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Lab Manual:

CONCRETE TECHNOLOGY LABORATORY(ACEC11)

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Course Information

1 Introduction

Concrete technology laboratory course emphasizes the practical aspects of the latest developments in the field of concrete construction. It focuses the latest Indian standard specifications and codes, which regulates the concrete construction. The laboratory course covers the properties of concrete and its constituent materials, the role of various admixtures in modifying these properties to suit specific requirements, such as ready mix concrete, reinforcement detailing, disaster-resistant construction, concrete machinery and it also enable the students to acquire knowledge on special and new generation concrete with their applications.

Student Responsibilities

The student is expected to be prepared for each lab.Lab preparation includes reading the labexperiment and related textbook material. If you have questions or problems with the preparation, contact your Laboratory Teaching faculty, but in a timely manner. Do not wait until an hour or two befor the lab and then expect the lab faculty to be immediately available.

Active participation by each student in lab activities is expected. The student is expected to askthe laboratory faculty any questions they may have.

A large portion of the student's grade is determined in the comprehensive final exam, resulting in a requirement of understanding the concepts and procedure of each lab experiment for the successfulcompletion of the lab class. The student should remain alert and use common sense while performing a lab experiment. They are also responsible for keeping a professional and accurate record of the labexperiments in the lab manual wherever tables are provided. Students should report any errors in the lab manual to the teaching assistant.

Laboratory Faculty Responsibilities

The laboratory faculty shall be completely familiar with each lab prior to class. Thel aboratory faculty shall provide the students with a syllabus and safety review during the first class.The syllabus shall include the laboratory faculty office hours,telephone number, and the name of the faculty coordinator. The laboratory facultyis responsible for ensuring that all the necessary equipmentand/or preparations for the lab a reavailable and in working condition.Lab experiments should be checked in advance to make sure everything is in working order. The laboratory faculty should fully answer any questions posed by the students and supervise the students performing the lab experiments. The laboratory faculty is expected to grade the lab notebooks and reports in a fair and timely manner.The reports should be returned to the students in the next lab period following submission. The laboratory faculty should report any errors in the lab manual to the faculty coordinator.

Faculty Coordinator Responsibilities

The faculty coordinator should ensure that the Data Structure laboratory is properly arranged. The coordinator is responsible for supervising the teaching assistants and resolving any questions or problems that are identified by the teaching assistants or the students. The coordinator may supervise the format of the final exam for the lab. They are also responsible for making any necessary corrections to this manual and ensuring that it is continually updated and available.

Lab Policy and Grading

The student should understand the following policy:

ATTENDANCE:

Attendance is mandatory and any absence must before valid excuse and must be documented.If the instructor is more than 15 minutes late, students may consider lab for the day cancelled.

LAB RECORDS:
The student must:
1. Perform the PreLab assignment before the beginning of each lab
2. Keep all workin preparation of and obtained during lab
3. Prepare a lab report on experiments selected by the laboratory faculty.

GRADING POLICY:
The final grade of this course is determined using the criterion detailed in the syllabus.

INSTRUCTIONS TO STUDENTS

• Before entering the lab the student should carry the following things (MANDATORY)
    o Identity card issued by the college.
    o Work Sheets
• Student must sign in and sign out in the register provided when attending the lab session without fail.
• Come to the laboratory in time. Students, who are late more than 15 min., will not be allowed to attend the lab.
• Students need to maintain 100% attendance in lab if not a strict action will be taken.
• All students must follow a Dress Code while in the laboratory
• Foods, drinks are NOT allowed.
• All bags must be left at the indicated place.
• Refer to the lab staff if you need any help in using the lab.
• Respect the laboratory and its other users.
• Workspace must be kept clean and tidy after experiment is completed.
• Read the Manual carefully before coming to the laboratory and be sure about what you are supposed to do.
• Do the experiments as per the instructions given in the manual.
• Copy all the programs to observation which are taught in class before attending the lab session.
• Students are not supposed to use floppy disks, pen drives without permission of lab- incharge.
• Lab records need to be submitted on or before the date of submission.
• Computer labs are established with sophisticated and high end branded systems, which should be utilized properly.
• Students / Faculty must keep their mobile phones in SWITCHED OFF mode during the lab sessions. Misuse of the equipment, misbehaviors with the staff and systems etc., will attract severe punishment.
• Students must take the permission of the faculty in case of any urgency to go out; if anybody found loitering outside the lab / class without permission during working hours will be treated seriously and punished appropriately.
• Students should LOG OFF/ SHUT DOWN the computer system before he/she leaves the lab after completing the task (experiment) in all aspects. He/she must ensure the system / seat is kept properly.

Course Goals and Objectives

Goal:

The concrete laboratory intends to train the students in the field of testing the ingredients of concrete and to study the behavior of fresh concrete, its workability and strength in hardened state, which are used directly or indirectly in the design of structural elements. In addition, the student should learn how to record experimental results effectively and present these results in a written report.

Objectives:

Students will try to learn:
1. The fundamental properties of construction materials like cement, aggregates and admixtures based on laboratory and field tests for identifying material quality.
2. The factors influencing workability and methods involved in measuring workability of fresh concrete.
3. The importance of water/cement ratio and its influence on compressive strength of hardened concrete.

Data Recording and Reports

The Laboratory Note book
Students must write their experimental outputs in the provided tables in this laboratory manual and reproduce the labreports.Reports are integral to recording the methodology and results of an experiment.In engineering practice,the laboratory notebook serves as an invaluable reference to the technique used in the lab and is essential when trying to duplicate a result or write a report. Therefore,it is important to learn to keep accurate data.Make plots of data and sketches when these are appropriate in the recording and analysis of observations. Note that the data collected will be an accurate and permanent record of the data obtained during the experiment and the analysis of the results. You will need this record when you are ready to prepare a lab report.

The Lab Report
Reports are the primary means of communicating your experience and conclusions to other professionals. In this course you will use the lab report to inform your laboratory facultyabout what you did and what youhave learned from the experience.Engineering results are meaningless unless they can be communicated to others. You will be directed by your laboratory facultyto prepare a lab report on a few selected lab experiments during the semester. Your assignment might be different from your lab partner's assignment.
Your laboratory report should be clear and concise.The lab report shall be typed on a word processor. As a guide, use the format on the next page.Use tables,diagrams, sketches, as necessaryto show what you did, what was observed, and what conclusions you can draw from this. Even thoughyou will work with one or more lab partners, your report will be the result of your individual effort in order to provide you with practice in technical communication.

