of existing concrete pavements using milling or percussive type cutters presents several problems. Among these problems is the spalling that occurs at vertical planes, particularly along transverse joint faces. Such damage results in increased infiltration of water and debris and possible damage to, or loss of, neoprene joint seals. One method of eliminating this type of joint damage involves reducing the cutting depth to zero when crossing joints. Using this method, transition of cutting depth when approaching and leaving joints must be closely controlled to prevent undesirable roughness, gouging, ridging, etc. Attempts to cross joints in this manner have not been entirely satisfactory. To alleviate these difficulties, a different method was proposed by C. VanDeusen of the Eisenhour Construction Co., who offered to demonstrate it at no cost to the Department. The procedure for the method is as follows:

1) Complete removal of the transverse joint seal material,
2) Refilling joints and open cracks with a fast-set mortar,
3) Texturing the surface continuously,
4) Resawing joints to remove mortar, and
5) Replacing joint seal material.

Test Site

Since texturing had been suggested as a possible treatment for the curve area of I 496/US 127 near Trowbridge Rd, it was requested that the Research Laboratory choose a suitable pavement demonstration site near Lansing, similar in age and construction to the I 496/US 127 curve area. The selected site, located on southbound US 127 near Harper Rd and between Holt and Mason, was constructed in 1966 as State Project F 33035A, C6. Transverse contraction joints in this 12-year old pavement are spaced at 71-ft intervals and all joint faces and neoprene seals are in excellent condition. Inside and outside shoulders are lower in elevation than the pavement edges (1/2 in. or more) so milling could extend full-width without damaging shoulder material. The length of the milling demonstration site was determined by mutual agreement between the Department and the contractor. It was decided that milling across 10 transverse joints would provide an adequate sample for determining the effectiveness of the joint treatment.

Procedure

Arrangements were completed with the contractor and appropriate District 8 personnel to perform the demonstration on May 11 and 12, 1978. District Maintenance personnel (Mason Garage) provided traffic control (single-lane closure) and removal of milled concrete debris. The contractor commenced work by extracting neoprene seals and filling joints with fast-set mortar (Poly-Carb) at 9:00 a.m., May 11. This work was completed and the milling operation started at 11:45 a.m.

The CMI Roto-Mill used on this job was fitted with a 9-ft cutting mandrel, requiring two passes (one 9-ft and one 3-ft) to texture each 12-ft lane without interrupting existing crown and drainage or restricting traffic. Milling progressed with alternate 9-ft (south to north) and 3-ft (north to south) cuts, beginning at the inside (east) edge of the southbound roadway. Midway through the second pass (3-ft cut, inside lane) the mill operators were dissatisfied with equipment performance. Production was stopped and a complete set of new standard size cutting tools installed. Earlier, the cutting mandrel had been equipped with smaller than standard diameter cutting tools, intended to produce a finer than normal texture. Production resumed after a 30 or 40-minute delay for cutter tool replacement and continued until completion of the texturing at 3:00 p.m. The equipment forward speed was reduced from 36 ft/min to 18 ft/min, for a distance of 71 ft on the third pass (9-ft cut, outside lane) at the north end of the demonstration site.

Resawing of transverse joints to remove mortar was completed between 9:00 a.m. and 1:00 p.m. on May 12. Rain forced postponement of the neoprene seal installation until Monday, May 15. The contractor returned on this date and completed the seal installation, including epoxy repair of some joint face spalling that had existed prior to milling, between 10:30 a.m. and 2:00 p.m. Two internal web configuration neoprene seal materials were installed. The northernmost four joints received five-unit (Brown) material; the remaining six joints received four-unit (Grace) material.

Results

The milling operation crossed 10 mortar-filled transverse joints without inducing spalling along joint faces. Figure 1 shows an overall view of the site and a mortar-filled joint after milling. One open transverse crack, also mortar filled, did not change significantly as a result of the milling operation (Fig. 2). However, other closed transverse cracks, unfilled, became slightly 'dished' at the pavement surface from minor spalling of leading and trailing edges. When milling extends full width, free pavement edges spalled and rounded off (Fig. 3). This type of spalling presents no immediate problem and is probably an advantage at this location since it reduced the sudden transition between pavement and shoulder. The contractor elected not to mill across the longitudinal centerline joint. The longitudinal ridge created by this procedure is shown in Figure 4. In this case, the ridge was too small to affect vehicle behavior. A small longitudinal ridge was also created by overlapping cuts on the inside lane (Fig. 5).

Cutting depths ranged from near zero to 5/8 in., averaging approximately 3/16 in., for the 660 lin ft of 24-ft roadway demonstration completed. Nearly 6 cu yd of chipped concrete material were removed to the Mason Garage for storage and reuse. An additional 1 or 2 cu yd was swept off the shoulder edges and left along the site.

