Proposed Special Specification for Sand Asphalt, Skid-Resistant, Wearing Course

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MEMO TO: A. O. Neiser
Assistant State Highway Engineer

SUBJECT: Sand-Asphalt Surface Specification

Attached is a proposed specification for sand-asphalt surface submitted for consideration by the Department of Highways Specification Committee. Mr. J. H. Haven's discussion of the specification and its development is included.

We believe that this surface can provide an excellent, skid-resistant, wearing course for resurfacings or new pavements.

Respectfully submitted,

W. B. Drake
Director of Research

Encs.
cc: Research Committee Members
    Bureau of Public Roads (3)
MEMO TO: W. B. Drake  
Director of Research  

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Because of the prominence that natural, sandstone, rock asphalt enjoyed in Kentucky during the past 50 years, sand-asphalts and sheet-asphalt mixes have not been used very extensively for paving in Kentucky. This is somewhat unfortunate because the natural, sandstone, rock asphalt has not been available since about 1955 and because there is now a need for a fine-textured, skid-resistance, wearing course for resurfacing work as well as on new pavements. These circumstances, coupled with the realization (1953-54) that surface courses and chip seals using 100% limestone aggregates tend to become slick, have emphasized the need for specifications for sand-asphalts. Further, it was in the interest of "building in" skid-resistance (about 1954) that Class I, Type B, surface was required to contain 50% siliceous, river sand for work on all roads having more than 700 vpd. Class I, Type B surface is normally laid 1-1/4 inches in depth -- which would be equivalent to about 65 lbs.
of river sand per sq. yd. This sometimes requires that river sands be transported into areas where manufactured limestone sands might otherwise be more economically available. Whereas the river sands are sought for the skid-resistance which they impart to the surface, river sands are notably deficient in fine sizes (filler) which impart stability and integrity to the mix.

As an alternative to "building in" skid-resistance throughout the 1-1/4-inch surface course, and as a means of achieving the aesthetic qualities of a fine-textured, sand surface, a possible recourse would be to relegate the siliceous, river sand to a thin, top course of 35 to 40 lbs. per sq. yd. in which as much as 50% could be limestone sand. Of course, limestone or river sands could then be substituted optionally in all underlying courses. Thus, the use of sand-asphalt wearing course in conjunction with one or more base courses such as Class I (modified) base (excluding binder and Class I, Type B surface) would not necessarily entail additional passes of the paver.

In re-surfacing work, it is anticipated that leveling and wedging would be done with Class I, Type B surface mix. On both re-surfacing and new work, it is anticipated that tack coats, if needed, will be diluted RS-1 or diluted SS-1H applied at the rate of about 0.05 gal. per sq. yd. (net asphalt). Whatever net asphalt quantity is applied as tack would then be deducted from the designed asphalt content of the sand-asphalt course.
The specifications for the sand allow considerable freedom in the selection of blending of types and sources, and they are particularly favorable to natural sands where they exist most abundantly to the manufactured sands elsewhere. While it is expected that crushed limestone sands would be used widely for blending with quartz sands, it is intended that crushed and graded conglomeratic sands and sandstone sands be permitted as alternates to river sands and bank sands as sources for the quartz sand portions.

The preferred grades of asphalt for the mix are PAC-3 and 5, although PAC-7 might be used where the traffic is expected to be light.

Our thinking in regard to the mix design is in general agreement with existing criteria insofar as stability is concerned. However, in consideration of skid resistance (see note) during rainy weather, we feel that the mix should be designed so as to maintain the percentage of voids within a range between 8 and 12 percent. Likewise, and in order to minimize any possibility of the mix becoming critically dense or unstable under traffic, it is recommended that the asphalt content be selected as far on the shy-side of optimum as the stability criterion would safely and judiciously allow.

Note: A completely impervious surface would not allow the escape of water from under the tire of a vehicle; and, unless the water can escape easily, there is reason to believe that at high speed tires may act as a hydroplane. Kentucky Rock Asphalt normally retained 10 to 15 percent voids, and it has been observed in rainy weather that tires tend to squeeze water into the pavement and to leave dry tracks on the surface. The idea of a porous
sand-asphalt surface course necessarily entrusts the protection and sealing of the underlying pavement to the tack coat.

The sandy texture is assured by limiting the maximum size of the sand to that which will pass the No. 8 screen. Wide latitude in the coarse sand sizes has been allowed, and this has been done on the premise that the properties of the mix are controllable within the fine sand and filler sizes. Mixes would necessarily have to be designed on a project-to-project basis in order to establish the optimum proportions of sands to be blended and to obtain the optimum asphalt content. It is possible, within the wide limits allowed in the gradation, to produce mixes which could be critically dense or more dense than should be in order to comply with the criterion of 8 to 12 percent voids. In any gradation, however, it is more-or-less understood that the mid-values are preferred and that the gradation should not be allowed to wander aimlessly between the extreme limits.

The fine limits for that portion of the sand passing the No. 8 sieve given in the Standard Specifications..., Article 4.3.4 A-1, for Type B and Type L surfaces fall near the middle of the proposed limits for sand-asphalt. The middle of the proposed limits conforms closely with the gradation that would be obtained if Class I sand conforming to the fine limits were to be scalped at the No. 8 screen. Additionally, the middle of the proposed gradation conforms closely with that of the fine sand-asphalts being used in Virginia. Actually, however, the gradation
proposed here allows wider limits on the amount of coarse sand. Graphs showing the proposed limits in comparison to some of the others referred to above are attached hereto.

