Al Imam Mohammad Ibn Saud Islamic University

Civil Engineering Department

LABORATORY

MANUAL

CE310
Concrete Properties

INSTRUCTOR: Eng. Rasheed ELHAJ

نسخة ذو الحجة 1438
September 2017

بسم الله الرحمن الرحيم

CE310: CONCRETE PROPERTIES

Laboratory Manual

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September 2017

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Introduction

General objectives

- ✓ To prepare specimens for un-reinforced, hardened concrete tests.
- ✓ To prepare the students to effectively link theory with practice and application and to demonstrate background of the theoretical aspects.
- ✓ To prepare the students to generate and analyze data using experiments and to apply elements of data statistics and use computers in analyzing the data.
- ✓ To emphasize the knowledge and application of safety regulations.

Batch Preparation

1. Weigh out selected materials according to Table given in the week 2 session.
2. Moisten sides of concrete mixer with water, a color change is sufficient. No standing water should be present.
3. Pour the aggregates into the mixer (coarse aggregate and sand). Turn on the mixer and mix thoroughly.
4. Stop the mixer. Add the cement after the aggregates have been blended. Cover the mixer to prevent the rise of cement dust in the laboratory. Turn on the mixer and mix thoroughly.
5. With the mixer on, add water by thirds. Do not let the paste or the mortar stick to the walls of the mixer. Failure to take care of this will result in a bad mix.
6. Mixing is complete when the aggregates are fully covered by paste. The fresh concrete shall not remain in the mixer for more than 2 minutes after it is ready.
7. Transport concrete by wheelbarrow to perform tests.

8. IMPORTANT: Do not flush concrete down any drain. Use trash bins as indicated by instructor. Failure to follow properly dispose of excess concrete will result in severe penalty to the lab grade.

Molding of Cylinders and Cubes for Hardened Concrete Tests (ASTM C39)

1. Clean the molds, making sure they are free of dust or old concrete.
2. Properly tighten all assembling parts of each mold.
3. With a small amount of lubricating oil, brush the insides of the molds. Do not let oil collect on the bottom of the molds. With a towel, wipe off the excess oil from the mold.
4. Weigh the empty mold and record.
5. Pour the fresh concrete in the molds using a scoop or a blunted trowel, making sure that you achieve symmetrical distribution of concrete and to minimize segregation of coarse aggregate inside the mold.
6. Fill the mold according to the following table.

Table- Specimen Preparation

Specimen Type	Number Of Layers	Number Of Roddings per Layer	Number of Mallet hits on sides per Layer
Cylinder	3 equal	25	15
Cube	2 equal	35	15

7. Ensure that the rod penetrates the bottom layer throughout its depth. Distribute the strokes uniformly over the cross section of the mold and for each upper layer allow the rod to penetrate at least 1/2 in into the underlying layer.
8. After each layer is rodded, tap the outside of the molds lightly 15 times with the mallet to close any holes left by rodding and to release any large air bubbles that may have been trapped. After tapping the last (overflowing) layer, spade and level the top with a trowel.

9. Insert an identification tag in the specimen (not on the mold) to identify your specimen later. Include the following information:
   - ✓ Trial Mix Number
   - ✓ W/C ratio
   - ✓ FA/CA ratio
   - ✓ Date Mixed

10. Cure 3 specimens by covering each mold with damp cloth and plastic sheet for the first 24 hours.
11. IMPORTANT: Do not discard any excess concrete unless all specimens have been made and fresh concrete tests performed.
12. IMPORTANT: After 24 hours, specimens must be stripped from molds, and 3 samples moved to the 100% humidity curing tank.
13. IMPORTANT: wash all equipment and return it to original location. Wipe clean and reassemble molds after demolding. Failure to do this will result in severe penalty to the lab grade.

Minimum Required Data from to be Presented in Lab Report

In general, a statistical analysis (averages, standard deviations, and coefficients of variation) is required for every test performed more than once, data from other sections is needed to supplement your section's data. Your instructor will explain the details of this requirement.

Your instructor will indicate the required format and guidelines for all lab reports.