Formatting and Style

• The lab report shall be typed in a word processor. All page margins must be 1.25 inches.All content (including text, figures, tables, etc.) must fitwithinthemargins.
• Body text should be double-spaced.
• Basic text should be in 12-point size in a commonly used text font.
• Set your main text justified (with even left / right margins).
• The first line of each paragraph should have a left indent.

• All the tables should have titles and should be numbered. Tables should be labeled numericallyas Table 1, Table 2, etc. Table captions appear above the table. The column headings should be labeled with theunits specified.
•Use MS-Word equation (under InsertEquation menu), MathType, or a similar tool to typeformulas.
•If you need to copy a schematic or figure from the lab manual to your report, use Copy and Paste function or take a screen shot by using Snipping Tool in MS-Windows.
•Do not place screenshots of your lab notebook in the report! Diagrams, tables, calculations, etc. must be generated using the existing tools in the word processor.

Order of Lab Report Components

COVERPAGE-Cover page must include lab nameand number,your name,yourlab partner's name, and the date the lab was performed.

OBJECTIVE-Clearly state the experiment objective in your own words.

SOFTWARE USED-Indicate which software was used in performing the experiment.

FOR EACH PART OF THE LAB:

• Write the lab's part number and title in bold font. Firstly, describe the problem that you studied in this part, give an introduction of the theory, andexplain why you did this experiment. Do not lift the text from the lab manual; use your ownwords.
•Secondly, describe the experimental setup and procedures. Do not follow the lab manual in listing out individual pieces of equipment and assembly instructions. That is not relevant information in a lab report. Your description should take the form of a narrative, and include information notpresent in the manual,such as descriptions of what happened during intermediate steps of theexperiment.
•Thirdly, explain your findings. This is the most important part of your report, because here, you show that you understand the experiment beyond the simple level of completing it. Explain (compare expected results with those obtained). Analyse (analyze experimental error). Interpret(explain your results in terms of theoretical issues and relate to your experimental objectives). All the results should be presented even if there is any inconsistency with the theory. It should be possible to understand what is going onby just reading through the text paragraphs, without looking at the figures.
•Finally, provide a summary of what was learned from this part of the laboratory experiment. If the results seem unexpected or unreliable, discuss them and give possible explanations.

CONCLUSIONS
The conclusion section should provide a take-home message summing up what has been learned from the experiment:

• Briefly restate the purpose of the experiment (the question it was seeking to answer)
• Identify the main findings (answer to there search question)
• Note the main limitations that are relevant to the interpretation of the results
• Summarize what the experiment has contributed to your understanding of the problem.

PROBING FURTHER QUESTIONS-

Questions pertaining to this lab must be answered at the end of laboratory report.

Lab -1 Introduction to Concrete Technology Laboratory

Introduction

In its simplest form, concrete is a mixture of paste and aggregates (rocks). The paste, composed essentially of Portland cement and water, coats the surface of the fine (small) and coarse (larger) aggregates. Through a series of chemical reactions called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete. Within this process lies the key to a remarkable trait of concrete: it's plastic and malleable when newly mixed, strong and durable when hardened. These qualities explain why one material, concrete, can build skyscrapers, bridges, sidewalks and superhighways, houses and dams.

Objective

To familiarize the students with the lab facilities, equipment, standard operating procedures, lab safety, and the course requirements.

Safety Precautions

1. Make sure that you know the location of Fire Extinguishers, First Aid Kit and Emergency Exits before.
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. safety or boots).
5. Do not play with valves, screws and nuts.
6. Do not try to run and operate any machine without permission and knowledge of the lab.

Background

Concrete in practice: Concrete is a composite with properties that change with time. During service, the quality of concrete provided by initial curing can be improved by subsequent wetting as in the cases of foundations or water retaining structures. However, concrete can also deteriorate with time due to physical and chemical attacks. Structures are often removed when they become unsafe or uneconomical.

In some developed countries, it is not uncommon to find large amount of resources, such as 30 to 50% of total infrastructure budget, applied to repair and maintenance of existing structures. As a result, many government and private developers are looking into lifecycle costs rather than first cost of construction. Durability of concrete depends on many factors including its physical and chemical properties, the service environment and design life. As such, durability is not a fundamental property.

One concrete that performs satisfactory in a severe environment may deteriorate prematurely in another situation where it is consider as moderate. This is mainly due to the differences in the failure mechanism from various exposure conditions. Physical properties of concrete are often discussed in term of permeation the movement of aggressive agents into and out of concrete. Chemical properties refer to the quantity and type of hydration products, mainly calcium silicate hydrate, calcium aluminate hydrate, and calcium hydroxide of the set cement. Reactions of penetrating agents with these hydrates produce products that can be inert, highly soluble, or expansive. It is the nature of these reaction products that control the severity of chemical attack. Physical damage to concrete can occur due to expansion or contraction under loading.

LAB-2: FINENESS OF CEMENT

Introduction
(IS: 269-1989 and IS: 4031-1988)
The fineness of cement has an important bearing on the rate of hydration and hence on the rate of gain of strength and also on the rate of evolution of heat. Finer cement offers a greater surface area for hydration and hence the faster and greater the development of strength. Increase in fineness of cement is also found to increase the drying shrinkage of concrete.

Fineness of cement is tested in two ways :
(a) By sieving.
(b) By determination of specific surface (total surface area of all the particles in one gram of cement) by air-permeability apparatus. Expressed as cm2/gm or m2/kg. Generally Blaine Air permeability apparatus is used.

Objective

To determine the fineness of the given sample of cement by sieving.

PreLab:

Students should know what are the methods used to test the fineness of cement
Fineness of cement is tested in two ways :
(a) By sieving.
(b) By determination of specific surface (total surface area of all the particles in one gram of cement) by air-permeability apparatus. Expressed as cm2/gm or m2/kg

EQUIPMENT
1. IS-90 micron sieve conforming to IS: 460-1965
2. Standard balance
3. Weights and
4. Brush

BACKGROUND

We know that cement hydrates with the presence of water. When cement is mixed with the water, a thin layer is formed around the particle. This layer grows bigger and makes cement particles to separate. Due to this, hydration process slows down. Therefore, the smaller particle will react much quicker than the larger particle. A particle with dia 1µm will react entirely in one day, whereas the particle with dia 10µm takes about one month. So the particle size distribution is more critical in attaining the final strength of cement in allowable time.
But too much of smaller particles in cement results in quick setting, leaving no time for mixing, handling and placing. So to increase the setting time of cement, cement is ground in a different range of particle sizes.
The following proportions are usually maintained in Cement: About 10% of the cement of fine particles is smaller than 2 µm, 10% of wt of cement is made of particles larger than 50 µm, and only a few wt% is particles larger than 90 µm

Safety Precautions
i. The weight of the cement should be noted carefully.
ii. Sieve pan should be close while shaking so that no amount of cement can be lost.
iii. The calculation should be done carefully.

iv. The sample should be taken from the same type of cement while doing the fineness test of cement.

