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GUIDANCE FOR COURSE EVALUATION FORM

The Course Evaluation Form on the following page is very important to the continuing improvement and success of this course. The form is included in each Participant Workbook. During the course introduction, the Instructor will call the participants' attention to the form, its content, and the importance of its thoughtful completion at the end of the course. Participants will be encouraged to keep notes, or write down comments as the class progresses, in order to provide the best possible evaluation. The Instructor will direct participants to write down comments at the end of each day and to make use of the back of the form if more room is needed for comments.

On the last day of the course, just prior to the written examination, the Instructor will again refer to the form and instruct participants that completion of the form after their last examination is a requirement prior to leaving. Should the course have more than one Instructor, participants should be directed to list them as A, B, etc., with the Instructor's name beside the letter, and direct their answers in the Instructor Evaluation portion of the form accordingly.

UDOT
TRANSPORTATION TECHNICIAN QUALIFICATION PROGRAM
COURSE EVALUATION FORM

The UDOT Transportation Technician Qualification Program would appreciate your thoughtful completion of all items on this evaluation form. Your comments and constructive suggestions will be an asset in our continuing efforts to improve our course content and presentations.

Course Title: _____

Location: _____

Dates: _____

Your Name (Optional): _____

Employer: _____

Instructor(s) _____

COURSE CONTENT

Will the course help you perform your job better and with more understanding? Yes Maybe No

Explain: _____

_____

Was there an adequate balance between theory and instruction? Yes Maybe No

Explain: _____

_____

Did the course prepare you to confidently complete both examinations? Yes Maybe No

Explain: _____

_____

What was the most beneficial aspect of the course? _____

_____

What was the least beneficial aspect of the course? _____

_____

GENERAL COMMENTS

General comments on the course, content, materials, presentation method, facility, registration process, etc. Include suggestions for additional Tips!

_____

_____

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INSTRUCTOR EVALUATION

Were the objectives of the course, and the instructional and exam approach, clearly explained? Yes Maybe No

Explain: _____

_____

Was the information presented in a clear, understandable manner? Yes Maybe No

Explain: _____

_____

Did the instructors demonstrate a good knowledge of the subject? Yes Maybe No

Explain: _____

_____

Did the instructors create an atmosphere in which to ask questions and hold open discussion? Yes Maybe No

Explain: _____

_____

COURSE OBJECTIVES AND SCHEDULE

Learning Objectives

Instructional objectives for this course include:

- Becoming proficient in the following specifications, practices, and procedures:

  FOP for AASHTO M 323
  Standard Specification for Superpave Volumetric Mix Design

  FOP for AASHTO R 35
  Standard Practice for Superpave Volumetric Mix Design

  FOP for AASHTO R 30 and UDOT MOI 8-988
  Guidelines for Laboratory Mixing of Hot-Mix Asphalt (HMA) and Mixture Conditioning of HMA

  FOP for AASHTO T 312
  Standard Method for Preparing and Determining the Density of Hot-Mix Asphalt HMA) Specimens by Means of the Superpave Gyratory Compactor

  FOP for AASHTO T 283
  Resistance of Compacted Bituminous Mixtures to Moisture Induced Damage

  FOP for AASHTO T 324 and UDOT MOI 9-990
  Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)

  FOP for AASHTO M 325
  Standard Specification for Stone Matrix Asphalt (SMA)

  FOP for AASHTO R 46
  Standard Practice for Designing Stone Matrix Asphalt (SMA)

  FOP for AASHTO T 305
  Standard Method of Test for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures

The overall goals of this course are to understand the basics of Superpave and SMA mix design, and to be competent with specific quality control test procedures identified for the Utah Department of Transportation (UDOT) Transportation Technician Qualification Program (TTQP).

It is assumed that the student has previously obtained a copy of the manual, and has adequately prepared for the qualification by studying and receiving training from a senior trainer.