Finished surface texture quality was found to be a function of cutting tool, cutting depth, forward speed of the milling equipment, and operator skill. Texture variation was induced at the demonstration site by changing either cutting tools or forward speed of the equipment. In either case, change in texture appearance was so slight as to be almost unnoticeable.

Discussion

Although any type of surface irregularity is undesirable, ridging, gouging, etc., can be controlled to an acceptable tolerance by close coordination between equipment and ground control operators and prompt replacement of worn or broken cutting tools.

Whenever possible, the width of the cutter should extend across the entire lane. This would minimize the matching of adjacent cuts, thus reducing the possibility of longitudinal ridges along overlapping cuts. Another obvious benefit is the reduction of milling time required for a single, as opposed to multiple, milling passes per lane.

The decision not to mill across the pavement centerline on this project was made for several reasons. It simplified traffic control by confining the operation to a single lane, eliminated the necessity for repainting the centerline marking, and served to demonstrate how an unmilled longitudinal strip of pavement might serve as a demarcation between lanes.

Mortar-filled transverse joints were allowed to stand over night before sawing. This practice should be avoided to prevent undue stress at restrained joints due to temperature changes.

Midway through the joint seal installation, it was noted that 1-in. neoprene was being used to replace the standard 1-1/4-in. material removed earlier. Existing joint groove widths measured 5/8 in. Historically, the maximum joint groove widths anticipated for this pavement length approach 1 in., which could result in seal failure in the smaller replacement material. Sawing depth for this test was equal to, or greater than, existing joint cuts. However, since the original saw cut depth (apparently minimal) was further reduced by the depth of material removed during texturing, installation of standard 1-1/4-in. neoprene might require resawing all 10 joints to accommodate the larger material. The change to 1 in. neoprene seal was allowed after discussion with Bill Wilson, Eisenhour Supervisor, who indicated that during the forthcoming winter, any seal failure resulting from use of the smaller material would be corrected at their expense.

The economic feasibility of the procedure remains in question. Based on total demonstration hours expended, percent time requirements break down as follows:

Work Item	Number of Hours	Total Hours, percent
Extract neoprene and fill with mortar	2.75	20
Pavement texturing (milling)	3.25	24
Remove mortar	4.0	30
Install seals and repair spalls	3.5	26

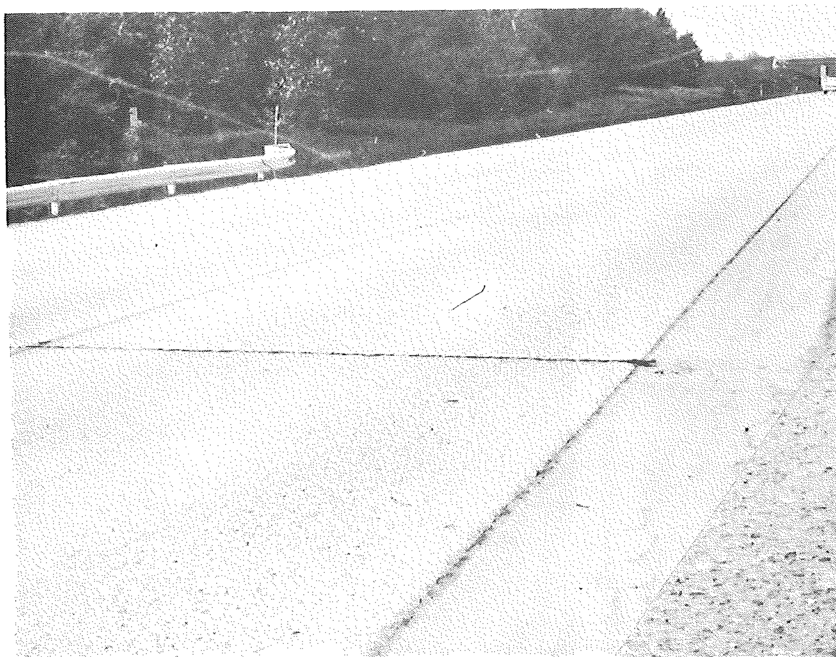
A summary of Maintenance Division equipment costs absorbed by the Department, as agreed upon with the contractor, for traffic control and clean up is as follows.