Procedure

1. Weigh accurately 100 g of cement and place it on a standard 90 micron IS sieve.
2. Break down any air-set lumps in the cement sample with fingers.
3. Continuously sieve the sample giving circular and vertical motion for a period of 15 minutes.
4. Weigh the residue left after 15 minutes of sieving.

Observations and Calculation

Sl. No.	Weight of sample taken (gm)w1	Weight of residue (gm)W2	Fineness %
1			
2			
3			

Fineness of cement= (W2/W1)100
Result:
Average of fineness %=

PROBING FURTHER QUESTIONS
1. Determine the fineness of different types of cements.

VIVA QUESTIONS
1. Discuss the effects of fineness on hydration of cement?
2. Enumerate the advantages and disadvantages of using finer cement
3. Discuss the effects of fineness on hydration of cement?
4. Enumerate the advantages and disadvantages of using finer cement.
5. What is the correction factor of a sieve? Explain its necessity.

Lab 3 - NORMAL CONSISTENCY OF CEMENT

Introduction

(IS: 269 - 1989 and IS: 4031 - 1988 (Part 4), IS :5513-1976,)
Vicat plunger to penetrate to appoint 5 to 7 mm from the bottom of the vicat mould in this test. It is expressed as amount of water as a percentage [by weight] of dry cement. Standard consistencyis also called normal consistency.
A certain minimum quantity of water is required to be mixed with cement so as to complete chemical reaction between water and cement less water than this quantity required wood not complete chemical reaction thus resulting in reaction strength and more water increases water cement ratio and it reduces the strength. So correct proportion of w/c is require

Objectives

To determine the percentage of water required for preparing cement paste of standard consistency.

Equipment

1. Vicat apparatus with plunger
2. I.S. Sieve No. 9
3. measuring jar
4. weighing balance

BACKGROUND:

The water requirement for various tests of cement depends on the normal consistency of the cement, which itself depends upon the compound composition and fineness of the cement.
This test is conducted to calculate the amount of water to be added to the cement to get a paste of standard consistency which is defined as that consistency which will permit the Vicat plunger to penetrate to a point 5 to 7 mm from the bottom of the Vicat mould. This experiment is done with the help of Vicat apparatus. The time taken between adding of water to the cement and filling of mould of Vicat apparatus is called as gauging time which should be between 3 to 5 minutes. For finding out initial setting time, final setting time, soundness of cement and compressive strength of cement, it is necessary to fix the quantity of water to be mixed in cement in each case. Since different batches of cement differ in fineness, pastes with some water content may differ in consistency when first mixed. For this reason the consistency of the paste is standardized by varying the water content until the paste has a given resistance to penetration.

Safety Precautions:

1. Clean appliances shall be used for gauging.
2. All the apparatus shall be free from vibration during the test.
3. The temperature of water and that of the test room, at the time of gauging shall be 27 C + 2 C. Care shall be taken to keep the needle straight.

PROCEDURE:

1. The vicat apparatus consists of a D- frame with movable rod. An indicator is attached to the movable rod, which gives the penetration on a vertical scale.
2. A plunger of 10 mm diameter, 50 mm long is attached to the movable rod to find out normal consistency of cement.
3. Take 300 gm of cement sieved through I.S. Sieve No. 9 and add 30% by weight (90 ml) water to it. Mix water and cement on a non-porous surface thoroughly with in 3 to 4 minutes.
4. The cement paste is filled in the vicat mould and top surface is leveled with a trowel. The filled up

mould shall be placed along with its bottom non-porous plate on the base plate of the vicat apparatus centrally below the movable rod.
5. The plunger is quickly released into the paste. The settlement of plunger is noted. If the penetration is between 33 mm to 35 mm from top (or) 5 mm to 7 mm from the bottom, the water added is correct. If the penetration is less than required, the process is repeated with different percentages of water till the desired penetration is obtained .

Observations and Calculation

Sl. No.	Amount of water mixed	Penetration of Plunger from top	Remark
1			
2			
3			

Result: The normal consistency of cement =

PROBING FURTHER QUESTIONS

1. Determine the consistency of different types of cements.

VIVA QUESTIONS:

1. What is meant by normal consistency? Why it is determined?
2. What are the factors which affect the consistency of cement?
3. Discuss the effect of different cement grades on normal consistency.
4. What is gauging time?

Lab 4 – INITIAL AND FINAL SETTING TIMES OF CEMENT

Introduction

(IS: 269- 1989 and IS: 4031 (Part 5) – 1988)
Cement when mixed with water forms slurry which gradually becomes lesser and lesser plastic, and finally forms a hard mass. In this process a stage is obtained when the cement paste is sufficiently rigid to with stand a definite amount of pressure. The time to reach this stage is called setting time. The setting time is divided into two parts: the initial setting time and the final setting time.
Initial set is a stage where the cement paste stiffens to such an extent that the Vicat needle is not permitted to move down through the paste within 5 ± 0.5 mm measured from the bottom of the mould. In other words, the cement paste starts losing its plasticity. The time elapsed between the moments that the water is added to the cement to the initial set is regarded as initial setting time. Any crack that may appear after initial set may not re-unite.
Final setting time is the time when the paste becomes so hard that the annular attachment to the needle under standard weight only makes an impression on the hardened cement paste.
In order that the concrete may be mixed, transported and placed in position conveniently, it is necessary that the initial set of cement is not too quick. But after, it has been laid; the hardening should be rapid so that the structure can be made use of as early as possible. For an ordinary portland cement, the initial setting time should not be less than 30 minutes while the final setting time should not be more than 600 minutes.

Objectives

To determine the initial and final setting times for the given sample of cement.

Equipment

1. Vicat apparatus with plunger
2. I.S. Sieve No. 9
3. Initial and final setting time needles
4. Measuring jar
5. Weighing balance, etc

BACKGROUND:

The setting time of the cement is influenced by factors such as: percentage of water, amount of kneading the paste, temperature and humidity of the environment. As per codal provisions; this test should be conducted at temperature of 27 degrees and 90% humidity. Flash set and false set are two terms, which are generally encountered in relation to the setting of cements. Flash set refers to the immediate stiffening of the cement paste due to violent reaction of pure cc3AA with water. To prevent flash set gypsum is added to the cement clinker during grinding. A phenomenon of abnormal and premature hardening of cement within a few minutes of mixing with water is termed as false set. It differs from flash set in that no appreciable heat is evolved, and remixing the cement paste without addition of water restores plasticity of the paste and the concrete sets in normal manner without a loss of strength. This happens due to dehydration of gypsum when it comes in contact with excessively hot clinkers during grinding.