Lab Report Discussion Questions

1. Effect of water-to-cement ratio (W/C) and fine aggregate-to-coarse aggregate ratio (FA/CA) on the properties of fresh and hardened concrete (workability, unit weight, strength … etc.).
2. What are the advantages and limitations of various workability tests.
3. Why is concrete tamped or vibrated when it is poured into the structure or control samples?
4. Why should concrete be properly cured? List different methods of curing used in practice today?
5. Etc.

Field groups

In the very beginning of the laboratory work, the students will be organized into groups. For this reason, regular attendance is strictly required.

Lab Eequipement

Equipment for each lab assignment will be checked out at the beginning of the lab and checked back in when the assignment is finished. Some important things to remember about the use and care of the equipment are as follows:

1. Much of the equipment we will use is very expensive and quite sensitive, great care should be taken to protect the equipment from damage.
2. Malfunctioning equipment should be reported to the instructor.

Lab reports:

1. The assigned lab reports are to be completed in a neat, organized and professional manner. **Use cover page given in the next page**. Print your groupe number at the top of each page. **Use only the front side of the paper** and box your final answer. **Staple multiple sheets**.
2. Lab reports will be due at the **beginning of the class period**.

Grading:

Final lab-Exam:	12%
Quizzes:	8%
Reports:	10%
Total=	30%

3. For each lab, students will be graded on their participation. Your lab report grade will be determined by this:

Full mark obtained by the group: Participated in all aspects of lab

Half of the mark obtained by the group: Did not participate during some of lab

0pt: Did not participate at all.

Laboratory safety regulations:

Students should always take precautions to avoid any possible hazards:

1. Make sure that you know the location of Fire Extinguishers, First Aid Kit and Emergency Exits before you start your experiments.
2. Get First Aid immediately for any injury, no matter how small it is.
3. Do not wear loose dress.
4. Always use close shoes (i.e. boots).
5. Do not try to run and operate any machine without permission and knowledge of the lab personnel.

Al Imam Mohammad Ibn Saud Islamic University

CE310: CONCRETE PROPERTIES

LABORATORY REPORT

Title:

Lab work dates: ___________ ________________________________

___________ ________________________________

___________ ________________________________

___________ ________________________________

___________ ________________________________

Submission date: __________________

Groupe #:______

Group members and assignements:

	Student Name	Student I.D.	Assignement	Lab work Attendance (Yes, No)	involvement in the report (Yes, No)
1					
2					
3					
4					
5					

LAB

1

Slump Test (ASTM C143)

Aim:

To find the workability of different water-cement ratios mix (W/C) and fine aggregate-to-coarse aggregate ratio (FA/CA) of concrete by slump cone test.

Apparatus:

1. Slump cone apparatus,
2. Steel tamping rod,
3. Trowel,
4. Scoop,
5. Measuring jar,
6. Scales sensitive to 1 g,
7. Concrete mixer
8. Wheelbarrow.

Theory:

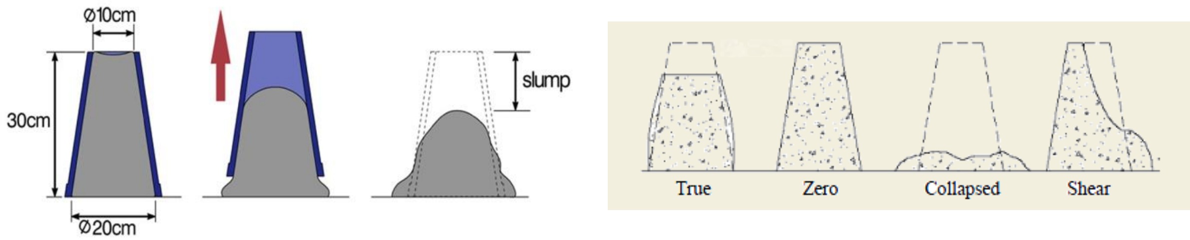
Concrete prepared from different batches should be of uniform consistency and workability so that it can be easily handled and applied in the required form. The term workability is used to describe the ease or difficulty with which the concrete is handled, transported, placed in the forms and compacted. The degree of workability depends on many factors (water cement ratio, fine aggregate-to-coarse aggregate ratio …etc.). To measure the workability of concrete, slump test is commonly used either in the field or in Laboratory work.

