QATAR UNIVERSITY
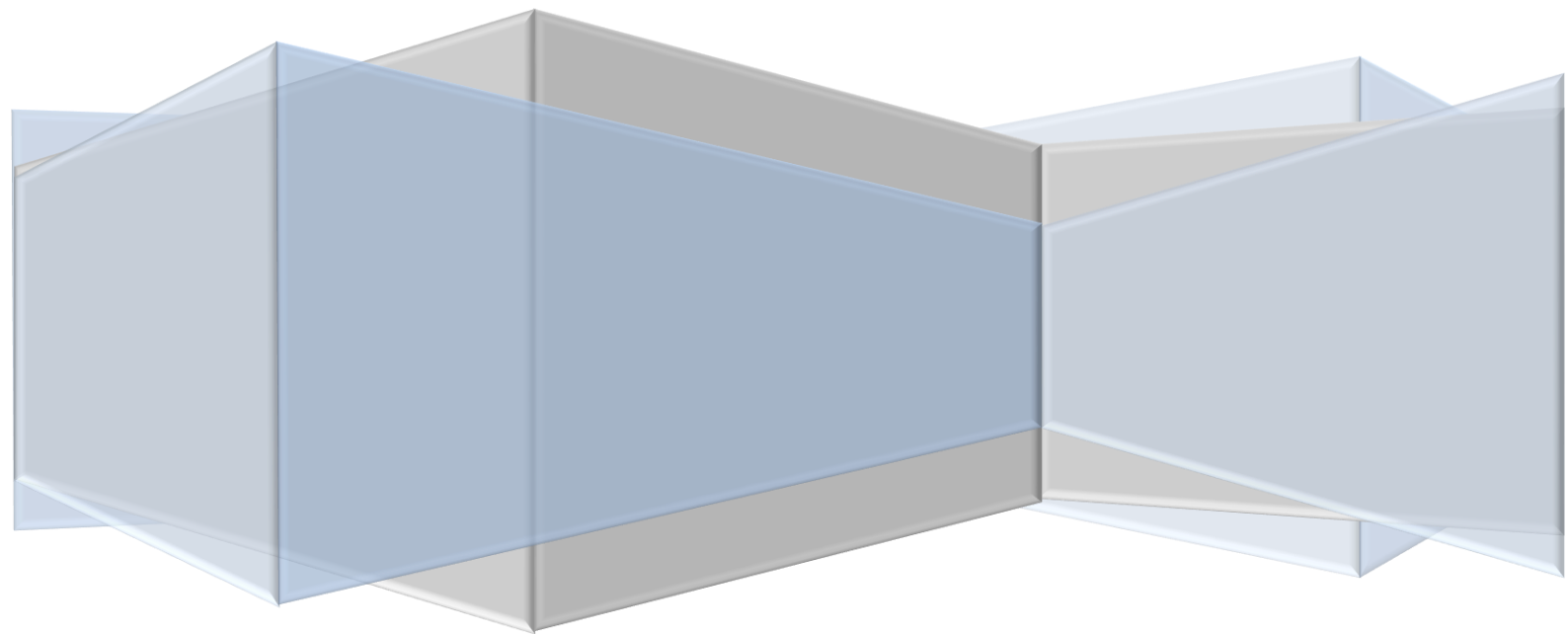**DEPARTMENT OF CIVIL & ARCHITECTURAL ENGINEERING**

MATERIAL TESTING LABORATORY MANUAL

Qatar University
College of Engineering- Department of Civil and Architectural Engineering
CVEN 210 Properties and Testing of Materials
Laboratory Test # 1
Sieve Analysis of Fine and Coarse Aggregates (ASTM 136)
Report Due Date: 1 week after the lab is performed

Scope : This test method covers the determination of the particle size distribution of fine and coarse aggregates by sieving. A weighed sample of dry aggregate is separated through a series of sieves of progressively smaller openings for determination of particle size distribution.

References

ASTM C117 Materials Finer Than 75- mm (No. 200) Sieve in Mineral Aggregates by Washing

ASTM E11 Specification for Wire Cloth Sieves for Testing Purposes

ASTM C33 Standard Specifications for Concrete Aggregates

ASTM C125 Standard Terminology Relating to Concrete and Concrete Aggregates

Definitions

Maximum Size: The smallest sieve that 100% of the aggregate must pass

Nominal Maximum Size: The smallest sieve which the major portion of the aggregate must pass. It may retain 5 % to 15 % of the aggregate, depending on the size number of aggregate.

Apparatus

Scale (or balance) - 0.1 g accuracy for fine sieve analysis, 0.5 g accuracy for coarse sieve analysis, Sieves, Mechanical Sieve Shaker, Drying Oven (110 +/- 5 °C)

Materials

Fine Aggregate (<No. 4 sieve) – **1000 g** (oven dried)

Coarse Aggregate (>No. 4 sieve) – **5000 g** (oven dried)

Procedure

(Perform for both fine and coarse aggregates)

1) Dry sample to constant weight at a temperature of 110 +/- 5 °C (230 +/- 9 °F).

