mastic asphalt concrete

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Mastic asphalt concrete was first placed in the United States on a main-line pavement in Pennsylvania in 1972. This paper describes that placement. The equipment used was specially constructed inasmuch as placement of mastic asphalt concrete required a propane-heated screed, chip spreader, and a crimper roll, which were not previously available in the United States. Also, the plant had to be modified to produce the asphalt at 410 to 450 F. Based on the experience gained on this project, advantages and disadvantages of mastic asphalt concrete placing are discussed.

•Mastic asphalt concrete, or Gussasphalt, is a paving material new to the United States. It was placed for the first time in this country on a main-line pavement in Pennsylvania during September 1972. Mastic asphalt concrete is a mixture that can be poured or cast in place and requires no rolling or compaction. The resulting mass is essentially voidless and is considered highly durable. The properties of conventional asphalt pavements are essentially governed by the qualities of the mineral aggregates. This is not true, however, of mastic asphalt concrete in which the mineral aggregates are considered to be of lesser influence. The pourable characteristics of the mastic asphalt concrete are instead controlled by the composition of the fine mineral filler and the properties of the asphalt cement. These are mixed to produce a mastic type of binder that holds the larger aggregates and supports the load imposed by vehicular traffic.

The purposes of the research program in Pennsylvania were to evaluate the mixing and placing characteristics of mastic asphalt concrete, to evaluate the immediate and long-range performance of the paving system, and to determine the cost-performance relationship of this system as compared to PennDOT's conventional, high type of bituminous concrete pavement (ID-2A).

EQUIPMENT AND MATERIALS

The equipment used to place the mastic asphalt concrete was specially constructed and was not previously available in this country. The entire paving train moves on rails and consists of three major components: a propane-heated screed, followed by a chip spreader, which is trailed by the crimper roll. One German Linhoff Kocher, an agitated, heated transporter, was mounted on an American truck body. Two other American-built transporters were patterned after the German Kocher and were fabricated to allow for a slightly larger hauling capacity.

The mastic asphalt concrete for this project consisted of a Trinidad and conventional asphalt cement blend, gravel fine aggregate, gravel coarse aggregate, and a limestone filler. The asphalt blend consisted of 20 to 25 percent natural Trinidad asphalt blended

with a standard AC-20 having a 40 to 50 penetration grade. The fine and coarse aggregates were gravel, and the filler was a graded limestone material. The cover chips, also gravel, were precoated by using 1 percent of the Trinidad-asphalt blend.

PLANT MODIFICATIONS

The plant had to be modified to produce the mastic asphalt concrete. The addition of a large amount of filler required a means of preheating the material before it was added to the pug mill. A heated screw assembly, added above the plant, was designed to maintain the temperature generally around 325 F. A portable bin, located near the dust collector storage system, was used to store and provide the needed filler. An agitation system was also needed for the asphalt storage tank. This was required to prevent the settlement of the fine material present in the natural Trinidad asphalt. The asphalt storage temperature was maintained between 400 and 405 F by means of circulation.

PROCEDURE

Plant

The mastic asphalt was produced at temperatures that ranged from 410 to 450 F. Mixing was accomplished by adding the coarse aggregate, fine aggregate, and filler into the pug mill. All materials were dry-mixed for 10 to 30 seconds, 20 seconds being the most appropriate dry-mixing time. The Trinidad-asphalt blend was then introduced, and wet-mixing was continued for 60 seconds. The initial design required an asphalt content of 9.5 percent, but this was gradually reduced to 8.9 percent. The initial design called for an addition of 25.4 percent filler but was finally adjusted to 23.7 percent.

Field

The completed mix was dropped directly from the pug mill into the heated trucks and transported to the paving train. The hot mastic asphalt was dumped onto the fine binder in windrows and allowed to flow in front of the heated screed. The entire paving train rode on rails, but wood forms were nailed to the fine binder to the desired width between the metal rails. The hot mastic asphalt concrete was screeded to the desired depth as the paving train moved forward.

The screeding operation was followed by the power-driven chip spreader, which spread the precoated chips at a rate estimated between 10 and 15 pounds per square yard. The final operation of the paving train was a spiked roller or crimping device which indented the cover chips into the hot mix and created a waffle effect on the surface. The spikes provided $\frac{3}{8}$-in. square indentations on $1\frac{1}{4}$-in. centers. The paving train could move at 3 to 9 feet per minute but averaged about 4 to 5 feet.

Joints were formed by saw-cutting the hardened material at the end of each day's production. Joints needed during the daily production were constructed by hand-cutting or other methods inasmuch as the material had not hardened sufficiently to allow saw-cutting. Traffic was restricted for a 24-hour period, and the finished pavement surface was power-broomed prior to its opening to remove the excess chips.

OBSERVATIONS

Although some difficulties were naturally encountered during the first-time construction of mastic asphalt concrete, these were corrected as the job progressed, and, generally, a fairly good pavement was achieved. The most difficulty centered on the inability of the plant, transport trucks, or both to produce a steady flow of material. This was im-

proved considerably as the job progressed. The project demonstrated that a successful mastic asphalt concrete could be mixed and placed and also provided valuable experience that should contribute to improvement of future projects. Based on the observations of this project, the following advantages and disadvantages are noted.

Advantages

1. The mastic asphalt concrete, with its 0 void content, has the potential for a long service life, free from the usual surface defects such as potholing, raveling, and surface oxidation.
2. The longer service life will reduce maintenance costs and may produce substantial savings despite the greater initial costs.
3. The construction season could be extended by cold-weather paving.
4. The system will produce a durable and highly skid-resistant pavement.
5. Because mastic asphalt concrete is impervious to water, it could provide a waterproof resurfacing system for concrete bridge decks.
6. The longer service life of the system would require fewer resurfacings of a pavement section and thus would reduce the inconvenience to traffic, particularly on high-volume roads.

Disadvantages

1. There are currently no manufacturers of the required paving equipment in this country. This will discourage widespread use of mastic asphalt concrete and keep its cost high until paving equipment can be produced or acquired.
2. Some bitumen plants may not want to produce the material because of the plant modifications required.
3. The present paving equipment must ride on rails over the work area.
4. There are safety hazards associated with placing the extremely hot material. With a temperature in excess of 400 F, severe burns could be caused if workmen were to come in contact with the asphalt.
5. Heated trucks with agitation are necessary for a uniform mastic asphalt.
6. Because the mastic asphalt concrete pavement has to be closed to traffic for 12 hours, this almost limits its use to four-lane pavements where traffic can use the other lanes during construction or to those pavements that can be completely closed. This condition requires more elaborate traffic control than that for placement of conventional asphaltic pavement.