DEPARTMENT OF MAINTENANCE

Preparing Old Pavements for Resurfacing With 50-Ton Compactor

J. L. STACKHOUSE, *Maintenance Engineer, Washington State Highway Commission*

The paper describes in detail use of the 50-ton compactor on a 4-mi project on a Washington state highway in preparation for widening and resurfacing with asphalt concrete an old portland cement concrete pavement constructed in 1924. A resume of the methods of preparation of old concrete pavements during the past 20 years is given and the inherent faults of reflection cracks and subsidence of the new pavement are discussed as a preliminary reason for the trial of the compactor method of preparation of the old pavement.

A description of the project is given, starting with the old cement concrete pavement, the layers of selected roadway borrow as widening foundation material on which was constructed a 6-in. layer of cement-treated base and the layers of base and top course aggregates over the old concrete pavement as well as the widened areas before the asphalt concrete pavement was constructed.

The compactor and its use are described, as well as the action of the compactor on the concrete slabs that are rocking or that bridge subsided subgrade areas. Sketches indicate this action and the subsequent desirable results obtained as the concrete slabs are broken under the weight of the compactor.

• THE WASHINGTON State Highway Department, for the past 20 years, has been searching for a method of resurfacing old portland cement concrete pavements with asphalt concrete mixtures so the surface would (a) not reflect cracks of the old concrete pavement in the wearing surface a few years after resurfacing and (b) retain a relatively true profile grade line of the completed roadway and resist the tendency of developing dips or subsided areas in the surface due to the old pavement settling into low or sunken areas in the subgrade which the concrete pavement had bridged.

It was observed in 1937 and 1938 that, although the relatively thin mats of asphalt concrete of 1- to 1½-in. thickness smoothed up the old pavement, the majority of the cracks in the old pavement reflected through to the surface during the first year of use and in addition became rougher due to subsidence. It was also noticed that the heavier asphalt pavement of 3-in.-plus thickness retained the original smoother riding surface over a longer period of time. However, the reflection cracks began to appear after two or three years and continued to increase in number with time.

Starting in 1947 and continuing for approximately five years, old concrete pavements were subsealed with a high-melting-point, air-blown asphalt cement in an attempt to fill voids under the pavements, stabilize them, and seal cracks before resurfacing with asphalt concrete. This plan was partially successful in reducing the reflection cracks and maintaining the original smooth ride after resurfacing. It was found that much depended on the character of the subsoil, with the gravelly sandy subbases resulting in the better jobs.

Early in 1956 it was decided to utilize a rather recent development in the machinery field in the form of the 50-

ton-plus, single-axle, variable-load, rubber-tired compactor to break down all bridging of the old concrete pavements over subsided areas of the subgrade and to find weak spots of the subgrade before the new wearing surface was constructed. In general, the plan provided for the towing of a 50-ton compactor over the old concrete pavement to break down the larger slabs, cover the entire area with a minimum 5-in. thickness of crushed rock surfacing, followed by a 3-in. minimum thickness of asphalt pavement laid in two courses.

DESCRIPTION OF PROJECT

One of the first projects constructed by this method and on which records of the rolling were kept was a 4-mi section of Primary State Highway 5 between Ethel and Salkum in southwestern Washington, where an old 18-ft wide cement concrete pavement constructed in 1924 was widened 6 ft on one side.

The contract on this project was awarded on May 29, 1956; the contractor started work in June 1956. The plans called for widening the existing 60-ft right-of-way to 150 ft by clearing and grubbing and excavating a width of 6 ft to a depth of 12 in. on the right side of the old pavement to provide for a 6-in. compacted layer of selected roadway borrow, on which was placed a 6-in. compacted depth of cement-treated base constructed to the approximate elevation of the compacted concrete pavement.

A single-axle compactor was then towed over the old pavement until all slabs that bridged void areas were broken and seated. Next, a compacted layer of crushed stone base course ($1\frac{1}{2}$ in. minus) was placed over the entire 24 ft of roadway with a minimum thickness of 3 in. over the high spots. A uniform compacted 2-in. thickness of crushed stone top course ($\frac{5}{8}$ in. minus) was then placed over the base course. When brought to grade and contour, the base course of asphalt concrete was constructed 24 ft wide.

Figure 1 shows the design of one section of pavement on this contract, which was constructed with thickened edges, as well as the depths and locations of the various courses previously noted. The second pavement design encountered on this project had a thickness varying from $7\frac{1}{2}$ in. at the center to 6 in. at the edges. This second design of pavement was constructed in one 18-ft wide slab whereas the first design was laid in two 9-ft wide slabs with dowel tie bars between the slabs at the centerline. It was reported that the pavement with center tie bars was more difficult to break down with the compactor than the single 18-ft slab.