2) Select suitable sieve sizes to obtain the required information as specified. The following sieves are applicable with reference to ASTM C33:

Table 1 Sieve sizes for Coarse and Fine Aggregates

SIEVE SIZES FOR COARSE AGGREGATE	SIEVE SIZES FOR FINE AGGREGATE
1" (25 mm)	No.4 (4.75 mm)
¾ " (19 mm)	No.8 (2.36 mm)
½ " (12.5 mm)	No.16 (1.18 mm)
3/8 " (9.5 mm)	No.30 (600 µm)
No.4 (4.75 mm)	No.50 (300 µm)
No.8 (2.36 mm)	No.100 (150 µm)
Pan	Pan

3) Nest the sieves in order of decreasing size of opening from the top to bottom. Place the pan below the bottom sieve. Place the sample on the top sieve. Place lid over top sieve.

4) Agitate the sieves by hand or by mechanical apparatus for a sufficient period such that not more than 1% by weight of the residue on any individual sieve will pass that sieve during 1 minute of additional hand sieving. **Ten minutes** of original sieving will usually accomplish this criteria.

5) Determine the weight of material retained on each sieve. The total retained weights should closely match the original weight of the sample (within 0.3%).

Calculations

1) Calculate percentages passing and total percentages retained to the nearest 0.1% of the initial dry weight of the sample.

2) Calculate the fineness modulus for Fine aggregate: F.M. = ?

Laboratory Report

Submit your report as a **GROUP** and include the following.

1) Total percentage of material passing each sieve (both tabulated and graphical presentations)

2) Total percentage of material retained on each sieve (tabulated).

3) Report percentages to 0.1%.

4) Report the fineness modulus to the nearest 0.01.

5-) Do these aggregates meet the ASTM specifications (ASTM C33), Table 2 and 3.? Show this by comparing the specifications with your gradations for both the coarse and fine aggregates (compare in tabular form and graphical form)

NOTE: TYPE YOUR REPORT USING A COMPUTER, HANDWRITING AND LATE REPORTS WILL <u>NOT</u> BE ACCEPTED.

Table 2 Coarse Aggregate Specification(ASTM C33)

SIEVE NO	% PASSING	
	Min	Max
1" (25 mm)	100	100
¾ " (19 mm)	100	100
½ " (12.5 mm)	100	100
3/8 " (9.5 mm)	85	100
No.4 (4.75 mm)	10	30
No.8 (2.36 mm)	0	10
No.16(1.18 mm)	0	5

Table 3 Fine Aggregate Specification(ASTM C33)

SIEVE NO	% PASSING	
	Min	Max
3/8 " (9.5 mm)	100	100
No.4 (4.75 mm)	95	100
No.8 (2.36 mm)	80	100
No.16 (1.18 mm)	50	85
No.30 (600 µm)	25	60
No.50 (300 µm)	5	30
No.100 (150 µm)	0	10

SIEVE ANALYSIS CALCULATION FOR COARSE AGGREGATE (ASTM C136)						
Sieve Size	Mass sieve (g) A	Mass sieve + Retained (g) B	Mass Retained(g) B-A	Percent Retained (%) (B-A) / ∑*100	Cumulative % Retained	Cumulative % Passing
1-1/2"(37.5mm)						
1" (25 mm)						
¾ " (19 mm)						
½ " (12.5 mm)						
3/8 " (9.5 mm)						
No.4 (4.75 mm)						
No.8 (2.36 mm)						
Pan						
Total (∑)						

SIEVE ANALYSIS CALCULATION FOR FINE AGGREGATE (ASTM C136)						
Sieve Size	Mass sieve (g) A	Mass sieve + Retained (g) B	Mass Retained(g) B-A	Percent Retained (%) (B-A) / ∑*100	Cumulative % Retained	Cumulative % Passing
No.4 (4.75 mm)						
No.8 (2.36 mm)						
No.16 (1.18 mm)						
No.30 (600 µm)						
No.50 (300 µm)						
No.100 (150 µm)						
Pan						
Total (∑)						

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CVEN 210 Properties and Testing of Materials
<u>Laboratory Test # 2</u>

Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine (ASTM C 131)
<u>Report Due Date: One week after the lab is performed</u>

<u>Scope</u>

This test method covers a procedure for testing sizes of coarse aggregate smaller than 1-1/2 inch (37.5 mm) for resistance to degradation using the Los Angeles testing machine.

