iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6175

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Analysis of various Properties of Subtropical Climatic Conditioned Soil

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Abstract: ***This paper presents various engineering properties of a disturbed and undisturbed soil sample of subtropical climatic conditions. The soil sample was taken from a isolated place of Gwalior zone of Madhya Pradesh, India. The soil has been tested as per IS Code; IS:2720(Part 3)-1980, IS:2720(Part 29)-1975, IS:2720(Part 28)-1974, IS:2720(Part 16)-1987, IS:2720(Part 5)-1985, IS:9259-1979, IS:2720 (Part 7)-1980, IS:2720 (Part 8)-1983 and various safety and testing parameter of construction industry. The permeability of sub-tropical conditioned soil sample was found k=0.0023 and water content of sub-tropical climatic conditioned soil sample by pycnometer was found w=0, dry density of sub tropical climatic conditioned crust sample was found 2.44gm/cc., dry density of sub tropical climatic conditioned crust sample by core cutter method was found 1.23gm/cc., bearing capacity of sub tropical climatic conditioned soil sample by California bearing ratio was found out to be 9.28% at 2.5mm penetration and 8% at 5.00mm penetration, liquid limit of sub tropical conditioned soil was found 32.90%, plastic limit of sub tropical conditioned soil was found 21.16%, plasticity index was found 11.74.***
Keywords: subtropical climatic conditioned soil, soil testing, moderate bearing capacity parameters.

I. INTRODUCTION

The ground on which we walk is never quite the same, it keeps on changing. Sometimes it is made up of millions of tiny granules and other times it is the hard surface of tar-covered roads. There was the time long back when this ground was mostly covered with soil and grass. And then came the roads, rails and so on. This soil is a very broad term and refers to a loose layer of earth that covers the surface of the planet.

The soil is the part of the earth's surface which includes disintegrated rock, humus, inorganic and other organic materials that provides the medium for plants growth. For the formation of soil, it takes around hundreds to thousands of years. The soil is usually generated when rocks break up into their constituent parts. When a range of different forces acts on the rocks, they break into smaller parts to form the soil. These forces also include the impact of wind, water and the reaction from salts.

There are three stages of soil:

1) Solid soil,
2) Soil with air in the pores,
3) Soil with water in the pores.

There are various types of soil that undergo diverse environmental pressures. The soil is mainly classified by its texture, proportions and different forms of organic and mineral compositions.

II. LITERATURE REVIEW

Mekonnen H. (2008) et. al. This review paper presents an overview of global impacts on soil and water resources as consequence of change in climate and summarizes the measures/adaptation options to minimize the risk. There is a strong scientific consensus that the earth's climate has changed and will continue to change as human activities increase the concentrations of greenhouse gases in the atmosphere. World population is increasing day by day and at the same time soil and water resources is threatened due to natural resource degradation and climate change.

Baoming Du (2014) et. al. Decreasing temperature and increasing precipitation along altitude gradients are typical mountain climate in subtropical China. In such a climate regime, identifying the patterns of the C stable isotope composition (δ13C) in plants and soils and their relations to the context of climate change is essential. In this study, the patterns of δ13C variation were investigated for tree leaves, litters, and soils in the natural secondary forests at four altitudes (219, 405, 780, and 1268 m a.s.l.) in Lushan Mountain.

Md. Khairul Alam (2014) et. al This study was conducted to know cropping cycles required to improve OM status in soil and to investigate the effects of medium-term tillage practices on soil properties and crop yields in Grey Terrace soil of Bangladesh under wheat-mungbean-T. aman cropping system. Four different tillage practices, namely, zero tillage (ZT), minimum tillage (MT), conventional tillage (CT), and deep tillage (DT), were studied in a randomized complete block (RCB) design with four replications.

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III. EXPERIMENT & ANALYSIS

The water content of the subtropical soil was determined by pycnometer as per the IS code standards.
The water content is obtained from the following expression,

$$w = \left[\left(\frac{W2 - W1}{W3 - W4}\right)\left(\frac{G - 1}{G}\right) - 1\right] \times 100\%$$

Specific Gravity G = (W2 – W1) / [(W4–W1)-(W3-W2)].
The Bearing Capacity of Sub Tropical Climatic Conditioned Soil Sample by California Bearing Ratio Test.

C.B.R. = (PT/PS) X 100

Where,

PT = Corrected test load corresponding to the chosen penetration from the load penetration curve.
The Water Content of Tropical Climate Conditioned Soil Sample by Liquid Limit was analyzed by Casagrande apparatus confirming to IS: 9259-1979, followed by plastic limit test of the same disturbed sample. The plasticity Index is defined as the numerical difference between its Liquid Limit and Plastic Limit.
Plasticity Index = Liquid Limit - Plastic Limit.

IV. PERMEABILITY OF SOIL SAMPLE BY FALLING HEAD METHOD

The stability of earthen made hydraulic structures and its foundation is affected by permeability of soil. Hence permeability is necessary to check the stability of hydraulic structures.

A. Constant Head Test

Permeability at temperature kT is calculated by:

$$kT = Q / (A \times I \times t)$$

And permeability at 27°C by using the expression

$$k27 = kT \times (\mu T/\mu 27)$$

Where,
μT = Coefficient of viscosity at T0C
μ27 = Coefficient of viscosity at 270C.

B. Falling Head Test

Permeability at temperature kT is calculated by:
$kT = 2.303 \times [aL/A(tf - ti)] \times \log10 (h1/h2)$
And permeability at 27°C by using the expression,

$$k27 = kT \times (\mu T/\mu 27)$$

Where,
μT = Coefficient of viscosity at T0C μ27 = Coefficient of viscosity at 270C.