Safety Precautions:

1. Clean appliances shall be used for gauging.
2. All the apparatus shall be free from vibration during the test.
3. The temperature of water and that of the test room, at the time of gauging shall be 27 C + 2 C.

Care shall be taken to keep the needle straight.

PROCEDURE:

Preparation of Test Block:

1. Prepare a neat cement paste by gauging 300 grams of cement with 0.85 times the water required to give a paste of standard consistency.

2. Potable or distilled water shall be used in preparing the paste.

3. The paste shall be gauged in the manner and under the conditions prescribed in determination of consistency of standard cement paste.

4. Start a stop-watch at the instant when water is added to the cement.

5. Fill the mould with the cement paste gauged as above the mould resting on a nonporous plate.

6. Fill the mould completely and smooth off the surface of the paste making it level with the top of the mould. The cement block thus prepared in the mould is the test block.

DETERMINATION OF INITIAL SETTING TIME: 1. Place the test blocks confined in the mould and rest it on the non-porous plate, under the rod bearing initial setting needle, lower the needle gently in contact with the surface of the test block and quickly release, allowing it to penetrate into the test block.

2. In the beginning, the needle will completely pierce the test block.

3. Repeat this procedure until the needle, when brought in contact with the test block and released as described above, fails to pierce the block to a point 5 to 7 mm measured from the bottom of the mould shall be the initial setting time.

DETERMINATION OF FINAL SETTING TIME: 1. Replace the needle of the Vicat apparatus by the needle with an annular attachment.

2. The cement shall be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression there on, while the attachment fails to do so.

3. The period elapsed between the time when water is added to the cement and the time at which the needle makes an impression on the surface of test block while the attachment fails to do so shall be the final setting time

Observations and Calculation
1. Weight of given sample of cement is =
2. The normal consistency of a given sample of cement is = %
3. Volume of water addend (0.85 times the water required to give a paste of standard consistency) for preparation of test block = ml

Time in minutes	
Height in mm fails to penetrate	

Result

1. Initial setting time of cement=
2. Final setting time of cement=

PROBING FURTHER QUESTION

1. Determine the Initial setting time of High alumina cement.
2. Determine the final setting time of Rapid hardening cement.

VIVA QUESTIONS:

1. Describe significance of each setting time?
2. How setting of cement differs from its hardening?
3. List out the factors which affect setting times.
4. Does setting time vary with grade of cement?
5. What is do you mean by false set? Why it occurs?

LAB - 5 SPECIFIC GRAVITY OF CEMENT

Introduction

(IS: 2386 PART -3)
Specific gravity is defined as the ratio between weight of a given volumeof material and weight of an equal volume of water. To determine the specific gravity of cement, kerosene is used which does not react with cement.

Objective

To determine the specific gravity of cement using Specific gravity bottle.

Equipment

1. Specific gravity bottle, 100ml, capacity balance capable of weighing accurately upto 0.1gms, kerosene.
2. Funnel.

BACKGROUND

Density of the cement and other material is one of the vital parameter, which determines the design of the concrete. Since concrete mix proposition is done based on the weigh batching not on volumetric so density is most important factor. The specific gravity of cement is important because it is one of the factor which determines the density of the cement. As we know that, the cement may contain lots of moisture content if it is exposed to various conditions and humidity.
water cement ratio is an important factor of cement paste. It is directly proportional to workability and strength of a bonding. If the cement has already more moisture content in it then, the value of water-cement ratio will actually affect the workability and strength of cement paste rather than increasing it.
If the specific gravity of cement is more than 3.19 then, the cement is either not minced finely as per the industry standard or it has more moisture (or water) content, which will affect the mix and bonding. This is why you find many chunks while mixing old stock cement for concrete. Every material contains solid particles and pores, which may contain moisture content due to extreme weather conditions. Which may rise the specific gravity of material.

Safety Precautions

1. The kerosene or Naphtha used should be free from water.
2. The specific gravity bottle and the Le Chatelier flask should be held in a constant temperature water bath sufficiently long to ensure the same temperature before each weighing is made.
3. Duplicate determination of specific gravity should agree within 0.01.
4. While introducing cement, care should be taken to avoid splashing and cement should not adhere to the inside of the flask above the liquid.

PROCEDURE

1. Clean and dry the specific gravity bottle and weigh it with the stopper (W1).

2. Fill the specific gravity bottle with cement sample at least half of the bottle and weigh with stopper (W2).

3. Fill the specific gravity bottle containing the cement, with kerosene (free of water) placing the stopper and weigh it (W3).

4. While doing the above do not allow any air bubbles to remain in the specific gravity bottle.

5. After weighing the bottle, the bottle shall be cleaned and dried again.

6. Then fill it with fresh kerosene and weigh it with stopper (W4).

7. Remove the kerosene from the bottle and fill it with full of water and weigh it with stopper (W5).

8. All the above weighing should be done at the room temperature of 27 0C + 10C.

Observations and Calculation:

1. Create a script in win runner in context sensitive mode?
2. What are the steps for synchronizing test in win runner?
3. Generate test cases for library application using win runner?
4. Generate test cases for online shopping?
5. Generate test cases for bank application?

Description of item	Trial 1	Trial 2	Trial 3 %
Weight of empty bottle W1 g			
Weight of bottle + Cement W2 g			
Weight of bottle + Cement + Kerosene W3 g			
Weight of bottle + Full Kerosene W4 g			
Weight of bottle + Full Water W5 g			

Specific gravity of kerosene Sk = (W4 – W1) / (W5 – W1)
Specific gravity of Cement =

Result:
Specific Gravity of Cement=

PROBING FURTHER QUESTION
1. Determine the specific gravity of different types of cements.

VIVA QUESTIONS:

1. What is the specific gravity of OPC cement?
2. Why water cannot be used for determination of specific gravity of cement?
3. What are the sources of errors in this experiment?
4. If the air bubbles are not completely removed from the flask, how the results will be affected?
5. Why is it necessary to keep the temperature of test chamber constant during this experiment?

Lab 6 - COMPRESSION STRENGTH OF CEMENT

Introduction

The compressive strength of cement mortars is determined in order to verify whether the cement conforms to IS specifications and whether it will be able to develop the required compressive strength of concrete. The average compressive strength of at least three mortar cubes (area of the face 50 cm2) composed of one part of cement and three parts of standard stand should satisfy IS code specifications.

Objective

To determine the compressive strength of standard cement mortar cubes.

