International Journal of Civil Engineering and Technology (IJCIET)
Volume 8, Issue 8, August 2017, pp. 1581–1588, Article ID: IJCIET_08_08_172
Available online at http://http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=8&IType=8
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

© **IAEME** Publication **Scopus** Indexed

AN EXPERIMENTAL STUDY ON EFFECT OF CONE DIAMETERS IN PENETRATION TEST ON SANDY SOIL

K. Venkat Raman, P. Dayakar
Department of Civil Engineering, BIHER, Bharath University, Selaiyur, Chennai, Tamilnadu, India

Dr. K.V.B. Raju
Director, GITAM University, Bengaluru

ABSTRACT

Cone Penetration Test (CPT) is an exploration tool used in site investigation and soil exploration. It has a long history in geotechnical engineering. From the basic tool of the Dutch to the advanced integrated modulus type, CPT had developed so much over the years. A considerable amount of experience and knowledge have been gained on the value of this method in the understanding and evaluation of the local soils behaviour. The sand collected from the Construction site of has been tested using CPT with different void ratio and different Diameters of 25mm, 20mm, 15mm. This study extracts about the effect of cone diameter in cone penetration test on sand, effect of moisture content on diameter, effect of Void ratio on cone diameter it can be concluded that the greater the Diameter, the lesser will be the Depth of penetration and Higher Penetration resistance

Keywords: Cone Diameter Sandy Soil

Cite this Article: K. Venkat Raman, P. Dayakar and Dr. K.V.B. Raju, An Experimental Study on Effect of Cone Diameters in Penetration Test on Sandy Soil, International Journal of Civil Engineering and Technology, 8(8), 2017, pp. 1581–1588.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=8&IType=8

1. INTRODUCTION:

CPT has been used for penetration test for quality control in sand of very uniform water content. It can also be derived to find the relationship between the cone penetration resistance and the liquefaction strength of the sand. It can also be used to estimate material properties of the soil such as its stiffness and strength in case of subgrade soil. Deepika. Chukka, Chakravarthi .V.K (2011) stated that as the void ratio decrease due to the effect of moisture content on DCPI, the value decreases as the bearing ratio also increases. The DCPI can be used to determine average CBR and the relation can be expressed as log. K. Been & A.

Quiñonez (2008) It is also apparent from these conclusions that there are many soils that do not easily fit the idealized "sand" or "clay" behaviour, on which much of soil mechanics depends.

Zakia.A Baghdadi, Fouad M. Ghazali and Ahmed M. Khan (2009) Provision of sleeve pipe around penetration rod greatly helped in accurate measurement of cone resistance *(q_c)* alone. The cone resistance is found to vary linearly with depth or surcharge for the same relative density of a homogeneous (sandy) soil strata. Abouzar Sadrekarimi (2012) the pore-pressure sensor, in particular, provides valuable information on thin layers of more, or less, permeable material, within a soil matrix. Isotropic consolidation has no effect on the shear strength of the soil at large displacements. Some of the widely used correlations to estimate the soil unit weight and relative density of loose sands were also evaluated.

2. METHODOLOGY

2.1. Properties of Sand

In a soil, the gravel, sand, silt and clay fractions are recognized as containing particles of decreasing magnitude. The results of soil properties may also be represented graphically in the form of a grain size distribution curve in which the cumulative percentages finer than known equivalent grain sizes are plotted against these sizes, the latter being on a logarithmic scale. The index properties of the sand used in this project work is furnished in table 1

Table 1 Properties of sand

Description	Sand
Specific Gravity	2.6
D_{10}	0.32
D_{30}	0.45
D_{60}	1.3
Cc	0.49
Cu	4.06
γ_{dmax}	1.89
OMC	14.8
e_{max}	0.629
e_{min}	0.525
e_{avg}	0.577