Description of equipment:

Slump cone consists of a metallic mold in the form of a frustum of a cone having top diameter 100 mm, bottom diameter 200 mm and height 300 mm. The thickness of the mold should not be thinner than 1.6 mm. The mold is provided with two handles at side for lifting the cone vertically up. Steel tamping rod 16 mm diameter and 600 mm long with bullet end is used for compacting concrete. An arrangement is provided for clamping the slump cone to non-absorbents surface and vertical guide scale for measuring the amount of slump.

Procedure: (ASTM C143)

1. The internal surface of the slump cone is thoroughly cleaned.
2. Hold the mold firmly in place by stepping on the foot pieces. Place the funnel on top of the mold.
3. Fill the mold in 3 equal volume layers (70mm, 160mm and 300mm) and rod it 25 times uniformly distributed over the cross-section of each layer (from outside to the center). Rod the 2^{nd} and the 3^{rd} layer throughout its depth so that strokes just penetrates into the under lying layer.
4. After the top layer is rodded, remove the funnel, strike off the surface and level the mix by rolling motion of temping rod.
5. Clean off the area immediately around the base of the cone of concrete which may be dropped accidentally.
6. Hold the mold firmly with your hands, step off the flaps, and carefully remove the mold vertically and place it upside down next to the sample.
7. Measure the vertical difference between the top of the mold and the top of the specimen to the nearest 5mm. Record this difference as the slump.
8. Return concrete material to the wheelbarrow (to be reused in other tests).



Slump Procedure, Types of Slump

Results:

Bach #	Date	Slump (in mm)	Comments (Visual findings)
TM_1			
TM_2			
TM_3			
TM_4			
TM_5			
TM_6			

Graph and comments:

A graph is drawn to show the variation of slump with the change in water – cement ratio. Take water-cement ratio along x-axis and slump in mm along y-axis; a second one to show the FA/CA effect. Comment results.

LAB

2

Compacting Factor Test (BS 1881-103)

Aim:

This test describes the method for determining the compacting factor of concrete of low, medium and high workability. The method applies to plain and air-entrained concrete, made with light weight, normal weight or heavy aggregates having a nominal maximum size of 40 mm or less but not to aerated concrete or no-fines concrete. The method is suitable for concretes having compacting factor in the range 0.7 to 0.98.

Apparatus:

1- The compacting factor apparatus, which consists of a holder fixing two conical hoppers and a cylinder at the base.

2- Tools and containers for carrying and mixing the materials.

3- Balance.

Procedure:

1- Prepare a concrete mix following steps mentioned in lab 0.

2- Damp the two hoppers and record the empty weight of the cylinder (W_1).

3- First, close the bases of the two hoppers.

4- Fill the upper hopper with the freshly mixed concrete (fill freely without compacting), then open the base of this upper hopper to allow concrete to fall under the effect of its weight to the lower hopper. This hopper is smaller than the upper one, thus it will be filled to overflowing.

5- Then open the base of the second hopper to allow concrete (also only under the effect of its weight) to fall into the cylinder. Excess concrete is cut by two floats slide across the top of the mold.

6- Certain mixes have a tendency to stick in one or both of the hoppers. If this occurs, help the concrete through by pushing the tamping rod gently into the concrete from the top until the lower end emerges from the bottom of the hopper. If this does not dislodge the concrete, raise the rod and repeat the process until the concrete falls through the hopper. Count the number of times the concrete is rodded as this provides a guide to the cohesiveness of the concrete.

7- Level the surface of the cylinder and clean the sides of the cylinder. Within 150 s of placing, weigh the cylinder with concrete inside. Record the weight [W2].

8- The difference between the weight of the concrete with the cylinder and empty cylinder will be the weight of partially compacted concrete [W_p].

9- Now empty the cylinder, clean it and cover the inside surface by a thin layer of mineral oil.

10- Fill the cylinder with concrete in six layers rodding each layer by 25 strokes equally distributed on the surface. Level the surface and clean sides.

11- Weigh the cylinder with its contents and record [W3].

12- The difference between the weight of the compacted concrete with the cylinder and the empty cylinder will be the weight of completely compacted concrete [W_f].