The new selected roadway borrow as well as the crushed stone base and top courses were constructed to the outer edges of the 10-ft shoulders each side of the traveled road surface.

Due to the work involved in clearing, grubbing and grading the widened right-of-way area, this project was not completed in 1956 and was closed down for the winter after the $1\frac{3}{4}$-in. asphalt leveling base course was completed. The carrying of traffic one winter season on the leveling course was an advantage to the

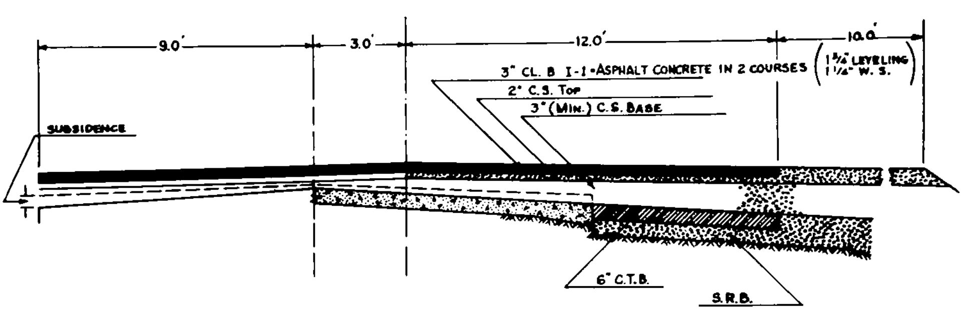

Figure 1. Cross-section of pavement as reconstructed.

Department. It enabled the contractor to correct any subsided or weak areas in the surface the next spring, resulting in a smoother riding surface. The wearing surface was completed in May 1957.

USE OF COMPACTOR

The compactor used by the contractor had a hopper capacity of 640 cu ft. The aggregate used to fill the hopper weighed 151 pcf and with the added weight of the compactor itself the total weight on the four tires was in excess of 59.6 tons, or approximately 656 lb per lin in. of tire width.

The recommended speed of 5 mph was found to be too fast for effective results and 2 mph was set for the operating speed. The number of passes over each 9-ft wide pavement slab with the compactor was found to be between six and twelve, with the average about nine to ten passes. There is danger of overrolling, especially where the subbase under the old pavement is composed of clay-type material and is wet. Figure 2 shows the compactor and tractor units used.

It was found that on the first or second trip with the compactor the pavement slabs that had no cracks in their 20-ft length would tilt or rock under the weight as shown in Figure 3. After the first few passes, the slabs would break, generally, at third-points both horizontally and longitudinally and lie flat on the compacted subgrade. The cracking and grinding of the slabs, as they were broken, could be heard as the compactor traveled at the slow speed. Figures 4 and 5 are close-ups of two sections of the edge of the pavement while the compactor tire rolled over the cracked slab. The movement of the broken slab edge (Fig. 4) was 0.2 in. Figure 6 shows the area and a rear view of the compactor.

Figure 7 shows the east end of the project before work started, indicating the poor condition of the pavement in some places. Figures 8 and 9 show sections of the old pavement after rolling with the compactor. Figure 10 is a close-up of the wearing course of the finished resurfaced pavement, which was class B asphalt concrete, Washington State standard specifications.

The final estimate on this project paid the contractor $350,852.50, of which $70,-645.05 was for asphalt pavement. The bid item for the compactor was $75 per 8-hr day. It was used 17⅝ days at a cost of $1,321.88, or $0.031 per square yard of pavement treated.

Figure 2. Compactor used to roll old slabs down to the subbase.

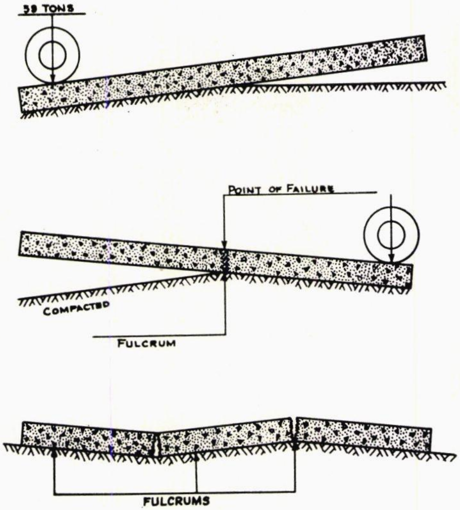

Figure 3. Theory of slab cracking to eliminate under-slab voids.