The format of the proposed special specification parallels Article 4.3.0 of the... Standard Specifications... and makes use of the requirements given there for the plant and construction methods. Thus, Article 4.3.0 may be amended easily, if so desired, to include the sand-asphalt type of surface.

The proposed specification more-or-less culminates about 4 years of study and experimentation. In this interim period, similar studies have been made in Virginia, by the Port of New York Authority, and elsewhere. In the fall of 1958, sand-asphalts of this type were placed on the Clark Memorial Bridge in Louisville and on the Ashland–Coal Grove Bridge*.


Although the sand-asphalt mixes were originally intended for more general use, they have exhibited excellent skid-resistance and wear-resistance on the two bridges.

Note: On the Ashland-Coal Grove Bridge, the sand-asphalt was placed over previous, bituminous concrete re-surfacing. There, de-slicking was the principal reason for the additional treatment. However, on the Clark Memorial Bridge, the reasons were two-fold: 1) to protect the reinforced concrete deck from further deterioration caused by freeze-thaw and de-icing salts, and 2) to provide a skid-resistant surface. The March 1961 "Performance Report..." provides rather convincing evidence that a thin, sand-asphalt overlay, in itself, does not offer the protection needed by badly deterioriated, concrete, bridge decks. A number of studied explanations for the poor performance of the material in this respect are offered in the 1961 "Performance Report...".

James H. Havens
Assistant Director of Research

JHH:dl
Encs. 1. Graphs showing gradation limits
2. Proposed specification for sand-asphalt surfaces
This Special Specification No.____, covers the material requirements and construction methods for Hot-Mixed, Hot-Laid, Sand-Asphalt, Surface Course, and shall be applicable when indicated on plans, proposals, and bidding invitations; and, when so indicated, it shall supersede all conflicting provisions of the Department's current Standard Specifications for Road and Bridge Construction. References herein are to the Department's 1956 Standard Specifications for Road and Bridge Construction and approved addenda, thereto.

I. DESCRIPTION

Hot-Mixed, Hot-Laid, Sand-Asphalt, is intended to provide a fine-textured, skid-resistant, wearing surface for pavements and bases. At least 50 percent of the sand therein shall consist of quartz (SiO₂); whereas, the remaining 50 percent thereof may consist of crushed limestone or slag sand. The sand, bituminous material, and the mixing and application thereof shall be in accordance with the respective requirements hereinafter described. The mixture shall be applied to a nominal, compacted thickness of 0.5 inch; and the finished surface shall conform with the lines and grades, shown on the plans and proposals.

II. MATERIALS

A. Requirements

1. Bituminous Materials. The asphalt cement to be mixed
with the sand shall be of the grade specified on plans or proposals and shall meet the particular requirements of Article 7.7.0, as amended.

Bitumen for the tack coat shall meet the requirements of Article 7.7.0 for the particular type and grade specified on the plans and proposals.

2. **Aggregate.** The aggregate shall consist, by weight, of not less than 50 percent quartz (SiO₂); whereas, the remaining 50 percent shall consist of quartz sands, crushed limestone sand, slag sand, or blends thereof. Quartz sand shall be crushed sandstone, conglomeratic sand, bank sand, river sand, or combinations thereof. Mineral filler meeting the requirements of Article 7.3.6 may comprise not more than 5 percent of the aggregate combination, provided that the final product contains 50 percent quartz and otherwise complies with the gradation and the mixture composition required. Natural sands shall comply with physical properties given in Article 7.3.2, Paragraphs B-1 and B-2. Crushed sands shall comply with the requirements given in Article 7.3.4, Paragraphs C-1, C-2, and C-3.

**B. Approval of Materials.** Article 4.3.2-B.

**III. PLANT AND EQUIPMENT**

Article 4.3.3, as amended.

**IV. PREPARATION OF MIXTURES**

**A. Composition of Mixtures**

The sand and asphalt cement shall be combined in such proportions that the composition of the mixture by weight shall be within
the general limits given in the following table. Closer limits shall be established by the Engineer for each project, and the proportions and gradings so established shall be maintained throughout the work. Deviations from the job-mix formula shall not exceed 0.5 percentage points in the asphalt content, 0.2 in fineness modulus of the sand gradation, and 1.5 percentage points in the amount of material passing the No. 200 screen.

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<td>200</td>
<td>2-10</td>
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<td>Percent Bitumen</td>
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B. Preparation of Aggregates

If sands from two or more sources are blended, they shall be metered from individual cold bins and in such proportions that will yield a product having the specified gradations. The sand shall be uniformly dried and heated to 225 to 325°F. If mineral filler is used, it shall be metered separately and directly into the mixer.

C. Preparation of Asphalt Cement

The asphalt cement shall be between 225 and 325°F. when discharged into the mixer.

D. Preparation of Mixture

The sand, after drying and heating, shall be screened and separated into two or more size-fractions as directed by the
Engineer; and each size-fraction shall be stored in separate bins or compartments. The sand-fractions, mineral filler (if used), and asphalt cement shall be metered or weighed separately and charged into the mixer in regulated proportions so as to produce a satisfactory mixture.

E. Temperature Requirements

Article 4.3.4-E

F. Transportation of Mixtures

Article 4.3.4-F

V. CONSTRUCTION METHODS. Article 4.3.5

VI. METHOD OF MEASUREMENT. Article 4.3.6

VII. METHOD OF PAYMENT. Article 4.3.7