iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** IV **Month of publication:** April 2015

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Volume 3 Issue IV, April 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Relating Infiltration Capacity with Soil Properties

Janani S [1], Gopalan V[2], Brinda lakshmi[3]
[1]Assistant Professor, Civil Department, [2]QA Engineer, [3]PG student
[1]Velammal Engineering College, Chennai, [2]Hindustan Construction Company Ltd, Kota, [3]Environmental Engineering Division, MANIT, Bhopal,

Abstract*: *In the present scenario, Water crisis has become a major problem Infiltration is one of the major components of the hydrologic cycle, replenishes the ground water. The ability to quantify infiltration is of great importance in watershed management. Hence a study was done to determine the infiltration capacity and physical properties of soils in three different places in and around AUT, Tiruchirapalli. These places were parted based on the soil type and land terrain. The soil properties like texture, bulk density, porosity, pH value were found out from various tests. The infiltration capacity of the soil was determined by double ring infiltrometer test for each place. The lowest infiltration capacity (7.09cm/hr) was recorded in the AUT-T Main entrance (left). The interrelationship between soil properties and infiltration characteristic were depicted.
Keywords*: *Infiltration Capacity, Double Ring Infiltrometer, Horton equation, Soil porosity, density.

I. INTRODUCTION

Water being the essential element in source of living for all the surviving organisms, and ground water contributes significantly in drinking water source. A study with objective to determine the infiltration capacity of the soil using double ring infiltrometer and relating it to the physical properties of the soil is carried out . The study is conducted in different soil types found in Anna University BIT campus, Tiruchirappalli. The study area is in thiruverumpur taluk, Tiruchirappalli district at a distance of 17 km from Tiruchirappalli, Tamilnadu. The soil series is identified to be of miscellaneous land type (MLT)

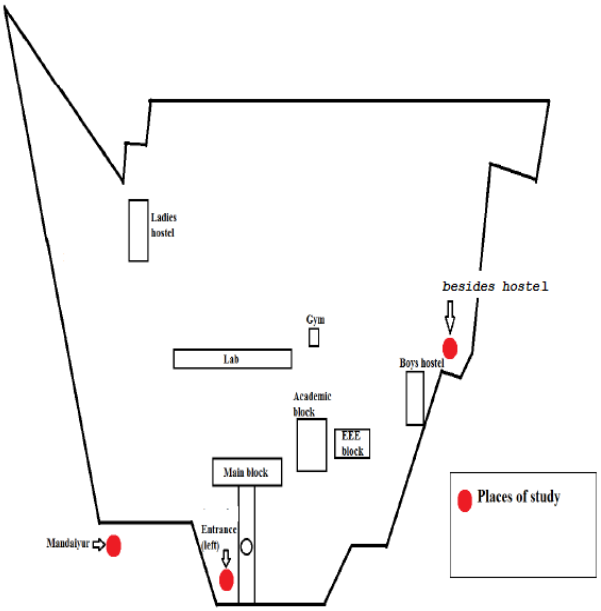


Fig. 1 Layout of study area.

II. METHODOLOGY

First Soil Atlas Map from Agricultural Engineering Department is collected to choose the study areas. Then the soil properties are found by conducting tests like pycnometer test, proctor compaction test, soil texture- feel method and colorimetric test. Third the infiltration capacity of the soil is determined by double ring infiltrometer and the Horton's equation is prepared for the region under study.

©IJRASET 2015: All Rights are Reserved

	AUT Garden		Mandaiyur		AUT Main Entrance left	
	15cm	30cm	15cm	30cm	15cm	30cm
Specific Gravity	2.56	2.28	1.76	1.622	3.75	3
Bulk Density (kg/m^3)	1098.60	1099.67	953.91	1071.81	1034.30	1234.29
Max Dry Density (kg/ m^3)	998.73	1018.22	868.36	951.23	937.83	940.27
Dry Unit Weight (kg)	9.797	9.988	8.52	9.33	9.20	9.22
Void Ratio (no unit)	1.57	1.24	1.25	0.7	2.99	0.96
Porosity (%)	61	51	55	61	47	49
pH Level	6.9	6.8	7.0	7.0	6.7	6.7

Table 2 Soil Characteristics of different soil types of study area

III. INFILTRATION CHARACTERISTICS

A. *Infiltration*

The basic infiltration rate Mandaiyur was found to be higher with the values of 61.36cm/hr and 54.04cm/hr respectively. The left of the main entrance of AUT-T has a lower infiltration value of 7.09cm/hr which is attributed to have lowest value of porosity and higher value of bulk density. On correlation of this basic infiltration rate with the porosity and bulk density, it shows that the infiltration rate is directly proportional to the porosity and indirectly proportional to the bulk density. The basic infiltration rate of the different soil types are presented in table