DISTRICT 8 MAINTENANCE DIVISION EQUIPMENT USAGE
(Mason Garage)

Unit	Daily Hours Worked			Total Hours	Hourly Rate	Cost
	5/11/78	5/12/78	5/15/78			
Dumptruck	7	-	-	7	$ 3.97	$ 27.79
Truck Mounted Directional Arrow	7	7	5	19	$14.85	282.15
Truck Mounted Broom	7	-	-	7	$ 5.67	39.69
			Total Equipment Cost			$349.63

Conclusion

This demonstration project, texturing continuous (filled joint) concrete pavement, was successful. The equipment and operators produced a satisfactory texture relatively free of defects. Transverse joint faces remained intact, suffering no damage from the milling process. After a full change of seasons, the 1-in. neoprene seal material is performing satisfactorily. One major disadvantage is the high cost resulting from all the handwork necessary for treating joints. Less expensive methods should continue to be sought.



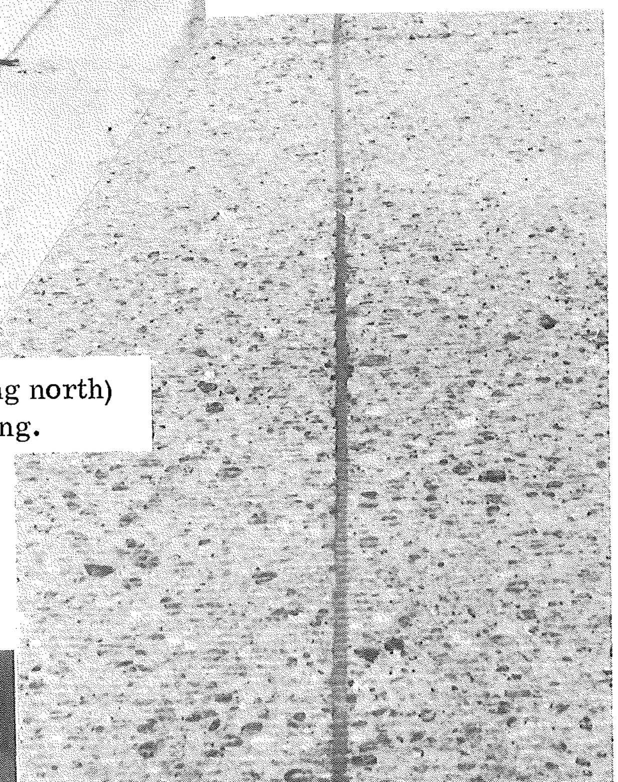


Figure 1. General view demo site (looking north) and close-up of mortared joint after milling.

Figure 2. Mortar-filled transverse crack.

Figure 3. Pavement edge spalling.

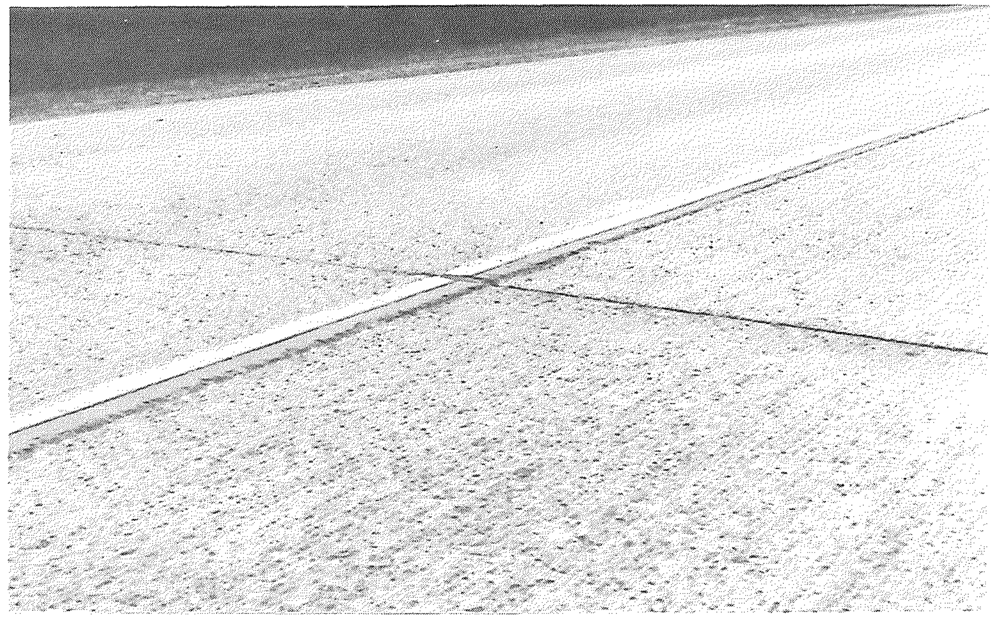


Figure 4. Longitudinal ridge along centerline.

Figure 5. Longitudinal ridge at overlapping cuts.