Soil Compaction

Soil compaction is the process of bringing the soil particles close together to dense state by the application of energy.

Compaction- Densification of soil by reducing air voids by application of mechanical energy. Compaction is used in construction of highway embankments, earth dams and many other engineering structures, loose soils must be compacted to improve their strength by increasing their unit weight The degree of compaction is measured in terms of its dry unit weight.

Another Definition of Compaction

Compaction is the densification of soil that is realized by re-arrangement of soil particles with outflow of air only. It is realized by application of mechanic energy. It does not involve fluid flow, but moisture content change.

Purpose of Compaction

1. To improve the shear strength of soils
2. Increases the bearing capacity of foundations
3. To improve the density of soil
4. Decreases the undesirable settlement of structures
5. Reduction in hydraulic conductivity
6. To reduce shrinkage of soil.
7. Increasing the stability of slopes on embankments.
8. To reduce the frost susceptibility of soil.

Role of Water in Compaction

For a given soil, the dry unit weight increases as water is added to the soil. This continues up to certain moisture content.

Beyond this moisture content, more water added will fill the void space with water so further compaction is not possible.

The moisture content at which the maximum dry unit weight is attained is generally referred to as the optimum moisture content.

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Laboratory Compaction tests

Purpose: Find the maximum dry unit weight and corresponding optimum moisture content.

The standard was originally developed to simulate field compaction in the laboratory There are two types of standard tests

1. Standard Proctor test

2. Modified Proctor test

Figure : Proctor molds and rammers

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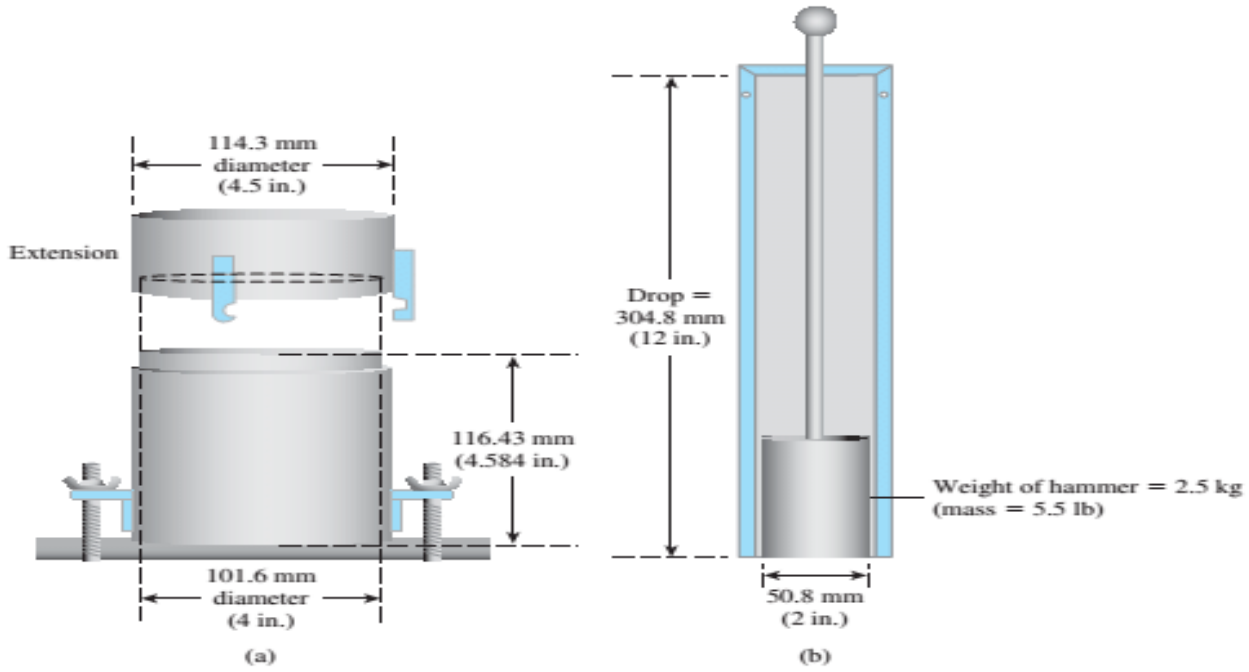

OBJECTIVE

The objective of this experiment is:

- **To evaluate the maximum dry unit weight, $\gamma_{d(max)}$ and optimum moisture content, w_{opt}, of compaction.**

Factors Effecting Compaction

<u>Factor Affecting Soil Compaction</u>:

1- Soil Type

2- Water Content (w_c)

3- Compaction Effort Required (Energy)

4- Compaction method

Type	Strength	Compressibility	Permeability	Interaction with Water	Uses	Problems
Gravel	High	Low	V. High	No effect	Pavement bases Filters	Prone to caving Small clay content affects properties
Sand	High	Low	High	Workable over wide range	Wide range of uses Fills (hydraulic) Backfill	Poor at ground surface Prone to caving Prone to erosion
Low plasticity silts/clays	Low	High	Low	Lose strength when wetted	Fills	Prone to frost heave Collapse potential
High plasticity silts/clays	Low	High	V. Low	Lose strength when wetted	Landfill covers/liners	Poor workability (sticky) Swell/shrink potential
Organics	Low	High	-	-	Landscaping	Typically removed

FIELD COMPACTION

Commonly by use of rollers.

Type of roller depends on the type of soil and the degree of compaction required. The roller may be self-propelled or towed. The most common types of rollers are:

1-Smooth-wheel roller

2-Pneumatic rubber-tired roller

3-Sheep-foot roller

4-Vibratory roller

5. Grid roller

Advantages of the Improved Design of the equipment Rollers

These features ensure high performance capabilities. The rollers with these features provide better, economical and more effective compaction.

1. Equal drum diameter

2. Centre-pin steering

3. Independent steering for front and rear drums (axles)

4. All wheels driven

VIBRATORY ROLLERS

a. Smooth drum-and-tire type vibratory roller
b. Pad-foot drum-and-tire type vibratory roller
c. Double-drum type vibratory roller
d. All-drum drive and vibration vibratory roller
e. Tractor towed vibratory roller
f. Hand-guided vibratory roller

COMPACTING CAPABILITY OF ROLLER

The amount of material (weight or volume) compacted to the specified density by a given roller per unit time is known as the capability of roller. It depends on the following factors.

1. Working width (W)

2. Speed of roller (S)

3. Number of passes (N)

4. Thickness of layer (D)

Asphalt Compaction

Theoretical capability =(W*S/N) *D*G

Soil Compaction

Theoretical capability = (W*S/N) *D

FACTORS AFFECTING FIELD COMPACTION

Following are the factors, which affect the field compaction.

1. Type of the compacting equipment
2. Field moisture content
3. Number of passes of the compacting equipment
4. Thickness of the lift (layer)
5. Speed of the compacting equipment
6. Soil type

Relation between dry density and number of roller passes

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