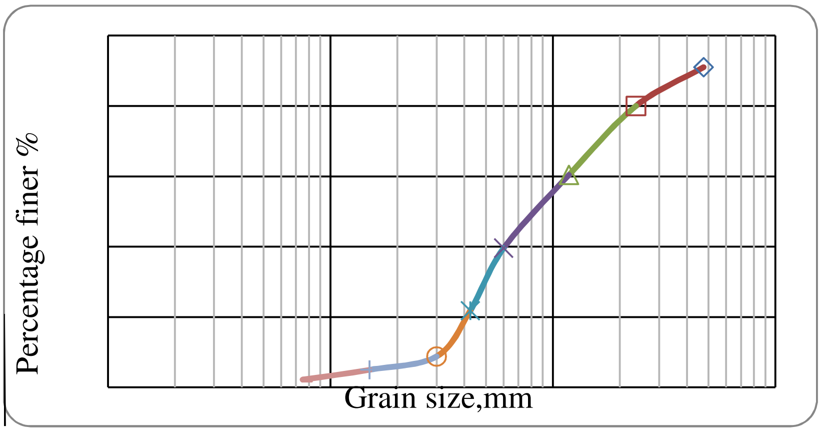

Figure 1 Particle size distribution analysis

This deals with the method for the determination of grain size distribution in soils. An analysis of this kind express quantitatively the proportions by mass of the various sizes of particles present in the soil. The purpose of a compaction test is to determine the proper amount of mixing water to be used, compacting the soil in the field and the resulting degree of denseness which can be expected from compaction at optimum moisture content.

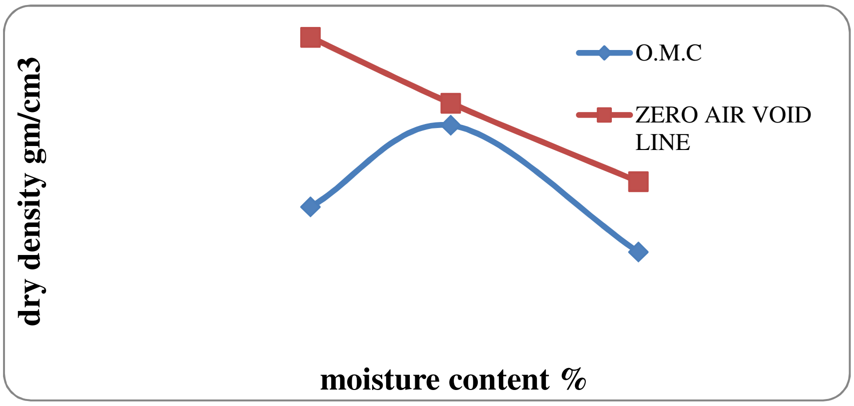

Figure 2 Compaction characteristics of sand

2.2. Cone Penetration Test,

The test method consists of pushing an instrumented cone, with the tip facing down, into the tank at a controlled rate, The resolution of the CPT in delineating stratigraphic layers is related to the size of the cone tip, with typical cone tips having a diameter of 15mm,20mm,25mm.and the setup for the experiment is shown in fig 3.

Table 2 Details of the experimental setup

Sl.no	Description	Value
1	Cone diameters	15mm,20mm,25mm
2	Tank size	20cmx20cmx20cm

