Superpave Asphalt Mix Design - Part B

Laboratory Procedures for the Preparation of HMA Test Specimens

Materials
The following materials will be used in the specimen production.

- Performance Graded Asphalt Binder
- Course Aggregate
- Fine Aggregate
- Mineral Filler (is needed for the mix)

Equipment
The following equipment will be utilized in the specimen production.

- Ovens, thermostatically controlled
- Mechanical Mixer, 10 qt.
- Flat bottom metal pans
- Metal Scoop, spatula, and spoons
- WD-40 or other light lubricating fluid
- Pouring pot, for heating and dispensing liquid asphalt binder
- Thermometers to measure 250-350°F
- Balances, 8 kg capacity
- Heat resistant gloves, Kevlar sleeves
- Yellow lumber crayon, for specimen identification marking
- Paper disks, 6 inches, for gyratory compaction
- Gyratory Compactor with computer (for compacting and recording specimen data)

Definitions
Although students should be familiar with the basic terminology of the asphalt mix design process from lecture, the following definitions are provided for ease of reference as these are used throughout the manual.

- **Asphalt Binder**: the asphalt cement used to mix and bind the aggregate and mineral filler.
- **Course Aggregate**: rock particles generally larger than the #4 sieve.
- **Fine Aggregate**: sand, silt, and clay particles generally smaller than the #4 sieve but larger than the #200 sieve.
- **Mineral Filler**: dust size particles used to fill small voids in the hot mix asphalt specimen.
- **Gyratory Compactor**: a piece of equipment used to compact the asphalt mix design specimen at a specified pressure, angle of tilt, and revolution cycles.
- **N\text{design}, Design Gyraions**: the number of gyrations for the particular mix design specimen. Corresponds to the compaction at the end of the pavements design life. This is where the optimum asphalt content is determined corresponding to the specified air voids.
- **N\text{init}**: the number of gyrations at which the specific gravity must not exceed 89 percent of Gmm. Corresponds to the expected compaction at the time of the pavement’s construction.
• $N_{max}$: the number of gyrations at which the specific gravity must not exceed 98 percent of $G_{mm}$. Corresponds to the maximum recommended density.

**Warning:** The asphalt mix design specimen procedure involves the use of heavy aggregates and hot asphalt liquid. Students should follow all lab safety procedures to avoid injury.

**Procedures**

The following steps outline the basic procedures in the HMA specimen production. These basic steps are taken from Asphalt Institute. (1996). “Superpave Mix Design: Superpave Series No. 2 (SP-2).” U.S.A. Some adjustments were made to help fit the sequence to our allotted lab schedule.

**Materials**

**Step 1**
Complete the pre-lab exercise described in Part A to determine the batch weights of course and fine aggregate, mineral filler and asphalt to be used for the HMA specimen production. Carefully weigh out the required aggregate sizes and place in separate containers. Put the aggregate in the oven and heat for 1 hour at 165+/-3°C (329+/-5°F).

**Step 2**
After preheating, remove the materials from the oven as you need them. Avoid allowing anything to cool before mixing.

**Combining and Mixing**

**Step 3**
Place the CA-16 aggregate into the mechanical mixing bowl. Do NOT add the FA-01 materials yet.

Form a “bowl” shape in the FA-01. Dispense the required amount of asphalt into this aggregate bowl.

Add the FA-01 and asphalt to the aggregate already in the mixing bowl. Mount the mixing bowl on the mixer. Turn the mixer on (low speed setting of 1) and mix until most of the asphalt is distributed. Turn the mixer off. Add the remaining aggregate filler fines, if any. Turn the mixer on and mix the batch until all the aggregate is fully coated with the asphalt binder. Periodically turn the mixer off and lightly scrape the material sticking to the sides of the bowl or upper portion of the mixing wisp. Turn the mixer off.

**Step 4**
Remove all the specimen materials from the mixer and place mixture onto two shallow metal pans. Spread mixture to an even thickness and place in the oven for 1 hour at 165°C. This time in the oven is done to simulate short-term aging that occurs during the actual HMA production and transportation phases prior to compaction.
Compaction
In this sequence, you will make a compacted HMA specimen. The gyratory compactor will monitor the compaction pressure, sample height and number of gyrations. This data will be displayed during the compaction phase and saved to a file on the computer. The computer program will stop the gyratory compactor at the specified endpoint, which for our lab will be after \( N_{\text{max}} \) gyrations of 42.

Step 5
While the mixture is aging in the oven, prepare the gyratory compactor for use. Connect the computer to the gyratory compactor via the COM1 serial port. Prepare the computer software that operates and collects the data from the compactor. For this operation, verify the compaction pressure of 600 kpa, compaction mold inclination angle of 1.25°, and enter the \( N_{\text{max}} = 42 \) into the software at the appropriate location on the screen. Place the compaction mold and mold bottom in the oven for 60 minutes at the 165°C temperature.

Step 6
Remove the mixture and the compaction mold from the oven at the same time. Spray a thin layer of a light lubricant (eg. WD-40) to coat the inside of the mold. Next, place a paper filter disk on the bottom plate of the mold.

Using a scoop or spatula, measure approximately 4,500 grams of the specimen mixture into a preheated bowl.

IMPORTANT: Record on the datasheet the actual mass of HMA to be placed in the mold.

Then dump the mix into the mold in one smooth operation.

Finally, gently level the top of the HMA specimen and place another paper filter disk on top of the specimen mixture in the mold. Do NOT tamp the loose HMA.

Step 7
Place the mold with the specimen into the gyratory compactor and click the Start button on the gyratory compactor program screen. During the compaction process, the computer will monitor the specimen height, the compaction pressure, tilt angle and number of gyrations. The program will stop the test once reaching the designated \( N_{\text{max}} \) gyrations. Be sure the compaction angle stays within 0.10° of the 1.25° target angle. If it varies, stop the compactor temporarily by lifting the guard door. This will stop the rotation so you can insert the handle to adjust the tilt angle. Then remove the handle, close the door and allow the compaction process to continue.

Step 8
Once the compaction is complete, remove the mold from the center hold. Center the mold over the top of the extraction piston on the compactor base. Press the extraction button on the compactor and extrude the specimen from the mold. Let the specimen cool enough so that it does not crumble or distort when carefully handled. Use a small fan to speed the cooling process.

Remove the paper disks and, using a lumber crayon or chalk, mark the top of the specimen with your lab group number for future identification.

Proceed to Part C for Validation test procedures.