Course Outline and Suggested Schedule

Day One

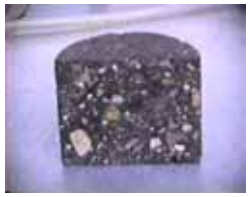
0900	Welcome Introduction of Instructors
0915	Presentations
1200	Lunch
1300	Presentations. Distribute copies of Sample Exams

Day Two

0800	Review Sample Exam and answer questions from the Previous Day
0900	Start of Written Exams
Varies	Practical Exams (After successful completion of written exam)

BASICS OF SUPERPAVE MIX DESIGNS

02

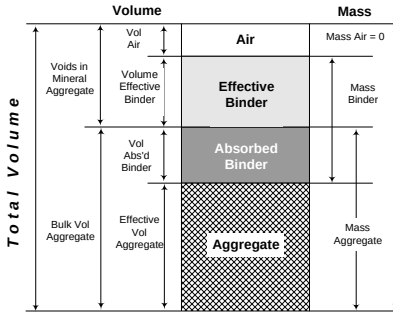


Introduction

Asphalt cement concrete (ACC) is a mixture of two primary ingredients: mineral aggregate and asphalt cement (AC) or binder as it is now termed. The binder holds the aggregate together in a moderately flexible rock-like mass. Hot mix asphalt (HMA) includes mixes that are produced at an elevated temperature. ACC and HMA are generally divided into three types of mixes, depending on the gradation of the aggregate: dense-graded, open-graded, and gap-graded.

Superpave HMA mixtures are a dense graded mix using high quality aggregates and binder used for the construction of surface courses on flexible pavements.

The binder is divided into two categories: absorbed (into the aggregate) and effective (which remains on the surface for binding aggregate particles together). Also, HMA contains air voids in addition to aggregate and binder.



Once the HMA mixture is mixed and compacted to optimum air void content (4%) it exhibits a certain level of stability that helps it withstand the combined action of environment and traffic loads. Several factors contribute to the level of stability offered by the HMA: the quality of aggregate and binder, and the gradation of the aggregate.

03

Five factors affect pavement performance:

1. Structural design
2. Mix design properties
3. Workmanship used to produce, place, and compact the mix
4. Loading factors
5. Environmental conditions.

This module presents information relating to item No. 2, Mix Design.

04

Mix Design

The objective of a mix design is to select the optimum binder content for a given aggregate source, binder source and optimum aggregate gradation. The FOP for AASHTO M 323 covers the Standard Specification for Superpave Volumetric Mix Designs.

The Superpave mix design and analysis system consists of three major components:

- Binder specification and selection
- Aggregate specification and evaluation
- Volumetric mix design and evaluation

The overall objective of the Superpave system is to specify the appropriate materials and mix design, and predict the performance of a given HMA pavement.

05

Binder

A binder specification is a process by which the designer can select and verify the appropriate grade of binder to be used on a specific project. To select a binder, it is important to understand how they behave.

06

How Binders Behave

The behavior of binders depends on:

- Temperature
- Time (duration) of Loading
- Age

The first step in developing and understanding a binder grading system is to appreciate the behavior of the binder and the various factors that impact such behavior. Asphalt binders are viscoelastic materials whose behavior is dependent on temperature and time of loading. Because their chemical composition may change with time, their relative age in the road also impacts their engineering properties and, therefore, their behavior.

A unique property of a viscoelastic material is the superposition of temperature and time of loading, which means that the impact of temperature and