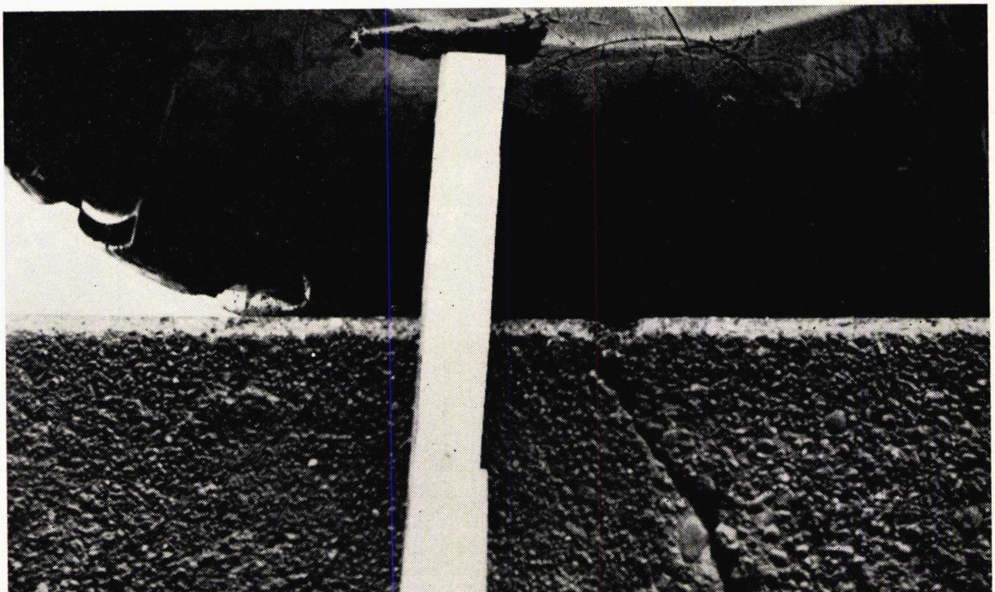

Figure 4. Close-up of slab edge under compactor tire.

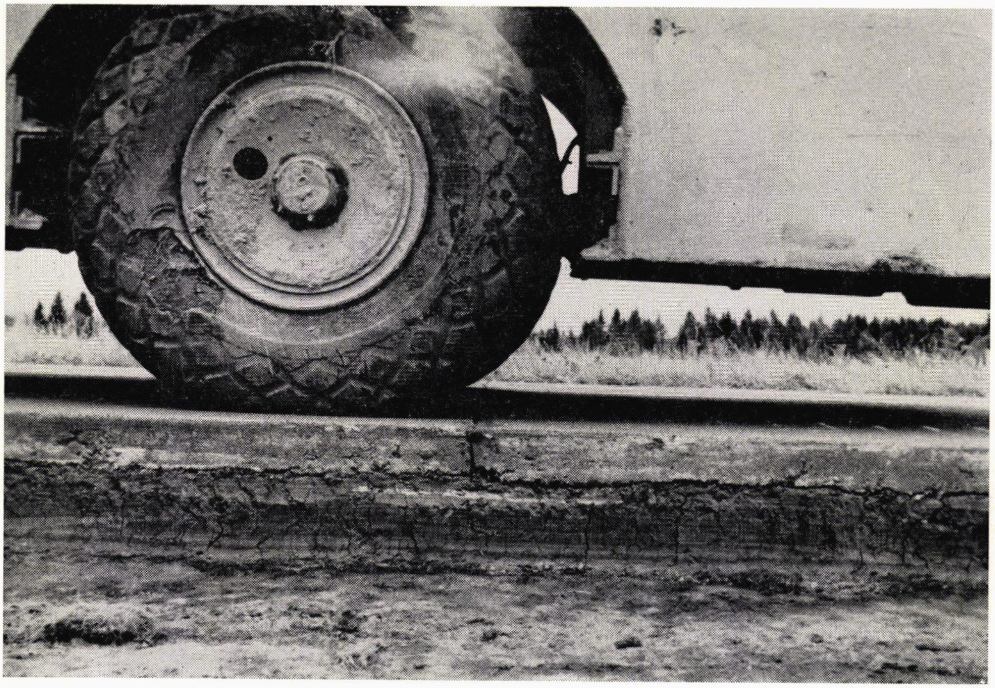

Figure 5. Slab edge under compactor load.

Figure 6. View of widening job with compactor on slab.

Figure 7. Condition of pavement before start of work.

