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COMPARISON OF BEARING CAPACITY CALCULATION METHODS IN DIFFERENT SITE CONDITIONS

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ABSTRACT

In civil engineering projects soil is regarded as the most important material. Properties of soil like density, moisture content and plasticity variation depend on various factors like depth of water table, weather, loading, etc. Bearing capacity which is considered as the most important property of soil is also affected by these factors. The foundation for any civil structure is designed according to bearing capacity of the soil at the site. There are several papers where bearing capacity of the soil are determined. Various methods and theories are used for the determination of bearing capacity like Terzaghi (1943), Meyerhoff (1963), Hansen (1970), Vesic (1973) and codes like Eurocode, Indian Standard (IS) Code and many others. Various methods use various scales of safety factors so result of the bearing capacity is different in every method. This paper works on the previously published work "Investigation of Soil and Bearing Capacity in Different Site Condition, (2012)". This paper compares the result of the bearing capacities of the soil at two sites determined by IS code 6403:1981 and Terzaghi method. This paper also compares the different factors that affect the bearing capacity of soil like shape of footing, foundation depth and depth of water table.

Keywords: Bearing Capacity, Water Table, Maximum Dry Density, Local Shear failure, Cohesion, Angle of Internal friction.

I. INTRODUCTION

Soil is naturally occurring material due to the weathering and disintegration of parent rocks and minerals. Bearing capacity is one of the important soil properties which help in designing suitable foundation. This property of soil is affected by several other properties of soil like cohesion, angle of internal friction, density of soil etc. Clayey soil has comparatively low bearing capacity than sandy and silty soil. Bearing capacity is the most important parameter in the field of geotechnical engineering. Along with bearing capacity, settlement is also important in the field of geotechnical engineering. Every civil engineering projects like reservoirs, dams, bridges, buildings require subsurface investigation and information for suitable design of both substructure and superstructure. Various factors and parameters affect the bearing capacity of the soil like water table, cohesion, angle of internal friction, density of soil, inclined loads, eccentric loads, etc.

Terzaghi (1943) proposed the first thorough analysis for the evaluation of ultimate bearing capacity for the case of strip footing with rough base for a c- Ø soil. This theory is only applicable for shallow foundations. Terzaghi (1943), Meyerhof (1963), Hansen (1970), Vesic (1973), Indian Standard (1981), Eurocode7 (1996) and BNBC (1993) are used for determining the bearing capacity of the soil. It is already clear that the value of the bearing capacity is different when we use different theories of bearing capacity. So along with the soil parameters and conditions, the used theory of bearing capacity also has the hand in altering the value of bearing capacity. There is no one ideal or mandatory theory for bearing capacity. Geotechnical engineers use appropriate theories that are suggested by the clients or that suits the site condition. The change in value for different theories are due to the different factors and parameters like depth factors, shape factors, mobilized

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cohesion and angle of internal friction and many others which are not considered by same means in all the theories.

This paper analyses the results of the experimental work "Investigation of Soil and Bearing Capacity in Different Site Condition" by Waghmare et al. (2012). The mentioned paper had determined the bearing capacitates of two sites using IS code 6403:1981. So, this paper discusses the relation of the bearing capacity with the site condition, shape of the footing and depth of the water table. This paper has determined the bearing capacities of soil at different depths of the two sites using Terzaghi's method of bearing capacity and tries to show the relation between the IS code and Terzaghi's method of bearing capacity.

II. SITE DETAILS

At Site-A geotechnical investigation was performed up to the depth of 3.0m while at Site-B the total depth of investigation was 1.8m. Soil was excavated and samples from each 1.5m interval from the pit were collected and lab tests were performed in these samples. Maximum dry density, cohesion and internal friction angle were determined at the laboratory. Peck et al., (1974) gave a curve for Nq and Nγ based on the assumption that soil fails in local shear when angle of internal friction (Φ) is less than 28° and soil fails in general shear if Φ is greater than 38°. Based on this assumption soil up to a depth of 1.5m failed due to local shear at Site-A and at Site-B soil failed due local shear up to a depth of 1.0m and after that general shear failure occurred in the soil. The geotechnical properties of the soil at Site-A and Site-B are given in Table I and II and variation in geotechnical properties with depth are shown in Figure 2-8.

In the graph Maximum Dry Density (MDD) vs depth, the value of the dry density increases with depth. The deeper we go into the pit, the value of the dry density increases. Similarly, the angle of internal friction also increases from 18 ° to 36°.

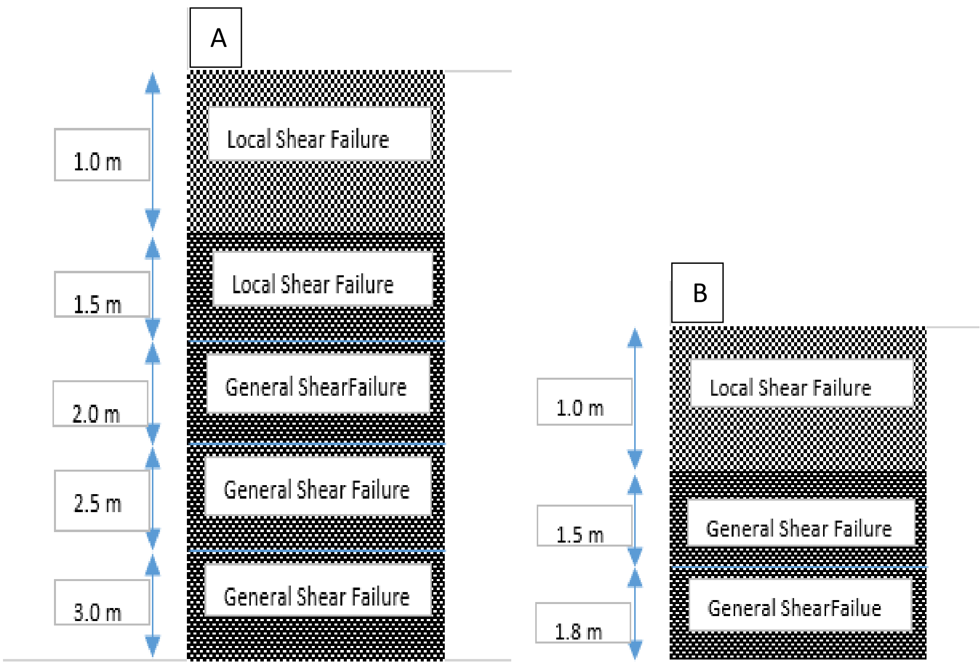

Figure 1: A) Variation of Failure type with depth at site A. B) Variation of failure type with depth at site B