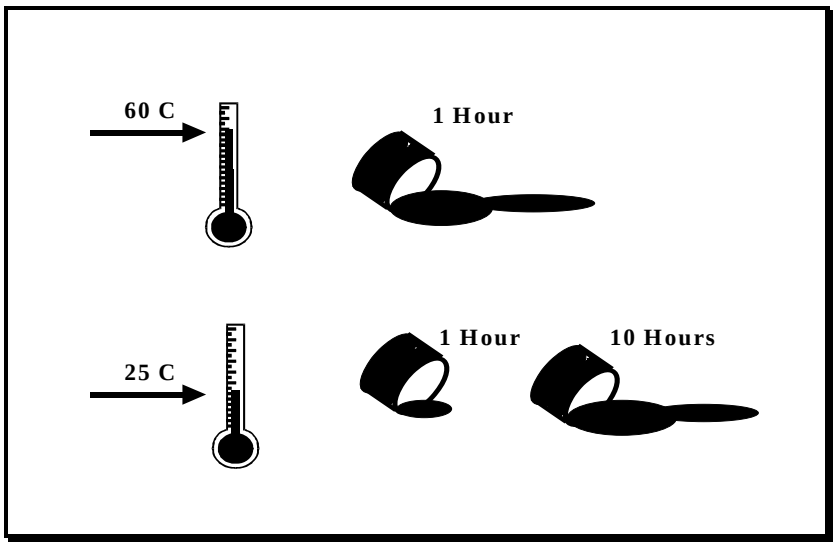
time of loading on binders are interchangeable. Testing the binder at elevated temperatures can simulate behavior of a binder under a very slow loading rate.

Using such interrelationships, laboratory testing is used to simulate actual field conditions.

07

Temperature

The temperature that a binder is exposed to in the field depends on the location of the project. In high temperatures, such as those found in desert climates and during summer, the binder acts as a viscous liquid. At low temperatures, such as those found in cold climates and during winter, the binder acts as an elastic solid, which is more brittle. At intermediate temperatures the binder is viscoelastic, it has characteristics of both a viscous liquid and an elastic solid. Binders may be exposed to a range of extreme high temperatures to extreme low temperatures.



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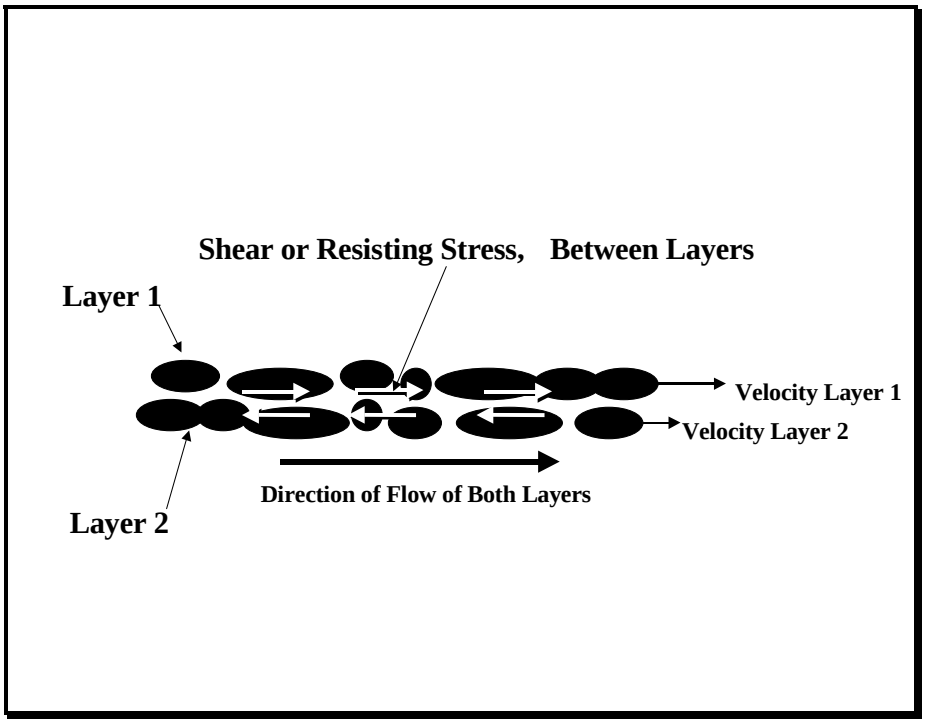
09

At elevated temperatures, when binders behave as viscous liquids, their resistance to shear deformations depends on the rate of shear stresses being applied. The resistance of binders to shear deformations is one important factor that controls the development of rutting in HMA mixtures.