Observations and Calculations:

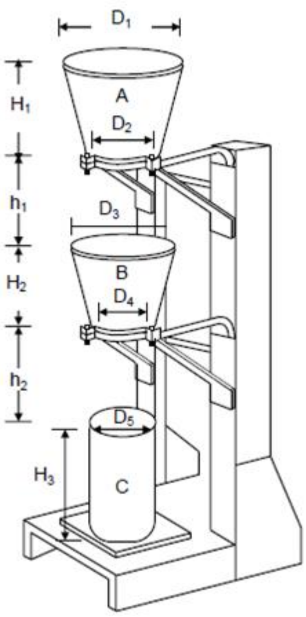
Mass of empty cylinder W_1=

Batch N^o	Water Cement ratio	FA/CA	Weight of Cylinder + Partially-compacted Concrete	Weight of Cylinder + Fully-compacted Concrete	Weight of Partially - Compacted Cylinder (W_p)	Weight of Fully Compacted Concrete, (W_f)	Compacting Factor (W_p/W_f) with 2 decimal points.

Note:-Typical range of the compacting factor is 0.70 to 0.98 Mass unit is kg.

Define the mixture comsistency by referring to the table below:

Consistency (or degree of workability)	Very dry	Very Hard	Hard	Plastic Hard	Plastic	Liquid	High Liquid
	Very low		Low	Medium		High	
Compacting Factor	0.7	0.78	0.85	0.89	0.92	0.95	0.98



The Compacting Factor Apparatus

LAB 3

VEE-BEE CONSISTOMETER (EN 12350-3)

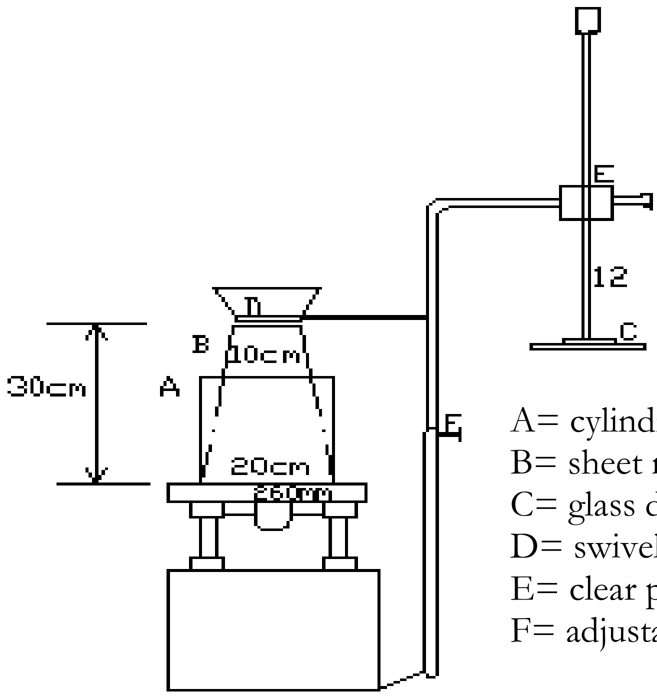
Aim:

To measure the workability of concrete by vee-bee consistometer test which determines the time required for transforming, by vibration, a concrete specimen in the shape of a conical frustum into a cylinder.

Apparatus required:

Vee-Bee Consistometer test apparatus:

1. A vibrator table resting upon elastic supports,
2. A metal pot,
3. A sheet metal cone, (same as Slump cone),
4. A standard iron rod, (16 mm in diameter and 600 mm length),
5. weighing device,
6. Tools and concrete mixer.



A= cylindrical pot
B= sheet metal cone
C= glass disc
D= swivel arm
E= clear plastic disc
F= adjustable screw

Procedure.

1. Placing the slump cone inside the sheet metal cylindrical pot of the consistometer.
2. Slump test as described earlier is performed, placing the slump cone inside the sheet metal cylindrical pot of the consistometer.
3. The clear plastic disc attached to the swivel arm is turned and placed on the top of the concrete pot.
4. The electrical vibrator is switched on and simultaneously a stop watch is started.
5. The vibration is continued till such a time as the conical shape of the concrete disappears and the concrete assumes cylindrical shape.
6. Immediately when the concrete fully assumes a cylindrical shape, the stop watch is switched off. The time required for the shape of concrete to change from slump cone shape to cylindrical shape in seconds is known as vee bee degree.