Place	Basic Infiltration rate f_0 (cm/hr)
Mandaiyur	54.04
AUT-T Garden	25.72
AUT-T Main Entrance left	7.09

Table 2 Basic infiltration rate of the places of study

B. *Observations and Generation of Horton's equation*

The infiltrometer is installed and the observations are taken until the time interval becomes constant. The values are tabulated and graph with time in X- axis and ln (f_p- f_c) in Y-axis is plotted. From the graph, the slope and intercept of Y – axis is used to generate the Horton's equation.

Time (hr)	Δt (hr)	fp (cm/hr)	fp-fc (cm/hr)	ln(fp-fc)
0.03	0.03	33.3333	18.8615	2.9371
0.062	0.032	31.25	16.7782	2.8201
0.097	0.035	28.5714	14.0996	2.6461
0.136	0.039	25.6410	11.1692	2.4132
0.1827	0.0467	21.4132	6.9415	1.9375
0.2305	0.0478	20.9205	6.4487	1.8638
0.297	0.0665	15.0376	0.5658	-0.56948
0.3661	0.0691	14.4717	0	
0.4352	0.0691	14.47178	0	

©IJRASET 2015: All Rights are Reserved

Table 3 Observations for Mandaiyur

Time (hr)	Δt (hr)	fp (cm/hr)	fp-fc (cm/hr)	ln(fp-fc)
0.0416	0.0416	24.0384	17.4681	2.8603
0.1153	0.0737	13.5685	6.9982	1.9456
0.1977	0.0824	12.1359	5.5656	1.7166
0.3022	0.1045	9.5693	2.9990	1.0983
0.408	0.1058	9.4517	2.8814	1.0583
0.5233	0.1153	8.6730	2.1027	0.7432
0.6591	0.1358	7.3637	0.7934	-0.2313
0.8086	0.1495	6.6889	0.1186	-2.1314
0.9608	0.1522	6.5703	0	
1.113	0.1522	6.5703	0	

Table 4 Observations for AUT-T Garden

Time (hr)	Δt (hr)	fp (cm/hr)	fp-fc (cm/hr)	ln(fp-fc)
0.174	0.174	5.74712	5.08001	1.6253
0.413	0.239	4.18410	3.51698	1.2576
0.6675	0.2545	3.9292	3.26216	1.1824
1.1438	0.4763	2.0995	1.4324	0.35935
2.6428	1.499	0.66711	0	
4.1418	1.499	0.66711	0	

Table 5 Observations for AUT-T Main entrance left

C. Horton's Equation

The Horton's equation showing the infiltration rate of any given soil at the given time is found out for each place where the infiltrometer was installed from the observations.

Places	Horton equation
Mandaiyur	$f_p = 14.46 + 39.58\, e^{-11.28t}$
AUT Garden	$f_p = 6.57 + 19.15\, e^{-5.4328t}$
AUT Main entrance left	$f_p = 0.67 + 6.424\, e^{-1.2585t}$

Table 6 Horton Equation

IV. CORRELATING OF PROPERTIES OBTAINED

Area	*Porosity in %*	*Bulk density (kg/m^3)*	*Basic infiltration rate f_O (cm/hr)*
Mandaiyur	*61*	*1065.38*	*54.04*
Garden	*51*	*1099.67*	*25.72*
Entrance	*47*	*1234.29*	*7.09*

Table 7 Properties correlation

V. CONCLUSION

The ground water is depleted at a higher rate and infiltration is one of the important means of increasing the ground water