Equipment

1. Vibration Machine
2. Poking Rod
3. Cube Mould size conforming to IS : 10080-1982
4. Weighing Balance
5. Trowel
6. Stop Watch
7. Graduated Glass Cylinders

BACKGROUND

The compressive strength test is done on cement, when it is used as cement mortar and concrete. As a construction material, concrete is employed to resist the compressive stresses. While, at locations where tensile-strength or shear-strength is of primary importance, the compressive strength is used to estimate the required property of cement mortar cubes. The mixture of cement and sand in water is generally weak in tension but it is strong in compression when it is subjected to tensile tension with iron rods. The mortar is used for plastering and brick masonry. The first case gives mortar heavy load in form of construction on it by placing bricks on mortar .that is why, it is important to know the strength of the mortar. The strength of the binder (cement) therefore has a significant effect on the performance characteristics of the mixture of cement and sand and ensures the overall quality of the finished product.

Safety Precautions

1. Use hand gloves, safety shoes & apron at the time of test.
2. After test switch off the machine.
3. Keep all the exposed metal parts greased.
4. Keep the guide rods firmly fixed to the base & top plate.
5. Equipment should be cleaned thoroughly before testing & after testing.

Procedure

1. Preparation of test specimens:- Clean appliances shall be used for mixing and the temperature of water and that of the test room at the time when the above operations are being performed shall be 27 ± 2°C.distilled water shall be used in preparing the cubes.
2. The material for each cube shall be mixed separately and the quantity of cement, standard sand and water shall be as follows: Cement 200 g and Standard Sand 600 g.
3. Water (P/4+0.3) percent of combined mass of cement and sand, where P is the percentage of water required to produce a paste of standard consistency.
4. Place on a nonporous plate, a mixture of cement and standard sand. Mix it dry with a trowel for

one Minute and then with water until the mixture is of uniform colour. The quantity of water to be used shall be as specified in step 2. The time of mixing shall in any event be not less than 3 min and should the time taken to obtain a uniform colour exceed 4 min, the mixture shall be rejected and the operation repeated with a fresh quantity of cement, sand and water.
5. Moulding Specimens: - In assembling the moulds ready for use, treat the interior faces of the mould with a thin coating of mould oil.
6. Place the assembled mould on the table of the vibration machine and hold it firmly in position by means of a suitable clamp. Attach a hopper of suitable size and shape securely at the top of the mould to facilitate filling and this hopper shall not be removed until the completion of the vibration period.
7. Immediately after mixing the mortar in accordance with step 1 & 2, place the mortar in the cube mould and prod with the rod. Place the mortar in the hopper of the cube mould and prod again as specified for the first layer and then compact the mortar by vibration.
8. The period of vibration shall be two minutes at the specified speed of 12 000 ± 400 vibration per minute.
9. At the end of vibration, remove the mould together with the base plate from the machine and finish the top surface of the cube in the mould by smoothing the surface with the blade of a trowel.
10. Curing Specimens:- keep the filled moulds in moist closet or moist room for 24 ± 1 hour after completion of vibration. At the end of that period, remove them from the moulds and immediately submerge in clean fresh water and keep there until taken out just prior to breaking.
11. The water in which the cubes are submerged shall be renewed every 7 days and shall be maintained at a temperature of 27 ± 2°C. After they have been taken out and until they are broken, the cubes shall not be allowed to become dry.
12. Test three cubes for compressive strength for each period of curing mentioned under the relevant Specifications (i.e. 3 days, 7 days, 28 days)
13. The cubes shall be tested on their sides without any packing between the cube and the steel plattens of the testing machine. One of the plattens shall be carried on a base and shall be self-adjusting, and the load shall be steadily and uniformly applied, starting from zero at a rate of 35 N/mm2/min.

Observations and Calculation:
1. Type of cement=.....
2. Brand of cement=.....
3. Date of casting=.....

trail No.	Age of cube	Dimensions of the specimen(mm)	weight of cement cube(gms)	cross-sectional area	Crushing Load(N)	Avg Compressive strength (Mpa)
1						
2						
3						

Compressive Strength = Crushing load/Cross section area

RESULT
The average compressive strength of the given cement
1)$3 days \ldots\ldots\ldots\ldots\ldots\ldots\ldots N/mm^2$
2)$7 days \ldots\ldots\ldots\ldots\ldots\ldots\ldots N/mm^2$
3)$28 days \ldots\ldots\ldots\ldots\ldots\ldots\ldots N/mm^2$

PROBING FURTHER QUESTIONS

1.Determine the compressive strength of concrete made with different mineral admixtures.
2. Determine the compressive strength of self compacting concrete.

VIVA QUESTIONS:

1. What will happen if the rate of application of load is more than the specified value?
2. What do you mean by standard sand? Why we need standard sand for present test?
3. What do you mean by standard sand? Why we need standard sand for present test?

Lab 7 - SOUNDNESS OF CEMENT

Introduction

One of the most important properties of cement is its soundness. Unsoundness in cement is caused by expansion of some of the constituents like free lime produced in the manufacturing process of cement. Another possible case of unsoundness is the presence of too high a magnesia content in the cement and presence of excess of lime than that could be combined with acidic oxide at kiln.

OBJECTIVE:

To determine the soundness of the given sample of cement by: Le-chatlier's Method.

REFERENCE

IS : 4031 (Pat 3) – 1988

Equipment

Le-Chatelier Apparatus Cement, Water , Glass plate.

BACKGROUND:

We know that cement is a macro product which consists of 8 micro-ingredients.
1. Lime (60% -65%)
2. Silica
3. Aluminia
4. Magnesia
5. Iron oxide
6. Calcium sulfate
7. Sulfur Trioxide
8. Alkaline

Each has its own set of properties and characteristics in order to make a perfect cement. As you can see lime is the main product which contributes almost 70%.
Deficiency of lime makes the cement set quicker and affects the property of cement. Meanwhile, the excessive amount of lime makes the cement unsound. It means it cause the cement expands more after it gets hardened. Unsoundness of cement makes the work saggy and looks like below one.

Safety Precautions

1. While taking the measurements, good care should be taken.
2. On the mold, while filling it, do not apply more pressure.
3. During boiling the water level should not fall below the height of the mold.
4. The determined expansion should not exceed 10 mm.

Procedure

1. Prepare a cement paste formed by gauging cement with 0.78 times water rag to give a paste of standard consistency. The gauging time should not be less than 3 minutes nor greater than 5 min.
2. On the inner surface of mould. Place the mould on glass sheet & fill it with cement paste taking care to keep the edges of the mould gently together cover the mould with another piece of glass sheet & place a small weight on this Covering glass sheet & immediately sulnnerage the whole assembly in water at a temp of 27 oc & keep it for 24 hrs.
3. Take out the assembly from water after 24 hrs measure the distance flow the indicator points & record its value.
4. Submerge the mould again in water in 25 to 30 minutes.

