جامعة بيرزيت

BIRZEIT UNIVERSITY

Faulty of Engineering and Technology

Civil Engineering Department

Soil Lab

ENCE311

Experiment #6 :

" Field unit weight by sand cone method "

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Introduction :

Field density test (sand cone method): The sand cone method is one of the most popular methods used to test field density in highway construction . A dry density test is performed in the field to check the pressure of the layers. Compression is very useful for setting up sub-base pitch and other pavement layers. Pressure is applied in the construction of the dam to increase stability as well as to decrease stability . In field pressure, the pressure moisture content must first be controlled and the adequacy of rolling must be controlled by checking the dry density achieved and comparing with the maximum dry density. In most earthworks specifications, the contractor is required to achieve a compressed field dry unit weight from 90 to 95% of the maximum Weigh the dry unit specified in the laboratory.

*Degree of compaction (R) = dry density (field)*100% / max dry density .

*dry density (field) = weight of solid soil particles / volume of the haul

the volume of haul equal the volume of sand required to fill the haul

*To determine the weight of the sand remaining in the cone after opening the nozzle:

$$W_3 = W_1 - W_2$$

Where:

W_1: Weight of jar and sand before open the nozzle on flat table.

W_2: Weight of jar and sand after open the nozzle on flat table.

W_3: Weight of sand in the cone.

*To determine the volume of sand required to fill the haul :

$$\text{Unit weight (sand)} = w_4\text{-}w_5\text{-}w_3 \text{ /volume of cylinder.}$$

Where:

W_4: Weight of jar and sand before fill the mold.

W_5: Weight of jar and sand after fill the mold.

W_3: Weight of sand in the cone.

*Volume of haul = ($W_6 – W_7 – W_3$) * (unit weight (sand))

Where:

W_6: Weight of jar and sand before fill the haul.

W_7: Weight of jar and sand after fill the haul.

W_3: Weight of sand in the cone.

Purpose :

Soil compaction is a common process in most construction projects and increases the strength and stability of the soil to support earthworks, structures and pavements. The techniques for achieving the maximum soil density are well known, and the main goal of this experiment is to know the degree of compression, which is an important factor in order to know the amount of water present and the extent of validity of the project.

Materials and Equipment's :

Look at the **" Table 1 "** that show the equipment we used in this experiment :

Equipment	The name of it :	Equipment	The name of it :
 Figure 1	**Plates**	 Figure 2	**Plastic jar filled with sand**
 Figure 3	**Tools for field digging**	 Figure 4	**Base Plate**
 Figure 5	**Balance**	 Figure 6	**Oven**

" Table 1 "

Procedure :

Calibration of cone :

1- The gallon bottle was filled with sand. The weight of the bottle +cone +sand was also determined (W_1), the valve of the cone which is attached to the bottle was closed well.

2- The base plate was placed on a flat surface and then the bottle with the cone attached to it was turned upside down and placed the open mouth of the cone in the center hole of the base plate.

3- The cone valve was opened. And then Sand will flow out of the bottle and gradually fill the cone. When the cone is filled with sand, the flow of sand from the bottle will stop.

4- The cone valve was closed. The bottle and cone combination was removed from the base plate and its weight (W_2) was determined.

5- The weight of sand that fill the cone = $W_1 - W_2$ was determined

Determination of dry unit weight of sand and Procedure of field work :

1- The unit weight of the sand that is wanted to fill the hole in the field by finding the weight of the needed sand to fill a certain volume (mold) with a diameter of 15 cm and height of 15 cm, which is named by the calibration of unit weight so we know the volume and the weight of the sand which is fell it.

2- The weight of the sand jar and the cone which are taken to the field was determined.

3- Then in the field after choosing the spot that's where the hole would be, the plate will be placed and a hole with depth 15 cm was excavated with borders of the plate's hole.

4- While digging the hole all the resulted soil was put in a plastic bag except the aggregates which is larger than 3/4 inch which should be put back in the hole to avoid errors in calculations.

5- Having the valve closed turn the gallon +cone upside down and place the cone in the centre hole of plate and open the valve so that sand flows to the hole .

6- After flow of sand stops the valve was closed, and the weight of the gallon + remain sand + cone was determined after returning back to the laboratory.

7- The weight of the sand which was taken from the hole was determined.

8- Then this resulted sand was taken and put in the oven for 24 hour.

9- The weight of the resulted sand was taken after 24 hour.

Data and Calculations :

Part One : Calibration of sand cone	
Weight of plastic jar filled with sand (W_1) " g "	**6127.5**
Weight of plastic jar with sand after use (W_2) " g "	**4452.5**
Weight of sand in the cone (W sand in the cone) = $W_1 - W_2$ = **1675 g**	

Part Two : Finding unit weight of sand (γ_{sand})	
Weight of plastic jar filled with sand (W_3) " g "	**9043**
Weight of plastic jar with sand after use (W_4) " g "	**1532.5**
Volume of cylinder " Cm^3 "	**4021.5**
Weight of sand in the cylinder = $W_3 - W_4$ – W sand in the cone = **5835.5 g**	
$\gamma_{sand} = \frac{\text{Weight of sand in the cylinder}}{\text{Volume of cylinder}}$ = **1.45 g/cm^3**	

Part Three : Finding dry unit weight for soil (γ_d)	
Weight of plastic jar filled with sand (W_5) " g "	**9934**
Weight of plastic jar with sand after use (W_6) " g "	**6127.5**
Weight of wet sample " g "	**3504.5**
Weight of dry sample (oven dry) " g "	**3443.5**
Weight of sand in the hole = $W_5 - W_6 -$ W sand in the cone = **2131.5 g**	
Volume of the hole = Volume of sand in the hole = $\frac{\text{Weight of sand in the hole}}{\boldsymbol{\gamma}\textbf{ sand}}$ = **1470 cm^3**	
$\boldsymbol{\gamma}_{\text{moist}} = \frac{\text{Weight of wet soil sample}}{\text{Volume of hole}}$ = **2.078 g/cm^3**	
w% = $\frac{\text{Weight of wet soil sample + Weight of dry sample}}{\text{Weight of dry sample}}$ = **2.018%**	
$\boldsymbol{\gamma_d} = \frac{\boldsymbol{\gamma}\text{ moist}}{1+\text{w}\%}$ = **2.037 g/cm^3**	

Results and Conclusion :

Results :

γ_d = 2.037 g/cm^3

Conclusion :

In this experiment we intend to check the compacted dry unit of soil and compare it with the specification for the construction after that we calculate the relative density percentage.in the specification the relative density (%) can be accept if it's fall between (90- 95)%. Errors can come from: human errors, error in balancing, and the field sample has a lot of particles that is larger than 3/4 in. so the results different widely from the real, we use in this experiment the Ottawa sand to determine the volume of the hall because it's have a well graded and similar grainsize which will give us an accurate volume .

Sources of errors :

- The plate that we used it to make the hole its not stable .
- The table is subjected to vibration, which causes the sample to be compressed .
- The sample that we put in the tool was found to contain large grains of sand, which affects the brewed sample .
- Perhaps it was not noticed that the sand comes down from the sand cone tool . When the sample came from, it was wrong .
- If we met a rubble pieces when are digging the hole then we have to neglect it so it will give a wrong mass of soil according to the volume .

References :

- Soil lab manual
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