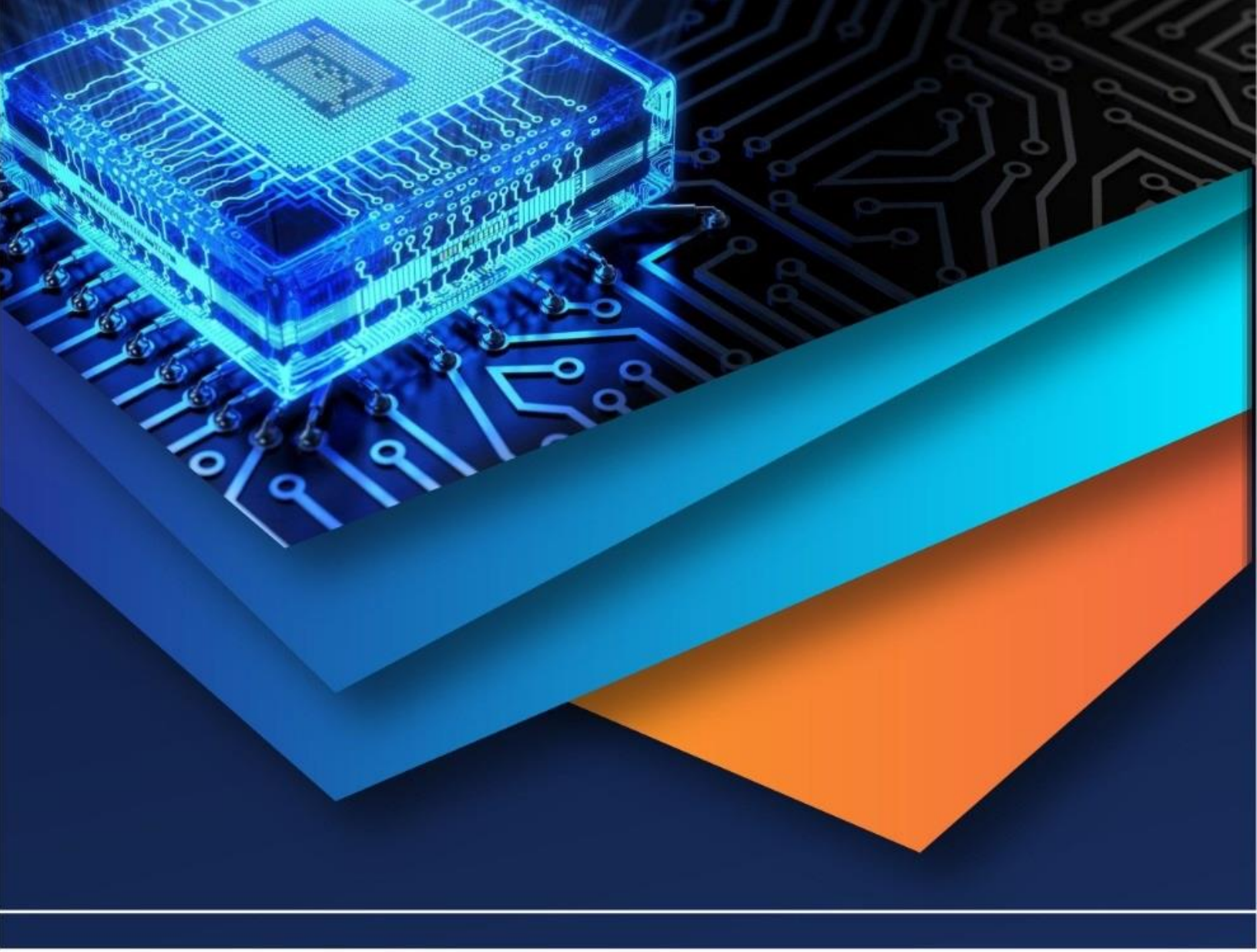
©IJRASET 2015: All Rights are Reserved

level. The infiltration rate is associated with soil properties and hence to determine both the former and latter is of utmost importance. Key areas with higher infiltration rate are associated with the soil properties. The porosity factor is found to have direct proportion to the Basic Infiltration Rate while the bulk density is inversely proportional to the infiltration rate. The Horton equation is framed for further investigational purposes.

REFERENCES

[1] ASTM (2003) D3385-03 standard test method for infiltration rate of soils in field using double-ring infiltrometer, Annual Book of ASTM Standards 04.08., Amer. Soc. Testing Materials, West Conshohocken, PA.
[2] Audra H. Hayden (2009), Correlation Between Falling Head And Double Ring Testing For A Full-Scale Infiltration Study
[3] David Whiting**,** Adrian Card, Carl Wilson and Jean Reeder (2011), Estimating Soil Texture: Sand, Silt or Clayey.
[4] Iowa Stormwater Management (2008) General information for infiltration practices 2E-1 manual, version 2.
[5] Makungo R and J.O. Odiyo(2011) Determination of Steady State Infiltration Rates for Different Soil Types in Selected Areas of Thulamela Municipality, South Africa
[6] Subramanya K (2008), Third Edition, Engineering Hydrology, TATA McGRAW HILL publications

©IJRASET 2015: All Rights are Reserved



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)