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Time of Loading

The time (duration) of loading that a binder encounters in the field depends on the actual use of the pavement facility. Pavements on parking lots, tollbooths, and traffic lights are subjected to sustained loads. Pavements on highways and freeways are subjected to rapid loads.

The behavior of the binders changes from viscous liquids, as they are subjected to sustained loads, to elastic solids, as they are subjected to rapid loads.

At facilities where traffic speed is intermediate, the binder behaves as a viscoelastic material.

- Sustained loads = Viscous liquid
- Rapid loads = Elastic solid
- Intermediate loads = Viscoelastic

12 **Aging Behavior**

Aging of binders is a process by which the binders become more brittle with time.

During construction the binder is subject to short-term aging due to hot mixing, placing, and compacting, which causes the volatiles to evaporate. In service the binder is subject to long-term aging because it reacts with oxygen, which results in oxidation or age hardening. Oxidation occurs more rapidly at elevated temperatures, a larger concern in hot, desert climates and hot summers.

13 **In-place performance**

The in-place life cycle of an HMA pavement depends on it's ability to resist:

- Permanent deformation (rutting)
- Fatigue cracking
- Thermal cracking

These factors are taken into consideration in the mixture design selection of binder and aggregate structure. Because binders are significantly impacted by temperature, time of loading and aging HMA pavements are also impacted by the same factors.

14 **Permanent Deformation (Rutting)**

The aggregate gradation is the most significant contributor to a mixtures ability to resist permanent deformation (rutting) although binder properties are significant.

15 **Fatigue Cracking**

Fatigue cracking in HMA pavements occurs as a long-term response to in-service conditions. The resistance of HMA pavements to fatigue cracking is generated through a complex interrelationship among binder, aggregate and pavement structure.

16 **Thermal Cracking**

Thermal cracking of HMA pavements is mainly controlled by the properties of the binder. Thermal cracking is caused by excessive tensile stresses due to shrinkage.

The binder carries these tensile stresses; as the binder ages, it becomes more brittle and its ability to resist tensile stresses diminishes.

17 **Superpave PG Binder specification**

The Superpave PG binder specification, as outlined in AASHTO M 320, measures the physical properties of binders that can be directly related to field performance by engineering principles.

Because of the viscoelastic nature of the binder, rheological testing must be performed to fully describe its engineering properties. (Rheology is the study of the deformation and flow of matter.)

18 The final outcome of the Superpave binder grading system is to assign a performance-based grade for the binder. This grade indicates the range of in-service temperatures of the binder to resist the various failure modes (rutting, fatigue and thermal cracking). The first number is the “high temperature grade,” and means the binder possesses adequate physical properties up to at least this temperature. The second number is the “low temperature grade,” and means the binder possesses adequate physical properties down to at least this temperature.

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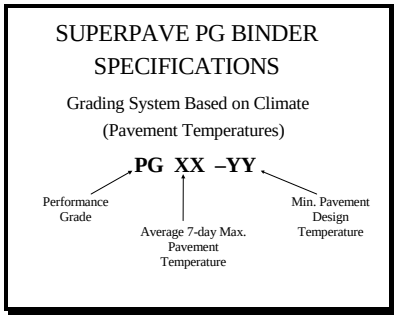


To identify the appropriate temperature range for the binder, its engineering properties must be evaluated at a temperature range that covers the expected temperatures during production, construction and service life.

As the binder is subjected to different levels of temperatures at various stages of its service life, its engineering (rheological) properties significantly change. Therefore, the critical properties that control the resistance of the binder to the various failure modes have to be evaluated at the appropriate combinations of temperature and aging conditions of the binder.