5. Remove the mould from the water. Allow it to cool & measure the distance the indicator points & record it. The difference b/w two measurements represent the same expansion of cement.
6. The sample should be tested & average of the results should be reported.

Observations and Calculation

Type of Cement Tested	
Initial Length Of The Specimen L1	
Final Length Of The Specimen L2	
Expansion Of The Specimen (L1- L2)	

RESULT:
Soundness of given cement =

PROBING FURTHER QUERSTIONS

1 Determine the soundness of the different types of cements.

VIVA QUESTIONS:

1. What are the causes of unsoundness in cement? List out the methods to reduce unsoundness.
2. Why the cement paste is kept submerged under water during the test?
3. What is the purpose of boiling the setup?

Lab 8 - FINENESS MODULUS OF FINE AND COARSE AGGREGATES

Introduction

Fineness modulus is a numerical index used to know the mean size of particle in the total Quantity of aggregate. Fineness modulus is to grade the given aggregate for most economical mix and workability with less assumption of cement lower FM gives uneconomical mix and higher FM gives harsh mix. It is defined the average cumulative % retained by 100 was known as fineness modulus.

OBJECTIVE

To determine the fineness of modulus of fine aggregate and coarse aggregate.

REFERENCE

IS: 2386 PART – I – 1963

Equipment

Indian standard test sieves set, weighting balance, sieves shaker pan, tray.

BACKGROUND

Aggregates are one of the major constituents of concrete and their properties greatly influence the basic properties of concrete. In this experiment, the moisture content and grading of aggregates are the main issues to be concerned.

The fineness modulus of fine aggregates is an index number which represents the mean size of the particles found in a sand. It is calculated by performing a sieve analysis with standard sieves. The cumulative percentage retained on each sieve is added before being subtracted by 100, which gives the value of fine aggregate. Importantly there is no need to determine the finesse modulus of coarse aggregate.

The fineness modulus of fine aggregates varies from 2.0 to 3.5mm. Fine aggregates with fineness modulus more than 3.2 should not be considered as fine aggregates for concrete. Various values of fineness modulus for different sands are detailed in the table below. The size and shape of particles in the fine aggregate alter the workability of concrete. For example, the use of a very fine sand requires more water to be added to achieve the workability that a coarser sand would provide.

Type of sand	Fineness modulus range
Fine sand	2.2 – 2.6
Medium sand	2.6 – 2.9
Coarse sand	2.9 – 3.2

Safety Precautions

1. The aggregate samples should be air-dried to prevent clogging in sieves.
2. Care should be taken to see that the sieves are not surcharged. The weight of the sand sample should not exceed 500 grams.
3. Sieves should be cleaned gently with soft brushes.
4. Sieving should be done by giving varied motion so that all particles get a sufficient chance of passing through the sieve opening (if done manually).

PROCEDURE

1. Arrange the test services with larger openings at top and smaller openings at bottom and finally below all keep a pan.

2. Take 1 kg of sand in to a tray and break the lumps, if any in case of fine aggregate and 1kg of samples in the case of coarse aggregate and mixed aggregate.
3. Keep the sample in the top sieve and keep the total set in the top sieve and keep the total Set in the shaker. Continue sieving for a period not less than 10 minutes.
4. Weigh the material retained on each sieve property.

Graph Draw a graph between IS sieve size (in log scale) and %passing.
Specification The following limits may be taken as guidance.
Fine sand : F.M—2.2—2.6
Medium sand : F.M—2.6—2.9
Coarse sand : F.M—2.9—3.2

Observations and Calculations:
Fine Aggregate

Sl.No.	IS Sieve Size	Wt. Retained (gm)	% Retained	% Passing	Cumulative % Retained
1	4.75 mm				
2	2.36 mm				
3	1.18 mm				
4	600 micron				
5	300 micron				
6	150 micron				

Coarse Aggregate

Sl.No.	IS Sieve Size	Wt. Retained (gm)	% Retained	% Passing	Cumulative % Retained
1	80 mm				
2	40 mm				
3	20 mm				
4	10 mm				
5	4.75 mm				
6	2.36 mm				
7	1.18 mm				
8	600 micron				
9	300 micron				
10	150 micron				

RESULT
Fineness modulus of fine aggregate =
Fineness modulus of coarse aggregate=

PROBING FURTHER QUESTIONS
1. Determine the fineness modulus of the various aggregate sample collected from different sources.

VIVA QUESTIONS:
1. What are a) fine aggregate, b) coarse aggregate, and c) all-in aggregate?
2. What is the significance of measuring fineness modulus of aggregates?
3. What is a well graded aggregate? How grading of aggregates can be controlled?
4. What is the use of gradation curve?
5. Why well graded aggregate is most suitable for concreting purpose?

Lab 9-BULKING OF SAND

Introduction

Increase in volume of sand due to presence of moisture is known as Bulking of sand. Bulking is due to the formation of thin film of water around the sand grains and the interlocking of air in between the sand grains and the film of water. When more water is added a sand particles got submerged and volume again becomes equal to dry volume of sand. To compensate the bulking effect extra sand is added in the concrete so that the ration of coarse to fine aggregate will not change from the specified value. Fine sands shown greater percentage of bulking than coarse sands with equal percentage of moisture.

Objective

To ascertain the bulking Phenomena of given sample of sand.

Equipment

Container, Sand, Water, Mixing Pan.

BACKGROUND

Bulking of sand is an important volumetric change that takes place in the sand when they are moist. Sand increase in volume, to the extent of 20-30 percent, when they contain moisture between 2-8 percent.

This is because moisture in small proportions forms thin films around the sand grains.

Fine sands bulk greater than coarse sand. When the moisture content is increased beyond 8-10 percent, the bulking of sand effect almost disappears.
It is established that the volume of sand will be more when water is present in it, even in small quantities. Safety Precautions

PROCEDURE:

1. Compact the sand in three layers in the vessel, each layer being given 25 strokes, and strike level at top.
2. Weigh it and dump it into a tray. Add a certain percent of water by weight (say 2%) of dry compacted tray.
3. Add a certain percent of water by weight (say 2%) of dry compacted sand. Mix, well till uniformly moist.
4. Fill the container with the wet sand without any tamping strike tip surface level, and find weight of the wet loose sand.
5. Repeat this with moisture contents of 4,6,8,10,12,14,16,18 and 20%.

