Highway Engineering Materials - CE 400
Spring 2009
Aggregate Labs
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T1) ASTM D4791-95: Flat and Elongated Particles in Coarse Aggregate. (Each group will perform the test).

Equipment needed:

- Proportional Caliper Device

Material:

- Sieve a small amount of coarse aggregate until about 100 particles of aggregate retained on the 12.5 mm (½ in) sieve are obtained

Procedure:

1. Select an aggregate and set end of calipers farthest away from pivot point to longest dimension.
2. Without moving the calipers, remove aggregate and try to fit the intermediate dimension in caliper opening at the other end.
3. Set end of calipers farthest away from pivot point to the intermediate dimension.
4. Without moving the calipers, remove aggregate and try to fit the shortest dimension in caliper opening at the other end.
5. If aggregate fits in second opening for either step 2 or 4, put it in the flat and elongated pile.
6. If aggregate does not fit in the second opening, put it in another pile.
7. At the end, record the number of particles in each pile and calculate the percentage of flat and elongated particles.
8. When finished, store in labeled ziplock bag for future use.

T2) AASHTO T-304: Fine Aggregate Angularity through Uncompacted Void Content Measurements. (Each group will perform the test).

Equipment needed:

- Fine aggregate angularity apparatus (funnel on stand, 100 cm^3 cylinder),
- Metal spatula (about 100 mm long by about 20 mm wide),
- Scale that is readable to 0.1 grams,
- Large pan (cookie sheet works well).

Materials:

- Wash and dry about 1,5000 gram of fine aggregate,
- Sieve dry aggregate over stack of sieves (4.75, 2.36, 1.18, 0.6, 0.3 mm, and pan),
- Combine fractions to meet mass per sieve size shown in test method and store in small labeled ziplock bag.

Procedure:

1. Determine the mass of the cylinder.
2. Place cylinder under funnel.
3. Place finger over bottom of funnel.
4. Pour aggregate into top of funnel.
5. Remove finger and let aggregate flow into cylinder.
6. Use spatula to strike off excess aggregate on top of cylinder. Take care not to bump or vibrate cylinder.
7. Brush off excess aggregate on cylinder.
8. Determine the mass of the aggregate and the cylinder.
9. After test is completed, save material in ziplock bag.

T3) ASTM C702-98 or AASHTO T248-02 Method A and B: Reducing Samples of Aggregate to Testing Size

Method A:

Equipment needed:

- *Sample Splitter* with at least 50% larger chutes than aggregate size

Material:

- At least twice the amount of material specified for the intended test.

Procedure:

1. Place the original sample into the hopper
2. Distribute the material evenly so that equal amounts of material are introduced into the opposing shuts

Method B:

Equipment needed:

- Straight edge
- Straight edged scoop or shovel
- Broom or brush

Material:

- At least twice the amount of material specified for the intended test.

Procedure:

1. Cone sample on a hard clean surface
2. Mix by forming a new cone
3. Quarter after flattening cone
4. Retain opposite quarters reject the other two quarters

T4) AASHTO T 84-95: Specific Gravity and Absorption of Fine Aggregates. (One test for all groups).

Equipment needed:

- Digital scale with an accuracy of 0.1 grams,
- 500 ml glass volumetric flask,
- Metal cone mold and tamper,
- Hair drier (for warm, gently moving air),
- Large flat metal pan (or large cookie sheet),
- Pan turner,
- 4 large metal pans (for drying aggregate),
- Wash bottle filled with water,
- Felt pens for labeling pans.

Materials:

- Screen fine aggregate over 4.75 mm screen and keep material that passes screen,
- Add about 4% water by mass of aggregate (this assumes that the absorption of the aggregate is less than 4%) and seal bag.

