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Standard Guide for Materials and Construction of Open-Graded Friction Course Plant Mixtures[1]

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1. Scope

1.1 This guide covers the construction of bituminous open-graded friction course plant mixtures. End-use specifications should be adopted to conform to job and user requirements. Where applicable, Specification D 3666D 3666 should be applied as a minimum for agencies testing and inspecting road and paving materials.

1.2 Bituminous open-graded friction courses are placed as the final wearing course for highways and airfields.

1.3 The values given in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C 29/C 29M Test Method for Unit Weight and Voids in Aggregate

C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C 127 Test Method for (Specific Gravity) Density, Relative Density, and Absorption of Coarse Aggregate

C 128 Test Method for (Specific Gravity) Density, Relative Density, and Absorption of Fine Aggregate

C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates

C 1252 Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)

D 75 Practice for Sampling Aggregates

D 140 Practice for Sampling Bituminous Materials

D 448 Classification for Sizes of Aggregate for Road and Bridge Construction

D 946 Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction

D 1461 Test Method for Moisture or Volatile Distillates in Bituminous Paving Mixtures

D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate

D 2995 Practice for Estimating Application Rate of Bituminous Distributors

D 3381 Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction

D 3515 Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

D 3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials

D 4791 Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

D 5821 Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate

D 5840 Specification for Type II Polymer Modified Asphalt Cement for Use in Pavement Construction

D 5841 Specification for Type III Polymer Modified Asphalt Cement for Use in Pavement Construction

D 5892 Specification for Type IV Polymer Modified Asphalt Cement for Use in Pavement Construction

D 5976 Specification for Type I Polymer Modified Asphalt Cement for Use in Pavement Construction

D 6114 Specification for Asphalt of Rubber Binder

D 6307 Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method

D 6373 Specification for Performance Graded Asphalt Binder

D 6390 Test Method for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures

D 7064 Practice for Open Graded Friction Course (OGFC) Mix Design

2.2 *Other References:*

TRB NCHRP Synthesis 284 Performance Survey on Open-Graded Friction Course Mixes

NCAT Report No. 2001-01 Design, Construction and Performance of New Generation Open-Graded Friction Courses

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[1] This guide is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.23 on Plant-Mix Bituminous Surfaces and Bases.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *open-graded friction course (OGFC), n*—special type of hot mix asphalt surface mixture used for reducing hydroplaning and potential for skidding, where the function of the mixture is to provide a free-draining layer that permits surface water to migrate laterally through the mixture to the edge of the pavement.

3.1.1.1 *Discussion*—Example gradings can be found in Appendix X1.

4. Significance and Use

4.1 This guide provides information to assist engineers with the design requirements and construction guidelines for paving an Open-Graded Friction Course (OGFC) surface layer. An OGFC is primarily used to improve the skid resistance and wear resistance of a bituminous pavement by providing an escape route for surface water beneath a moving wheel load. The mixture is typically produced with a low amount of fine aggregate particles and high air void content to provide a passageway of interconnected voids for moisture to drain away from the travelway. The film thickness of the asphalt and overall asphalt content is important for better stripping resistance and durability and aging properties.

NOTE 1—OGFCs may also be placed to reduce the tire-pavement interface noise and may also be placed to reduce the occurrence and severity of reflective cracking.

5. Types of Specification Information

5.1 Contract documentation for bituminous OGFC typically includes the following information:

5.1.1 Type of asphalt (for example, asphalt cement, polymer modified asphalt, asphalt rubber) and specification designation;

5.1.2 Grade of asphalt;

5.1.3 Quantity of asphalt required;

5.1.4 Type of aggregate (for example, crushed stone, crushed gravel, crushed slag, gravel, slag) specification designation;

5.1.5 Aggregate quality requirements (for example, coarse aggregate angularity, fine aggregate angularity, L.A. abrasion, soundness, water absorption, sand equivalent);

5.1.6 Size or sizes of aggregate to be furnished;

5.1.7 Quantity of additive, or anti-stripping agent, or both;

5.1.8 Quantity of open-graded mix; and

5.1.9 Special requirements.

6. Aggregate

6.1 Aggregate shall conform to Classification D 448D 448 and Specification D 3515D 3515, except where noted in this guide.

6.2 *Size*—Aggregate should be as close to one size as is economically practical, preferably in the range of ½ in. to No. 4 (12.5 to 4.75 mm), for OGFC with up to 1.0 in. (25 mm) in compacted thickness.

6.3 *Shape*—The ideal shape is cubical or angular. To achieve adequate angularity it is suggested that the coarse aggregate have at least 95 % one-fractured face and 90 % two-fractured face as measured by Test Method D 5821D 5821. To help achieve a more cubical shape it is suggested that the coarse aggregate maximum amount of flat or elongated particles as measured by Test Method D 4791D 4791 not exceed 10 % with a ratio of 5 to 1 in maximum dimension to minimum dimension. Rounded particles are not acceptable. The uncompacted void content (fine aggregate angularity-FAA) as measured by Test Methods C 1252C 1252 should be 40 % or greater.

6.4 *Cleanliness*—It is important that the aggregate be clean. The sand equivalent value of the fine aggregate passing the No. 8 (2.36 mm) sieve according to Test Method D 2419D 2419 should be at least 45 % or greater. It is recommended that the material to be tested be separated on the No. 8 (2.36 mm) sieve because of the coarse grading of the aggregate. It is also very important to remove any coatings or fines adhering to the coarse material.

7. Asphalt Binder

7.1 Asphalt cement shall conform to Specifications D 946D 946, D 3381D 3381, or D 6373D 6373.

7.2 When modified asphalt is used, it shall conform to Specifications D 5840D 5840, D 5841D 5841, D 5892D 5892, D 5976D 5976, or D 6373D 6373.

7.3 When asphalt-rubber is used, it shall conform to Specification D 6114D 6114.

NOTE 2—The asphalt type and grade to be used depends on the type of construction, climatic conditions, amount and nature of traffic.

8. Composition of Open-Graded Mixtures

8.1 The asphalt content shall be determined in accordance with the owner's selection method or Practice D 7064D 7064.

8.2 The asphalt cement open-graded mixture will typically consist of 93 to 95 % aggregate and 5 to 7 % asphalt by weight of total mixture.

8.3 The modified asphalt open-graded mixture typically consists of 92 to 94 percent aggregate and 6 to 8 % modified asphalt by weight of total mixture.

8.4 The asphalt-rubber open-graded mixture typically consists of 90 to 91.5 percent aggregate and 8.5 to 10 % asphalt-rubber by weight of total mixture.

NOTE 3—Due to the open-graded nature of the mixture it may be advisable to add 1 to 2 % cement or hydrated lime or a suitable anti-stripping agent to prevent stripping.

NOTE 4—The selected asphalt content should be checked by performing a suitable asphalt draindown test such as Test Method D 6390D 6390. Draindown may be reduced by using cellulose or mineral fiber. Typically the dosage is in the range of 0.2 to 0.5 % by mixture mass as per the mix design procedure test results. Polymer modified asphalt or asphalt-rubber mixes may not require fiber additives to obtain good performance or control draindown.

9. Production and Placement

9.1 Bituminous OGFC should not be placed during periods of cold or wet weather, or both. The existing surface shall be warm, clean, and dry while paving the OGFC.

9.1.1 Typically the minimum air temperature should be 60°F (16°C) in the shade and rising and the minimum surface