Introduction
This manual outlines the steps necessary to design, prepare and evaluate a hot mix asphalt (HMA) specimen using the Superpave™ (Superior Performing Asphalt Pavements) mix design method and criteria. Superpave™ has been recently adopted by many state highway departments, replacing the Marshall and the Hveem methods for asphalt mix design.

This manual includes the following parts.
A. Project parameters, aggregate blending, asphalt binder selection, and material properties.
B. Preparation of the hot mix specimen.
C. Validation of the final mix results.
D. Appendix with supporting data and lab worksheets.

Related topics of asphalt binder properties and selection, equipment calibration and performance testing are not part of this document. Students wishing to learn more about the total Superpave™ process can contact the instructor for a list of additional resources.

Design Criteria
Superpave mix design requires many aggregate and asphalt cement (IDOT refers to this as bituminous) properties to be evaluated and selected to meet a particular set of standards. In Illinois, as in most states, certain characteristics of the final mix design have been adopted and must be used for certain projects. To reduce detail work that is beyond the scope of CE330L, many of the properties have already been selected. The following procedures are based on the selected properties. The specifications given in Table 1 are presented to highlight the primary design target values necessary for approval of the mix under IDOT’s criteria (modified AASHTO M 323) for the IL-9.5L mix designation only. For other mixes, refer to appropriate sources for the target values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Initial Density, N_{initial}</td>
<td>5</td>
</tr>
<tr>
<td>Required Design Density, N_{design}</td>
<td>30</td>
</tr>
<tr>
<td>Required Maximum Density, N_{max}</td>
<td>42</td>
</tr>
<tr>
<td>Design Air Voids (V_{a})</td>
<td>4.0%, target at N_{design}</td>
</tr>
<tr>
<td>Voids in Mineral Aggregate (V_{MA})</td>
<td>15%, minimum at N_{design}</td>
</tr>
<tr>
<td>Percent (%) Voids in Total Mix (VT_{M})</td>
<td>2.0%, minimum to 8.0%, maximum at N_{design}</td>
</tr>
<tr>
<td>Voids Filled with Asphalt (V_{FA})</td>
<td>65-78% at N_{design}</td>
</tr>
<tr>
<td>Dust/AC ratio (D/AC)</td>
<td>1.0 maximum</td>
</tr>
<tr>
<td>Maximum percentage of G_{mm} @ N_{initial}</td>
<td>89%</td>
</tr>
<tr>
<td>Maximum percentage of G_{mm} @ N_{max}</td>
<td>98%</td>
</tr>
</tbody>
</table>

(Note: G_{mm} is the theoretical maximum specific gravity of the mix.)

Safety Considerations
This lab experiment involves working with hot aggregates and hot liquid asphalt at temperatures of up to about 350 °F. The asphalt ignition oven will be operating at about 1100 °F. Also, there is risk that some of the materials could stain your clothing, so plan to wear appropriate clothing.
In addition to the standard lab safety requirements, you are required to bring and wear the following safety items:
- safety glasses
- long pants
- shoes that completely cover your feet

In addition to the items above, you will be provided with heat-resistant gloves, Kevlar sleeves, a lab coat and face shield as needed for certain operations in the lab.

**Procedures**

A key step in the procedure for designing a Superpave mix is to select appropriate amounts of standard aggregate gradations to achieve a well-graded, dense mix. Though you have already tested the aggregates in a previous experiment, we will use standardized results in the actual mixing procedures to reduce variations in the final mix since each group will share their HMA mix design results with the other groups.

Testing was performed to find the gradation characteristics of the materials stockpiled for this lab. Table A1 shows the gradations required for the IL-9.5L mix. Table A2 shows the results of the sieve and specific gravity tests for the four standard aggregate gradations stockpiled for this lab. Table A3 shows the standardized aggregate proportions for the Superpave HMA mix design to be used in the experiment.

**Step 1**

Refer to Table A3 which shows the percentage of each aggregate gradation to be used to make a 7,000-gram batch, which includes the mass of the asphalt. Compute the mass of each aggregate per this table. Note that the standard mix design procedure for the CA-16 material is to presort and place into individual buckets to separate the larger particle sizes (3/8” inch through #30). This is done to reduce the effects of particle size segregation on the final mix design. Using this method, the mass of each particle size gradation to be used from the CA-16 stock is given in the table. However, if reasonable precautions have been taken to prevent particle size segregation, the CA-16 does not need to be presorted. Your instructor will let you know which method to use for this lab. Complete the table by computing the total mass of each aggregate required for the asphalt content assigned to your group. The total should add to 7,000 grams.

**Step 2**

Superpave uses the 0.45 power chart for plotting the mix gradation (Figure A1). Using the results of your group’s sieve tests, plot the total batch percentages for each sieve size of the combined aggregates on the 0.45 power chart. Verify that the batch gradation is within the control points. For the purpose of this experiment, mention any deviations in your report.

**NOTE:** In actual practice the aggregate used for the trial batch must be within the gradation parameters of the 0.45 power chart in order to proceed. If it doesn’t meet the parameters, then the mix designer must adjust material percentages, recalculate the batch percentages, and plot the resulting new batch gradation.

**Step 3**

Having successfully obtained the trial batch gradation percentages, make a batch of asphalt mix. For specific instructions on how to make the asphalt mix refer to Part B of this manual.