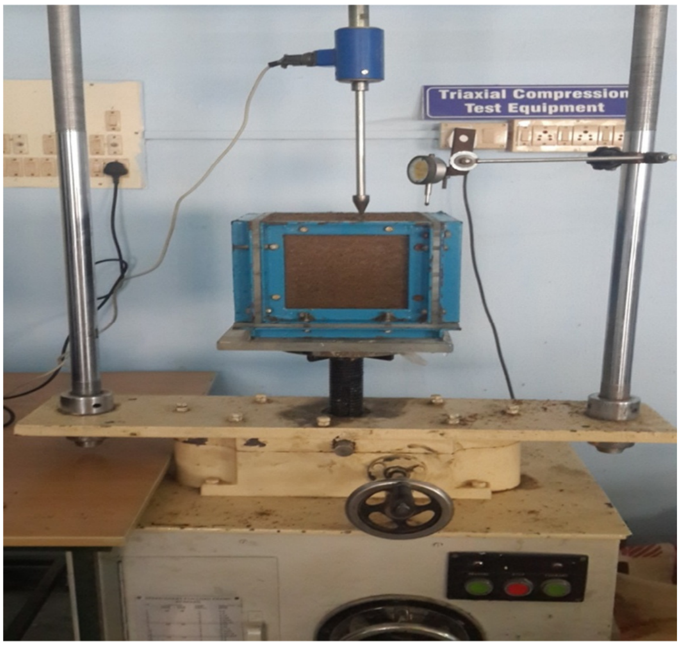

Figure 3 Setup of Cone Penetration Test on sand

The notations followed for various states of sands for determining the effect of cone diameter is furnished in table 3.3. CPT is carried out by progressively penetrating the soil under static force. Usually 60° cone (10-15 cm^2 area) is pushed at the rate of 1-2 cm/sec approximately till the final depth is reached. Continuous record and easing penetration resistance are maintained.

3. RESULT AND DISCUSSION

A method of testing soils by penetrating a cone of standard dimensions into the soil under a known load and there displacement, Penetration of cone is done with the medium dense and dense in dry state and respectively in the wet state of sand varying with different diameter of the cone.

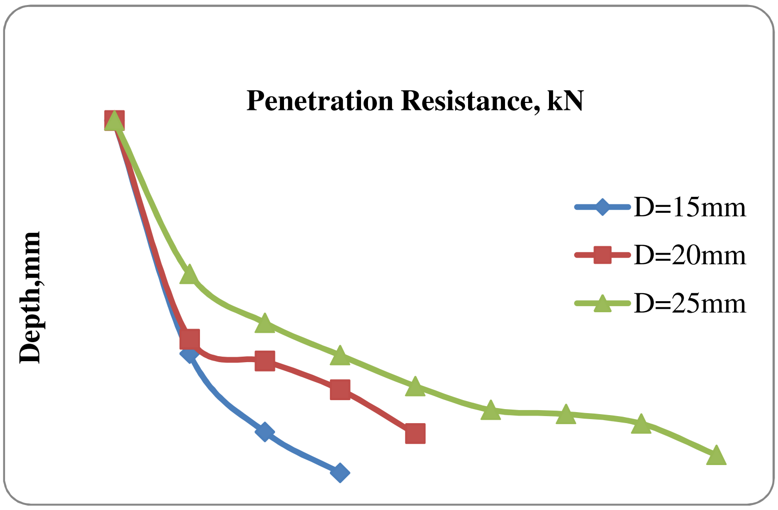

Figure 4 Penetration resistance vs Depth in mm with different diameter of cone

The figure 4 shows the 25mm diameter takes more load than its smaller counterparts at a given depth. At a specific depth (say 30mm),uniformity is seen in 15 and 20mm diameter of cone while a greater cone diameter such as 25mm diameter will vary due to larger skin friction of the cone.

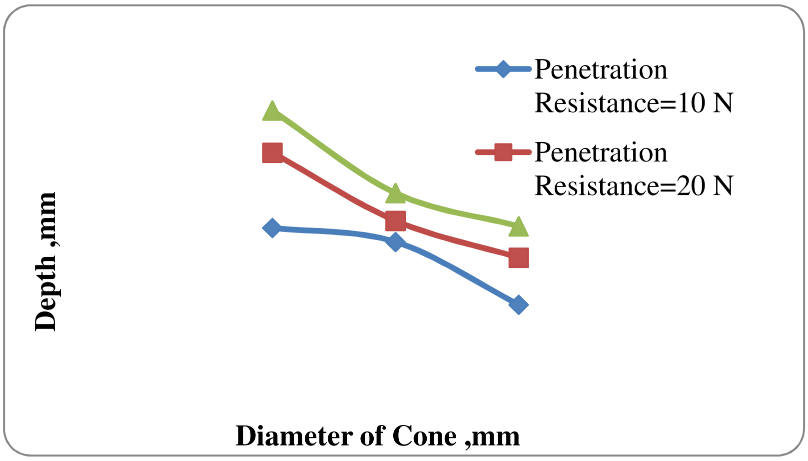

Figure 5 Depth of penetration vs Cone Diameter in different load

From the graph shown above, declares clearly that the diameter of the cone has its effect in the penetration on the sandy soil, the penetration resistance of 10N, 20N and 30N, was taken as a constant to check on the effect of the diameters of a cone on the process.

