INVESTIGATION OF NARROW WIDTH REINFORCING MATS AND LONGER SLABS WITH SLIP-FORM PAVING

(Work Plan No. 12)

MICHIGAN HIGHWAY RESEARCH LABORATORY SECTION

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

INVESTIGATION OF NARROW WIDTH REINFORCING MATS AND LONGER SLABS WITH SLIP-FORM PAVING

(Work Plan No. 12)

J. E. Simonsen

Research Laboratory Section
Testing and Research Division
Research Project 71 F-121
Research Report No. R-889

Lansing, October 1973

This report completes the investigation of the use of narrow width reinforcing mats and longer slabs to minimize the problem of forward motion of the reinforcement during slip-form paving operations. The project was a "Category 2" experiment carried out in cooperation with the Federal Highway Administration as per MDSHT Work Plan No. 12.

When the reinforcement mats are placed too near the edge of the pavement, interference with the sliding forms on the slipform paver sometimes occurs. This is thought to cause forward motion of the reinforcement, thus disturbing previously placed mats. Observed depressions in the finished surface at lap locations are believed to result from such reinforcement movement. In severe cases the reinforcement has been carried across the joint which, if not discovered, causes inoperative joints.

The purpose of this study was to determine the amount of interference between steel mats and forms and the resulting surface profile using two different mat widths and slab lengths.

Scope

Two test sections with standard slab lengths (71 ft-2 in.), one containing standard mats (11 ft-6 in. wide) and one containing narrow mats (11 ft-0 in. wide), and two sections with "long" slabs (72 ft-0 in.) one having standard mats and one having narrow mats, were constructed on a rural freeway project.

Location and Description

The test sections are located on Federal Project I 475-8(16)103 (Michigan Project I 25132-00372A) on I 475 from I 75 north to Maple Rd, near Grand Blanc. Figure 1 shows the layout of the three experimental sections and the standard section. As shown, the experimental pavement consists of both the south and northbound roadways, each containing two 12-ft lanes, between stations 38+00 and 161+74 on the southbound roadway and stations 11+57 and 161+74 on the northbound roadway.

The pavement is 9-in. uniform thickness and all joints contain load transfer assemblies having 1-1/4 in. diameter by 18-in. long steel dowels spaced on 12-in. centers. A joint groove is sawed over the center of the load transfer dowels and sealed with a neoprene seal.

The reinforcement mats were 15 ft long and lap lengths were 13 in. Each lap was fastened in two places. Five mats were required to span the

