# Compaction Test

**Objectives**

To determine the optimum moisture content and maximum dry density of a soil by standard proctor test.

**Apparatus:**

**Theory :**

**Application**

Due to compaction, the density, shear strength and bearing capacity of soil increase. The result of compaction is to reduce void ratio, porosity, permeability and settlements. The stability of earthen dams, embankments, roads are achieved from results of compaction tests.

**Procedure:**

**Observation and calculations :**

**Standard proctor test**

Volume of mound (v) =

Weight of rammer = 2.5 kg

Number of blows = 25

Number of layers = 3

**Determination of bulk density of soil ($\gamma_b$),**

| Observation no. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1.weight of mould + base plate, $W_1$(g)<br><br>2.weight of mould + base plate + compacted soil ,$W_2$(g)<br>3.weight of compacted soil (w) = ($w_2$-$w_1$)<br>4.Bulk density, $\gamma_b = \frac{w}{V}$ g/cm$^3$ | | | | |

**Determination of water content and dry density of each compacted soil sample**

| Observation no. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Can no.<br>2.weight of can($w_1$)<br>3.weight of can +wet soil ($w_2$)<br>4. weight of can +dry soil ($w_3$)<br>5.weight of water = $w_2$-$w_3$<br>6. weight of dry soil ($w_d$)<br>7.water content<br>W = $\frac{Ww}{Wd} * 100\%$<br>8.Dry density = $\frac{\gamma b}{1+w}$ g/cm$^3$ | | | | |

Plot a graph between dry density and water content and find out the optimum moisture content and maximum dry density from the graph where dry density is plotted as ordinate and water content as abscissa.

**RESULT:**

**DISCUSSION AND CONCLUSION:**

**OBJECTIVES**: **To determine field density of soil by sand replacement method**

**APPARATAUS: ……**

**Theory**: ……

**Procedure** -:

- Determination of density($W_1$) of sand in laboratory
- Density of soil in the field

**Observation and Calculations :**

1) **FOR DENSITY OF SAND:**

Volume of mould ($v_{mould}$) =…$cm^3$

Weight of mould ($W_1$) = …gm

Weight of mould +sand ($W_2$) = …gm

Weight of sand ($W_s$) = ($W_2$- $W_1$) gm

Density of sand=$\frac{(W\,s)}{(V\,mould)}$=$g$/$cm^3$

2) **FOR DENSITY OF SOIL:**

Total weight of vessel+sand($W_1$)=

Weight of tray ($W_2$) =

Weight of excavated soil+tray ($W_3$) = …

Net weight of excavated soil=$W_3$- $W_2$

Now,

After pouring,

Weight of vessel+sand ($W_4$) =….

Weight of cone+sand ($W_5$) =….

Weight of cone ($W_6$) =…….

Weight of total sand ($W_7$) = $W_{1-}$ $W_4$

Weight of sand in cone ($W_8$) = $W_{5-}$ $W_6$

Weight of sand in pit ($W_9$) = $W_{7-}$ $W_8$

Volume of pit = $\frac{W\,9}{density\ of\ sand}$= $cm^3$

Density of soil $\frac{Net\ weight\ of\ excavated\ soil}{volume\ of\ \ pit}$ =gm/ $cm^3$

**RESULTS: ……**

**CONCLUSION: ……**

**Liquid Limit and Plastic Limit**

**Theory:-**

- What is liquid limit?
- What is plastic limit?

**Applications:-**

- From liquid limit and plastic limit we can find flow index, toughness index and plasticity index.
- These gives an idea about plasticity, cohesiveness, compressibility, shear strength and permeability of cohesive soil

**Liquid limit test**

**Objective:-** To determine liquid limit of soil.

**Apparatus:-**

**Procedure:-**

**Observation and Calculations:**

**Liquid limit**

| **Observation no.** | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1.Number of blow (N)<br>2.Can number<br>3.weight of can(w1)(g)<br>4.weight of can +wet soil (w2)(g)<br>5.weight of can +dry soil,w3(g)<br>6.weight of water (ww)=(w2-w3)(g)<br>7.weight of dry soil (wd)=($w_3$-$w_1$)(g)<br>8.Water content w= $\frac{w2-w3}{w3-w1}*100\%$ $=\frac{Ww}{Wd}*100\%$ | | | | |

Plot log N on x-axis and water content(w) on y-axis. From plot find the water content for 25 number of blows (drops) .This gives liquid limit .

## PLASTIC LIMIT TEST

**Objectives:** To determine plastic limit of soil

**Apparatus:-**

**Observation and Calculations:-**

**Plastic Limit**

| Observation no. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1.Can no.<br>2.weight of can $w_1$(g)<br>3.weight of can +wet soil $w_2$(g)<br>4.weight of can + dry soil,$w_3$ (g)<br>5.weight of dry soil ($w_d$)=($w_3$-$w_1$)(g)<br>6.weight of water ($w_w$)=($w_2$-$w_3$)(g)<br>7.plastic limit = $\frac{w2-w3}{w3-w1}*100\,\%$ (water content ) | | | | |

**RESULTS:**

**DISCUSSION AND CALCULATIONS:**

# SIEVE ANALYSIS

**Objective:**

To determine grain size distribution of a soil by sieve analysis

**APPARATUS REQUIRED:**

**Theory:**

**Application:**

The results of grain size distribution are widely used for soil classification, design of filters, construction of earth dam, highway embankments, for construction of building, hydraulic structures and road construction etc.

**Procedure:**

a) Coarse sieve analysis

b) Fine sieve analysis

**Observations and calculations**

**F0R FINE SIEVE ANALYSIS**

Weight of soil taken for analysis =1000gm

| IS sieve size (mm) | Wt. of empty sieve | Wt. of empty sieve +Wt. of soil retained (g) | Wt. of soil retained (g) | Percentage wt. Retained | Cumulative percentage retained | Percentage finer (passing) N |
|---|---|---|---|---|---|---|
| 4.75 | | | | | | |
| 2.36 | | | | | | |
| 1.18 | | | | | | |
| 0.60 | | | | | | |
| 0.30 | | | | | | |
| 0.15 | | | | | | |
| 0.075 | | | | | | |
| Pan | | | | | | |

1. Plot curve between percentage finer and grain size on semi log graph.

2. Find particle size for 10% finer $D_{10}$, particle size for 30% finer $D_{30,}$ particle size for 60% finer $D_{60}$

$D_{60}$ =diameter of particle corresponding to 60% fines

$D_{30}$ =diameter of particle corresponding to 30% fines

$D_{10}$ =diameter of particle corresponding to 10% fines

3. Find uniformity coefficient, Cu

$$Cu = \frac{D60}{D10}$$

4. Find coefficient of curvature,

$$C_c = \frac{D30 * D30}{D60 * D10}$$

**Result:**

Cu =

$C_c$ =

**Conclusion:**