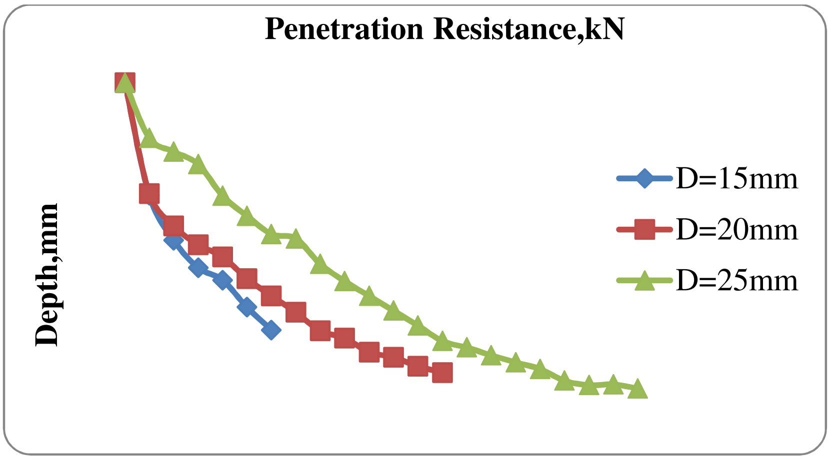

Figure 6 Penetration resistance vs Depth with different diameter of cone in saturated sandy soil

From the relationship between Penetration resistance and depth as, it can be stated that the diameter has its effect in the penetration test done on saturated sandy soil, the larger the diameter the more resistance it takes and less depth required, and the lesser the diameter of the cone the less load it will takes with maximum depth