***Table 1:** Geotechnical Properties of Soil at Site A*

Depth of pit in meter	Specific Gravity	MDD (gm/cm3)	OMC %	Cohesion (kN/m²)	Angle of Internal friction (Ø)
1.00	2.54	1.45	26.40	24.00	18.00
1.50	2.62	1.64	18.10	13.00	27.00
2.00	2.68	1.71	16.90	8.00	33.00
2.50	2.73	1.75	15.10	6.00	34.00
3.00	2.76	1.82	14.20	4.00	36.00

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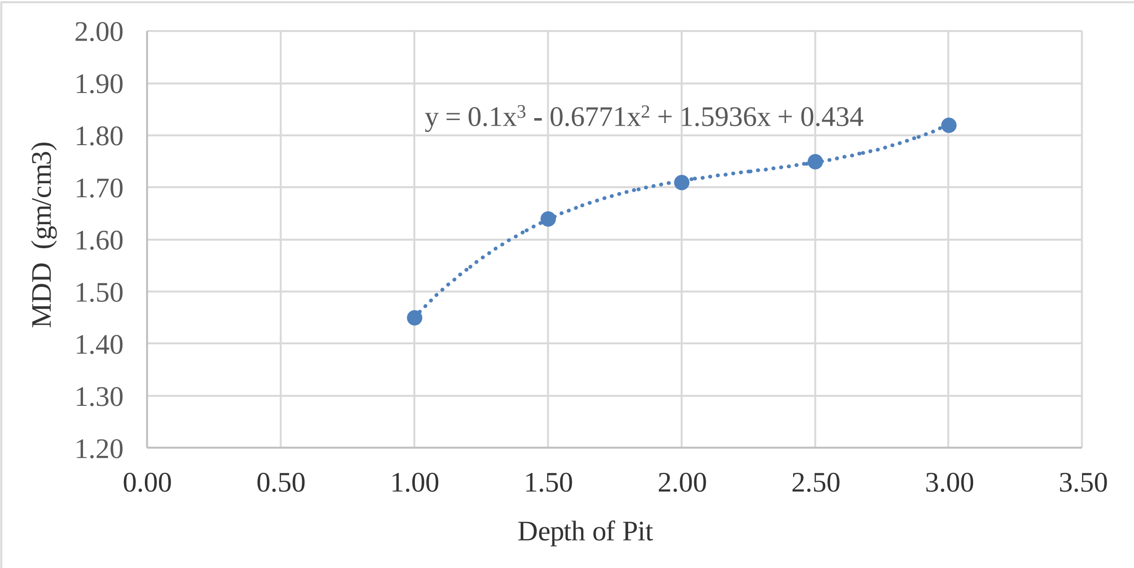

Figure 2: Variation of MDD with depth at site A

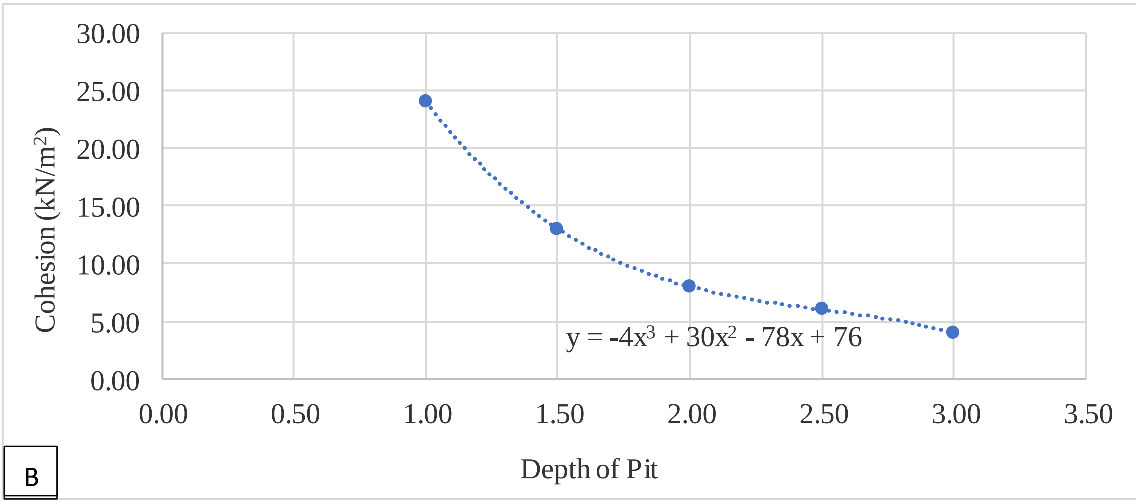

Figure 3: Variation of cohesion with depth at site A

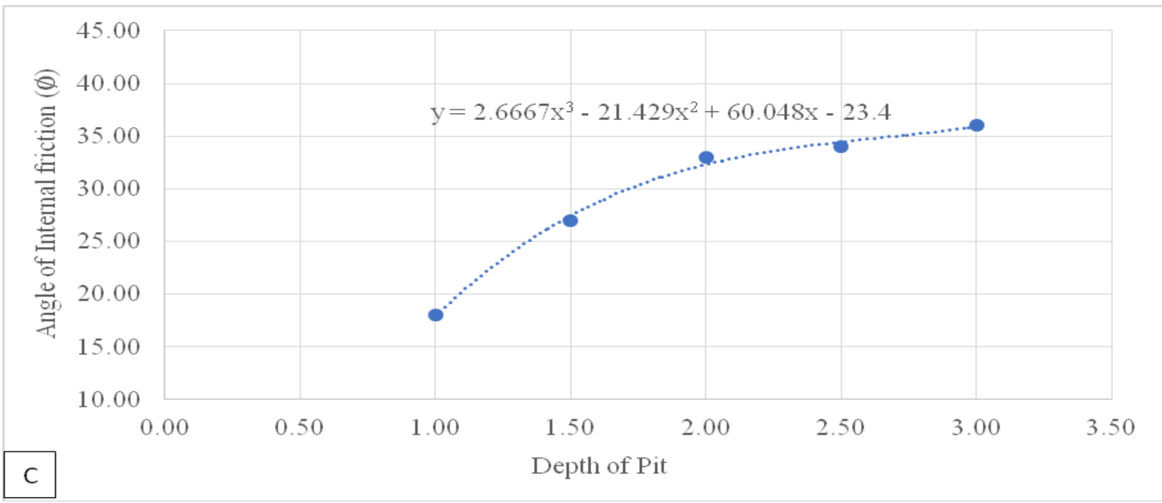

Figure 4: Variation of angle of internal friction with depth at site A

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Since the angle of internal friction at depth 1.0m and 1.5m are less than 29 °, local shear failure occurs at these depths. The decrease in the value of cohesion with depth is due to the increase in angle of internal friction.

