CIVL 111 Construction Materials
LAB I: AGGREGATE TEST

Test 1. Sieve analysis of fine aggregate (ASTM C 136 - 96)

Procedures

- Secure 1000 g sample of fine aggregate. Place sample on top of an appropriate nested sieve series.
- Place sieve series in mechanical shaker and start shaking. Continue sieving for 1 minute.
- Remove sieves and weigh residue remaining in each sieve layer.
- Record results.
- Clean and replace sieves.

Calculations

- Use information gathered above to fill in gradation table.
- Plot particle size distribution and cumulative particle size distribution.

Net weight of aggregate =

<table>
<thead>
<tr>
<th>Gradation Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size (mm)</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>5.0</td>
</tr>
<tr>
<td>2.36</td>
</tr>
<tr>
<td>1.18</td>
</tr>
<tr>
<td>0.6</td>
</tr>
<tr>
<td>0.3</td>
</tr>
<tr>
<td>0.15</td>
</tr>
<tr>
<td>Pan</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Fineness</td>
</tr>
</tbody>
</table>

Plot particle size distribution and cumulative particle size distribution.

Discussion Questions:
(1) Based on the results of the sieve analysis, is the batch of aggregates suitable for making concrete? You are expected to go to the library to find out about grading requirements of aggregates. You can base your discussions on any available standard (BS, ASTM, etc).
(2) If additional 5 mm aggregates are added to the mix, would the fineness modulus increase or decrease?
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Test 2: Unit weight of coarse aggregate test (ASTM C 29/C 29 M - 97)

Procedures
- Secure representative sample of the aggregate (maximum size 12.5 mm) and calibrated measure (volume 0.0028 m$^3$)
- Fill measure 1/3 full with aggregate and level with fingers.
- Rod the layer of aggregate with 25 strokes of a tamping rod evenly distributed over the surface
- Fill the measure to overflowing, then level and rod as above. Level the surface of the aggregate with a straight edge when finished
- Determine the weight, to nearest 0.05 kg, of the measure plus the aggregate and of the measure alone.

Calculations
- The unit weight of a compacted coarse aggregate can be calculated as follows:

\[ UW = \frac{(W_t - W_m)}{V} \]

Where \( UW \) = unit weight of aggregate (kg/m$^3$);
\( W_t \) = weight of aggregate plus measure;
\( W_m \) = weight of the calibrated measure;
\( V \) = volume of measure. The average value should be used.

Table for calculation

<table>
<thead>
<tr>
<th>Weight of Measure (Wm)</th>
<th>Weight of Measure and Aggregate (Wt)</th>
<th>No. of measure times</th>
<th>Height of container (cm)</th>
<th>Diameter of container (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volume :</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ UW = \frac{(Wt - Wm)\text{}}{V} \]

Discussion Questions:

Using this batch of aggregates, would the resulting concrete be lightweight, normal weight or heavy weight?
Test 3.: Moisture Content of Coarse Aggregate Test (ASTM C 566 - 96)

Procedures:
- Secure a representative sample of the aggregate (Min. 2 kg.)
- Weigh sample to nearest 0.1% of load
- Dry sample thoroughly with selected source of heat at a temperature of 110 ± 5°C
- Sample must be kept in oven until further heating would cause less than 0.1% additional loss in weight
- Cool samples in air for about 1 hour
- Weigh the dried sample to nearest 0.1% load

Calculations
- Calculate the moisture content as follows:

\[ MC(OD) = \frac{W_{stock} - W_{OD}}{W_{OD}} \times 100\% \]

Where: MC (OD) = moisture content at OD condition, W_{stock} = original sample weight, and W_{OD} = oven dried sample weight

W_{stock} =
W_{OD} =
MC(OD) =

Test 4.: Absorption and specific gravity of coarse aggregate test

Definition:
- Saturated-surface dry condition (SSD): A state of moisture in aggregate where the pores are filled with water and no free moisture exists on the surface.

- Bulk specific gravity under dry condition: The ratio of the weight in air of a unit volume of the aggregate to the weight of an equal volume in water at a stated temperature.

- Bulk specific gravity (SSD): The ratio of the weight in air of a unit volume of aggregate, including the weight of water within the voids, compared to the weight of equal volume of water at a stated temperature.
Procedures
- Secure representative samples of aggregate (Done in test 3)
- Dry sample thoroughly with selected heat source (Done in test 3)
- After sample has cooled, immerse in water at room temperature for 24±4 hours.
- Remove test samples from bath and dries off surface moisture.
- Weigh the test sample in the saturated-surface dry condition to 0.1% of load.
- Place test samples in the container and determines its weight in water; take care to remove all entrapped air.

Calculations:
- Calculate the percent absorption as follows:

\[
Absorption = \frac{W_{SSD} - W_{OD}}{W_{OD}} \times 100\%
\]

= 

- Calculate the specific gravity as follows:

\[
BSG(OD) = \frac{W_{OD}}{W_{SSD} - W_w}
\]

= 

\[
BSG(SSD) = \frac{W_{SSD}}{W_{SSD} - W_w}
\]

= 

Where \(W_{OD}\) = weight of oven dry sample, \(W_{SSD}\) = weight of sample at SSD condition, and \(W_w\) = weight of saturated test sample in water.

Discussion Question:
Based on Test 3 and Test 4, what is MC (SSD) for the aggregate? Is this positive or negative? What does it tell you about the condition of the aggregate (Air dry, saturated surface dry or wet)?