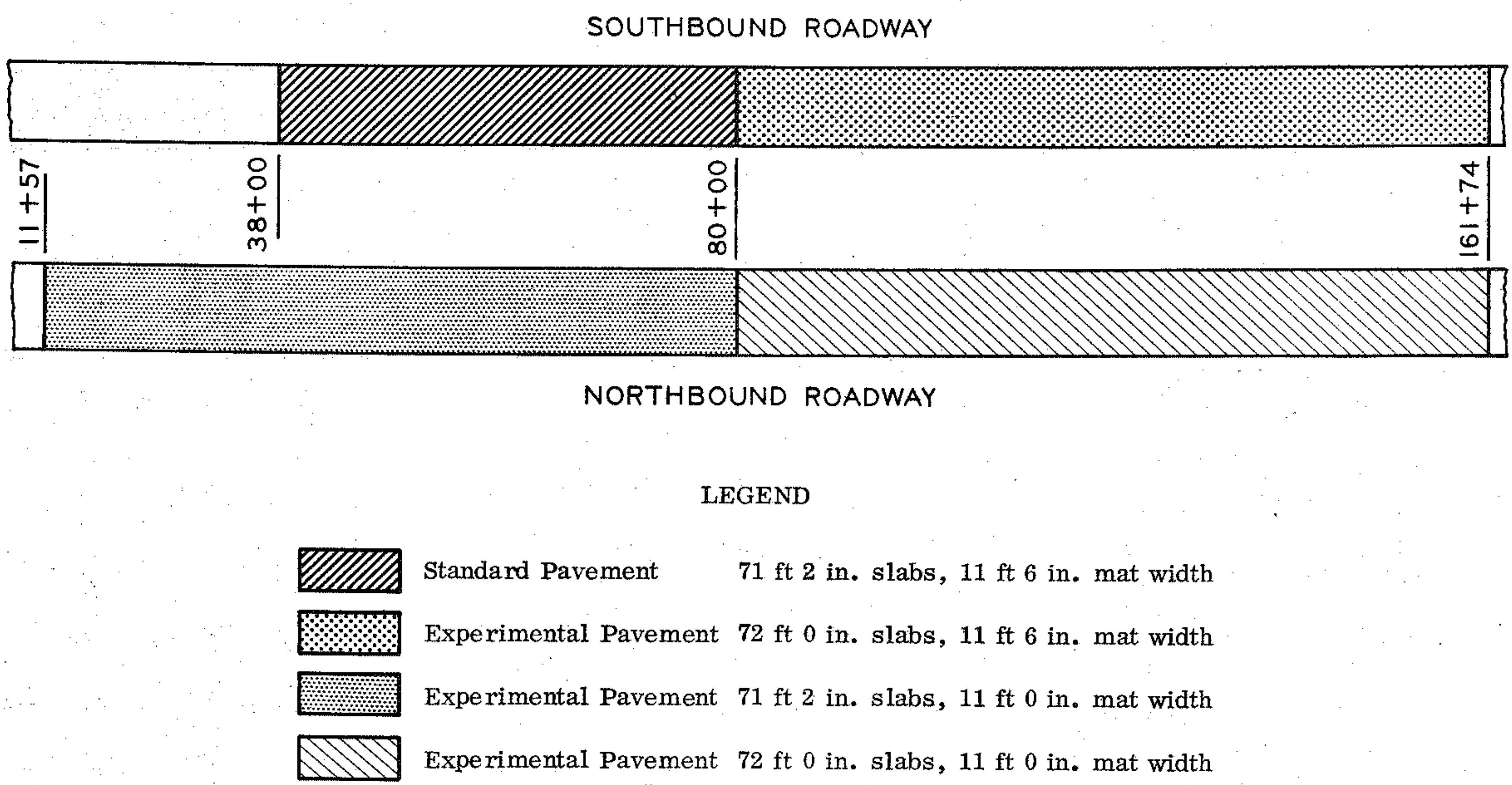

Figure 1. Test section layout on I 475 from I 75 to Maple Road.

distance between joints. In the 71 ft-2 in. slab the reinforcement began and ended 3 in. from the joint centerline. In the 72 ft-0 in. slab the distance from the joint centerline to the beginning and end of the mats was 8 in.

The edge clearance with the 11 ft-6 in. mats was 3 in., and 6 in. with the 11 ft-0 in. mats, provided the mats were placed symmetrical about the lane centerline.

Pavement Construction

Construction of the pavement began in October 1971 and the portion containing the experimental sections was completed that fall. The remaining part of the mainline pavement and ramp lanes were completed in the summer of 1972. Single lane slip-form paving was employed. The concrete was batched in a central mix plant and delivered to the site in agitator trucks.

Two paving machines were used to place the pavement. The first paver placed the concrete and struck if off full depth. The reinforcement was laid on top of the fresh concrete and the second paver depressed the steel mats and finished the slab. Final finish of the slab was accomplished by use of a tube float and hand floating. The surface was then burlap finished and membrane curing compound applied.

In an attempt to prevent forward motion of the reinforcement, the contractor had mounted a device, containing a series of sprocket wheels, just ahead of the mesh depressor on the second paver. The device was designed with the intent that the sprocket wheels engage each transverse wire as it turned, in a manner similar to a chain and sprocket engagement. Observations of the machine in operation revealed that in many cases the wires were not engaged by the sprockets and the success of this method to prevent forward steel movement was somewhat limited.

Evaluation

To determine whether forward motion of the reinforcement occurred during pavement construction the installation of 200 mats was observed. Half of the mats were of standard width (11 ft-6 in.) and the other half were 11 ft-0 in. wide. The motion of the mats was observed just prior to depressing them. If motion was noted the amount of forward movement was estimated. The observations were all made in the sections with 72 ft-0 in. slab lengths.