<u>References</u>

ASTM C136 Sieve Analysis of Fine and Coarse Aggregate

ASTM C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM E11 Specification for Wire-Cloth Sieves for Testing Purposes

<u>Summary</u>

The Los Angeles test is a measure of degradation of mineral aggregates of standard gradings resulting from a combination of actions including abrasion or attrition, impact and grinding in a rotating steel drum containing a specified number of steel spheres. The L.A. Abrasion test is widely used as an indicator of the relative quality or competence of mineral aggregates.

<u>Apparatus</u>

Los Angeles testing machine , Sieves , Balance(accurate within 0.1% of range required for test),

Charge -the charge shall consist of steel spheres averaging approximately 46.8 mm in diameter and each weighing between 390 and 445 g. The charge, depending upon the grading of the test sample, shall be as follows:

Grading	Number of Spheres	Weight of Charge, g
A	12	5000 ± 25
B	11	4584 ± 25
C	8	3330 ± 20
D	6	2500 ± 15

<u>Materials</u>

The test sample shall be washed and oven-dried (105 to 115 °C) to substantially constant weight, separated into individual size fractions, and recombined to the grading (Table 1) most nearly corresponding to the range of sizes in the aggregate as originally furnished.

Procedure

• Wash the coarse aggregate test sample, per ASTM C136, and oven-dry (105 to 115 °C) to substantially constant weight. Separate into individual size fractions, and recombine to the grading (Table 1) most nearly corresponding to the range of sizes in the aggregate as originally furnished. The weight of the sample prior to test shall be recorded to the nearest 1 g.

• Place the test sample and the charge in the Los Angeles testing machine

• Rotate the machine at a speed of 30 to 33 rpm for 500 revolutions.

• Discharge the material from the L.A. abrasion machine and separate the sample on a **No. 12 sieve (1.70 mm).**

• Weigh the material coarser than the No. 12 sieve and record this as the final weight.

Table 1. Gradings of Test Samples

Sieve Size (Square Openings)		Weight of Indicated Sizes, g			
		Grading			
Passing	Retained on	A	B	C	D
37.5 mm (1-1/2 in.)	25.0 mm (1 in.)	1250 ± 25			
25.0 mm (1 in.)	19.0 mm (3/4 in.)	1250 ± 25			
19.0 mm (3/4 in.)	12.5 mm (1/2 in.)	1250 ± 25	2500 ± 10		
12.5 mm (1/2 in.)	9.5 mm (3/8 in.)	1250 ± 25	2500 ± 10		
9.5 mm (3/8 in.)	6.3 mm (1/4 in.)			2500 ± 10	
6.3 mm (1/4 in.)	4.75 mm (No. 4)			2500 ± 10	
4.75 mm (No. 4)	2.36 mm (No. 8)				5000 ± 10
Total		5000 ± 10	5000 ± 10	5000 ± 10	5000 ± 10

Calculation

• Calculate the L.A. abrasion loss as the difference between the original weight and the final weight of the test sample as a percentage of the original weight of the test sample.

L.A. Abrasion Loss (%) = [(Original Weight – Final Weight)/(Original Weight)] *100

Report

1) The L.A. abrasion loss as a percentage (nearest 1%).

Questions

1. What is the maximum allowable abrasion loss for concrete coarse aggregate as specified in ASTM C33, Standard Specifications for Concrete Aggregates?

2. Do your test results satisfy the abrasion loss requirements for concrete coarse aggregate as specified in ASTM C33, Standard Specifications for Concrete Aggregates?

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Laboratory test # 3
Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate (ASTM C 127)
Report Due Date: One week after the lab is performed

Scope

Test method ASTM C127 covers the determination of specific gravity and absorption of coarse aggregate. The specific gravity may be expressed as bulk specific gravity, saturated-surface-dry bulk specific gravity (SSD), or apparent specific gravity.

References

ASTM C127 Specific Gravity and Absorption of Coarse Aggregate

ASTM E12 Definitions of Terms Relating Density and Specific Gravity of Solids, Liquids, and Gases

ASTM C125 Terminology Relating to Concrete and Concrete Aggregates

ASTM C566 Total Moisture Content of Aggregate by Drying

Definitions

Specific Gravity - the ratio of the mass (or weight) in air of a unit volume of material to the mass of the same volume of water at a specified temperature. Specific gravity is a dimensionless term.

Apparent Specific Gravity - the ratio of the weight in air of a unit volume of the impermeable portion of aggregate to the weight in air of an equal volume of gas-free distilled water at specified temperature.

Bulk Specific Gravity - the ratio of the weight in air of a unit volume of aggregate (including the permeable and impermeable voids in the particles, but not including the voids between particles) to the weight in air of an equal volume of gas-free distilled water at specified 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 filled to the extent achieved by submersion in water for 24 hour (but not including the voids between particles) to the weight in air of an equal volume of gas-free distilled water at specified temperature.