Table 2: *Geotechnical Properties of Soil at Site B*

Depth of pit in meter	Specific Gravity	MDD (gm/cm3)	OMC %	Cohesion (kN/m²)	Angle of Internal friction (Ø)
1.00	2.64	1.70	16.90	14.00	25.00
1.50	2.72	1.86	10.20	4.00	37.00
1.80	2.77	1.89	10.10	2.00	40.00

Also, at site B, the dry density and angle of internal friction increases with depth while the cohesion decreases with depth. The cohesion changes from 14kN/m² to 4kN/m² from depth 1.0m to 1.5m and internal friction angle increases from 25° to 37°. This indicates change in failure of soil from local shear to general shear within this increase in depth.

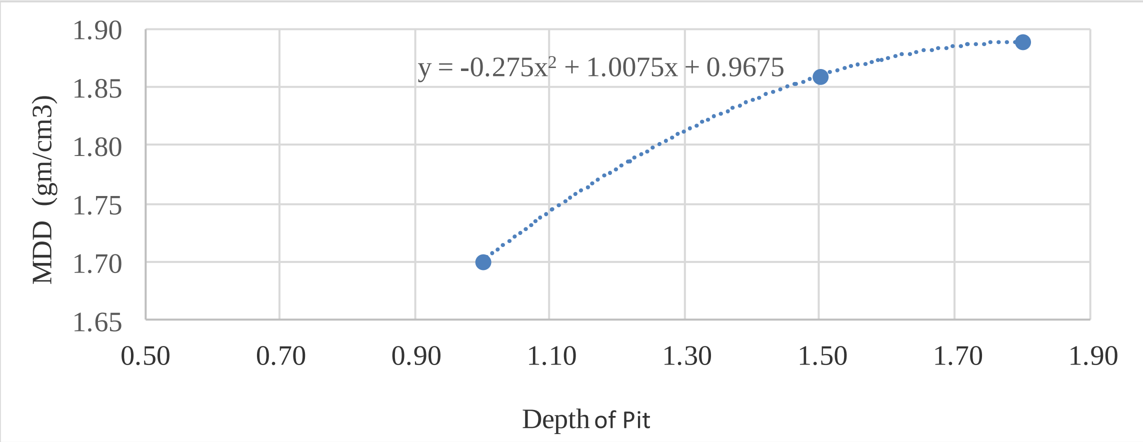

Figure 5: Variation of MDD with depth at site B

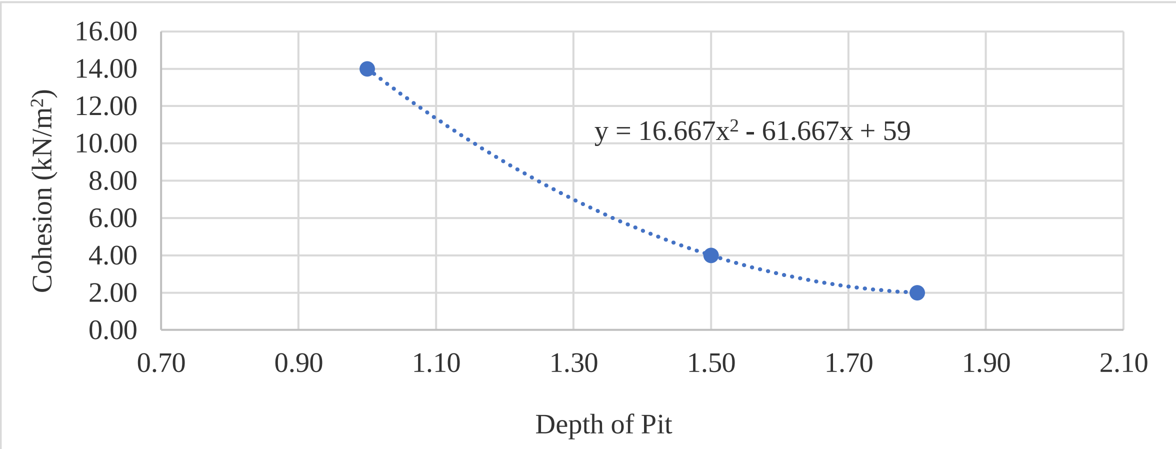

Figure 6: Variation of cohesion with depth at site B

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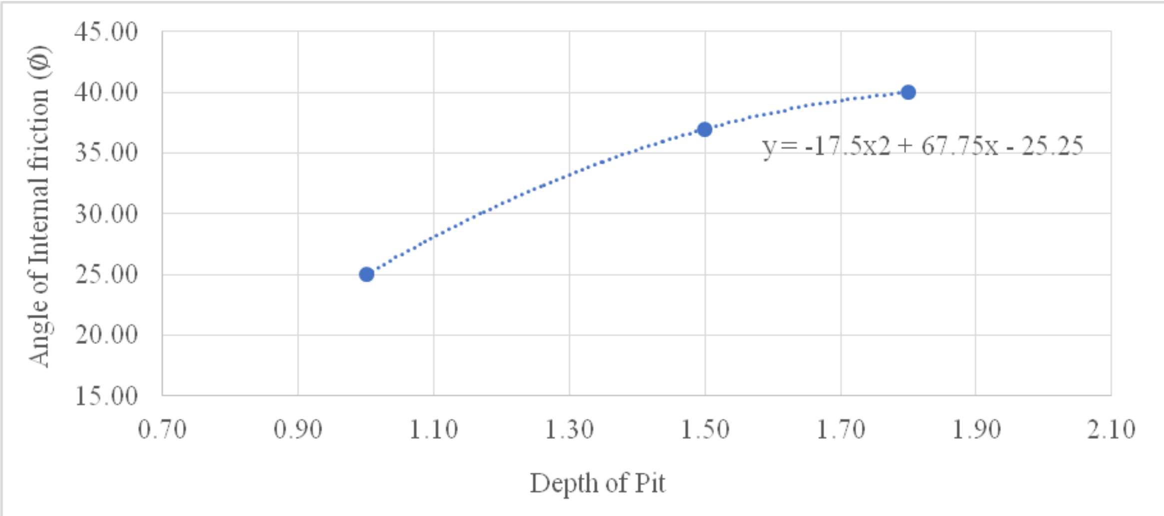

Figure 7: Variation of angle of internal friction with depth at site B

III. RESULTS AND DISCUSSION

A. Calculations

The bearing capacities at both the sites were calculated following IS code 6403:1981 in the previously published work "Investigation of Soil and Bearing Capacity in Different Site Condition" by Waghmare et al. (2012). To avoid any confusion, the bearing capacities were calculated again using IS 6403:1981 as well as Terzaghi's method of bearing capacity. Doing so produced some deviations from the original work. The recalculated values of bearing capacities using IS code 6403:1981 for different shapes of footings are given in the table below:

Table 3: *Net Ultimate Bearing Capacity at Site-A: Rectangular Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m²)	(Ø)	MDD (gm/cm)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m²)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	ic	i_q	i_y	
1.0	24.0	18.0	1.45	12.28	9.54	3.14	1.87	1.13	1.13	0.73	1.25	1.03	1.03	1.00	1.00	1.00	369.61
1.5	13.0	27.0	1.64	18.85	13.94	5.83	4.76	1.13	1.13	0.73	1.42	1.05	1.05	1.00	1.00	1.00	460.08
2.0	8.0	33.0	1.71	33.00	39.73	27.34	37.78	1.13	1.13	0.73	1.74	1.07	1.07	1.00	1.00	1.00	1942.45
2.5	6.0	34.0	1.75	34.00	42.92	30.32	42.90	1.13	1.13	0.73	1.94	1.07	1.07	1.00	1.00	1.00	2382.11
3.0	4.0	36.0	1.82	36.00	51.96	39.48	60.31	1.13	1.13	0.73	2.18	1.08	1.08	1.00	1.00	1.00	3452.67

Table 4: *Net Ultimate Bearing Capacity at Site-B: Rectangular Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m²)	(Ø)	MDD (gm/cm3)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m²)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	i_c	i_q	i_y	
1.0	14.0	25.0	1.70	17.35	12.78	5.10	3.94	1.13	1.13	0.73	1.41	1.08	1.08	1.00	1.00	1.00	394.80
1.5	4.0	37.0	1.86	37.00	57.80	45.66	72.58	1.13	1.13	0.73	1.60	1.08	1.08	1.00	1.00	1.00	2435.31
1.8	2.0	40.0	1.89	40.00	75.31	64.20	109.41	1.13	1.13	0.73	1.77	1.09	1.09	1.00	1.00	1.00	3708.12

Table 5: *Net Ultimate Bearing Capacity at Site-A: Square Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m²)	(Ø)	MDD (gm/cm3)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m²)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	i_c	i_q	i_y	
1.0	24.0	18.0	1.45	12.28	9.54	3.14	1.87	1.30	1.20	0.80	1.25	1.03	1.03	1.00	1.00	1.00	420.26
1.5	13.0	27.0	1.64	18.85	13.94	5.83	4.76	1.30	1.20	0.80	1.42	1.05	1.05	1.00	1.00	1.00	513.82
2.0	8.0	33.0	1.71	33.00	39.73	27.34	37.78	1.30	1.20	0.80	1.74	1.07	1.07	1.00	1.00	1.00	2119.86
2.5	6.0	34.0	1.75	34.00	42.92	30.32	42.90	1.30	1.20	0.80	1.94	1.07	1.07	1.00	1.00	1.00	2581.48
3.0	4.0	36.0	1.82	36.00	51.96	39.48	60.31	1.30	1.20	0.80	2.18	1.08	1.08	1.00	1.00	1.00	3714.67

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Table 6: *Net Ultimate Bearing Capacity at Site-B: Square Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m^2)	(Ø)	MDD (gm/cm3)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m^2)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	i_c	i_q	i_y	
1.0	14.0	25.0	1.70	17.35	12.78	5.10	3.94	1.30	1.20	0.80	1.27	1.05	1.05	1.00	1.00	1.00	409.25
1.5	4.0	37.0	1.86	37.00	57.80	45.66	72.58	1.30	1.20	0.80	1.60	1.08	1.08	1.00	1.00	1.00	2632.38
1.8	2.0	40.0	1.89	40.00	75.31	64.20	109.41	1.30	1.20	0.80	1.77	1.09	1.09	1.00	1.00	1.00	3978.87

Table 7: *Net Ultimate Bearing Capacity at Site-A: Continuous Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m^2)	(Ø)	MDD (gm/cm3)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m^2)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	i_c	i_q	i_y	
1.0	24.0	18.0	1.45	12.28	9.54	3.14	1.87	1.00	1.00	1.00	1.25	1.03	1.03	1.00	1.00	1.00	330.98
1.5	13.0	27.0	1.64	18.85	13.94	5.83	4.76	1.00	1.00	1.00	1.42	1.05	1.05	1.00	1.00	1.00	420.17
2.0	8.0	33.0	1.71	33.00	39.73	27.34	37.78	1.00	1.00	1.00	1.74	1.07	1.07	1.00	1.00	1.00	1833.28
2.5	6.0	34.0	1.75	34.00	42.92	30.32	42.90	1.00	1.00	1.00	1.94	1.07	1.07	1.00	1.00	1.00	2241.00
3.0	4.0	36.0	1.82	36.00	51.96	39.48	60.31	1.00	1.00	1.00	2.18	1.08	1.08	1.00	1.00	1.00	3251.03

Table 8: *Net Ultimate Bearing Capacity at Site-B: Continuous Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m^2)	(Ø)	MDD (gm/cm3)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m^2)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	i_c	i_q	i_y	
1.0	14.0	25.0	1.70	17.35	12.78	5.10	3.94	1.00	1.00	1.00	1.27	1.05	1.05	1.00	1.00	1.00	333.54
1.5	4.0	37.0	1.86	37.00	57.80	45.66	72.58	1.00	1.00	1.00	1.60	1.08	1.08	1.00	1.00	1.00	2400.59
1.8	2.0	40.0	1.89	40.00	75.31	64.20	109.41	1.00	1.00	1.00	1.77	1.09	1.09	1.00	1.00	1.00	3660.85

Table 9: *Net Ultimate Bearing Capacity at Site-A: Circular Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m^2)	(Ø)	MDD (gm/cm3)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m^2)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	i_c	i_q	i_y	
1.0	24.0	18.0	1.45	12.28	9.54	3.14	1.87	1.30	1.20	0.60	1.25	1.03	1.03	1.00	1.00	1.00	417.51
1.5	13.0	27.0	1.64	18.85	13.94	5.83	4.76	1.30	1.20	0.60	1.42	1.05	1.05	1.00	1.00	1.00	505.76
2.0	8.0	33.0	1.71	33.00	39.73	27.34	37.78	1.30	1.20	0.60	1.74	1.07	1.07	1.00	1.00	1.00	2052.23
2.5	6.0	34.0	1.75	34.00	42.92	30.32	42.90	1.30	1.20	0.60	1.94	1.07	1.07	1.00	1.00	1.00	2502.63
3.0	4.0	36.0	1.82	36.00	51.96	39.48	60.31	1.30	1.20	0.60	2.18	1.08	1.08	1.00	1.00	1.00	3598.75

Table 10: *Net Ultimate Bearing Capacity at Site-B: Circular Footing Using IS 6403:1981*

