**TRIBHUWAN UNIVERSITY**
Institute of Engineering
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Department of Civil Engineering

# A Report on
# Civil Engineering Materials Practical

Course Code: CE-506



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*Date: 2075/11/21*

# *List of Experiments:*

1. Water Absorption Capacity of Brick
2. Compressive Strength of Brick
3. Normal Consistency of Cement
4. Soundness of Cement
5. Setting Time of Cement
6. Compressive Strength of Cement

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TITLE : COMPRESSIVE STRENGTH OF BRICK

OBJECTIVE:

To determine the compressive strength of the given brick samples.

APPARATUS REQUIRED:

1) Compressive strength testing machine
2) Weighing balance
3) Trowel
4) Measuring cylinder
5) Clean plate

MATERIALS REQUIRED:

1) Brick
2) Cement
3) Sand
4) Water

THEORY:

Bricks used in construction work should have adequate compressive strength to resist load. Bricks can be classified according to their compressive strength, into various classes.

| Class of brick | Compressive strength ($N/mm^2$) |
|---|---|
| 1st | more than 10.5 |
| 2nd | 7.0 to 10.5 |
| 3rd | 3.5 to 7.0 |

PROCEDURE:

1) Mortar was prepared by mixing cement and sand in 1:3 ratio.
2) Frog and voids of bricks were then filled with it so as to make the faces parallel and smooth.
3) Then, it was left to dry and after 7 days its strength was measured. For this, the brick sample was placed in the compression testing machine and the maximum load at failure was noted.
4) Compressive strength was obtained by dividing maximum load of failure by area of brick of loaded surface.

TITLE : WATER ABSORPTION CAPACITY OF BRICK

OBJECTIVE :

To determine the water absorption capacity of brick sample

APPARATUS REQUIRED:

a) Weighing machine

MATERIALS REQUIRED :

1) Brick
2) Water

THEORY :

Water absorption capacity of brick is defined as the ratio of weight of water absorbed to the dry weight of the brick in a standard period of time. Water absorption ~~idi~~ indicates the degree of porosity in a brick. Less water absorption ( <20 %) is good quality brick and suitable for contruction work strength, stiffness, and other properties of water decreases with porosity.

| Class of brick | Water Absorption |
|---|---|
| 1st | <20 % |
| 2nd | >20% and <28% |
| 3rd | >28 % |

PROCEDURE

Nepali (local) and Chinese bricks were weighted in dry conditions and then kept submerged fully in water for 24 hours. Then, their weights were measured Then the water absorption capacity was calculated.

OBSERVATION:

Initial weight of Nepali brick =

Final weight of Nepali brick =

Initial weight of Chinese brick =

Final brick of Chinese brick =

CALCULATION:

TITLE: TO DETERMINE THE NORMAL CONSISTENCY OF CEMENT

OBJECTIVE:

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

APPARATUS:

1) Vicat's apparatus with plunger - 10mm dia.
2) Weighing balance
3) Trowel
4) Measuring glass
5) Clean plate to prepare cement paste

MATERIALS:-

1) Cement
2) Water

THEORY:

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 quantity wouldn't complete chemical reaction. Thus, resulting in reduction of strength and more water would increase water to cement ratio and would also reduce the strength. So, a correction proportion of water is required to achieve the proper desired strength while using cement in structures. The correct proportion can be determined by knowing the standard consistency of the cement paste.

Standard cement consistency (Normal consistency)

Standard consistency of cement paste is defined as that cement paste in which Vicat's apparatus pluger of 10mm diameter penetrates 30 to 35 mm top of Vicat's mould in the test. It is expressed as amount of water as a percentage (by weight) of dry cement

## Necessity and uses of standard consistency

Generally, normal consistency of cement is 30% but cement from different factories may not have same properties, so it is necessary to standardize the consistency of the cement used. The knowledge of standard consistency is required for performing other tests like setting time test, soundness test, etc. as these tests are performed with cement paste made using water of standard consistency proportion.