High/Intermediate Temperature Properties

20 The high/intermediate temperature properties are measured by:

- Rotational Viscometer (RV)
- Dynamic Shear Rheometer (DSR)
  - Original (not aged)
  - Short-term aged = RTFO
    (Rolling Thin Film Oven)
  - Long-term aged = PAV
    (Pressure Aging Vessel)

Low Temperature Properties

21 The low temperature properties are measured by:

- Bending Beam Rheometer (BBR) at RTFO and PAV
- Direct Tension Tester (DTT) at RTFO and PAV
  - Short-term aged = RTFO
    (Rolling Thin Film Oven)
  - Long-term aged = PAV
    (Pressure Aging Vessel)

22 ### Binder selection

The selection of the binder depends on the climatic condition of the project site:

- Low temperature
  Lowest pavement temperature (not air temperature)
- High temperature
  Average 7-day maximum pavement temperature (not air temperature)

The selection of the binder also makes some adjustments for the anticipated traffic speed.

Aggregate Specification and Evaluation

23 **Consensus Properties**

The aggregate specifications include consensus properties determined by the following test procedures:

- Coarse aggregate angularity (ASTM D 5821)
- Fine aggregate angularity (AASHTO T 304)
- Flat and elongated particles (ASTM D 4791)
- Clay content (AASHTO T 176)

Because aggregates make up approximately 95 percent of the HMA mix, their properties are critical to the performance of the mix. The Superpave mix design system specifies critical properties for the fine and coarse portions of the aggregates. Fine aggregates are defined as passing the #4 sieve. Coarse aggregates are defined as retained on the #4 sieve.

The gradation of the aggregates controls the long-term performance of the HMA mix. The concept of the gradation specification is that a dense graded mix, which does not experience tenderness during the construction process, should provide good performance.

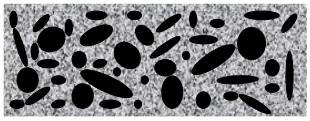
A large portion of the Superpave aggregate specification deals with the physical shape of the aggregate because it significantly impacts the interlocking and adhesion properties of the aggregates.

The rutting resistance of the HMA mixture is highly dependent on the interlocking of the aggregate particles. Rounded and smooth aggregates slip relative to each other when subjected to loads. Therefore, the resistance of HMA mixtures to shear deformations is increased when large percentages of cubical and rough-textured aggregates are used.

The design aggregate structure approach ensures that the aggregate will develop a strong stone skeleton to enhance resistance to rutting, while allowing for sufficient void spaces to enhance mixture durability.

Contrasting Stone

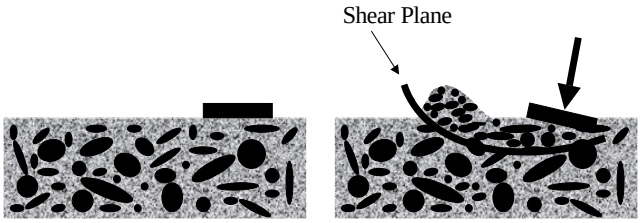
Cubical Aggregate



Rounded Aggregate

24

Shearing Behavior of Aggregate



Before Load After Load

25

26 **Gradation Controls**

- Nominal Maximum Size
- 0.45 power chart
- Control points

27 **Aggregate Source Properties**

The Superpave aggregate specifications also recognize properties that are controlled by the aggregate source:

- L. A Abrasion (AASHTO T 96)
- Soundness (AASHTO T 104)
- Clay lumps and friable particles (AASHTO T 112)

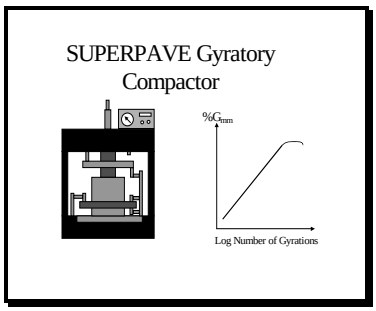
These aggregate specifications include properties that are considered to be critical to the overall quality of the aggregate particle. It is up to the highway agency to set the limits that have worked well under local conditions.

28 ## Mix Design Overview

The Superpave system includes:

- **Volumetric Mix Design**
- Performance based tests
- Performance prediction

This module is concerned with the Volumetric Mix Design.