Depth of Foundation (m)	c (kN/m^2)	(Ø)	MDD (gm/cm3)	(Ø) or (Ø')	Bearing Capacity Factor			Shape Factor			Depth Factor			Inclination Factor			q_{nc} (kN/m^2)
					N_c	N_q	N_y	S_c	S_q	S_y	d_c	d_q	d_y	i_c	i_q	i_y	
1.0	14.0	25.0	1.70	17.35	12.78	5.10	3.94	1.30	1.20	0.60	1.27	1.05	1.05	1.00	1.00	1.00	402.37
1.5	4.0	37.0	1.86	37.00	57.80	45.66	72.58	1.30	1.20	0.60	1.60	1.08	1.08	1.00	1.00	1.00	2489.69
1.8	2.0	40.0	1.89	40.00	75.31	64.20	109.41	1.30	1.20	0.60	1.77	1.09	1.09	1.00	1.00	1.00	3758.45

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The results of the net ultimate bearing capacity varying with depth for different shapes of footings are shown in graph below:

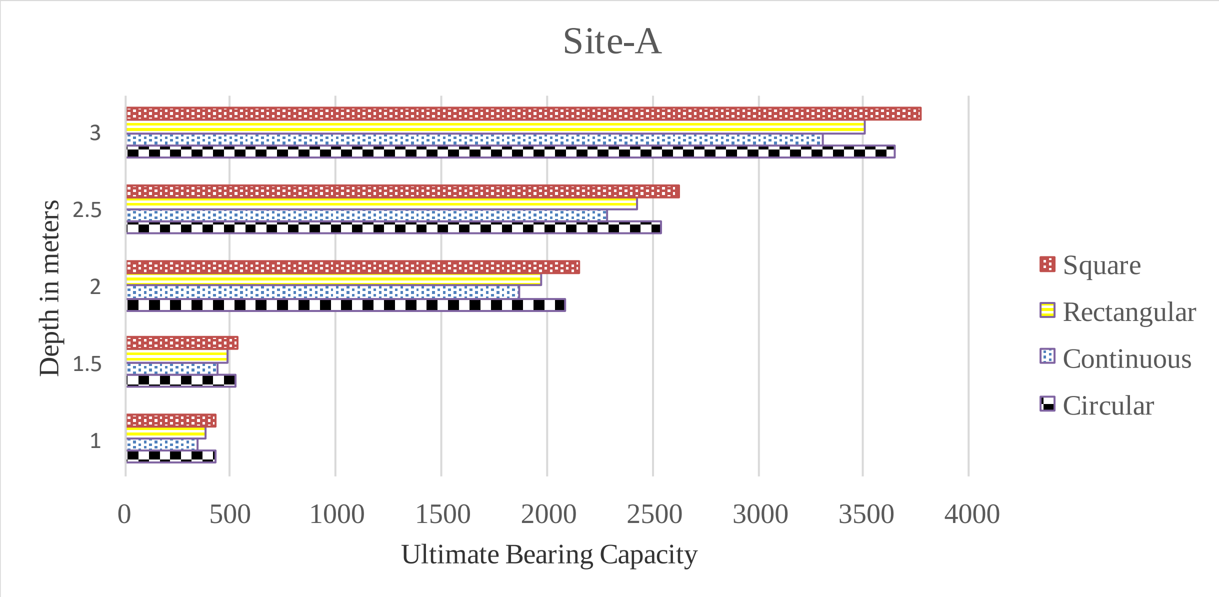

Figure 8: Ultimate Bearing Capacity of various footings varying with depth at site A

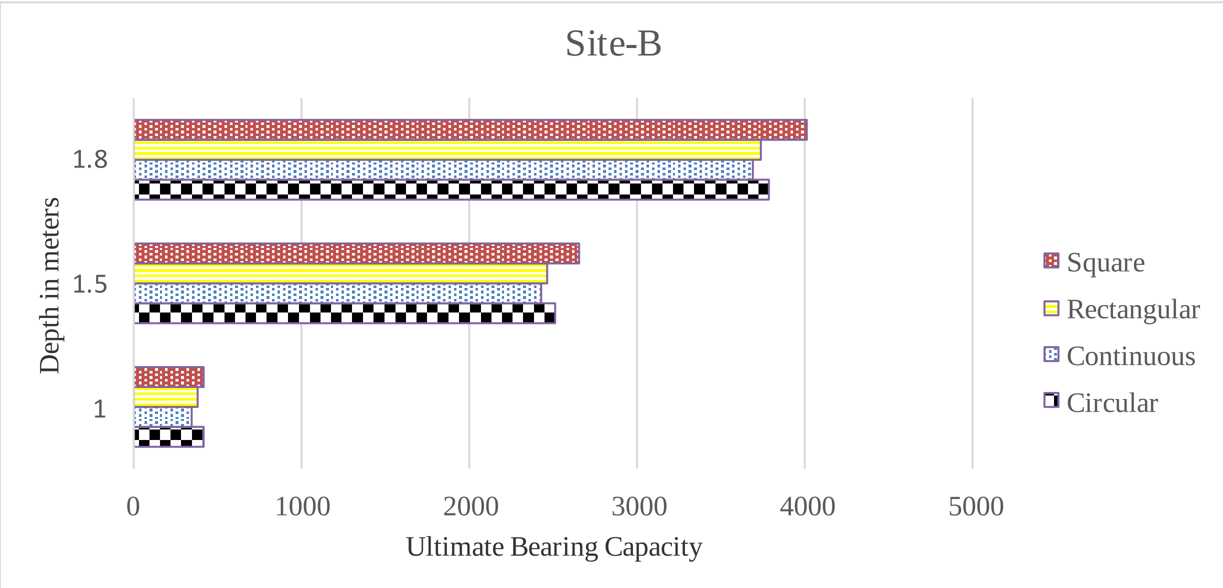

Figure 9: Ultimate Bearing Capacity of various footings varying with depth at site B

The bearing capacities of the soil at both the sites are shown in the table (III-X). There is local shear failure for about first 2m at both the sites. That's why the bearing capacities at the depths are lower than comparatively to the deeper ones. It is worth mentioning that the maximum bearing capacity is achieved at Site-B at the depth of 1.8m for square footing with the value of 3978.872kN/m^2. It may be due the high value of internal friction angle of soil which was 40°. On the other hand, the lowest bearing capacity is achieved at obvious 1.0m at Site-A with the value of 330.980kN/m2. It is seen that the shape of the footing also affects the bearing capacity of the soil. At both sites A and B, the lowest bearing capacity is for continuous footing and maximum is for square footings.

