



IES College of Technology

Bhopal

Roll No..... Scholar No.....

REVISION PAPERS

ISSUE



APPLE

Experiment No. 1

Sub:- Meotech Engg. (CE 701)

Determination of water content by oven drying method.

Aim :- To determine water content or moisture content of soil sample.

Apparatus required for oven drying method:-

- i) Hot Air oven
- ii) Non-corrodible air tight containers (3 no's)
- iii) Digital weight machine (accuracy of 0.04% of mass sample)
- iv) Desiccator
- v) Tong

Minimum soil sample quantity :-

- The soil sample collected from the field should be of required quantity to find the water content. The quantity of soil required depends upon the maximum particle size and graduation of soil sample.

Table 1 : Minimum Quantity of soil reqd
for water content determination.

size of Particles & More than 90% of Passing	Minimum Quantity (grams)
425 micron sieve	25
2 mm sieve	50
4.25 mm sieve	200
10 mm sieve	300
20 mm sieve	500
40 mm sieve	1000

* Test Procedure of oven drying method :-

→ The test procedure of oven-dry method to find the moisture content of soil consists following steps.

- In first step, clean and dry the containers and weight them and note down the mass of each container (M_1). Also Note down the number of each container along with its weight.



IES College of Technology

Bhopal

Roll No..... Scholar No.....

PAPERS

VAL

SESSION

S



APPLE

- Collect the soil sample from field. Remove the top layer of soil and collect the wet soil from bottom layers.
- Fill the containers with required quantity of soil sample and weight the each container and note down its mass (M_1) .
- Place the containers in hot air oven, arrange temperature $110^\circ\text{C} \pm 5^\circ\text{C}$ and allow them to dry for 24 hours.
- After ~~20~~ 24 hours turn off the oven and take out the containers using tongs.
- Cool down the container in desiccator for one hour.
- After that weight containers and note down the mass (M_2) of each container.

* observation, and Calculations of oven dry method.

→ The data collected during the test is noted in below data sheet. from this data the water content of given soil sample is calculated by the below shown formula.

$$W = \frac{M_2 - M_3}{M_3 - M_1} \times 100$$

where,

M_1 = mass of empty container with lid,

M_2 = Mass of the container with wet soil and lid,

M_3 = Mass of the container with dry soil and lid.

W = Water Content

or
Moisture content



APPLE



IES College of Technology

Bhopal

5

Roll No..... Scholar No.....

SESSIONAL PAPERS



APPLE

Table : 2 ; Observations and Calculation
of oven dry Method.

S.I. No.	Observations and calculations	Determination No.		
		1	2	3
Observation				
1.	Containers No.			
2.	Mass of empty (M_1)			
3.	Mass of container + dry soil (M_2)			
4.	Mass of container + dry soil (M_3)			
Calculations				
5.	Mass of water (M_w) $= M_2 - M_3$			
6.	Mass of solids (M_s) $= M_3 - M_1$			

Result of oven dry method -

→ Water content of the given soil
Sample - %.

Soil remained - 1

Initial weight - 10 gm

Weight after loss of water - 5 gm

Loss of weight - 5 gm

Water content of the soil - 50%



IES College of Technology

Bhopal

Roll No..... Scholar No.....

EXperiment No - 2

Determination of water content by
Pycnometer.

Aim:- To determine water content OR
moisture content of soil sample.

Apparatus Required for Pycnometer
method :-

Apparatus used in Pycnometer method

are :-

- i) Pycnometer
- ii) weighing balance with an accuracy of 1.0g.
- iii) U-tube rod
- iv) Vacuum Pump.

* Test procedure of Pycnometer method-

→ Test procedure of Pycnometer method
is as follows,

- i) First clean the pycnometer glass tube and
then wash with water.
- ii) Then dry the glass tube.

APPLE

- Wash, clean and dry the Pycnometer and note down its mass (M_1) along with brass cap and washer using weighting balance with an accuracy of 1.0 g.
- Now place a sample of wet soil about 200 to 400g in Pycnometer and note down its mass (M_2).
- Then add water to the soil in the Pycnometer to make it about half full.
- Stir the soil using glass rod to remove air voids of all the soil sample. If available connect the vacuum pump to the soil specimen to remove entrapped air.
- Add some more water and after eliminating the entrapped air stop stirring and fix the brass cap. More water is added through hole in brass cap until the water is flush with the hole.