Gauging time : It is the period observed from the time water is added to cement for making cement paste till starting the filling into mould of Vicat's apparatus.

## Vicat's apparatus :

It consists of a metal frame to which is attached a movable rod weighing 300g (along with cap and attachment) and having diameter and length as 10mm and 50mm ~~length is attached~~ respectively. The movable rod is provided with a releasing pin to let the rod free and is attached with an indicator to take readings on a vertical scale which is graduated from 0 to 40mm in either direction which gives the penetration. The Vicat mould is in the form of a cylinder (it can be split into two halves) and is placed on a non-porous plate. There are following three attachments :

i) Square needle : used for initial setting time test
ii) Plunger : used for consistency test
iii) Annular collar : used for final setting time test.

## PROCEDURE

300gm cement was weighted then water, equal to 35% of the weight of cement was added and it was mixed to form paste of cement, then the paste was poured into Vicat's apparatus mould. After preparing the mould, plunger of 1mm dia. was penetrated through it ~~after~~ by first bringing it into contact with the top surface Penetration distance was noted from graduated scale of Vicat's apparatus. Then, by hit and trial method, different volume of water was choosen and same process was carried out until the penetration was obtained within 30mm to 35mm in order to prepare the cement paste of standard consistency, i.e., 5mm to 7mm from the bottom of the mould.

## OBSERVATION

| Percentage of Water Added | Distance from the bottom of the mould |
|---|---|
| 35 % | 3.8mm |
| 30 % | 7.3 mm |
| 33 % | 6.2 mm |

## RESULT

Normal consistency of water was found to be 33%.

## CONCLUSION

Thus, we determined the normal consistency of the cement sample in the lab, using Vicat's apparatus.

TITLE: TO TEST THE SOUNDNESS OF CEMENT SAMPLE

OBJECTIVE:

To determine whether there is presence of lime and magnesium which are uncombined in cement.

APPARATUS:

1) Le- chatelier split cylinder mould with two indicators
2) Weighing balance
3) Measuring cylinder
4) Glass plates
5) Temperature control water bath
6) Scale to measure distance

MATERIALS:

1) 100 gm cement
2) Water

THEORY:

Cement is said to be sound if it doesnot contain uncombined lime and/or magnesium. Any structure has to be durable. Its durability depends on how sound the material is. For cement, soundness depends on its ingredients. Especially, excess causing disintegration. This test is designed to increase expansion in cement by application of head. Expansion beyond certain limit results in unsoundness of cement. Le- chatelier apparatus is used to ~~describe~~ determine the soundness of cement. It consists of small brass cylinder (30 mm diameter, 30mm high and 0.5mm thick).

Two indicator arms with pointed ends of 165 mm are attached to the cylinder one on each side of the split.

## PROCEDURE

100gm of cement was taken and water equal to 33% by weight, i.e. 33 ml was added to make a paste. The paste was poured into split cylinder of Le-chatelier apparatus with glass plate on both sides to cover the mould. Then, it was fully submerged in temperature-controlled (24-35°C) water bath. After 24 hours the distance between the indicators was measured. Then, the mould was immersed in water again and brought to boil in 30 minutes. After boiling for 1 hour the mould was removed and after cooling, the distance between the indicators was again measured. The increase in this distance represents the expansion of the cement. The distance was noted and the difference calculated.

## OBSERVATION:

Distance between indicators before boiling, $d_1$ =

Distance between the indicators after boiling, $d_2$ =

TITLE : TO DETERMINE THE INITIAL AND FINAL SETTING TIMES OF CEMENT

OBJECTIVE:

To know the time to be allowed to pass between mixing of ~~cement~~ concrete and placing in position in structure.