29 The **Volumetric Mix Design** includes:

- Materials Selection (Aggregate & Binder)
- Gradation Selection (Trial Series)
- Optimum Binder Content Selection

30

31 ## Definition of Terms

- G_{mm} = theoretical maximum specific gravity
- G_{mb} = measured bulk specific gravity
- G_{sb}(OD) = oven-dry bulk specific gravity of aggregate
- G_{sa} = apparent specific gravity of aggregate
- G_{se} = effective specific gravity of aggregate
- G_b = specific gravity of the binder

32

- V_a = air voids
- VMA = voids in mineral aggregate
- VFA = voids filled with asphalt binder
- V_{ba} = absorbed binder volume
- V_{be} = effective binder volume
- P_b = percent binder content
- P_{ba} = percent absorbed binder

33 - P_{be} = percent effective binder content
- P_s = percent of aggregate
- $P_{.075}/P_{be}$ = dust to effective binder ratio
- RAP = Reclaimed Asphalt Pavement
- Nominal Maximum Aggregate Size:
  One sieve size larger than the first sieve to cumulatively retain more than 10%
- Maximum Aggregate Size:
  One sieve size larger than the nominal maximum aggregate size

34 - Design ESALs:
  Design equivalent 18,000 lb (80kN) single axle load. For mixed traffic levels standard load equivalent factors are used.

  Design ESALs are the anticipated project traffic level expected over a 20-year period. ESALs should be calculated for a 20-year design life.

35 **Prerequisite Tests**

- AASHTO T 2 Sampling of Aggregates
- AASHTO T 248 Reducing Samples of Aggregate to Testing
- AASHTO T 11 Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing
- AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates
- AASHTO T 84 and T 85 Specific Gravity of Fine and Coarse Aggregates

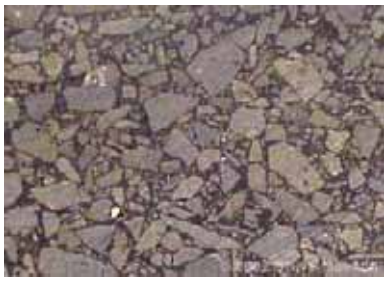
36 **Optimum Aggregate Gradation Selection (General)**

1. Establish three trial aggregate gradations that meet all aggregate requirements.
2. Determine initial binder content for each trial aggregate gradation.
3. Compact two samples for each trial aggregate gradation at the initial binder content.
37 4. Measure volumetric properties of the compacted samples.
5. Estimate volumetric properties at V_a= 4.0%.
6. Select the aggregate gradation that best satisfies the design criteria.

38 **Select Optimum Binder Content (General)**

1. Prepare and compact replicate samples of the design gradation at four levels of binder content. (Est. design, 0.5% below, 0.5% above and 1.0% above)
2. Measure volumetric properties of the compacted samples.
3. Determine the optimum asphalt binder content.
39 4. Check the volumetric properties at the optimum binder content against the design criteria.
5. Check design criteria at N_{max} (replicate specimens).
6. Check moisture susceptibility of the mixture at the recommended P_b (AASHTO T 283).

BASICS OF STONE MATRIX ASPHALT (SMA) MIX DESIGNS



Stone Matrix Asphalt Aggregate Structure

Superpave Aggregate Structure

Introduction

SMA is a gap-graded mixture having a concentration of coarse aggregate particles resulting in “stone-on-stone” contact. The aggregate is combined with a rich asphalt binder mortar consisting of binder, mineral filler, and stabilizing additive. The combination of proper aggregate structure and binder mortar allows design of mixtures based on volumetric properties with “normal” air void content (approximately 4.0 percent) that, when properly produced and placed, can result in greater durability and resistance to rutting.

SMA was developed in Europe as a response to the critical need for pavements that were resistant to abrasion from the use of studded tires, and various pavement distresses induced by heavy traffic. SMA proved very successful in Germany, and its use continued even after elimination of studded tires.

SMA was initially adopted from the Germans by Sweden and Denmark, but is now used extensively in Norway, Finland, Austria, France, Switzerland, and the Netherlands.

