MICHIGAN
STATE HIGHWAY DEPARTMENT
Charles M. Ziegler
State Highway Commissioner

THE INFLUENCE OF SUBSEALING ON PAVEMENT DEFLECTION AT TWO TEST LOCATIONS ON US-24 & 25

L. T. Oehler & R. D. Behr

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At the request of Mr. W. W. McLaughlin, Testing and Research Engineer, the Research Laboratory has made a pavement deflection study on US-24 and 25 to determine, if possible, the vertical movement of the pavement during the subsealing operation and the effect of subsealing on the load deflection characteristics of the pavement.

Pavement Load Deflection Study

The test locations (See Figure 1) where continuous concrete patches of satisfactory length for testing had at some previous time been placed, were picked for the deflection study. The remainder of the pavement had a bituminous resurfacing which would have had to be removed adjacent to the pavement deflectometers for testing purposes. Therefore, to expedite the work and to interrupt the flow of traffic as little as possible, these concrete areas were selected.

Electrical strain gage deflectometers (See Figure 2) were placed on the pavement edge at eight points at location 1 and nine points at location 2. These locations provided tests at both cracks and joints. Pavement deflection moved the cantilever deflectometer, changing the electrical resistance of the strain gage on the deflectometer. This change in electrical resistance was recorded by the Hathaway Recording Oscillograph as a trace deflection on photo-sensitive paper. The displacement of the trace had a known relationship to the actual pavement deflection. The MSHD Walters Truck was used as the test load and was operated at creep speed and at approximately 15 mph over the test areas. Four or five passages of the test truck were made at each speed. The lateral position of the test truck in the pavement lane was accomplished by driving the truck so that the right front tire of the truck followed a direction stripe 2'-0" from the longitudinal pavement edge. This placed the center of the outside dual wheels for the 2nd and 3rd axles at 22" from the edge of pavement. This would place the outer edge of the contact area of the outside tire about 10" from the pavement edge.

The following observations were made:

	Before Subsealing	After Subsealing
Test Location 1	Aug. 3, 1953 5:05 PM to 6:00 PM	August 25, 1953 5:25 PM to 6:30 PM
Test Location 2	Aug. 4, 1953 12:10 PM to 12:40 PM	August 26, 1953 10:35 AM to 11:15 AM

In order to study only the effects of pavement subsealing on pavement deflection, all other significant variables were held as constant as possible. The following procedure was used to attempt to remove all unwanted influences from affecting this pavement deflection study.

1. The truck and the axle weights were constant during the testing program.
2. The speed of the truck was regulated to either creep speed or approximately 15 mph.
3. The lateral position of the truck in the lane was strictly enforced.
4. The time of day of testing, before and after sealing, for each location was nearly the same. (The time of day that pavement deflection studies are made is very significant because the warping of the slab due to temperature greatly influences the magnitude of the pavement deflection.)
5. The points at which pavement deflection were observed before and after subsealing were identical.

With the above mentioned items controlled as closely as possible, the deflection data shown in Table I were obtained. This table gives the deflection at each position for both locations, before and after the subsealing operation, and also the ratio of the deflections after subsealing to the deflections before subsealing. The deflections at Positions 1 and 3 of Location 2 have been omitted because of an error in calibration.

The average deflections at each position of Location 1 and 2 are presented in Figures 3 and 4 respectively. At Location 1, the average ratio of the deflection after subsealing to the deflection before subsealing was approximately 1.8. At Location 2, this same ratio was approximately 7.3 which indicates that on the average the deflections after subsealing were approximately 7.3 times the deflections before subsealing at that location. For all points the average deflection was 4.4 times greater after subsealing than before subsealing. The data in Table 2 indicates considerable variation in this ratio between test points.

A study of the pavement load deflection data did not indicate that there was any rocking of the slabs for either test location, either before or after the subsealing operation.

<u>Vertical Movement of the Pavemnt Edge During Subsealing</u>

The vertical movement of the longitudinal edge of the pavement during the subsealing operation was measured at three points in the southbound traffic lane. These points were not in the same vicinity as where the pavement deflection studies previously mentioned were made. A lead block, with a one-thousandths inch dial attached, was placed on the slab near the longitudinal free edge and opposite a hole where asphalt was injected (see Figure 5). The stem of the dial was made to bear on a plate which was attached to a steel stake driven into the soil adjacent to the edge of the pavement. Vertical movement of the pavement edge was recorded while the subsealing operation approached and passed beyond each location.

According to the data presented in Figure 6, the pavement moved upward slightly while the sealing operation was approaching the point of observation. This pavement movement started when the asphalt was pumped into the hole 12.5 feet from the point of observation. However, the major portion of the movement occurred while asphalt was being pumped into the hole opposite the point where the pavement movement was observed. The pavement movement would commence as soon as the pumping of the asphalt started and was gradual until the pumping stopped. Between pumping operations, the pavement would gradually settle and unless the effect of filling subsequent holes interrupted this gradual settlement, the settlement would continue for a few minutes and then stop. The change in elevation at this time due to the subsealing operation for Positions 1 through 3 was 0.078, 0.159, and 0.091 in. respectively. However, this lifting of the slab may not have been permanent for, within a few hours after subsealing of an area, it was again subjected to normal traffic which may have caused further consolidation of the asphalt beneath the slab.

<u>Summary</u>

This study has revealed that pavement deflections after subsealing can be greater than those which occur before subsealing, all other conditions assumed to be equal. In this particular case, the average ratio of pavement deflection after subsealing to pavement deflection before subsealing at joints and cracks was approximately 4.4 to 1.0. Further in this respect, there was a considerable variation in the performance after subsealing from point to point. For instance, the ratio of deflection after to deflection before subsealing varied from less than one to more than eighteen. Further study would be required to determine whether this phenomenon would consistently occur on other subsealing projects or whether this was peculiar to this particular project. Perhaps the greater pavement deflections due to load, observed after the subsealing operation, occurred because the asphalt (25-40 penetration) was consolidated by the pressure of normal traffic soon after sealing. Such consolidation, which would have been greatest at joints and cracks, and might have caused a lack of support, at least temporarily at these points, could be the cause of increased deflections after subsealing at such points. It is not known whether this increased deflection will continue or whether the deflections will gradually decrease. Even though the subsealing does increase the deflection of the pavement caused by load, the primary function of the subsealing (the prevention of pumping) may be satisfactorily fulfilled. The seal, although compressed, may be intact.