APPARATUS :

1) Vicat's apparatus
2) Weighing machine
3) Trowel
4) Measuring glass
5) Clean plate to make cement paste

MATERIALS:

1) Cement
2) Water

THEORY:

When cement is mixed with water (25 to 30% by weight), sticky paste is formed which remains plastic for a short period. With the passage of time, the plasticity gradually disappears and the cement paste becomes stiff due to initial hydration of cement. This phenomenon by virtue of which the plastic cement changes into a solid mass is known as setting of cement. On setting, the cement binds the aggregates into a solid mass, which gains strength as the time elapses till the hydration of cement is complete. Hydration means reaction of cement with water.

Initial setting time:

It is the time interval between the time when water is added to cement and the time it acquires a certain firmness to resist certain definite pressure, as determined by standard test in which needles make an impression on the test block.

Significance of setting times:

As the loss of plasticity starts at the end of initial setting time, the concrete must be mixed, transported and placed in position before initial setting time. As final setting time approaches, cement becomes harder and harder and concrete can not be placed or deposited

## PROCEDURE

300gm cement was taken and required amount of water was added to form paste of cement then paste was poured in Vacat's apparatus (mould). With the help of square needle of $1mm^2$ area, penetration was checked after every time of 5 minutes interval. Then, the initial setting time was obtained as the difference of initial time and the time when penetration was 5mm from bottom. Then, the mould was tested with annular collar. If it made depression on mould final setting time was considered to have occured

## OBSERVATION

Weight of cement, $w = 300g$

Water added $= w \times 0.85P$ ml, where $P$ = normal consistency $= 33\%$

TITLE: TO DETERMINE THE COMPRESSIVE STRENGTH OF CEMENT SAMPLE

OBJECTIVE:

TO DETERMINE THE SUITABILITY OF CEMENT FOR DEVELOPING REQUIRED COMPRESSIVE STRENGTH OF CONCRETE AND MORTAR.

APPARATUS REQUIRED:

1) Standard mould of 70mm x 70mm x 70mm
2) Vibrating machine
3) Weighing balance
4) Trowel
5) Clean plate to make cement paste
6) Compression testing machine

MATERIALS REQUIRED:

1) Cement - 185gm
2) Fine sand - 185gm
3) Medium sand - 185gm
4) Coarse sand - 185gm

THEORY:

As shrinkage, cracks are formed in dried cement paste, test cannot be carried out properly on a block of cement paste. So, the test is carried out indirectly on blocks of mortar made up of cement, sand and water.

As the quality of sand varies with sources, it is necessary to use sand of standard quality for this test.

Significance of this test:

1) Many other properties of cement concrete or cement mortar such as durability, porosity, shear or tensile strength are related to compressive strength.

2) Compressive strength of cement from different sources or cement of different kinds are different. Thus, this test indicates the quality of cement.

## PROCEDURE:

Cement, fine sand, medium sand, coarse sand, each of 185gm were mixed and then calculated amount of water (90ml) was added to prepare the mortar. Then with trowel, the mixture was poured into a cube of 70mm side and the cube was placed on vibrating machine for the compaction of mortar in the cube. The cube was totally filled with the mixture. After 24 hours, the cube of mortar was taken out from the mould and kept in water for several days. After seven days, the mould was taken out, dried and its compressive strength was measured in the lab with the compressive-strength testing machine.

## OBSERVATION:

Weight of cement = 185 gm
Weight of fine sand = 185gm
Weight of medium sand = 185gm
Weight of coarse sand = 185gm
Water added = $(\frac{P}{4} + 3.5)$ % of the total weight,
where, P = normal consistency of water

Weight of dry cube of cement, sand, water =
Volume of cube = 7cm x 7cm x 7cm = 343 $cm^3$ = 343,000 $mm^3$
Area of cross-section (A) = 70 ~~mm~~ x 70mm = 4900 $mm^2$
Breaking load = ~~128 kN~~ 73kN
Compressive strength = $\frac{73 \text{ ~~125~~ kN}}{4900 mm^2}$ = ~~0.0261 kN/mm²~~

= 14.89 N/$mm^2$