Absorption - the increase in the weight of aggregate due to water in the pores of the material, but not including water adhering to the outside surface of the particles, expressed as a percentage of the dry weight. Dry aggregate is achieved when all uncombined water has been removed at a temperature of 110°C.

ASTM C127 (Coarse Aggregate)

Apparatus

Scale (or balance), Sample Container (wire basket), Water Tank, Sieves (No. 4),Drying Oven

Materials

Coarse Aggregate (>No. 4 sieve, i.e., gravel) - soaked for 24 hours, then saturated-surface-dried (SSD)

Coarse Aggregate - Oven dried at 110°C, then cooled to room temperature.

Note: The same gravel sample is used for both the SSD and oven dried states.

Procedure

1) Sieve dry material and reject all material finer than a number four sieve.

2) Obtain approximately 2 kg of the water soaked material and roll it in a large absorbent cloth until all visible films of water are removed. Wipe large particles individually as required to achieve a SSD condition. Weigh the test sample in his SSD condition to the nearest 0.5 g or 0.05% of the sample weight, whichever is greater.

3) Subsequently, place this SSD sample in the sample container and determine its weight in water. Be sure to tare out the sample container (wire basket) prior to placing the sample. Remove all air before weighing by shaking the basket while immersed.

4) Dry the sample to constant weight in an oven at 110°C, then allow to cool to room temperature. Weigh this dry sample of coarse aggregate.

5) Calculate the following:

a) Bulk Sp. Gr. = $A/(B-C)$

b) Bulk Sp. Gr. (SSD) = $B/(B-C)$

c) Apparent Sp. Gr. = $A/(A-C)$

where: A = weight of oven dried test sample in air, g

B = weight of SSD sample in air, g

C = weight of saturated sample in water, g.

Express the above three values in terms of density, i.e., multiply the above calculated values by the density of water at 4°C (62.43 lb/ft^3).

d-) Determine the dry rodded unit weight of Coarse Agg.?

6) Calculate the percentage of absorption as follows:

Absorption, % = $[(B-A)/A] *100$

Report

1) Report specific gravity results to the nearest 0.001.

2) Report corresponding densities to the nearest 0.1 kg/m^3 .

3) Report the absorption to the nearest 0.1%.

4) Also, determine the dry rodded unit weight of coarse aggregate (ASTM C 29)

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CVEN 210 Properties and Testing of Materials
<u>**Laboratory test # 4**</u>

Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate (ASTM C 128)
<u>**Report Due Date: One week after the lab is performed**</u>

<u>Scope</u>

Test method ASTM C128 covers the determination of bulk, SSD specific gravity, and apparent specific gravity, and absorption of fine aggregate. The bulk and apparent specific gravity are defined according to ASTM E12, while absorption is defined in ASTM C125.

<u>References</u>

ASTM C128 Specific Gravity and Absorption of Fine Aggregate

ASTM E12 Definitions of Terms Relating Density and Specific Gravity of Solids, Liquids, and Gases

ASTM C125 Terminology Relating to Concrete and Concrete Aggregates

ASTM C566 Total Moisture Content of Aggregate by Drying

<u>Definitions</u>

Specific Gravity - the ratio of the mass (or weight) in air of a unit volume of material to the mass of the same volume of water at a specified temperature. Specific gravity is a dimensionless term.

Apparent Specific Gravity - the ratio of the weight in air of a unit volume of the impermeable portion of aggregate to the weight in air of an equal volume of gas-free distilled water at specified temperature.

Bulk Specific Gravity - the ratio of the weight in air of a unit volume of aggregate (including the permeable and impermeable voids in the particles, but not including the voids between particles) to the weight in air of an equal volume of gas-free distilled water at specified 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 filled to the extent achieved by submersion in water for 24 hour (but not including the voids between particles) to the weight in air of an equal volume of gas-free distilled water at specified temperature.

Absorption - the increase in the weight of aggregate due to water in the pores of the material, but not including water adhering to the outside surface of the particles, expressed as a percentage of the dry weight. Dry aggregate is achieved when all uncombined water has been removed at a temperature of 110°C.

ASTM C128 (Fine Aggregate)

Apparatus

Scale (2 kg), Pycnometer - A flask or other suitable container into which the fine aggregate test sample can be readily introduced and in which the volume content can be reproduced within 0.1 cm^3. **Mold** - A metal mold in the form of a frustum of a cone with dimensions of 40 mm top diameter, 90 mm bottom diameter, and 75 mm height. **Tamper** - A metal tamper weighing 340 g and having a flat circular tamping face of 25 mm diameter. **Drying Oven**

Materials

Fine Aggregate (<No. 4 sieve, i.e., sand) - soaked for 24 hours

Fine Aggregate - Oven dried at 110°C, then cooled to room temperature.

Note: The same sand sample is used for both the SSD and oven dried states.

Procedure

1) Obtain approximately 1 kg of the water soaked material by the following process. Decant excess water from the pan in which the fine aggregate has been soaking, being careful to avoid loss of fines.