Procedure:

1. Empty damp aggregate onto cookie sheet and spread out,
2. Use hair drier to help dry aggregate to saturated surface dry (SSD),
3. Use pan turner to continually move aggregate around so that it dries uniformly,
4. When aggregate approaches SSD, clear a space on cookie sheet, place metal cone in center and loosely fill with aggregate,
5. Lightly tamp aggregate with 25 light drop starting about 0.5 mm (0.2 inches) above the surface each time,
6. Firmly hold cone and brush aggregate away from base,
7. Lift mold vertically. At least a portion of the aggregate won't be able to hold its shape at SSD,
8. Repeat steps 2 through 7 until SSD condition is reached,
9. Partially fill flask (pycnometer) with water and add 500 ± 10 g of SSD aggregate. Record mass of SSD aggregate used,
10. Fill flask with additional water until about 90% full. Roll and gently agitate to eliminate all air bubbles. The tip of a paper towel can be used to disperse foam,
11. Bring the water level in the flask up to the volumetric mark. Determine and record mass of flask, water, and aggregate,
12. Tare pan, record mass, and empty aggregate and water into pan. Use wash bottle to rinse flask into pan,
13. Label pan and place in oven to dry overnight,
14. Next morning, remove pans from oven, cool to room temperature and determine the mass of the pan and aggregate.

T5) AASHTO T 85-91 Specific Gravity and Absorption of Coarse Aggregate. (One test for all groups).

Equipment needed:

- Scale which reads to 0.1 g with an attachment for weighing samples in water,
- Wire basket with handle,
- Water tank,
- 4 buckets or large pans for soaking aggregates,
- Large terry cloth towels,
- Spray bottle filled with water.

Material:

- Screen a large sample of the coarse aggregate over a 4.75 mm screen,
- Save the material retained and waste the material passing,
- Prepare 4 samples of 2,500 g of coarse aggregate, washed and left in pan under water.

Procedure:

1. Determine mass of basket under water.
2. Pour excess water off of aggregate.
3. Empty aggregate onto pre-dampened towel.
4. Dry aggregate until surface is uniformly dull (no free water). Take care to keep aggregate not being dried covered with sides of towel.
5. Empty aggregate into wire basket and determine SSD mass of aggregates.
6. Hang basket under water and determine mass in water.
7. Remove basket from water. Tare pan, record mass, and empty aggregate into pan. Take care not to lose any material. Dry overnight.
8. Next morning, remove pan from oven, cool to room temperature, determine dry mass of pan and aggregate.

T6) ASTM C136-84 or AASHTO T27-93: Sieve Analysis of Coarse and Fine Aggregates. (Each group will perform the test).

Equipment needed:

- *Mary-Ann* type sifter shaker and set of sieves (we have all the necessary 12"-diameter sieves require by Superpave, namely 1, ¾, ½, 3/8 inches and No.'s. 4, 8, 16, 30, 50, 100 and 200).

Material:

- The amount of material required for obtaining a representative gradation depends on the max nominal aggregate size, e.g., for ½-inch, 2 kg of material is required.

Procedure:

1. Get the tare weight of all the sieves using a 0.1 g resolution , after ensuring that they are clean (i.e., no stuck particles in the fine openings).
2. Have the aggregate dried to a constant weight (110±5 °C).
3. Split batch, if large, according to ASTM C702-93, to obtain weight of sample required.
4. Stack sieves and order of increasing opening with the pan at the bottom and cap it with the lid, (note that *our Mary-Ann* Shifter fits only 5 sieves plus the pan and needs to run twice in sequence to accommodate the 10 sieves of interest).
5. Let the shaker run until the change in percent retained in each sieve is less than 0.5%, (i.e., for our shaker assume that a 3-minute sifting period is sufficient).
6. Weigh each sieve with the material in it and perform the % passing calculations.

Note: The test above is specified as a "dry" sieving test. AASHTO T-11, describes a "wet" variation of this test, whereby the amount of passing N. 200 is determined by washing the aggregate through a No. 200 sieve to ensure that all the fines are washed out. The fraction retained in the No. 200 sieve is then dried and sieved as described above. The washed-out fines, after drying, are added to the fines passing the No. 200 in the "dry" part of the sieving test. Washing ensures, that all the fines are "captured" avoiding losses in the form of dusting in the pans and the coarser particles.