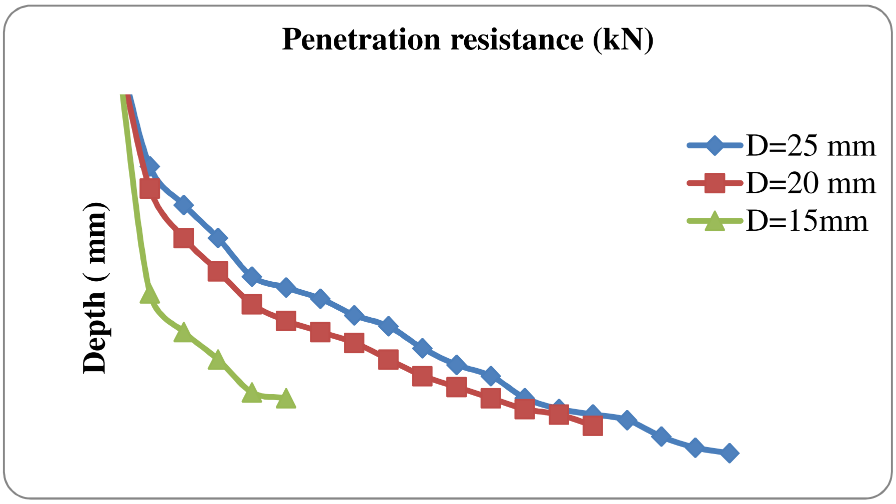

Figure 7 Penetration resistance vs Depth with different diameter of cone

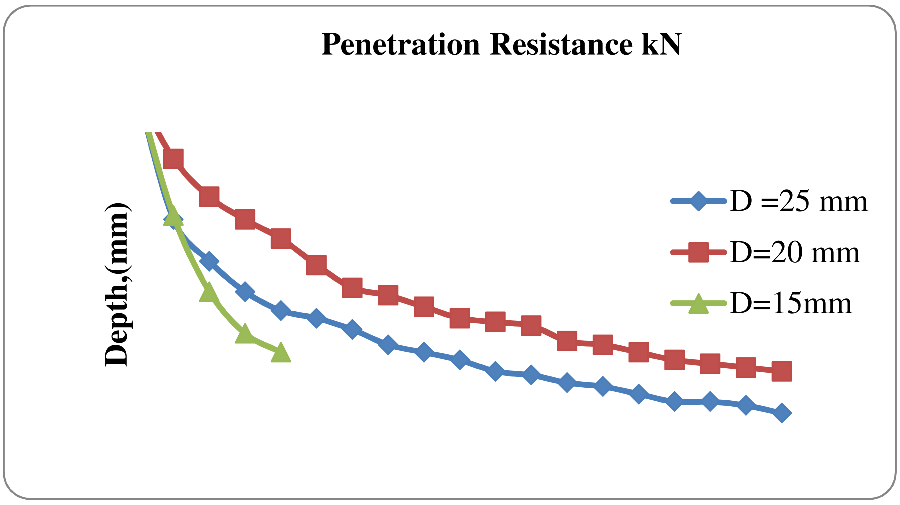

Figure 8 Penetration resistance vs Depth with different diameter of cone

In this graph, all the three diameters takes more loads because the dry density of the soil is more compare to the other state and it is noticed that 20mm and 25mm diameters seems to be parallel to each other from the depth of 40mm onwards. This show the linearity of their proportionality of their property

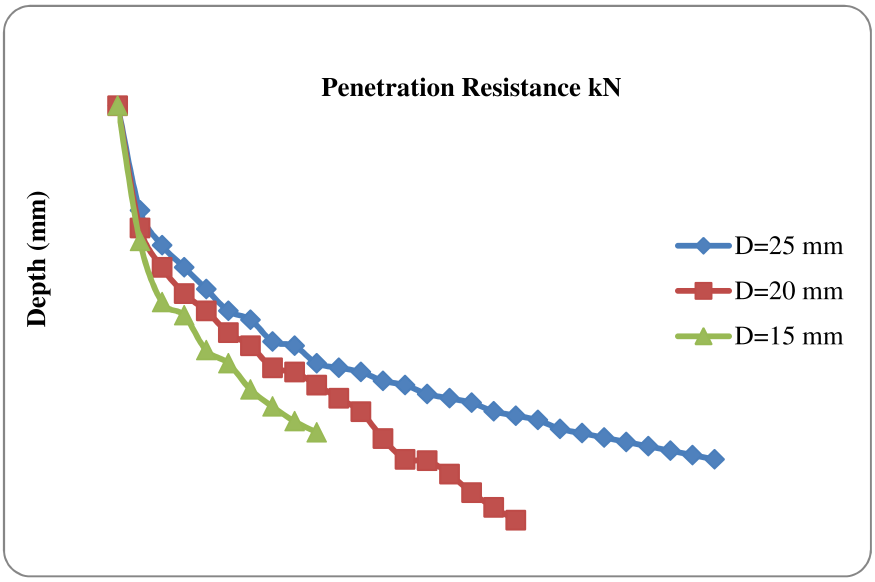

Figure 9 Penetration resistance vs Depth with different diameter of cone

From this graph, it is observe that as the depth increases, the larger diameter takes more load due to its size and it clearly seen that at 25mm depth the load is same for all the three diameters.