Observation, Calculation and result:

Trial batch number and date:		
Initial reading on the graduated rod, a :		
Final reading on the graduated rod, b :		
Slump (b) – (a), mm :		
Time for complete remoulding, (seconds) :		
Conclusion:	The Vee Bee Degre of concrete indicate ………. **(Low/ Medium/ High)** Degree of workability	The Vee Bee Degre of concrete indicate ………. **(Low/ Medium/ High)** Degree of workability

Comments:

1. Describe the factors affecting the choice of the method of test.
2. What are the advantages and disadvantages of Vee-Bee method of test over the other Methods?
3. Compare Slump and Vee-bee results.

LAB

4

FLOW TABLE TEST (C230/C)

Aim:

To measure the flow and workability of the concrete by using flow table

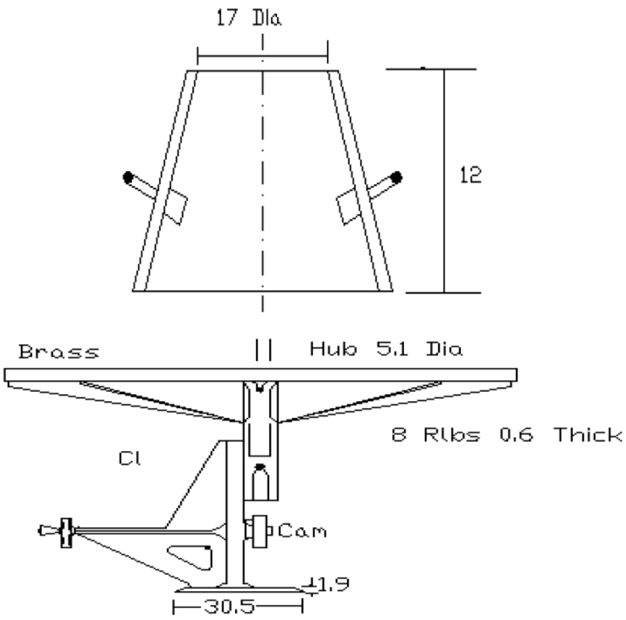
Apparatus required: Flow table test apparatus

Procedure:

The apparatus consists of flow table about 76cm. in diameter over which concentric circles are marked. A mould made from smooth metal casing in the form of a frustum of a cone is used with the following internal dimensions. The base is 25cm. in diameter upper surface 17cm. in diameter and height of the cone is 12cm.

1. The table top is cleaned of all gritty material and is wetted. The mould is kept on the center of the table, firmly held and is filled in two layers.
2. Each layer is rodded 25 times with a tamping rod 1.6cm in diameter and 60cm long rounded at the lower tamping end.
3. After the top layer is rodded evenly the excess of concrete which has overflowed the mould is removed.
4. The mould is lifted vertically upward and the concrete stands on its own without support. The table is then raised and dropped 12.5cm 15times in about 15 seconds.
5. The diameter of the spread concrete is measured in about 6 directions to the nearest 5mm and the average spread is noted. The flow of concrete is the percentage increase in the average diameter of the spread concrete over the base diameter of the mould.
6. The value could range anything from 0 to 150 per cent. A close look at the pattern of spread of concrete can also give a good indication of the characteristics of concrete such as tendency for segregation.

$$\text{Flow, per cent} = \frac{\text{Spread diameter in cm} - 25}{25} \times 100$$



Flow table apparatus

Observation, Calculation and result:

Trial batch number and date:						
Measurements of the diameter of the spread concrete (to the nearest 5mm):						
Average diameter of the spread concrete (mm) :						
Remarks (tendency for segregation, ...):						
Conclusion ((Low/ Medium/ High) Degree of workability**:**						

Comments:

1. Describe the factors affecting the choice of the method of test.
2. What are the advantages and disadvantages of flow table test over the other Methods?
3. Compare Slump and flow table test results.

LAB

5

DETERMINATION OF AIR CONTENT OF FRESH CONCRETE (ASTM C 231)

Aim:

To determine the air content of freshly mixed concrete from observation of the change in volume of concrete with a change in pressure (Pressure Method).