2) Spread sample on a flat nonabsorbent surface exposed to a gently moving current of warm air, stirring frequently to ensure uniform drying.

3) Follow the cone test for surface moisture, subsequently described; this cone test determines whether or not surface moisture is present on the fine aggregate particles. The first trial of the cone test must be made with some surface water present in the sample. Continue drying with constant stirring of the sample and cone tests at frequent intervals until the cone test indicates that the fine aggregate has reached a saturated-surface-dry condition.

4) Cone Test - Place mold, large side down, on a dry nonabsorbent surface. Place a portion of the partially dried sample *loosely* in the mold by filling it to overflowing. Lightly tamp the sample into the mold with 25 light drops of the tamper (each drop should start about 5 mm (0.2 in.) above the top surface of the aggregate). The tamper should free fall under gravity during each drop. Distribute the 25 drops over the surface of the sample. Remove loose sand from around the outside base and lift the mold vertically. If surface moisture is still present, the sand cone will retain its molded shape. When the molded shape slightly slumps, a saturated-surface-dry condition has been reached.

5) Partially fill the pycnometer with water. Immediately introduce 500 g of saturated-surface-dry fine aggregate prepared as above. Record the weight of this SSD fine aggregate placed in the pycnometer. Fill the pycnometer to 90% of capacity. Roll, invert, and agitate the pycnometer to eliminate all air bubbles (this can take 15 to 20 min). Bring the pycnometer to its calibrated capacity. Determine the total weight of the pycnometer, specimen, and water. Note: Use distilled gas-free water in the pycnometer.

6) Remove the fine aggregate from the pycnometer and dry to constant weight in an oven at 110°C, then cool to room temperature, and weigh.

7) Determine the weight of the pycnometer filled to its calibration capacity with water.

8) Calculate the following:

a) Bulk Sp. Gr. = A/(B+S-C)

b) Bulk Sp. Gr. (SSD) = S/(B+S-C)

c) Apparent Sp. Gr. = A/(B+A-C)

where:

A = weight of oven dried test sample in air, g

B = weight of pycnometer filled with water to calibration mark, g

S = weight of SSD sample in air, g (prior to placement in pycnometer)

C = weight of pycnometer with specimen and water to calibration mark, g.

Express the above three values in terms of density, i.e., multiply the above calculated values by the density of water at 4°C (1 kg/m^3).

9) Calculate the percentage of absorption as follows:

Absorption, % = [(S-A)/A] *100

Report

1) Report specific gravity results to the nearest 0.001.

2) Report corresponding densities to the nearest 0.1 kg/m ^{3}.

3) Report the absorption to the nearest 0.1%.

Questions

1) Why is % Absorption important?

2) What would be the consequence of using oven dry aggregate in concrete mix?

Qatar University
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CVEN 210 Properties and Testing of Materials
Laboratory test # 5

Portland Cement Normal Consistency and Set Time by Vicat Needle (ASTM C187 & C191)
Report Due Date: One week after the lab is performed

Scope

This test method covers the determination of the time of setting of hydraulic cement by means of the Vicat needle.

References

ASTM C187 Normal Consistency of Hydraulic Cement

ASTM C191 Time of Setting of Hydraulic Cement by Vicat Needle

Apparatus

Vicat apparatus - Consists of a frame, a movable rod weighing 300 g with a 10 mm plunger on one end and a 1 mm removable needle on the other end.

Conical Ring, Glass Plate, Balance - 0.01g resolution and Timer - 0.5s resolution.

Materials

Hydraulic Cement ~ 650 g. Water (23°C)

Procedure

1. Mix 650 g of cement with the required amount of clean mixing water to obtain a paste of normal consistency (C187 & C305).

   a) Place all the mixing water in the mixing bowl.

   b) Add the cement to the water and allow 30 s for the absorption of water.

   c) Start the mixer and mix at slow speed (140 rpm) for 30 s.

   d) Stop the mixer for 15 s; during this rest period scrap down into the batch any paste that may have collected on the sides of the bowl.

   e) Start the mixer at medium speed (285 rpm) and mix for 1 minute.

Note: Approximately 214.5 g of mixing water is a good starting point to determine the normal consistency of the cement.

2. Quickly form the cement paste prepared above into the approximate shape of a ball with gloved hands. Then toss six times through a free path of about 6 inches from one hand to the other producing a nearly spherical ball shaped mass.

3. Press the ball, resting in the palm of one hand, into the larger end of the conical ring held in the other hand, completely filling the ring with paste. Remove the excess at the larger end by a single

movement of the palm of the hand. Place the ring on its larger end on the glass plate, and slice off the excess paste on the smaller end at the top of the ring by a single oblique stroke of a sharp edge trowel. Smooth the top if necessary.