The values of these bearing capacities are compared with the values obtained from Terzaghi's method of bearing capacity for rectangular footing. The result of the bearing capacities from Terzaghi's method are shown in the table below:

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Table 11: *Ultimate Bearing Capacity at Site-A for Rectangular Footing Using Terzaghi's Method*

Depth of Foundation (m)	c (kN/m²)	(Ø')	MDD (gm/cm3)	c or c'	(Ø) or (Ø')	Bearing Capacity Factor			q_u (kN/m²)
						N_c	N_q	N_y	
1.0	24.00	18.00	1.45	16.00	18.00	10.96	3.42	1.38	233.82
1.5	13.00	27.00	1.64	8.67	18.76	11.28	3.60	1.50	196.71
2.0	8.00	33.00	1.71	8.00	33.00	49.56	33.84	33.32	1811.29
2.5	6.00	34.00	1.75	6.00	34.00	53.68	37.62	37.86	2261.66
3.0	4.00	36.00	1.82	4.00	36.00	65.38	49.38	54.00	3388.50

Table 12: *Ultimate Bearing Capacity at Site-B for Rectangular Footing Using Terzaghi's Method*

Depth of Foundation (m)	c (kN/m²)	(Ø')	MDD (gm/cm3)	c or c'	(Ø') or (Ø'm)	Bearing Capacity Factor			q_u (kN/m²)
						N_c	N_q	N_y	
1.0	14.00	25.00	1.70	9.33	17.27	10.65	3.24	1.26	164.04
1.5	4.00	37.00	1.86	4.00	37.00	72.96	57.36	65.60	2460.26
1.8	2.00	40.00	1.89	2.00	40.00	95.70	81.30	100.40	3835.42

The bearing capacity obtained from Terzaghi's method is ultimate bearing capacity, so for comparison of IS code and Terzaghi's method, overburden pressure is added to the value obtained from IS code method. The ultimate bearing capacities for rectangular footing obtained from the two methods are given in the table below:

Table 13: *Terzaghi vs IS Code Method of Bearing Capacity for Rectangular Footing (Site-A)*

Method of analysis	Depth of Footing in meters				
	1.0	1.5	2.0	2.5	3.0
IS Code 6403:1981	383.84	484.21	1976.00	2425.02	3506.23
Terzahgi's Method	233.82	196.71	1811.29	2261.66	3388.51

It is seen from the table XIII and XIV that the values of the bearing capacities are slightly higher that are obtained from the IS code method. It may be due to the depth factors and shape factors inclination factors used in this method. The highest deviancy is seen at Site-A at the depth of 1.5m with the difference of 287.5kN/m².

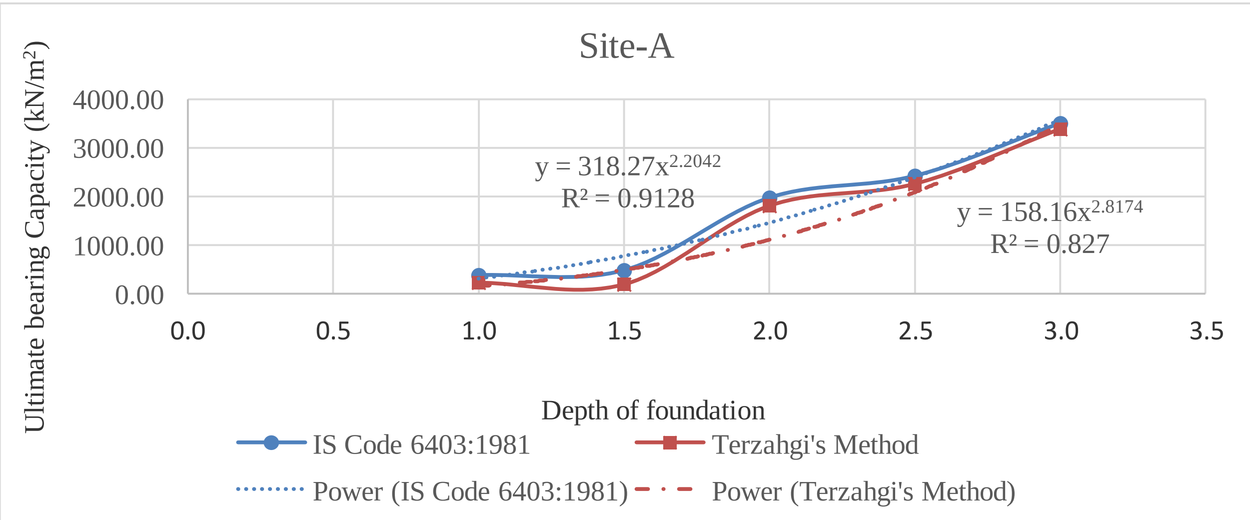

Figure 10: Ultimate Bearing Capacity of varying with depth at site A calculated using IS code 6403-1981 and Terzaghi's method

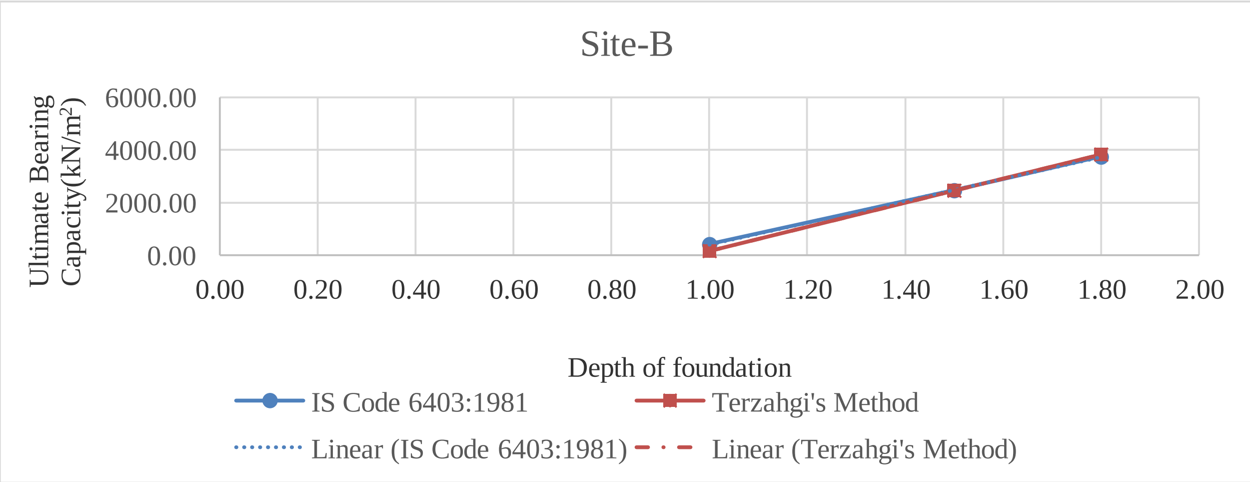

Figure 11: Ultimate Bearing Capacity of varying with depth at site B calculated using IS code 6403-1981 and Terzaghi's method

The correlation developed between ultimate bearing capacity and depth of foundation for both methods are given by the equation below:

$y = 318.27x^{2.2042}$ (For IS code Method)

$y = 158.16x^{2.8174}$ (For Terzaghi method)

Where x= Depth of foundation in meters(m) and y= Ultimate Bearing bearing capacity in kN/m^2.