SESSIONAL PAPERS

SESSIONAL PAPERS



APPLE

- Now take the mass pycnometer (M_3).
- Now empty and wash the pycnometer. Then filled it with only water and take its mass (M_4).

* Observations and Calculations of Pycnometer method.

→ The water content (w) of the soil sample using pycnometer method is calculated from the below formula-

$$w = \left[\frac{M_2 - M_1}{M_3 - M_4} \left(\frac{G_1 - 1}{G_1} \right) - 1 \right] \times 100$$

where, M_1 = mass of empty pycnometer

M_2 = mass of the pycnometer with wet soil.

M_3 = mass of the pycnometer and soil, filled with water

M_4 = mass of pycnometer filled with water only

G_1 = specific gravity of solids.

Table: observations and calculations of Pycnometer method.

S.I No.	Observation and Calculation	Determination No.		
		1	2	3
observation				
1.	Mass of empty Pycnometer (M_1)			
2.	Mass of Pycnometer + wet soil (M_2)			
3.	Mass of Pycnometer Soil filled with water (M_3)			
4.	Mass of Pycnometer filled with water only (M_4)			
calculations				
5.	$M_2 - M_1$			
6.	$M_3 - M_4$			
7.	$(M_2 - M_1) / M_3$			
8.	w (using above formulae)			



IES College of Technology

Bhopal

"

Roll No..... Scholar No.....

SESSIONAL PAPERS



APPLE

Result of Pycnometer Method -

water content of the given soil sample
----- %.



Experiment No. → 03

Determination of soil field density by
with core cutter method.

Aim :- To determine the field density
of soil by core cutter method.

Apparatus :-

1. Cylindrical core cutter
2. Steel rammer.
3. Steel dolly
4. Balance
5. Steel rule
6. Spade or Pickaxe
7. Straight edge
8. Knives

Procedure :

1. Measure of height (h) and internal diameter (d) of the core cutter and apply grease to the inside of the core cutter.
2. Weigh the empty core cutter (w_1)
3. Clean and level the place where density is to be determined.

UNIVERSITY PAPERS

4. Drive the core cutter, with a steel捣棒 on its top, into the soil to its full depth with the help of a steel rammer.
5. Excavate the soil around the cutter with a crow bar and gently lift the cutter without disturbing the soil in it.
6. Trim the top and bottom surfaces of the sample and clean the outside surface of the cutter.
7. weigh the core cutter with soil (w_e)
8. Remove the soil from the core cutter, using a sample ejector and take representative soil sample from it to determine the moisture content.
9. In the form of core cutter to the determination of soil field desity and the completed test from the apparatus.



Observations and Calculations :-

Calculate wet unit weight (γ_{wet}) of the soil using the following relationship.

$$\gamma_{wet} = \frac{(w_2 - w_1)}{v}$$

where,

w_1 = Empty weight of core cutter

w_2 = Weight of core cutter + Soil

v = Volume of core cutter ($\pi D^2 h / 4$)

D = Inner diameter of core cutter.

H = Height of core cutter.

→ The experimental setup of the cylindrical core cutter is first made.

→ The steel dolly is then placed over the cutter to prevent damage to the edges of the core cutter.

→ The surplus soils at both ends is trimmed and the weight of the cylinder with soil is determined.

EXAMINER'S PAPERS

S.I No.	Observations and Calculations	Determination No.			
		1	2	3	
<i>Observations:</i> (i) Adm. water content = 11.9%					
<i>Core cutter No. 100 mm dia.</i>					
1.	Internal diameter	30.0	30.0	30.0	
2.	Internal height	10.0	10.0	10.0	
3.	mass of empty core cutter (M ₁)	3.0	3.0	3.0	
4.	mass of core cutter with soil (M ₂)	13.0	13.0	13.0	
5.	Mass of core cutter with soil (M ₂)	10.0	10.0	10.0	
<i>Calculations:</i>					
6.	$M = M_2 - M_1$	7.0	7.0	7.0	
7.	The volume of cutter V	300	300	300	
8.	water content	11.9	11.9	11.9	
9.	Dry density using the formula	1.6	1.6	1.6	



SESSIONAL PAPERS

• Results of the core cutter method -

The dry density of the soil = g/ml



Experiment No. 4

Aim :- Determination of Field Density test of soil by sand replacement method.