The recorded movements for 11 ft-6 in. and 11 ft-0 in. mats are given in Table 1. The mats are numbered in the direction of the pour and mat

TABLE I
FORWARD MOMENT OF REINFORCEMENT

Mat Width	Station	Movement (in.) Mat Number 1	2	3	4	5	Amount of Concrete Surcharge Carried
11 ft 6 in. mat width	99+75	1	2	1	1	1	Half
	100+46	2	4	2	3	2	Half
	101+11	1	0	2	1	0	Quarter
	101+92	0	2	3	2	2	Full
	102+63	1	0	2	2	1	Full
	103+34	3	4	2	1	2	Full
	104+05	6	3	2	3	8	Full
	104+76	8	2	2	2	2	Full
	105+47	5	2	2	6	3	Half
	106+18	3	3	6	1	2	Half
	111+28	0	1	0	0	0	Quarter
	112+03	2	4	2	3	6	Full
	112+74*	10	10	6	6	6	Full
	113+45	6	1	6	6	6	Full
	114+16	6	1	2	1	3	Full
	114+87	3	2	1	2	2	Full
	115+58	3	1	3	2	2	Quarter
	116+29	2	1	2	2	2	Half
	117+08	3	2	1	1	2	Half
	117+79	3	2	1	1	1	Quarter
11 ft 0 in. mat width	134+70	2	1	1	2	1	Half
	133+98	3	1	2	1	1	Half
	133+26	1	1	1	2	2	Half
	132+54	2	1	1	1	2	Half
	131+82	1	0	0	0	0	Quarter
	131+10	0	0	0	0	0	Quarter
	130+38	0	0	0	0	0	Quarter
	129+66	0	0	1	1	1	Half
	128+94	1	1	0	1	2	Half
	128+22	2	1	2	1	1	Half
	147+65	10	3	3	2	2	Full
	146+94	4	4	4	3	2	Full
	146+23	4	0	2	2	2	Full
	145+49	2	2	2	2	1	Half
	144+78	2	1	1	2	1	Half
	144+07	2	1	1	2	1	Half
	143+36	1	1	2	1	1	Quarter
	142+65	1	0	1	0	1	Quarter
	141+94	2	1	1	3	3	Half
	141+23	1	1	2	2	1	Half

*Reinforcement carried across joint - correction made by cutting off 9 in. of reinforcement.

No. 1 is always before a joint. The estimated forward movement of the mats ranged from 0 to 10 in. in both the narrow and standard width mat sections and, as noted in Table 1, the reinforcement was carried across the joint at one location. None of the 200 mats interfered with the form of the paver, and it appeared that the movement of the steel was related to the amount of concrete surcharge carried in front of the paver screw. The amount of concrete carried is shown in the table in terms of the height of the screw. As can be seen, when the concrete surcharge was up to only one quarter of the screw height the movement, in general, was less than when the concrete was up to the full screw height.

Pavement profiles were obtained for each test section using the Rapid Travel Profilometer. Analysis of these data indicated the following: There is no difference in pavement roughness using narrow width mats and longer slabs. The existence of periodic or almost periodic (14 to 15 ft) waves in the pavement surface of all test sections was discerned (Fig. 2). The amount of power, or energy, at this wavelength is four times that which should be expected. Previous work shows this to be characteristic of single lane slipform paving and is equal to the effective reinforcement mat length. Although this periodic wave appears to be deleterious to ride quality, no subjective measure is currently available.

Conclusions

On the basis of observations made during pavement construction and analysis of pavement surface profiles the following conclusions are drawn:

1. Forward movement of the reinforcement occurs with both standard and narrow width mats. The observed movements were not caused by interference between mat and form, but rather appeared to be related to the amount of concrete surcharge carried by the paver.

2. Increasing the slab length from 71 ft-2 in. to 72 ft-0 in. does not provide sufficient distance in all cases for forward movement of the mat to prevent the steel from being pushed across the joint centerline.