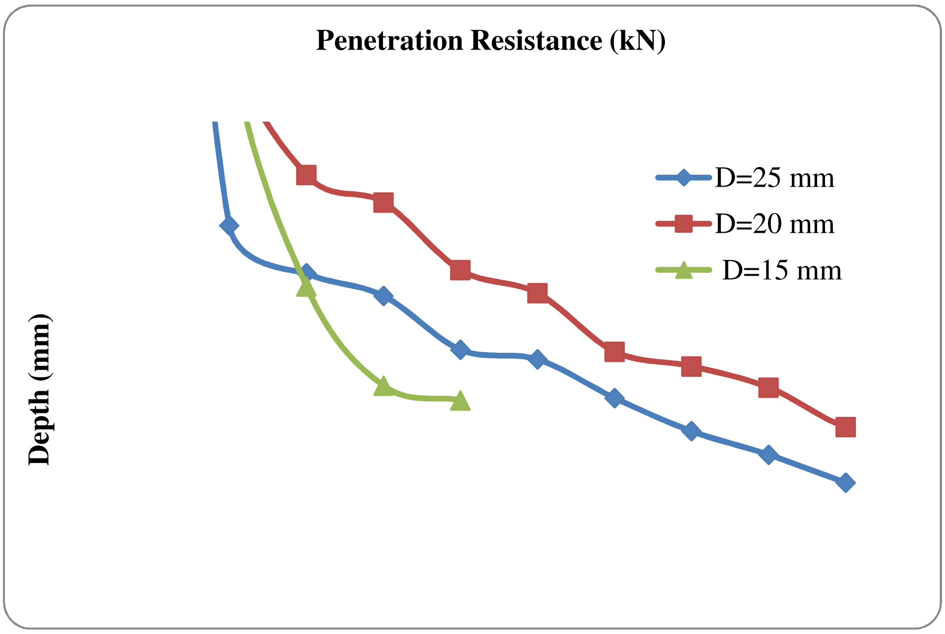

Figure 10 Penetration resistance vs Depth with different diameter of cone

The graph above states that the different diameter of the cone in the dense state of the soil with the saturated form increases the depth of penetration. The cone of 25 and 20 diameter shows a gradually similar rate of increment in the depth of the penetration

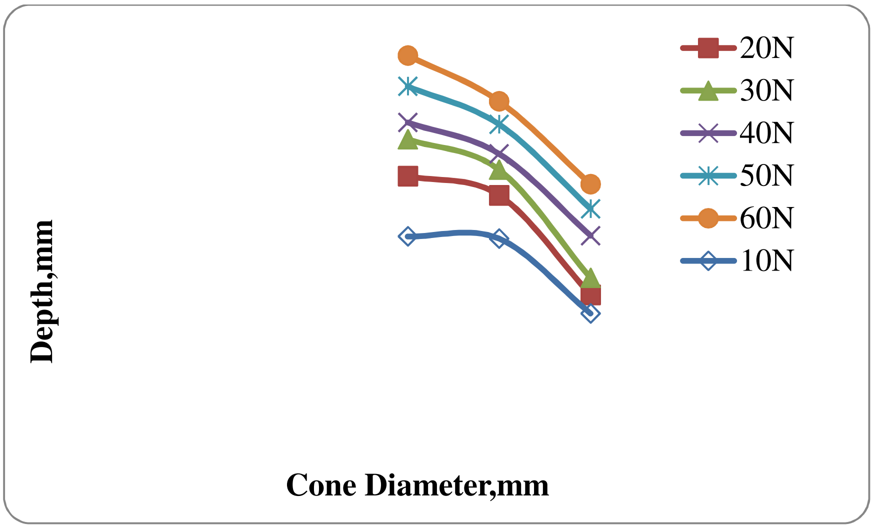

Figure 11 Effect of cone Diameter on penetration

The above graph terms that for a given specific load, the depth will vary accordingly in ascending order for 15mm, 20mm and 25 mm cone diameter respectively. As the load increases the depth tends to align in a linear manner.

4. CONCLUSION

CPT has advantages over the traditional Standard Penetration Test (SPT) as it's faster and requires less labour. CPT has been used for penetration test for quality control in sand of very uniform water content. It can also be derived to find the relationship between the cone penetration resistance and the liquefaction strength of the sand. It has greater accuracy with continuous digital data record enabling the analysis in real time. Other advantages are its better resolution, its versatility and attainment of pore water pressure, dynamic soil properties, etc.

In a Medium dense state of sand the Cone penetrate more depth because the penetration resistance is less. In Dense state of sand as compare to the Medium dense, Cone achieving an early resistance with minimum depth and has the maximum Penetration resistance. It is clearly founded that the variation in Diameters does effect the penetration of cone into the Sample. The sudden drop of penetration Resistance from the Maximum load to the Zero shows that the Soils has its point of weakness or loose state even beneath.

REFERENCE

[1] Robertson P .K, Sasitharan,S., Cunning,J.C., and Sego,D.C.(1995). Shearwave velocity to evaluate in-situ state of Ottawa sand. Journal of Geotechnical Engineering, ASCE, 121(3): 262-273.

[2] Deepika.Chukka, Chakravarthi V. K (2013) Evaluation of Properties of Soil Subgrade Using Dynamic Cone Penetration", Journal of Geotechnical Engineering, ASCE, P.P 212-218

[3] Interpreting CPT results in unsaturated sands, A. R. Russell, M. Pournaghiazar& N. Khalili, (2012) Journal of soil mechanics and technology, The University of New South Wales, Sydney, NSW, Australia.