The National Asphalt Pavement Association (NAPA) was introduced to the mix during a European asphalt study tour in 1990, after which the U.S. began experimenting with SMA mixtures. Since then, SMA use has increased in the U.S.A.

FOP’s for the Standard Specification for SMA (AASHTO M 325) and the Standard Practice for Designing SMA (AASHTO R 46) are contained in this manual.

Basics of SMA

Superpave Gyratory Compactor (SGC)

The Superpave Gyratory Compactor (SGC) is the method used for preparing compacted specimens during SMA mix design. Mixtures are normally compacted using 100 gyrations (75 gyrations are used when the coarse aggregate has L.A. Abrasion loss exceeding 30 percent).

As stated in the introduction, SMA is a gap-graded mixture. This means that the intermediate size fractions, present in dense-graded materials, are largely missing in SMA.

During design, SMA mixtures are evaluated for compliance with certain specified volumetric properties including voids in the mineral aggregate (VMA), air voids (V_a), as well as voids in the coarse aggregate fraction of the combined grading (VCA). VCA is expressed in two ways:

1. VCA_{DRC} describes VCA in the dry-rodded condition when tested according to AASHTO T 19.
2. VCA_{MIX} describes VCA in the compacted mixture.

Compliance of the mixture with AASHTO M 325 requires that VCA_{MIX} be less than VCA_{DRC}. (Calculation methods for VCA_{DRC} and VCA_{MIX} are contained in the FOP for AASHTO R 46).

The SMA specification for mixture properties requires relatively high values for minimum VMA and binder content, while maintaining V_a of approximately 4.0 percent. This results in SMA mixtures having binder contents significantly higher than those of dense-graded mixtures such as Superpave.

"Fat" spots due to draindown

Binder content is required to be at least 6.0 percent and may be higher, depending on grading and aggregate specific gravity. This results in greater potential for draindown (migration of binder away from aggregate particles). For this reason, stabilizers such as cellulose and mineral fibers are added to the binder to prevent excessive draindown characteristics.

The mixture is tested during the design phase, and during production, according to AASHTO T 305 to assess draindown potential and compliance with the specification.

49 The mixture must also be evaluated for damage due to moisture susceptibility according to the FOP for AASHTO T 283. This test is conducted on specimens compacted according to the FOP for AASHTO T 312 at an air void content of approximately 6 percent.

50

Binder Requirements

Binders used in SMA mix design must comply with AASHTO M 320. Reference is also made to AASHTO M 323 for binder adjustments specific to project climate conditions and traffic loading.

51

Aggregate Requirements

The SMA aggregate specification requires use of materials that are 100 percent crushed, meeting properties based on the results of certain specified test methods.

Coarse aggregate quality requirements are based on tests for Los Angeles Abrasion, Flat and Elongated Particles, Absorption, Soundness, and Crushed Content (Fractured Face). Fine aggregate quality requirements are based on tests for Soundness, Liquid Limit, and Plasticity Index.

Mineral filler specifications require use of finely divided mineral matter, such as crusher fines and fly ash, that are free from organic impurities and that have a plasticity index not greater than four.

AASHTO M 325 provides combined grading bands for three nominal maximum aggregate sizes: 3/4" (19 mm), 1/2" (12.5 mm), and 3/8” (9.5 mm). Coarse aggregate is defined as material retained on the No. 4 sieve for the 3/4" and 1/2" nominal maximum aggregate sizes, and as material retained on the No. 8 sieve for the 3/8” nominal maximum size.

When the oven-dry bulk specific gravity of the different materials used in the mixture vary by more than 0.2, combined grading must be calculated based on volumetric percentage.

52

Mixture Property Requirements

Final mixture property requirements may be summarized as follows:

- Air Void Content: Generally 4.0 percent, but not less than 3.0 percent for low traffic levels or colder climates.
- VMA: 17.0 percent minimum
- VCA_{MIX}: Lower than VCA_{DRC}
- TSR: 0.80 minimum
- Draindown: 0.3 percent maximum
- Binder Content: 6.0 percent minimum. Some adjustment is allowed for aggregates of high specific gravity.