4. Center the paste specimen under the 10 mm end of the Vicat apparatus. Lower the movable rod until the 10 mm end makes contact with the paste. Zero the indicator. Release the movable rod. A "*normal consistency*" is obtained when the penetration, below the original surface after 30 seconds, is 10 mm +/- 1 mm.

5. Repeat this process, using fresh cement, with varying percentages of water until the normal consistency is obtained.

6. Prepare a *normal consistency* paste, using the previously determined amount of water. Mix and place the paste specimen in the ring using the procedure outlined in Steps 1 through 3 above.

7. Place the prepared specimen in a moist closet for 30 minutes after molding without being disturbed.

8. Determine the 30 second penetration using the 1 mm needle at 30 minutes and every 15 minutes thereafter until a penetration of 25 mm or less is obtained.

All post 30 minute penetrations shall not be made closer than 5 mm to a previous penetration and at least 10 mm away from the inner side of the mold. Place the specimen back in the moist closet between readings. Also, clean the needle between readings to remove any paste residue. Record the penetration values and determine the time for 25 mm penetration using interpolation. This is the initial setting time.

9. Determine the final setting time as the time when the needle does not sink visibly into the paste.

Report

1) The initial setting time to the nearest 5 minutes.

2) The final setting time to the nearest 5 min. (No need to report the value due to time constraint)

Questions

1) Are the set times satisfactory?

2) What is the quality of the cement used? (Poor or good).

3) What items in the test procedure will affect the results of the normal consistency test?

4) What items in the test procedure will affect the result of the set time test?

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CVEN 210 Properties and Testing of Materials
Laboratory test # 6
SLUMP OF HYDRAULIC CEMENT CONCRETE (ASTM C143)
Report Due Date: One week after the lab is performed

Apparatus

Slump mold w/base plate (see photo), Tamping Rod (16 mm diameter), Scale (tape measure),

Shovel, hand scoop

Materials

0.0085 m^3 of mixed plastic concrete

Procedure

The test procedure for the air content by pressure method test is part of ASTM 192.

1) Start the test within 5 min. after obtaining the final portion of the mixed concrete sample.

2) Dampen the mold (inside) and place on the dampened base plate.

3) Hold the mold firmly in place during the filling and rodding operation (by the operator standing

on the two foot pieces).

4) Fill the mold in three layers, each approximately one-third the volume of the mold.

5) Rod each layer with 25 strokes of the tamping rod. During filling and rodding the top layer,

heap the concrete above the mold before rodding is started.

6) Strike off the surface by a screeding and a rolling motion of the tamping rod.

7) Remove the mold immediately by raising it in a vertical direction. (steps 2 through 7 should be

completed in less than 2.5 minutes).

8) Place the empty mold (inverted) adjacent to the concrete sample and measure the vertical

difference between the top of the mold and the displaced original center of the sample. This is the

slump.

 Report

1) Record the slump in cm to the nearest 0.5 cm.

Discussion

1) What is the type of the slump (i.e. shear , collapse or true slump)?

2) Is the recorded slump satisfactory?

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CVEN 210 Properties and Testing of Materials
<u>**Laboratory test # 7**</u>
AIR CONTENT OF FRESHLY MIXED CONCRETE BY THE PRESSURE METHOD (ASTM C231)
<u>**Report Due Date: One week after the lab is performed**</u>

<u>**Significance**</u>

This test method covers the determination of the air content of freshly mixed concrete made with dense aggregate (non-lightweight aggregate). A suitably designed air meter employing the principle of Boyle's law is used to determine the air content of the plastic concrete.

<u>**Apparatus**</u>

Air Meter Type B (see photo) – consists of a measuring bowl (capacity of 0.20 ft^3) and cover assembly with pressure gauge, Tamping Rod (5/8" diameter), Scale (0.01 lb accuracy), Mallet - rubber, weighing approximately 1.25 lb, Strike off bar

<u>**Materials**</u>

0.4 ft^3 of mixed plastic concrete

<u>**Procedure**</u>

The test procedure for the air content by pressure method test is part of ASTM 192

1) Calibrate the air meter per the manufacturer's instructions (also, see ASTM C231 annex).

a) Fill the bowl with water.

b) Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover. Clamp the cover on the bowl with the tube extending into the water.

c) Open both petcocks; add water with syringe through the petcock having the tube extension below until all air is forced out the opposite petcock. Leave both petcocks open.

d) Pump up air pressure, using built in pump, to a little beyond the pre-determined initial pressure line. Wait a few seconds for compressed air to cool to normal temperature and then stabilize the gauge needle at the proper initial pressure line by pumping or bleeding off as needed.

e) Close both petcocks and immediately press down on the thumb lever exhausting air into the bowl. Wait a few seconds until the needle is stabilized. If all the air was eliminated and the initial pressure line was correctly selected, the gauge should read 0%. If gauge does not read 0%, then adjust initial pressure line to compensate. Repeat steps a through e until an initial pressure line is determined that results in a reading of 0%.