Theory :- The field density test of soil is conducted in the field to know whether the specified compaction is achieved or not. Normally sand replacement method is adopted for this purpose.

- Sand Replacement is also known as sand cone method.
- The apparatus used in this field density test consists of a sand pouring cylinder, with pouring cone at its base.

Test standard :

AASHTO

T99-86

ASTM

D446-82

BS 1377 : Part 4

APPARATUS :

1. Sand Cone Apparatus, filled with uniformly graded sand passing through No. 20 sieve and retained on No. 30 sieve.
2. Density Plate, with a central circular hole of diameter equal to the diameter of Pouring Cone.
3. Diggings rocks
4. Balances sensitive to 1 gm & 0.1 gm.
5. Spoon
6. Brush
7. Moisture containers
8. oven

(a) calibration of APPARATUS

- The cylinder is filled with sand weighed. A calibrating container is placed below the pouring cylinder, and the sutter is opened.



SESSIONAL PAPERS

- * The unit weight of the sand is determined as under :

$$\gamma = \frac{(w_1 - w_2) - w_3}{V_c}$$

where,

w_1 = initial weight of cylinder with sand.

w_2 = weight of sand in the cone only.

w_3 = weight of cylinder after pouring sand into the cone and the contained.

V_c = volume of container.

- (b) Measurement of volume of the hole.

- A tray with a central hole is placed on the prepared group surface which had been cleaned and properly leveled.
- A hole about 100 mm diameter and 150mm deep is excavated in the ground using the hole in the tray as a pattern.
- The soil removed, is carefully collected as weighed (w)

$$\gamma_s = \frac{(w_1 - w_2) - w_3}{V_c}$$

where,

w_1 = weight of cylinder and sand after before pouring into the hole.

w_2 = weight of sand in the cone only

w_3 = weight of cylinder after pouring sand into the hole.

γ_s = unit weight of sand, as found from calibration.

The wet density or bulk density of soil is computed as :

$$\gamma = \frac{w}{V}$$

After determining the water content (m.c) of soil, the dry density of soil is computed as :

$$\gamma_d = \frac{\gamma}{1+m.c}$$

- Through the surface of dry density of soil compacted to the combusted the compressive



NATIONAL PAPER SESSIONS

Sand Replacement method procedure:

1. Calibration of cone apparatus should be done firstly.
2. weight the sand cone apparatus full of known density sand.
3. seat the density plate on leveled clean test ground.
4. Dig out soil 4" to 6" deep with the same diameter as the density plate hole. Clean all loose soil out of the test hole with brush and spoon.
5. collect all the excavated soil and weight it.
6. weight and sand cone apparatus with remaining sand.
7. Collect as much of the sand from the hole as possible.
8. Put a sample of the excavated soil in the weighed moisture container and place it in the oven for water content determination.

S S S S S
TIONAL PAPERS

Precautions

water content determination of sand
Replacement method.

Moisture container no. 6 F 1203

- ① wt. of contained = w_1 15.9 gm.
- ② wt. of container + wet soil. = w_2 34 gm
- ③ wt. of container + wet soil. = w_3 33.2 gm
- ④ wt. of water ($w_2 - w_3$) = 18.1 gm
- ⑤ wt. of dry soil. ($w_3 - w_1$) = 17.3 gm
- ⑥ water content = m.c. = $\frac{(w_2 - w_3)}{(w_3 - w_1)} \times 100$ 46%
- ⑦ Dry density, $\gamma_d = \gamma + 1 + m.c = 2.44 \text{ gm/c.c.}$

→ Showing

Resulting of sand Replacement method

→ The field dry density of soil is 2.44 gm/c.c.