Observations and Calculations

Weight of unit volume of dry compacted sand = W1

Weight of loose wet sand of unit volume = W2

If moisture content be x% in sand, and if W3 is weight of dry sand in W2 of loose wet sand,
Then W2 = W3 + (0.01) x W3

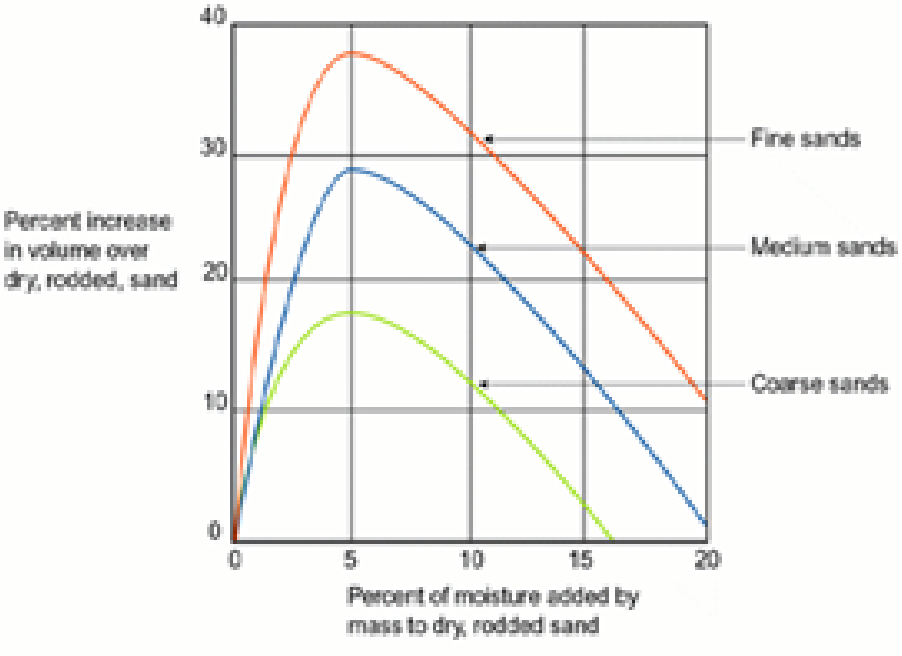
Sl.No.	% of water added (X%)	Wt. of wet sand W2 gm	Wt. of dry sand in wet sand W3 gm. = W2 / (1+0.01 x)	Bulk Factor = W1 / W3	Bulking % = (B.F-1) * 100
1	2				
2	4				
3	6				
4	8				
5	10				

W3 = W2/ (1+0.01 X).

Bulking factor (B.F.) = W1 /W3.

Bulking percentage = (W1 – W3) X 100 / W3.
or (B.F. –1) X 100.

Graph Plot graph between B.F. on (Y- axis) and water content on (X- axis).



Result
1. Moisture content at maximum bulking =
2. Percentage of maximum bulking =

PROBING FURTHER QUESTIONS
1. Determine the percentage of bulking for different samples of fine aggregate.

VIVA QUESTIONS:

1. What is meant by bulking of sand? Why it happens?
2. What is the significance of bulking of sand experiment?
3. Define bulking factor?
4. What is the effect of moisture on bulking?

Lab 10 - WORKABILITY TESTS ON FRESH CONCRETE

Introduction

This is the test extensively used in site work all over the world. Fresh unsupported concrete will flow to the sides and the vertical sinking of concrete is known as slump. The slump cone is a hollow frustum made of thin steel sheet with internal dimensions, as the top diameter 10 cms. The bottom diameter 20 cms, and height 30cms.

Objective

To assess the workability of given concrete mix by slump test.

Equipment

1. Slum cone
2. Graduated cylinder
3. Balance
4. Vibrator
5. Vee bee apparatus
6. stop watch

BACKGROUND:

The word —workability‖ or workable concrete signifies much wider and deeper meaning than the other terminology —consistency‖ often used loosely for workability. Consistency is a general term to indicate the degree of fluidity or the degree of mobility. The factors helping concrete to have more lubricating effect to reduce internal friction for helping easy compaction are given below:
(a) Water Content
(b) Mix Proportions
(c) Size of Aggregates
(d) Shape of Aggregates
(e) Surface Texture of Aggregate
(f) Grading of Aggregate
(g) Use of Admixtures.

Safety Precautions

1. Use hand gloves, safety shoes & apron at the time of test.
2. After test switch off the machine.
3. Keep all the exposed metal parts greased.
4. Keep the guide rods firmly fixed to the base & top plate.
5. Equipment should be cleaned thoroughly before testing & after testing.

Procedure

1. Mix the dry constituents thoroughly to get a uniform colour and then add water.
2. The internal surface of the mould is to be thoroughly cleaned and placed on a smooth, horizontal and non-absorbent surface.
3. Place the mixed concrete in the cleaned slump cone in 4 layers each approximately 1/4 in height of the mould. Tamp each layer 25 times with tamping rod.Using the tampering rod or a trowel strike of the excess concrete above the concrete cone. Measure the vertical height of cone (h1).
4. Slowly and carefully remove in the vertical direction. As soon as the cone is removed the concrete settles in vertical direction. Place the steel scale above top of settled concrete in horizontal position and measure the height of cone(h2).

5. Complete the experiment in two minutes after sampling.
6. The difference of two heights (h1-h2) gives the value of slump.

OBSERVATIONS: • Type of cement=.....
• Brand of cement=.....
• Density of concrete=.....

Trail No.	Proportion	Slump in mm	Remarks
1			
2			
3			

(B) COMPACTION FACTOR TEST

Introduction
The compaction factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete. The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. It is more precise and sensitive than the slump test and is particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration.

Objective
To assess the workability of given concrete mix by compaction factor test.

Equipment
1. Compaction factor apparatus
2. Graduated cylinder
3. Balance
4. Vibrator
5. Vee-Bee apparatus
6. stop watch
7. spatula
8. Trowel
9. Tamping rod

Background Compacting Factor Test: The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. It is more precise and sensitive than the slump test and is particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration. The method applies to plain and air-entrained concrete, made with lightweight, normal weight or heavy aggregates having a nominal maximum size of 40 mm or less but not to aerated concrete or no-fines concrete. Safety Precautions

Procedure
1. Grease the inner surface of the hoppers and the cylinder and Fasten the hopper doors.
2. Weigh the empty cylinder accurately (W1. Kgs) an Fix the cylinder on the base with nuts and bolts.
3. Mix coarse and fine aggregates and cement dry until the mixture is uniform in colour and then with water until concrete appears to be homogeneous.
4. Fill the freshly mixed concrete in upper hopper gently with trowel without compacting.
5. Release the trap door of the upper hopper and allow the concrete of fall into the lower hopper bringing the concrete into standard compaction.
6. Immediately after the concrete comes to rest, open the trap door of the lower hopper and allow the concrete to fall into the cylinder, bringing the concrete into standard compaction.
7. Remove the excess concrete above the top of the cylinder by a trowel.
8. Find the weight of cylinder i.e cylinder filled with partially compacted oncrete(W2kgs).
9. Refill the cylinder with same sample of concrete in approx. 4 layers, tamping each layer with tamping for 25 times in order to obtain full compaction of concrete.
10. Level the mix and weigh the cylinder filled with fully compacted concrete (W3 Kg).
11. Repeat the procedure for different for different a trowel.