Apparatus required: Concrete pressure meter (HM-30)

Procedure:

Procedure Checklist ASTM C 231

TYPE B METER

1. Dampen the interior of the bowl and place on a flat, level, firm surface.
2. Using a scoop, place the concrete in the measuring bowl in the required number of layers, moving the scoop around the perimeter of the bowl opening to ensure an even distribution of the concrete.
3. For the first layer: fill the bowl approximately 1/3 of its volume; rod the layer 25 times throughout its depth, using care not to damage the bottom of the measuring bowl. Distribute the roddings uniformly over the cross section of the bowl; tap the outside of the bowl smartly 10 to 15 times with the mallet to close voids left by the tamping rod.
4. For the second layer: fill the bowl approximately 2/3 of its volume; rod the layer 25 times, penetrate the first layer about 1 in. (25 mm), evenly distribute the roddings over the cross section of the bowl; tap the outside of the bowl smartly 10 to 15 times with the mallet to close voids left by the tamping rod.
5. For the third layer: add concrete in a manner to avoid excessive overfilling; rod the layer 25 times, penetrate the second layer about 1 in. (25 mm), evenly distribute the roddings over the cross section of the bowl; tap the outside of the bowl smartly 10 to 15 times with the mallet to close voids left by the tamping rod.

6. Strike-off the top layer of concrete: if using a strike-off plate while performing C138, press the strike-off plate on the top surface of the measure to cover 2/3 of the surface and withdraw the plate with a sawing motion to finish only the area originally covered; place the plate on top of the measure to cover the original 2/3 of the surface and advance it with a vertical pressure and a sawing motion to cover the whole surface of the measure and continue to advance it until it slides completely off the measure; incline the plate and perform several strokes with the edge of the plate to produce a smooth finish.
7. Strike-off the top layer of concrete: If using a strike-off bar while performing C231, strike-off the top surface by sliding the strike-off bar across the top flange or rim of the measuring bowl with a sawing motion until the bowl is just level full.
8. Thoroughly clean the flange/rim of the bowl and cover assembly.
9. Clamp the cover to the bowl ensuring a pressure-tight seal.
10. Close the main air valve between the air chamber and bowl. Open both petcocks on the cover.
11. Use a syringe to inject water through one petcock until water emerges from the opposite side petcock. Jar the meter gently until all air is expelled.
12. Close the air bleeder valve and pump air into the air chamber until the hand of the dial gauge is on the initial pressure line. Allow a few seconds for the compressed air to cool.
13. Stabilize the gauge hand at the initial pressure line by bleeding, pumping and lightly tapping the gauge by hand.
14. Close both petcocks.
15. Open the main air valve between the air chamber and bowl. Tap the sides of the bowl smartly with the mallet. Lightly tap the pressure gauge by hand to stabilize the gauge hand.
16. Read the percentage of air on the dial of the pressure gauge.
17. Close the main air valve and then release the pressure in the bowl by opening both petcocks before removing the covers.
18. Report the air content to the nearest 0.1% using the aggregate correction factor (or to the nearest ½ scale division if the gauge reading exceeds 8%).
    Air Content = ± 0.8 %

Comments:

1. Describe how the air content affects workability of concrete.
2. Are there any relation between air content and strength of concrete?
3. Are there any relation between air content and sustainability of concrete?

LAB

6

PULSE VELOCITY THROUGH CONCRETE

(ASTM C598-83)

Aim:

1. This test method covers the determination of the pulse velocity of propagation of compression waves in concrete.

2- The pulse velocity is independent of the dimensions of the body, provided reflected waves from the boundaries do not complicate the determination of the arrival time of the directly transmitted pulse.

The pulse velocity V is related to the physical properties of a solid by the equation:

$$V = (K)\,(E)/D$$

Where:

k =a constant

E = the. modulus of elasticity,

D = the density.

Calculation

The pulse velocity as follows:

$$V=L/T$$

Where:

V= Pulse velocity, m/s

L= Distance between transducers, m

T = Effective transmit time, s.

The relationship is independent of the frequency of the vibrations.

Apparatus:

1- The apparatus used in this test is called " PUNDIT" . This name is derived from the initial letters of " Portable Ultrasonic Non-destructive Digital Indicating Tester".

2- Two transducers (54 KHz).

3- Two transducer leads.

4- Reference bar for checking zero.

5- Tin of couplant.

Procedure:

1- Before switching on the PUNDIT, the transducers should be connected to the sockets marked "TRAN" and "REC". The connection or disconnection of the transmitting transducer should not be made while the instrument switched on. The PUNDIT may be operated from either:

i) The internal battery,

ii) An external battery,

iii) The A.C. mains supply.

