MICHIGAN
STATE HIGHWAY DEPARTMENT
G. Donald Kennedy
State Highway Commissioner

VALUE OF CONCRETE SPREADER

IN

CONCRETE PAVEMENT CONSTRUCTION

By

J.W. Kushing

Research Project 39 F-7 (2½)

Research Laboratory
Testing and Research Division
Report No. 9
January 29, 1941

VALUE OF CONCRETE SPREADER IN PAVEMENT CONSTRUCTION

by

J. W. Kushing, Research Engineer
Michigan State Highway Department

Presented at American Road Builders' Association,
January 1941 meeting, New York City.

In 1940, the Michigan State Highway Department constructed an experimental highway project on route M-115 located in the north central portion of the lower peninsula. This project, designated as the "Michigan Test Road" consists of 17.8 miles of 22-foot concrete pavement and is divided into two distinct sections. One section 7.7 miles in length is devoted to a durability study of concrete, the balance of the project 10.1 miles in length pertains entirely to design and construction problems.

The object of the project is to establish certain fundamental principles in concrete pavement design and to correlate laboratory studies with construction methods in order to develop more durable concrete pavement. Included in the test road are all of the latest ideas of modern concrete road construction.

One of the important construction features incidental to the design study was the use of a mechanical spreader to handle the concrete. The purpose of using a mechanical spreader was to make a comparative study between mechanical versus hand methods for placing concrete on the subgrade to determine the relative merits of the two methods with respect to economy to the user and from an engineering view-point.

The means of mechanically spreading concrete on road construction particularly in conjunction with side discharge truck mixers, has been in successful operation for at least five years. Recently, the mechanical

Mixing of the Concrete

Varying degrees of segregation of the separated coarse aggregates was noted when the batches were dumped on the subgrade; however, this partial segregation was definitely corrected by the rotating screw. With the standard hand method any segregation of this type remained undisturbed.

Another feature noted was the thoroughness of mixing not only of single batches but the mixing of several batches together producing uniformity in the slab. This method of remixing the concrete after deposition on the subgrade should eliminate, to a great degree, the non-uniformity in slab construction caused by irregular concrete batches. Hand methods rather tend to augment the situation because invariably the worker tends to move the more workable part of the deposited mixture leaving a compacted portion where the batch was originally deposited.

The concrete mixture used in the construction of the design section was designed on the basis of 5.5 sacks of cement per cubic yard by the mortar void method. The consistency as measured by the slump cone was between 1 to 3 inches and the required modulus of rupture at 7 and 28 days was 550 and 650 pounds per square inch, respectively. No trouble was encountered by the spreader in handling the low slump mixture.

Distribution of the Concrete

A noticeable improvement in the distribution of the concrete was noted with the use of the spreader in comparison to the standard method. The manner in which the concrete was placed on the subgrade did not affect the uniformity of distribution materially; the mixing action of the screw adequately redistributed the ill-placed batches. At no time was there found an insufficient amount of concrete at the forms or in the center of the pavement. This was not always true of the standard method.

spreader was used on the Pennsylvania Turnpike with marked success for lane construction. However, on the Michigan project, it was the first time that mechanical spreading was employed on a 22-foot construction.

The mechanical spreader used on the "Michigan Test Road" was designed and constructed by the Jaeger Machine Company, of Columbus, Ohio. The Jaeger concrete spreader is a power driven four-wheel frame with suitable forward and reverse speeds, on which is mounted a reversible 14-inch spiral screw which manipulates the concrete to one side or the other at the will of the operator. The screw may be quickly adjusted vertically so that the strike-off plate, which is located behind the screw, may be used to obtain the desired height of concrete on the subgrade. The concrete is dumped on the subgrade from the power bucket at regular intervals and the spreader screw moves through the pile, breaking it down and distributing it laterally first in one direction and then in the other, resulting in a uniform distribution of the concrete throughout the slab. At the same time, additional mixing of the concrete is obtained. The mechanical spreader was designed and constructed to handle the concrete for the full 22-foot slab width and to operate on the slab forms. Pictures 1 and 2 illustrate the unit in operation on this project.

With the exception of 600 lineal feet, the concrete for the entire 10.1 miles of the design section was placed and consolidated by means of the mechanical spreader. The comparative study embodied both visual and physical observations including mixing of the concrete, distribution on the subgrade, physical characteristics of the concrete, operations and general considerations.

Change in Density

No specific tests were made to determine the relative densities of the concrete involved in the two methods; however, from careful observations it is believed that concrete placed by the mechanical spreader is compacted and of more uniform density throughout the slab.

Coordination of Spreader

It was observed that in order to obtain desirable results from the spreader, it was necessary to coordinate the forward motion of the machine and the rotating speed of the screw under varying load conditions. When the forward motion of the spreader was too slow, the rotating screw feeds too much concrete to the strike-off resulting in a bulging of the surface behind the strike-off. When the forward motion of the machine was too rapid for the rotational speed of the screw, a comparatively smooth but loose surface is formed. The surface had a tendency to tear and ravel. Under normal operation of the spreader when the ratio of the forward motion of the machine was synchronized with rotational speed of the screw under normal uniform load, a smooth and compact surface resulted.

Strike-Off and Placement of Mesh

It was very seldom necessary to correct or suspend operations to prevent the mesh from being placed on an improperly prepared base. Occasionally, a ridge of concrete had to be leveled by hand where the operator, in an attempt to rush operations, would neglect to lower the strike-off blade at the proper time or failed to run the spreader far enough ahead in striking off for the mesh. This is not a serious fault because during normal operations this condition rarely happens. During the final strike-off (second course) operation there was a tendency for the mesh to move forward. If the

concrete was rolled and spread properly no serious movement of the mesh was noted, however, if the concrete was pushed, the mesh could be expected to move. A dry mix aggrevates this condition more readily than a mix of a wetter consistency because of the nature of its stiffness and resistance to movement. It was evident that the success of the spreader depends upon the ability of the operator to handle the machine properly under all conditions.

Economic Consideration

It was controversial on this project whether or not the spreader delayed operation to the extent that it effected the number of lineal feet of pavement possible in a day. It was true that the mixer was delayed a portion of the time in the process of strike-off for the mesh; however, no study was made ofthe time saved by the mixer in being permitted to dump batches almost at will and with little concern to location as is the case under the standard practice. Even allowing that a measurable amount of time was lost with no compensations, this time is only a fraction compared to the time losses by various other operations. In brief, until outstanding efficiency is attained in other equipment and personnel, it is not fair to criticize a new and promising piece of equipment as the mechanical spreader.