[4] Simultaneous interpretation of CPT/DMT tests to ground characterization Rabarijoely S., Garbulewski K. Department of Geotechnical Engineering, War saw University of Life Sciences, Poland.

[5] The Study of Relative Density and Boundary Effects for Cone Penetration Tests in Centrifuge, M. D. Bolton' and M. W. Gui 2 CUED/D-SOILS/TR256 1993.

[6] K. Venkat Raman, P. Dayakar, Dr. K.V.B. Raju (2012) "Study on Improvement of Problematic Soil with Sand Layer" International Journal of Biotech Trends and Technology (IJBTT) – Volume2 Issue 4 Number2–P.P 21-29.

[7] K. Venkat Raman, P. Dayakar, Dr. K.V.B. Raju (2012) "Ground Improvising Techniques By Applying Geogrid On Layered Soil. International Journal of Biotech Trends and Technology (IJBTT) – Volume2 Issue 1 Number2– P.P 46-53.

[8] Ai, Z. and Han, J. (2006) A Solution to Plane Strain Consolidation of Multi-Layered Soils. Soil and Rock Behavior and Modeling: pp. 276-283.

[9] Morbidelli, R., Govindaraju, R., Corradini, C., Saltalippi, C., and Flammini, A. (2008) A Preliminary Analysis of Field-Scale Infiltration into Layered Soils. World Environmental and Water Resources Congress 2008: pp. 1-8.

[10] Sridharan, A., Gandhi, N., and Suresh, S. (1990). Stiffness Coefficients of Layered Soil Systems." J. Geotech. Engrg., 10.1061/(ASCE)0733-9410(1990)116:4(604), 604-624.

[11] K. Venkat Raman, P. Dayakar, Dr. K.V.B. Raju (2012) "Study On Settlement Behavior of Layered Soils" International Journal of Biotech Trends and Technology (IJBTT) – Volume2 Issue 4 Number2– P.P 40- 45.

[12] Kumar J., Sathish Kumar K., Dayakar P., Effect of microsilica on high strength concrete, International Journal of Applied Engineering Research, v-9, i-22, pp-5427-5432, 2014.

[13] Dayakar P., Vijay Ruthrapathi G., Prakesh J., Management of bio-medical waste, International Journal of Applied Engineering Research, v-9, i-22, pp-5518-5526, 2014.

[14] Iyappan L., Dayakar P., Identification of landslide prone zone for coonoortalukusing spatialtechnology, International Journal of Applied Engineering Research, v-9, i-22, pp-5724-5732, 2014.

[15] Swaminathan N., Dayakar P., Resource optimization in construction project, International Journal of Applied Engineering Research, v-9, i-22, pp-5546-5551, 2014.

[16] Swaminathan N., Sachithanandam P., Risk assessment in construction project, International Journal of Applied Engineering Research, v-9, i-22, pp-5552-5557, 2014.

[17] Srividya T., Kaviya B., Effect on mesh reinforcement on the permeablity and strength of pervious concrete, International Journal of Applied Engineering Research, v-9, i-22, pp-5530-5532, 2014.

[18] Sandhiya K., Kaviya B., Safe bus stop location in Trichy city by using gis, International Journal of Applied Engineering Research, v-9, i-22, pp-5686-5691, 2014.

[19] Ajona M., Kaviya B., An environmental friendly self-healing microbial concrete, International Journal of Applied Engineering Research, v-9, i-22, pp-5457-5462, 2014.

[20] Kumar J., Sachithanandam P., Experimental investigation on concrete with partial replacement of scrap rubber to granite stones as coarse aggregate, International Journal of Applied Engineering Research, v-9, i-22, pp-5733-5740, 2014.

[21] Deepjyoti Das, Dhrubajyoti Kaundinya, Raja Sarkar and Bikramjit Deb, Shear Strength Improvement of Sandy Soil Using Coconut Fibre. International Journal of Civil Engineering and Technology, 7(3), 2016, pp.297–305.

[22] Nkakinii, S. O. Draught Force Requirements of a Disc Plough at Various Tractor Forward Speeds in Loamy Sand Soil, During Ploughing. International Journal of Advanced Research in Engineering and Technology, 6(7), 2015, pp. 52-68.