The battery operation is most convenient for field use while the mains operation is generally more suitable for laboratory use.

2- If using the A.C. mains supply, plug the mains cable into the 3 way socket mounted on the rear panel, switch the P.S.S. to MAINS and depress the reset button to switch the PUNDIT ON.

3- Before using the PUNDIT, it should be calibrated using the reference bar. After putting the coupling agent on the transducers faces, the transducers faces are placed and pressed against the reference bar ends, using the "set free button". The reading of the instrument should be adjusted to read the transit time recorded on the calibration bar.

4- After applying an appropriate coupling agent (such as water, oil, petroleum jelly, grease, or other viscous materials) to the transducer diaphragms, the test surface, or both, to avoid entrapped air between the contact surface of the diaphragms of the transducers and the surface of the concrete. Press the faces of the transducers against the surfaces of the concrete and measure the transit time. Measure the length of the shortest direct path between the centers of the diaphragms.

5- The test will be conducted two times with two different divices for each sample.

6- The digital apparatus will give you directly the pulse velocity.

Comments:

1. Comment the accuracy of the results by analyzing the results obtained by each device and comparing them.
2. The results are matching your prevision or not?
3. Is there any convergence between the results of the two non- destructive tests?

Testing using PUNDIT

LAB

7

Rebound Number of Hardened Concrete

(ASTM C805-85)

Aim:

This test is also known as the Schmidt hammer or impact hammer, and is a non-destructive method of testing concrete. The test is based on the principle that the rebound of an elastic mass depends on the hardness of the surface against which the mass impinges.

Apparatus:

1. Rebound hammer.
2. Abrasive stone: consisting of medium-grain texture silicon carbide or equivalent material.

Selection of Test Surface:

Concrete members to be tested shall be at least 100 mm thick and fixed within a structure. Smaller specimens must be rigidly supported. Areas exhibiting honeycombing, scaling, rough texture or high porosity should be avoided.

Concretes should be approximately the same age and moisture condition in order to be compared. Dry concretes give higher rebound numbers than wet concrete, and the surface layer of concrete may be carbonated, yielding higher rebound numbers.

Preparation of test surface:

A test area shall be at least 150 mm in diameter. Heavily textured, soft, or surfaces with loose mortar shall be ground smooth with the abrasive stone. Smooth formed or toweled surface shall be tested without grinding. Concretes over 6 months old may require grinding to a depth of 5 mm if they are to be compared to younger concretes. Grinding to this depth is not feasible without power equipment.

Procedure:

1. Set the digital hammer and check all parameters.
2. Firmly hold the instrument in a position that allows the plunger to strike perpendicularly to the surface tested. Gradually increase the pressure on the plunger until the hammer impacts.
3. Repeat this 20 times for each sample:
    - 5 impactes for each of the four lateral faces of cubic samples.
    - 5 impactes for each of the four lateral line For cylindrical samples (for that draw 2 diametric lines on each end of the specimen and than four lengthwise lines centered on the lines on the ends of the cylinder).

4. No two impact tests shall be closer together than 25 mm.
5. The digital hammer will give the average of the strength and the standard deviation based on an internal calibration curve.
6. Conduct the test two times with two different divices for each sample.

Comments:

1. Comment the accuracy of the results by analyzing the results obtained by each device and comparing them.
2. The results are matching your prevision or not?
3. Is there any convergence between the results of the two non- destructive tests?

Testing concrete using the Schmidt hammer

LAB

8

Compressive Strength of Cylindrical Concrete Specimens

(ASTM C 39-86)

Aim:

The test method covers the determination of compressive strength of cylindrical concrete specimens, such as molded cylinders and drilled cores. It is limited to concrete having a unit weight > 800 kg/m^3

Apparatus:

1. Compression testing machine.
2. Cylinders (150 mm in diameter and 300 mm in height) and cubes (150 mm x 150mm x 150 mm) prepared during previous labs.

