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F.N. Hveem

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Summary

The purpose of this discussion is to point out and emphasize the importance of engineering methods in the design, control and construction of bituminous mixtures. Attention is directed to several causes of error or irregularity in plant operations or in the placing of bituminous pavements, and the need for understanding and the ability to recognize the various types of failures which may develop in order that maintenance methods will be intelligently and efficiently directed.

As a majority of asphaltic pavements are constructed under contractual arrangements, the first essential is an adequate and comprehensive specification which clearly sets forth the composition of the paving mixture and the details covering properties of materials and the essentials of plant control. It is obviously impossible for the engineer to require a contractor to carry out a more expensive or complicated operation than has been stated or implied in the specifications under which the work is being done.

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By

F. N. Hveem
Materials and Research Engineer
California Division of Highways
Sacramento, California

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F. N. Hveem
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of the aggregate and encourages the use of excessive amounts of asphalt. The second item of primary importance is the control of plant temperatures as poor performance of many asphalt pavements can be directly charged to poor control at the plant and especially to overheating of the aggregates.

The essentials of control for the plant inspector are:

1. Maintain uniformity of grading of the aggregates.

2. Maintain uniformity proportion in the amount of aggregates and bituminous binder.

3. Maintain uniformity of temperature of the aggregates at the lowest temperature at which it is possible to secure a good mixture to permit placing on the street.

In the majority of cases, it is a waste of time and money to place a thin patch or a seal over a bituminous pavement when it is failing because of a weak base; yet this practice is all too common.

The second type of distress is that characterized by disintegration of the surface. Disintegration may result from the action of water in which the asphaltic binder is stripped or removed from a hydrophilic aggregate. There do not appear to be any simple rules for correcting this type of failure under maintenance. Remedial measures must depend entirely upon the extent or severity of the problem. Stripping action caused by surface water can often be stopped by the application of a substantial seal coat or surface treatment. If the action is due to moisture rising from below, the condition is usually more difficult to control and may require a complete reworking and resurfacing with materials that are less susceptible. A more frequent cause of disintegration or raveling is the lack of asphalt or road oil which may be due to an insufficient amount added during construction or more often is caused by the asphalt being absorbed or blotted up by a porous stone. Many bituminous mixtures that "appeared" to have a sufficient amount of asphalt when first placed upon

In conclusion, it may be stated that all advances and improvements in the quality and performance of bituminous pavements are in direct proportion to the extent to which engineering control is substituted for personal opinion and experience which means the utilization of definite methods of testing to determine the properties of materials and the mixture proportions in lieu of design by guess and from visual appearance.

the road may later dry out and develop surface failures. This condition is again the result of depending upon appearance during the construction period.

The third class of troubles which may develop in a bituminous pavement are those due to instability, which is the tendency to deform and develop grooves or transverse waves under the action of traffic. Instability may be caused by too much asphalt or too much moisture in the mix, or both; usually accompanied by an excessive amount of fine dust or filler. Many old-time paving engineers believed that filler dust was essential for proper bituminous pavement design. However, the modern trend places much less emphasis upon the dust fraction and while a certain amount of dust may be desirable, it is undoubtedly true that there have been more failures and difficulties occasioned by an excess of filler dust rather than by the lack of it. Many satisfactory road surfaces of the open graded or macadam type have been constructed, but mixtures with a high dust content are difficult to design and control.

Unstable surfaces can be corrected by scarifying and remixing when the more liquid asphalts are used. Where the harder paving grades of asphalt are involved, correction under maintenance may become difficult and expensive.

MAINTENANCE OPERATIONS

When properly constructed over an adequate foundation, a bituminous pavement three to four inches in thickness should require little or no maintenance expenditure on the road surface for a period of at least six or seven years, after which it may become necessary to place a light surface treatment such as a seal coat in order to counteract the effects of weathering or oxidation which may or may not develop noticeably within the period of time indicated.

Unfortunately, however, all construction may not have been carried out in a manner to prevent the development of failures or distress of one type or another and corrective measures may be required. Such failures may be divided into three types. First, are the failures caused by inadequate base or foundation. These are probably the most numerous of all because the adequacy of the base is too often judged by its appearance at the time the bituminous pavement is placed. Engineers in charge of construction are very prone to base their conclusions on the superficial evidence or appearance of material during construction. Few engineers are aware of the marked change in behavior in clay-bound gravels after they have been covered up for a period by dense bituminous pavement.

The specifications for bituminous mixtures should indicate the type of aggregate that will be acceptable and the gradation of the aggregate. They should stipulate that all batch plants be equipped with scales to be checked by the official sealer of weights and measures. All sieve analyses should be subject to correction when necessary to compensate for differences in the specific gravity of the fine and coarse particles. When sieve analyses are made, all samples should be washed in order to determine the exact amount of dust or fines. The specifications should require that asphalt plants be equipped with pyrometers to continuously indicate the temperature of the aggregate entering into the mixer.

Very few screening or paving plants will operate properly without continuous inspection and checking by the plant engineer in charge. The essential duties of the plant inspector are easily described. First, to see that all batches are uniform and that fluctuations in the grading of the aggregate and in the amount of asphalt are held to the absolute minimum. Attempts to speed up production beyond the capacity of the plant nearly always results in the carry-over of fine material into the coarse bins resulting in an excess of fines in the mix and generally results in marked variation in the temperature