Table 14: *Terzaghi vs IS Code Method of Bearing Capacity for Rectangular Footing (Site-B)*

Method of analysis	Depth of Footing in meters		
	1.00	1.50	1.80
IS Code 6403:1981	411.47	2462.68	3741.50
Terzahgi's Method	164.05	2460.27	3835.43

It is seen that the correlation between the depth of foundation and ultimate bearing capacity at Site-B is linear for both methods. This shows that there is strong relationship between depth of foundation and ultimate bearing capacity at site B.

B. Effect of Water table in Bearing Capacity of soil

The calculations of the net ultimate bearing capacities at different water table conditions are given in the table below:

Table 15: *Effect of Water Table on Net Ultimate Bearing Capacity: Rectangular Footing at Site A*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m^2)		
	Without water table Correction	Water table may reach up to the base of the footing	Water table may reach up to the ground level
1.00	369.61	364.58	351.79
1.50	460.08	445.31	390.58
2.00	1942.45	1818.45	1408.00
2.50	2382.11	2237.56	1618.78
3.00	3452.67	3240.16	2195.30

Table 16: *Effect of Water Table on Net Ultimate Bearing Capacity: Rectangular Footing at Site B*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m^2)		
	Without water table Correction	Water table may reach up to the base of the footing	Water table may reach up to the ground level
1.00	364.25	351.64	323.70
1.50	2435.31	2173.72	1689.07
1.80	3708.12	3304.02	2409.41

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***Table 17**: Effect of Water Table on Net Ultimate Bearing Capacity: Square Footing at Site A*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m^2)		
	Without water table Correction	Water table may reach up to the base of the footing	Water table may reach up to the ground level
1.00	420.26	414.76	401.39
1.50	513.82	497.70	440.22
2.00	2119.86	1984.60	1553.98
2.50	2581.48	2423.79	1773.25
3.00	3714.67	3482.84	2383.33

***Table 18:** Effect of Water Table on Net Ultimate Bearing Capacity: Square Footing at Site B*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m^2)		
	Without water table Correction	Water table may reach up to the base of the footing	Water table may reach up to the ground level
1.00	409.25	395.49	366.31
1.50	2632.38	2347.01	1842.24
1.80	3978.87	3538.03	2603.76

***Table 19:** Effect of Water Table on Net Ultimate Bearing Capacity: Continuous Footing at Site A*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m^2)		
	Without water table Correction	Water table may reach up to the base of the footing	Water table may reach up to the ground level
1.00	330.98	324.11	315.26
1.50	420.17	400.03	358.85
2.00	1833.28	1664.19	1361.71
2.50	2241.00	2043.89	1567.48
3.00	3251.03	2961.24	2141.59

***Table 20:** Effect of Water Table on Net Ultimate Bearing Capacity: Continuous Footing at Site B*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m^2)		
	Without water table Correction	Water table may reach up to the base of the footing	Water table may reach upto the ground level
1.00	333.54	316.34	297.76
1.50	2400.59	2043.89	1742.15
1.80	3660.85	3109.80	2514.93

***Table 21:** Effect of Water Table on Net Ultimate Bearing Capacity: Circular Footing at Site A*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m^2)		
	Without water table Correction	Water table may reach upto the base of the footing	Water table may reach upto the ground level
1.00	417.51	413.39	398.64
1.50	505.76	493.67	432.16
2.00	2052.23	1950.78	1486.35
2.50	2502.63	2384.37	1694.41
3.00	3598.75	3424.88	2267.42

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Table 22: *Effect of Water Table on Net Ultimate Bearing Capacity: Circular Footing at Site B*

Depth of Footing in meter	Net Ultimate Bearing Capacity (kN/m²)		
	Without water table Correction	Water table may reach up to the base of the footing	Water table may reach up to the ground level
1.00	402.37	392.05	359.43
1.50	2489.69	2275.67	1699.56
1.80	3758.45	3427.82	2383.34

It is seen from the above tables that the water table has increasing affect with its rise. The tables show two different conditions of water table and respective net ultimate bearing capacity at those conditions. It is also seen from above tables that when water table reaches up to the ground level, bearing capacity decreases by significant amount as compared when the water table was at the base of the foundation. At site-B at the depth of 1.8m, the net ultimate bearing capacity which was 3758.45kN/m² when no water table was considered decreased to 2383.34 with the difference of 1375.11kN/m². Hence, it can be concluded that with every rise in water table, the bearing capacity of soil decreases.

The comparative graph of the net ultimate bearing capacity at different water table conditions for different shape of footings are given below:

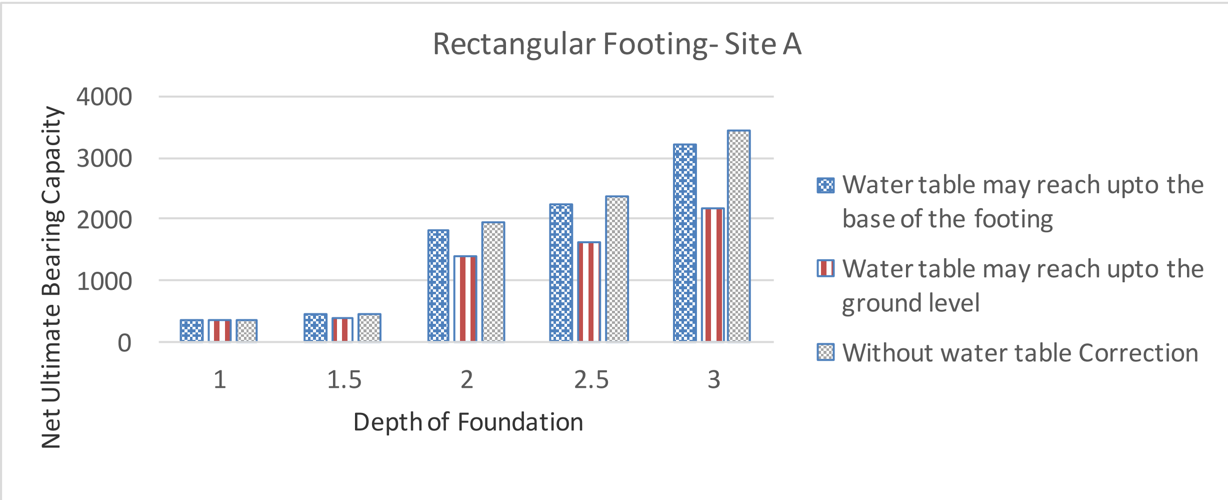

Figure 12: Net Ultimate Bearing Capacity of rectangular footing with varying depth of water table at Site-A