f) Screw curved tube into the outer end of petcock and by pressing on thumb lever and controlling the flow with petcock lever, fill the 5% calibrating vessel (345 mL).

g) Release air at the free petcock. Open the other petcock and let the water in the curved pipe run back into the bowl. There is now 5% air in the bowl of the air meter.

h) With both petcocks open, pump air pressure in exact manner as describe in paragraph d. Close petcocks and immediately press the thumb lever. Wait a few seconds for exhaust air to warm to normal temperature, and for gauge needle to stabilize. The dial should now read 5%.

i) When gauge needle reads correctly at 5%, additional water may be withdrawn to check results for 10%, 15%, 20%, etc.

2) Place the concrete in the measuring bowl in three layers of approximately equal volume. Consolidate each layer of concrete with 25 strokes of the tamping rod evenly distributed over the cross section. After each layer is rodded, tap the sides of the measure *smartly* 10-15 times with the mallet. The rodding action should only penetrate previous placed layers by about 1 inch.

3) Strike off the top surface with a sawing motion of the flat strike off bar.

4) Clean all excess concrete from the exterior of the measuring bowl and the top bowl flange (use a dampened towel if necessary).

5) Assemble the apparatus by clamping on the cover (without straight tube) with petcocks open.

6) Using the rubber syringe, inject water through one petcock until all air is forced out the opposite petcock. Leave petcocks open.

7) Pump up air to "initial pressure" line on gauge. Wait a few seconds for compressed air to cool to normal temperature and then bleed off as needed so gauge reads at the "initial pressure" line.

8) Close both petcocks and press down on "thumb lever" to release the air into the bowl. Hold down lever for a few seconds and lightly tap gauge with finger to stabilize the gauge reading. Do not tilt the air meter.

9) Read the apparent air content (%) and record.

10) Calculate the air content as the apparent air content less the aggregate correction factor and report this value.

11) Open the petcocks to release pressure in the air meter. Remove the cover. Clean the base, cover, and petcock openings.

Report

1) Report the apparent air content to the nearest 0.1 %.

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Laboratory test # 8

COMPRESSIVE STRENGTH OF CYLINDRICAL CONCRETE SPECIMENS (ASTM C 39)
Report Due Date: One week after the lab is performed

Scope

This ASTM test method covers the determination of the unconfined compressive strength of cylindrical concrete specimens. The test method consists of applying a compressive axial load to molded cylinders (or cores) at a rate which is within a prescribed range until failure occurs. The compressive strength of the specimen is calculated by dividing the maximum load attained during the test by the cross-sectional area of the specimen.

References

ASTM C39 Compressive Strength of Cylindrical Concrete Specimens

ASTM C617 Capping Cylindrical Concrete Specimens

ASTM C192 Making and Curing Concrete Test Specimens in the Laboratory

Capping Cylindrical Concrete Specimens (ASTM C617)

Apparatus

Capping Plate (mold), Alignment Device (guide bars), Melting Pot, Fume Hood (exhaust fan)

Materials

Moist-cured concrete cylinders (with no moisture on the surface), Sulfur mortar (5000 psi strength at 2 hours)

Procedure

1) Prepare sulfur mortar for use by heating to about 265°F (130°C). Fresh sulfur mortar must be dry at the time of placement in the melting pot (dampness will cause foaming). Note: The flash point of sulfur mortar is approximately 440°F (225°C).

2) Oil the capping plate lightly.

3) Stir the molten sulfur mortar immediately prior to pouring each cap.

4) Dry the ends of the moist-cured specimens to preclude the formation of steam and foam pockets in the caps.

5) Pour the molten sulfur mortar into the capping plate (mold). Lower the specimen, using the alignment device guide bars, ensuring that the axis of the specimen is perpendicular to the plate.

6) The molded end caps on the specimen should have a minimum thickness of 1/8 " (3 mm) but less than 5/16" (8 mm).

7) After the sulfur mortar has set, remove the specimen from the mold plate using a slight twisting motion.

8) Repeat this process, capping both ends of the specimen.

9) Maintain the specimen in a moist condition between the completion of capping and the time of testing.

Compressive Strength of Cylindrical Concrete Specimens (ASTM C39)

Apparatus

Compression Test Machine

Materials

Capped cylindrical concrete specimens

Procedure

1) Maintain the specimen in a moist condition up to the time of compression testing. Compression tests are made as soon as practicable after removal from moist storage. The specimens are tested in this cured moist condition.

2) Wipe clean the bearing surfaces of the upper and lower platens of the compression testing machine. Also, wipe clean both end caps of the test specimen.

3) Center the specimen on the lower platen of the testing machine. 4) Carefully align the axis of the specimen with the center of thrust of the spherically seated upper platen.