3. There is no significant difference in pavement roughness using narrow width mats and longer slabs. Also, a dominant wave in the pavement surface of 14 to 15 ft in length was found in all experimental and the standard sections.

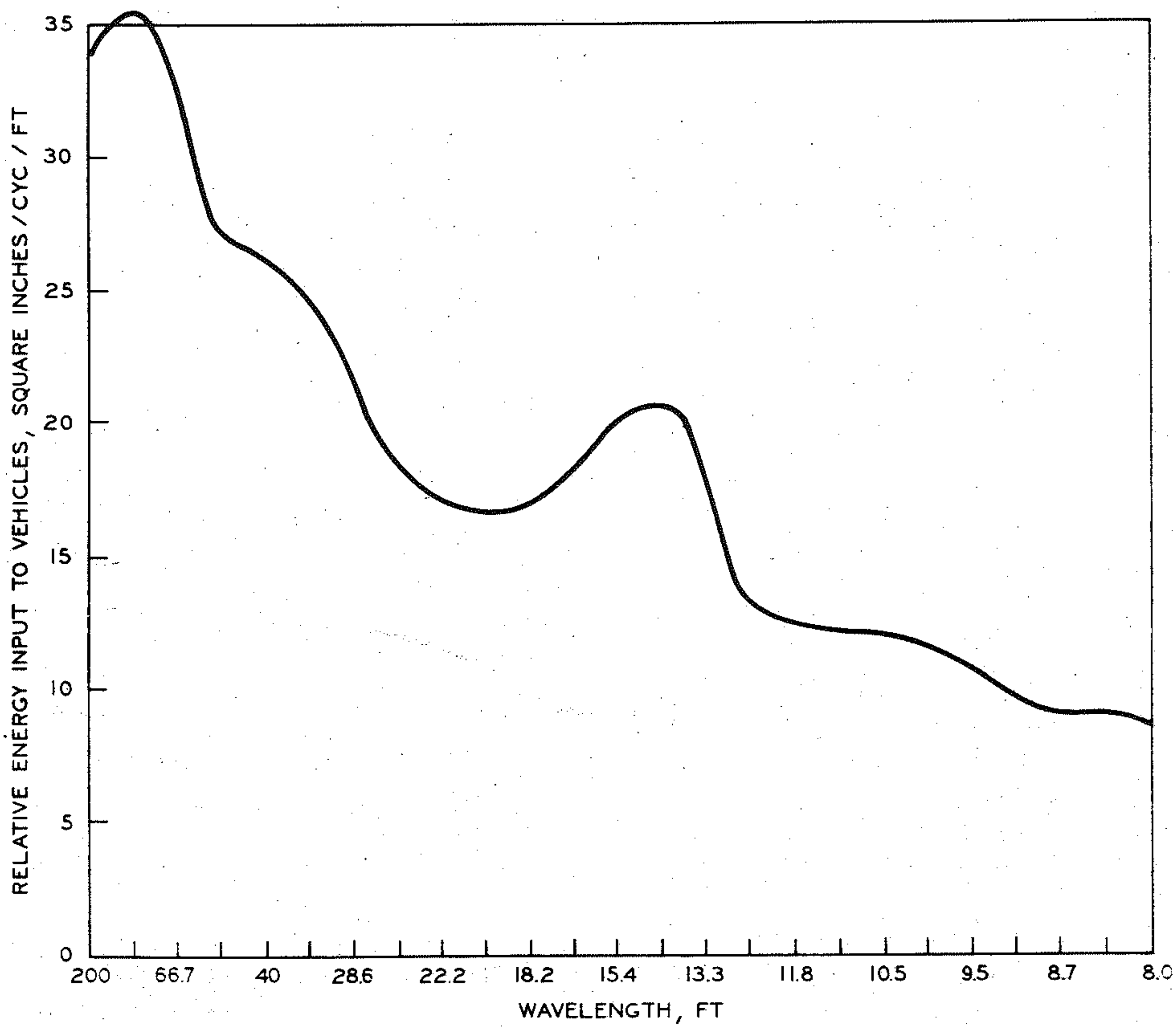

Figure 2. Road profile power spectral density analysis for I 475 between I 75 and Maple Rd.