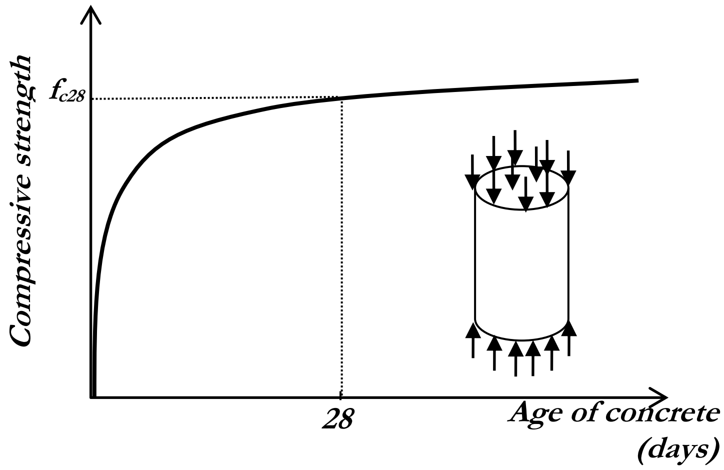
Procedure:

1. Use the specimens performed in Lab1 to accomplish this Job.
3. Before testing, ensure that all testing machine bearing surfaces are wiped clean.

4. Carefully center the cylinder on the lower platen and ensure that the load will be applied to two opposite cast faces of the cylinder.

5. Without shock, apply and increase the load continuously at a nominal rate within the range of (0.2 MPa.s to 0.4 MPa.s) until no greater load can be sustained.

6. Record the compressive strength indicated by the testing machine at failure. Note the type of failure and appearance of fracture.



Comments:

1. Comment the graphs given by the compressive machine.
2. The results are matching your prevision or not?
3. Are ther any divergence between the non destructive tests results and those obtained by direct compressive strength test?

LAB

9

Splitting Tensile Strength of Cylindrical Concrete Specimens

(ASTM C496-86)

Aim:

This method covers the determination of the splitting tensile strength of cylindrical concrete specimens.

Apparatus:

1. Compression testing machine.
2. Three cylinders (150 mm diameter and 300 mm in height).
3. A jig for aligning concrete cylinder and bearing strips.

Procedure:

1. Prepare three cylindrical concrete specimens.
2. Two bearings strips of nominal (1/8 in or 3.175 mm) thick plywood, free of imperfections, approximately 25mm wide, and of length equal to or slightly longer than that of the specimen should be provided for each specimen.
3. The bearing strips are placed between the specimen and both upper and lower bearing blocks of the testing machine or between the specimen and the supplemental bars or plates.

4. Draw diametric lines on each end of the specimen using a suitable device that will ensure that they are in the same axial plane. Center one of the plywood strips along the center of the lower bearing block.
5. Place the specimen on the plywood strip and align so that the lines marked on the ends of the specimen are vertical and centered over the plywood strip.
6. Place a second plywood strip lengthwise on the cylinder, centered on the lines marked on the ends of the cylinder.
7. Apply the load continuously and without shock, at a constant rate (within the range of 689 to 1380 kPa/min) splitting tensile stress until failure of the specimen.
8. Record the tensile strength indicated by the testing machine at failure. Note the type of failure and appearance of fracture.

The splitting tensile strength of the specimen is as follows:

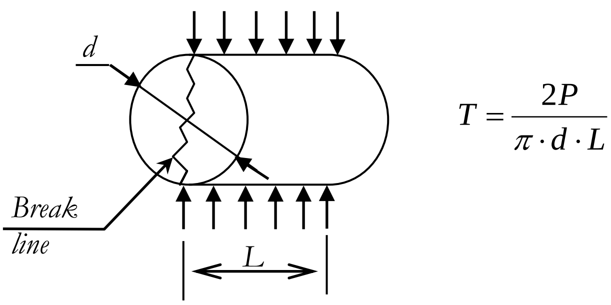
$$T = 2P/\pi Ld$$

Where;

T=splitting tensile strength, kPa

P=maximum applied load indicated by testing machine, kN

L= Length, m; d= Diameter, m



Note:

1- This test is not a true tension test, but it fails in tension and used to indicate the tensile strength of concrete.
2- Modern testing machines give directly the tensile strength of the concrete. No need than for calculation of T.

Cylinder in the compression machine
with the jig for aligning concrete cylinder and bearing strips

Comments:

1. Comment the graphs given by the compressive machine.
2. The results are matching your prevision or not?
3. Are ther any divergence between the non destructive tests results and those obtained by this test?

Appendix