5) Bring the upper platen to bear on the specimen, adjusting the load to obtain uniform seating of the specimen.

6) Apply the load at a loading rate of 20 to 50 psi/s (140 to 350 lb/s for 3" diameter cylinders, 250 to 630 lb/s for 4" diameter cylinders, 560 to 1400 lb/s for 6" diameter cylinders). The time to failure for 3000 psi concrete is 1 to 2.5 minutes.

7) Apply the load at the prescribed loading rate until the specimen fails. Record the maximum load (lb). Note the type of failure and the appearance of the concrete (see Figure 1).
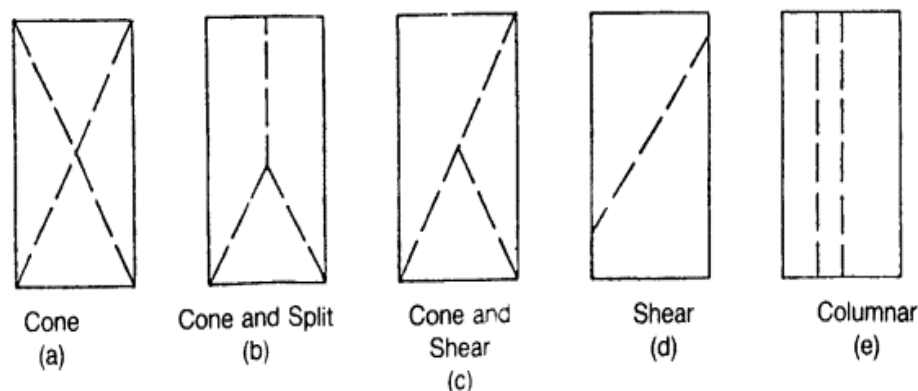

Figure 1. Types of Concrete Fracture.

Report

1) Report the size (diameter and length) and the age of the specimen (7, 14 or 28 days).

2) Record the maximum load to the nearest 5 kg.

3) Report the type of failure and appearance of the concrete.

4) Calculate the unconfined compressive strength of the specimen by dividing the maximum load by the cross-sectional area of the specimen. Report this strength to the nearest 10 psi.

Assignment

1) Measure the unconfined compressive strength of previously prepared specimens at 7 days.

2) For purposes of design of concrete structures, the 28 day strength is typically used. What is f_{cr}' based on the acquired 7-day test results? In other words, Can you predict the 28-day strength using the 7-day compressive strength value?

Qatar University
College of Engineering- Department of Civil and Architectural Engineering
CVEN 210 Properties and Testing of Materials
Laboratory test # 9
REBOUND NUMBER OF HARDENED CONCRETE (ASTM C 805)
Report Due Date: One week after the lab is performed

Scope

This ASTM test method covers the determination of the rebound number of hardened concrete using a spring-driven steel hammer.

Summary

A steel hammer impacts, with a predetermined amount of energy, a steel plunger in contact with a surface of concrete, and the distance that the hammer rebounds is measured.

Significance and Use

This test method may be used to assess the in-place uniformity of concrete, to delineate regions in a structure of poor quality or deteriorated concrete, and to estimate in-place strength development. To use this method to estimate strength development requires establishment of a relationship between strength and rebound number for a given concrete mixture.

Apparatus

Rebound Hammer – a spring-loaded steel hammer which when released strikes a steel plunger in contact with the concrete surface.

Test anvil – a 6 inch diameter by 6 inch long high-carbon steel cylinder hardened to Rockwell 65-67 C.

Abrasive stone – silicon carbide of medium grain texture.

Procedure

1) Firmly hold the instrument in a position that allows the plunger to strike vertically downward against the test anvil and verify that the rebound hammer provides the rebound number specified. Be sure to follow the same procedure as for testing the subsequent concrete test surface. Note that the test anvil shall be placed on a solid surface, e.g., concrete floor.

2) Grind and clean the concrete surface using the abrasive stone.

3) Firmly hold the instrument in a position that allows the plunger to strike perpendicularly to the concrete test surface.

4) Gradually increase the pressure on the plunger until the hammer impacts.

5) Examine the impression; if the impact crushes or breaks through a near surface void, discard the reading.

6) After impact, record the rebound number to the nearest whole number.

Report

1) Report the test date, type of concrete, and estimated unconfined compressive strength.

2) Hammer orientation, i.e., downward, upward, horizontal, or at a specific angle.

3) Average rebound number to the nearest whole number.

Test Date:	
Concrete Type:	
Estimated Strength (Mpa):	
Hammer Orientation:	
Rebound Numbers:	
Reading #1	
Reading #2	
Reading #3	
Reading #4	
Reading #5	
Reading #6	
Reading #7	
Reading #8	
Reading #9	
Reading #10	
Average Rebound Number	