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STUDY OF ENHANCEMENT OF CARRYING CAPACITY OF FOUNDATION IN SOFT CLAY SOIL USING SAND PILE

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Abstract - *The enhancement of carrying capacity of foundation by soil confinement using sand piles with external links under axial loads. The soil is confined laterally using PVC pipes and external links. The load carrying capacity of the sand piles were tested using Universal Testing Machine. Load carrying capacity and the deflection of the specimen were determined. The failure pattern of the sand pile under axial and lateral pressure was investigated.*

Key Words: soil confinement, sand pile, lateral pressure

1. INTRODUCTION

The strength and the carrying capacity of soil is improved by confining the soil. The confinement of soil means not allowing water to escape or the application of pressure from all sides. This pressure is provided as soil is entrapped or covered with a PVC ,if it does not let soil move in lateral direction which give confined pressure. Continuous application of load causes disorientation of soil particles in foundation which causes displacement and settlement. Confinement of soil helps to avoid disorientation of soil particles hence increases strength of soil.

Soil stabilization is the alteration of soils to enhance their physical properties. Stabilization can increase the shear strength of soil and/or control the shrink-well properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundation.

This method of soil confinement helps to stabilize the soft clay soil. During the application of load the sand pile gets compacted and exerts certain stress and strain towards the external load. At a certain point the sand pile exerts pressure towards the surrounding clay soil. Due to the continuous pressure in the soft clay soil its gets compressed and the voids in it gets reduced. So that the soil is compacted and packed tightly which helps in the stabilization of soil.

1.2. SCOPE AND OBJECTIVE

a) To study the overall failure pattern of confined soil.

b) To study the deformation of soil by gradually increasing the load on soil.

c) To increase the deformation of soil with different intensity of loads.

d) To study the strength improvement of soil with PVC pipes and external rings.

1.2 . PROBLEMS IDENTIFICATION

a) There is a problem of uneven settlement in soft soils.

b) This problem can be solved by the installation of sand piles.

c) The method of lateral confinement of soil helps in proper stabilization of soft soil and hence safe bearing capacity of soft soil is increased.

d) Thus the strength and carrying capacity of soil is increased.

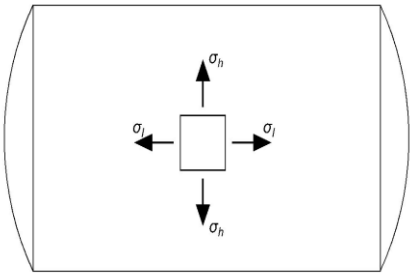
HOOP CIRCUMFERENTIAL STRESS:

The hoop stress is acting circumferential and perpendicular to the axis and the radius of the cylinder wall.

$$\sigma h = (p d) / 2t$$

where,

- σh = hoop stress due to soil pressure (Mpa)
- p = internal pressure in PVC pipe
- d = internal diameter of PVC pipe (mm)
- t = thickness of PVC pipe (mm)



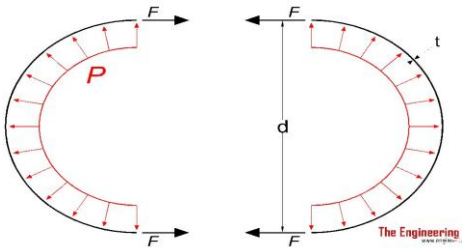
LONGITUDINAL AXIAL STRESS

For the cylinder closed at both ends internal pressure creates a force along the axis of the cylinder. The longitudinal stress caused by this force can be calculated as,

$$\sigma l = (p d) / 4t$$

where,

- σl = longitudinal stress (Mpa)



2. EXPERIMENTAL INVESTIGATION

COLLECTION OF MATERIALS:

A. : PVC Pipe:

- Length = 500mm
- Diameter = 180mm

B. PVC caps

PVC caps of diameter 180mm are used to close the PVC pipes at the bottom.

C. Steel Plate

Steel plate of 180mm diameter and 2mm thickness is used to apply load evenly on the top surface of the PVC filled with sand.

D. Steel Rings

Steel rings of 180mm diameter is used for the lateral confinement of soil with bolts and nuts

3. TEST ON SANDY SOIL

3.1 GRAIN SIZE DETERMINATION BY SIEVE ANALYSIS

- % of material retained on any sieve = (Mn / M) x 100
- Percentage finer, N = 100 – cumulative percentage retained
- Co-efficient of uniformity, Cu = D60 / D10 = 6.5
- Co-efficient of curvature, Cc = $D30^2$ / (D10 x D60) = 1.9

Fig.1 grain size determination by sieve analysis

3.2 DIRECT SHEAR TEST

- Type of soil = Sandy Soil
- Size of Shear box = 6 cm x 6 cm
- Proving ring constant = 0.243
- shear stress = load / Area

Normal stress Kg/sq.cm (σ)	Shear Load		Shear Stress Kg/sq.cm
	Div	In Kg	In Kg
0.5	9.3	0.063	2.26
0.8	11.4	0.077	2.77
1.0	15.6	0.13	4.72
1.5	27.1	0.183	6.59
2.0	36.4	0.246	8.84
2.5	44.2	0.299	10.74

3.3 TEST OF SAND PILE WITH EXTERNAL RINGS IN UNIVERAL TESTING MACHINE

1. PVC pipe is filled with sand in three layers and compacted 25 times for each layer.
2. The PVC is confined with 2 rings at the top and 2 rings at the bottom followed by 1, 2 and 3 rings at center.
3. The PVC is placed in universal testing machine and tested.
4. The ultimate compressive load and the deflection is noted.

S.NO	Lateral confinement	Ult. Load (F max) (kN)
1	Without rings	30.7
2	Top 2 rings & bottom 2 rings	40.6
3	2 rings @ top & bottom with 1 ring at center	46.3
4	2 rings @ top & bottom with 2 ring at center	53.1
5	2 rings @ top & bottom with 3 ring at center	59.3

Fig.2 Sand Pile with external ring

Fig.3 Sand Pile with external rings in UTM

Fig. 4 Failure Pattern of the sand pile

4. CONCLUSION

The discussion above presented the data relating to the enhancement of carrying capacity of soft clay soil using sand pile installation. The improvement of bearing capacity in soil is studied using sand pile using PVC pipes and the external rings. The load bearing capacity of soil is increased by confining the soil laterally according to theory of thin cylinders.

When compared to the sand pile without external rings the sand pile confined with external rings is said to have increased carrying capacity. The more the external rings are added the more the bearing capacity of the soil.

Also due to even distribution of load the stress in the sand pile exerts pressure towards the soft clay soil and hence helps in further compaction and stabilization of the soft clay soil which helps in the further enhancement of the strength and bearing capacity of the soil. Thus the problem of uneven settlement in soft caly is rectified

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