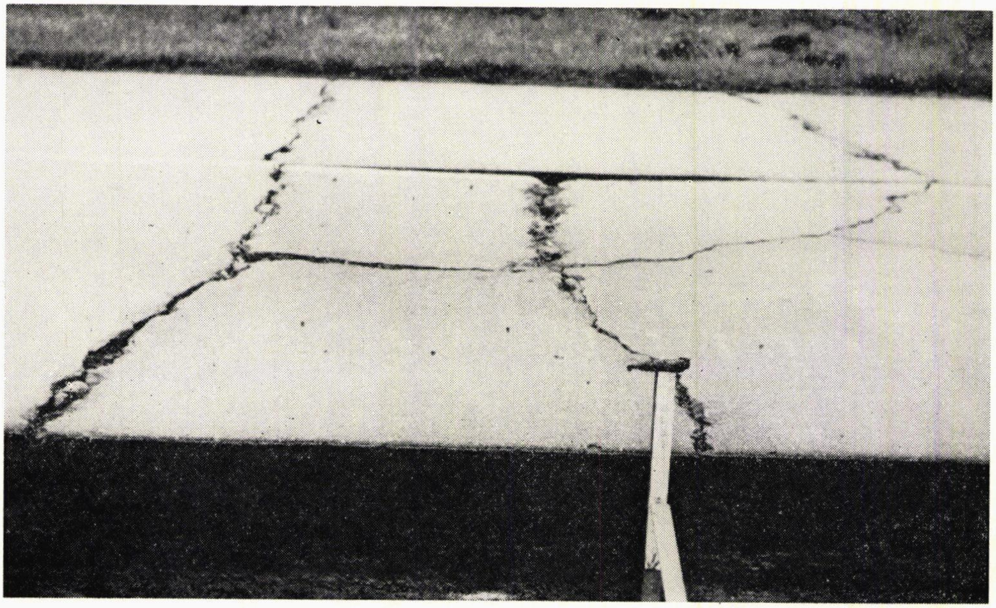

Figure 8. Section of pavement broken by compactor.

Figure 9. Section of pavement broken by compactor.

Figure 10. Wearing course of finished resurfaced pavement.

REMARKS AND CONCLUSIONS

Numerous level readings to 0.001 in. were made at the edges and center points of the old pavement before, during, and after rolling in an attempt to determine if there was any uniformity in the compacting rate of the subbase material. Results indicated there was no uniformity, with some areas subsiding from a maximum of 1½ to 2 in. at the edges and an average compaction on center line of approximately ½ in. Some areas remained at the same elevation after rolling.

In one case the slab opposite the slab being rolled lifted a slight amount. After re-rolling, the raised area again returned to its original elevation. It was observed that the areas of concrete which had broken under traffic reacted more quickly to the weight of the compactor and required fewer passes than the areas that were bridging subsided or weak portions of the subbase. Over-rolling of very unstable areas tended to increase their instability.

After approximately 18 months of traffic, the Ethel-to-Salkum pavement has developed no reflection cracks, nor have subsided areas appeared. From visual inspection the profile grade line has remained uniform, even without the usual dips showing in the center line stripe.

One suggestion made by the resident engineer that appears to have merit and accomplish the same results with fewer compactor passes over any given point is to design a two-axle compactor with an adjustable frame so that the distance between axles can be varied from 8 ft to 15 ft. The rocking of the unbroken slabs would be eliminated and the slab would break at the fulcrum point after the first or second pass. It is believed that the weight on each axle could be reduced approximately 50 percent. It also is recommended that all cracks in the rolled pavement be poured with a crack-sealing compound to prevent entrance of surface water that might percolate through the various layers either during construction or afterwards. The cracks were not sealed on this project.

The compactor cannot be given full credit for the elimination of the reflection cracks. The effect of the layers of crushed stone surface in insulating the contracting and expanding forces from the asphalt wearing surface is believed to be mainly responsible for the correction of this inherent defect in former designs of resurfacing of portland cement concrete. However, due to the low cost per square yard of the compactor bid unit, its use should be included to remove all bridging or void areas under cement concrete pavements when this type of improvement is undertaken. Its use will reduce future subsidence of the finished wearing surface, thus eliminating the need of patches to smooth low, settled areas in future years.

An advantage of the compactor appears to be that it is heavier in weight than legal loads allowed on the highway. It will seek out and find weak areas in the old pavement. These areas, when found, can be dug out, drained, and unstable material replaced with stable material. With the addition of aggregates to level up the old pavement, the load-carrying ability of the highway is assured and apparently is adequate to carry the traffic using the highway. Unless the present ceiling of maximum axle loads or wheel loads is raised, the over-loaded weight of the compactor provides a factor of safety to the highway.

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