53

Mix Design Overview

SMA mix design includes the following:

- Materials Selection (Aggregates, Binder, Mineral Filler, Stabilizing Additive)
- Gradation Selection (Trial Series)
- Optimum Binder Content Selection

54

Definition of Terms

- **Air Voids (V_a)**
  The total volume of the small pockets of air between the coated aggregate particles throughout a compacted paving mixture, expressed as a percent of the bulk volume of the compacted paving mixture.
- **G_{CA}**
  Oven-dry bulk specific gravity of the coarse aggregate fraction of the combined grading.

55

- **P_{CA}**
  Percent of coarse aggregate in the combined grading.
- **SMA Mortar**
  A mixture of asphalt binder, filler (material passing the No. 200 sieve), and stabilizing additive.

SMA Surface

- **Stabilizing Additive**
  Either cellulose or mineral fiber.

56 - **Stone Matrix Asphalt (SMA)**
  A Hot-Mix Asphalt (HMA) mixture consisting of a coarse aggregate skeleton with stone-on-stone contact, and a rich asphalt binder mortar.

57

58 - **Stone-on-Stone Contact**
  The point where the VCA of the compacted mixture is less than the VCA of the dry-rodded coarse aggregate.

59 - **VCA**
  Volume of voids between coarse aggregate particles in the combined grading.

- **VCA_{DRC}**
  Volume of voids between coarse aggregate particles in the combined gradation (dry-rodded condition).

- **VCA_{MIX}**
  Volume of voids between coarse aggregate particles of the compacted mixture (air voids, binder, fine aggregate, mineral filler, and stabilizing additive).

60

Prerequisite Tests

- **AASHTO T 2 –** Sampling of Aggregates
- **AASHTO T 248 –** Reducing Samples of Aggregate to Testing Size
- **AASHTO T 11 –** Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing
- **AASHTO T 27 –** Sieve Analysis of Fine and Coarse Aggregates
- **AASHTO T 84 and T 85 –** Specific Gravity and Absorption of Fine and Coarse Aggregates

61 - **AASHTO T 19 –** Bulk Density ("Unit Weight") and Voids in Aggregate
- **AASHTO T 89 and T 90 –** Liquid Limit, Plastic Limit and Plasticity Index
- **AASHTO T 96 –** Los Angeles Abrasion of Coarse Aggregate

- **AASHTO T 104 –** Soundness of Coarse and Fine Aggregates

62 - **ASTM D 4791 –** Flat Particles, Elongated Particles, or Flat & Elongated Particles in Coarse Aggregate
- **ASTM D 5821 –** Determining the Percentage of Fractured Particles in Coarse Aggregate

63 **Optimum Gradation Selection (General)**

1. Perform prerequisite procedures / tests.
2. Establish at least three trial blend gradings (either from experience, or one each along coarse and fine limits and the center of the grading band).
3. Establish trial binder content. AASHTO R 46 recommends binder content from 6.0 to 6.5 percent when previous experience is not available.
4. Mix and compact trial blend specimens according to the FOP's for AASHTO R 30 and T 312.
5. Evaluate compacted trial mixtures.
6. Select optimum aggregate grading (lowest coarse aggregate content where the mixture meets the minimum VMA, and VCA_{MIX} is lower than VCA_{DRC}).

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Select Optimum Binder Content (General)

Using the optimum grading, the steps for selecting the optimum binder content are:

1. Select Binder Contents (minimum of three binder contents that will encompass required air void content).
2. Fabricate and Compact Specimens (using FOP's for AASHTO R 30 and T 312).
3. Select Optimum Binder Content (binder content at which the mixture meets air void and minimum VMA requirements, and where VCA_{MIX} is lower than VCA_{DRC}).
4. Evaluate TSR at optimum binder content (compact at 6 percent air voids according to T 312, test according to T 283).
5. Evaluate Draindown at optimum binder content (T 305).