Observations and Calculations

Weight of cylinder W1 =..... Kgs

Trail No.	Quantity of material	Mass of cylinder with partially compaction W2 (Kgs)	Mass of cylinder with fully compaction W3 (Kgs)	Compaction Factor
1				
2				
3				

Compaction Factor =

Results

Compaction factor IS =.....

PROBING FURTHER QUESTIONS

1. Determine the workability of different types of concrete.

Determine the workability of high density concrete.

VIVA QUESTIONS:

1. What is meaning of consistency in concrete?
2. What is slump of concrete?
3. What is the significance of shear slump?
4. What is segregation?

Lab 11 - TEST FOR COMPRESSIVE STRENGTH OF CEMENT CONCRETE

Introduction

Concrete is very strong in compression. It is assumed that whole of the compression will be taken up by the concrete while designing any RCC structure. The most important strength test for concrete is the compression test.

Objective

The tests are required to determine the strength of concrete and therefore its suitability for the job.

Equipment

1. Testing Machine
2. Specimen mould
3. tamping rod
4. weighing device
5. Tools and containers for mixing.

They should have knowledge on automated functional tool

PRE LAB

Compressive strength results are primarily used to determine that the concrete mixture as delivered on site meets the requirements of the specified strength.
Everone must know the different grades of concrete, Mix proportions of various grades of nominal mix.

BACKGROUND

Age at Test - Tests shall be made at recognized ages of the test specimens, the most usual being 7 and 28 days. Where it may be necessary to obtain the early strengths, tests may be made at the ages of 24 hours $\pm \frac{1}{2}$ hour and 72 hours $\pm$ 2 hours. The ages shall be calculated from the time of the addition of water to the dry ingredients. Number of Specimens - At least three specimens, preferably from different batches, shall be made for testing at each selected age.

Safety Precautions

1. Use hand gloves, safety shoes & apron at the time of test.
2. After test switch off the machine.
3. Keep all the exposed metal parts greased.
4. Keep the guide rods firmly fixed to the base & top plate.
5. Equipment should be cleaned thoroughly before testing & after testing.

Procedure

• Sampling of Materials - Samples of aggregates for each batch of concrete shall be of the desired grading and shall be in an air-dried condition. The cement samples on arrival at the laboratory shall be thoroughly mixed dry either by hand or in a suitable mixer in such a manner as to ensure the greatest possible blending and uniformity in the material.
2. Proportioning - The proportions of the materials, including water in concrete mixes used for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work.
3. Weighing - The quantities of cement, each size of aggregate, and water for each batch shall be determined by weight to an accuracy of 0.1 percent of the total weight of the batch.

4. Mixing Concrete - The concrete shall be mixed by hand or preferably in a laboratory batch mixer in such a manner as to avoid loss of water or other materials. Each batch of concrete shall be of such a size as to leave about 10 percent excess after moulding the desired number of test specimens.

5. Mould - Test specimens cubical in shape shall be 15 × 15 × 15 cm.
6. Compacting - The test specimens shall be made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance.
6. Curing - The test specimens shall be stored in a place free from vibration in moist air of at least 90 percent relative humidity and at a temperature of 27° ± 2°C for 24 hours ± $\frac{1}{2}$ hour from the time of addition of water to the dry ingredients.
7. Placing the Specimen in the Testing Machine - The bearing surfaces of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen which are to be in contact with the compression platens.
8. In the case of cubes the specimen shall be placed in the machine in such a manner that the load shall be applied to opposite sides of the cubes as cast that is not to the top and bottom.
9. The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing shall be used between the faces of the test specimen and the steel platen of the testing machine.
10. The load shall be applied without shock and increased continuously at a rate of approximately 140 kg/sq cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained.
11. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

Observation:
1) Mix proportion =.....
2) Date of casting=.....
3) Date of Testing=.....
4) Age of concrete=.....
5) Curing history=.....
Results
Compressive strength of concrete =

PROBING FURTHER QUESTIONS
1. Determine the compressive strength of different grades of concrete.

VIVA QUESTIONS:
1. What is the effect of W/C ratio on compressive strength of concrete?
2. Mention the factors those affect the compressive strength of concrete?
3. What is butting of concrete mixture? Why is it done?
4. How does strength correlate with other properties of hardened concrete?

Lab -12 STUDIES ON NON-DESTRUCTIVE TESTING OF CONCRETE

Introduction

Nondestructive testing (NDT) is the process of inspecting, testing, or evaluating materials, components or assemblies for discontinuities, or differences in characteristics without destroying the serviceability of the part or system

Objective

To familiarize the students with the Non-destructive testing, equipment, standard operating procedures.

Safety Precautions

1. Make sure that you know the location of Fire Extinguishers, First Aid Kit and Emergency Exits before.
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. safety or boots).
5. Do not play with valves, screws and nuts.
6. Do not try to run and operate any machine without permission and knowledge of the lab.

Background

The standard method of evaluating the quality of concrete in buildings or structures is to test specimens cast simultaneously for compressive, flexural and tensile strengths.
The main disadvantages are that results are not obtained immediately; that concrete in specimens may differ from that in the actual structure as a result of different curing and compaction conditions; and that strength properties of a concrete specimen depend on its size and shape.

Although there can be no direct measurement of the strength properties of structural concrete for the simple reason that strength determination involves destructive stresses, several non- destructive methods of assessment have been developed.

These depend on the fact that certain physical properties of concrete can be related to strength and can be measured by non-destructive methods. Such properties include hardness, resistance to penetration by projectiles, rebound capacity and ability to transmit ultrasonic pulses and X- and Y-rays. These non-destructive methods may be categorized as penetration tests, rebound tests, pull-out techniques, dynamic tests, radioactive tests, maturity concept.

Methods of Non-Destructive Testing of Concrete

Following are different methods of NDT on concrete:

1. Penetration method
2. Rebound hammer method
3. Pull out test method
4. Ultrasonic pulse velocity method
5. Radioactive methods