V. OBSERVATIONS & RECOMMENDATIONS

S.No	Title	Soil Sample	Result
1.	Water Content of Sub Tropical Climatic Conditioned Soil Sample.	Undisturbed	w=0
2.	Determination of Bearing Capacity of Sub Tropical Climatic Conditioned Soil Sample By California Bearing Ratio Test	Disturbed	9.28%@2.5mm 8%@5.0mm
3.	Determination of Water Content of Tropical Climate Conditioned Soil Sample By Liquid Limit	Disturbed	32.90%
4.	Determination of Water Content of Tropical Climate Conditioned Soil Sample By Plastic Limit	Disturbed	21.16%
5.	Determination of Plasticity Index	-	11.74
6.	Determination of coefficient of permeability of soil Sample by Falling Head Method	-	K=0.0023

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The permeability of sub-tropical conditioned soil sample was found k=0.0023 and water content of sub-tropical climatic conditioned soil sample by pycnometer was found w=0, dry density of sub tropical climatic conditioned crust sample was found 2.44gm/cc., dry density of sub tropical climatic conditioned crust sample by core cutter method was found 1.23gm/cc., bearing capacity of sub tropical climatic conditioned soil sample by California bearing ratio test was found 9.28% at 2.5mm penetration and 8% at 5.00mm penetration, liquid limit of sub tropical conditioned soil was found 32.90%, plastic limit of sub tropical conditioned soil was found 21.16%, plasticity index was found 11.74.

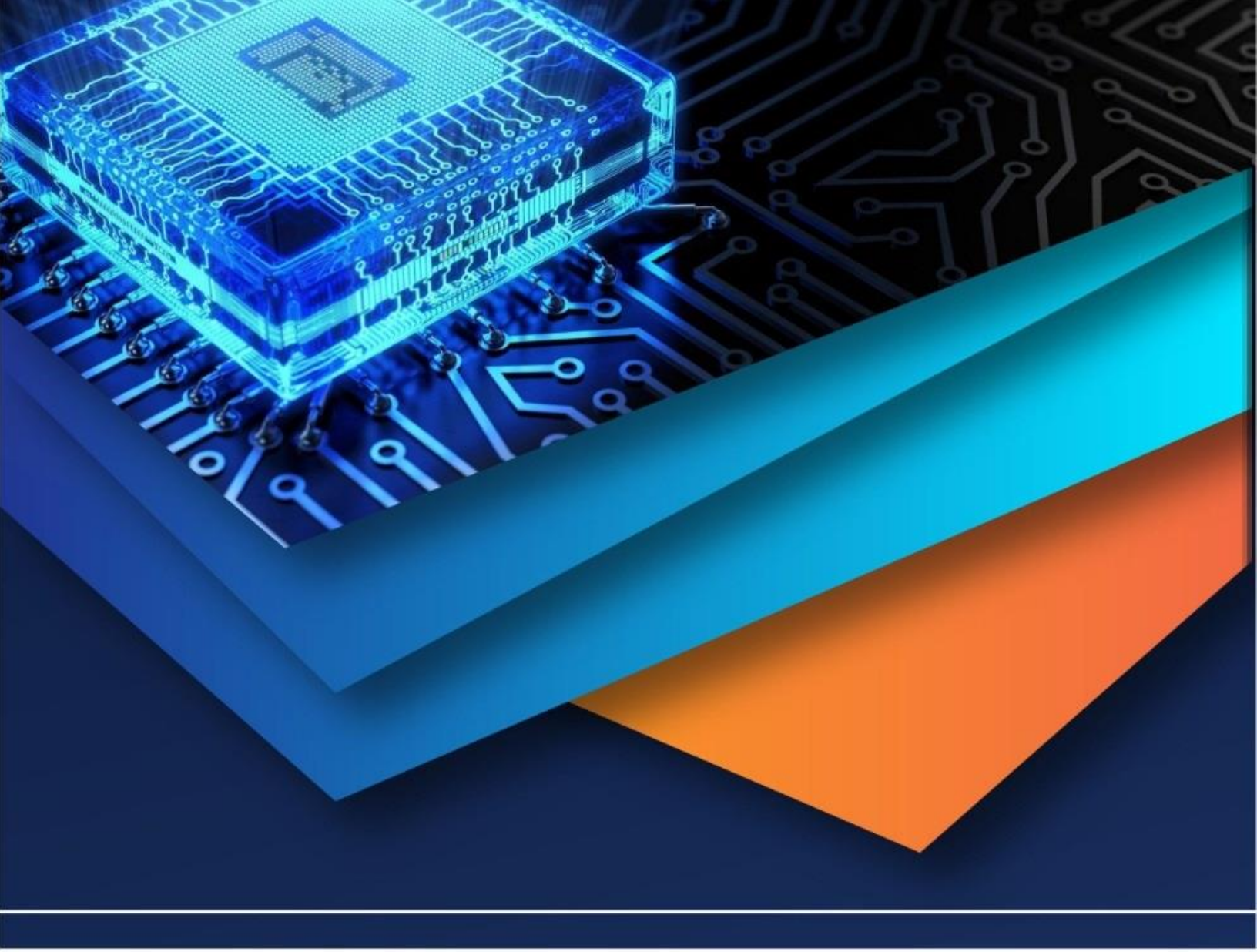
VI. CONCLUSION

As per the observation and calculation done by following all the India standard parameters of soil testing it has been found that the soil available in subtropical condition zone Village Ratwai, Gwalior, M.P. of India is having a moderate bearing capacity.

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