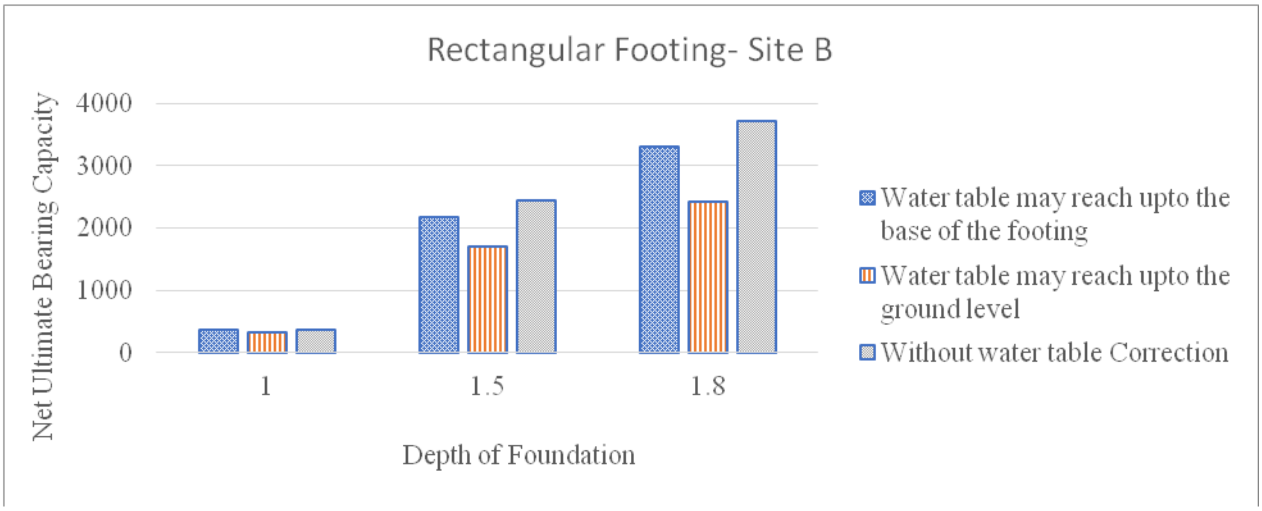

Figure 13: Net Ultimate Bearing Capacity of rectangular footing with varying depth of water table at Site-B

doi no.: 10.2016-56941953; DOI Link :: http://doi-ds.org/doilink/12.2020-12127347/

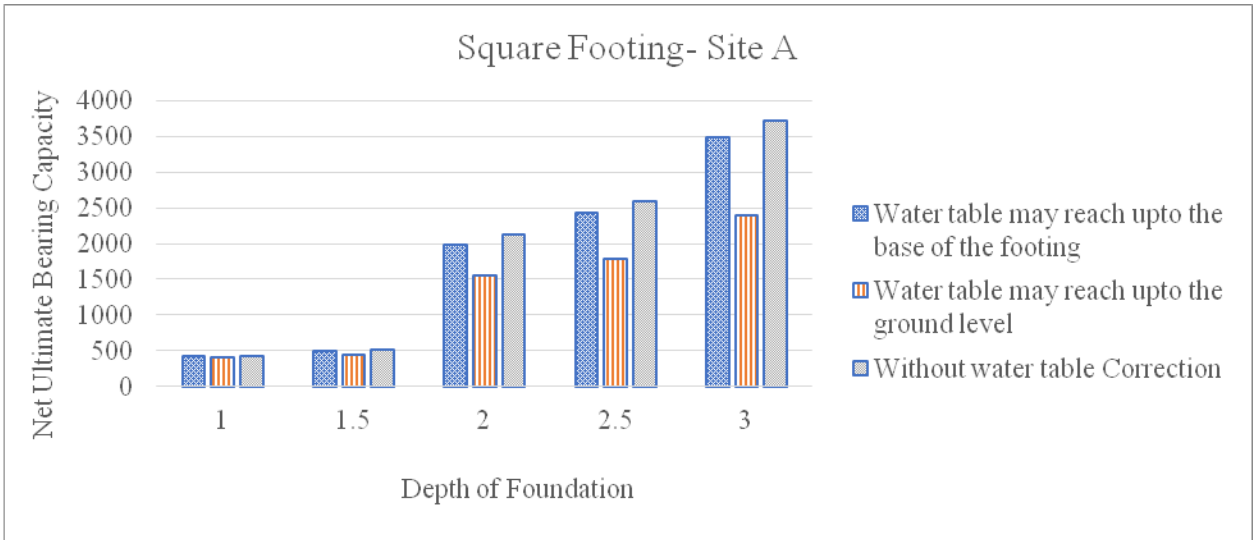

Figure 14: Net Ultimate Bearing Capacity of square footing with varying depth of water table at Site-A

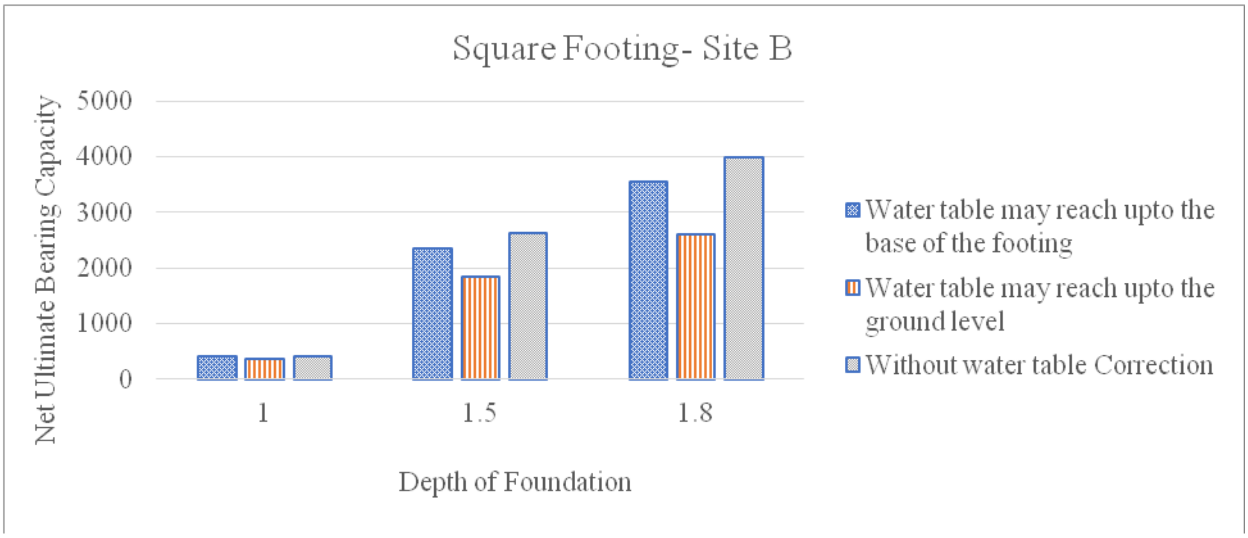

Figure 15: Net Ultimate Bearing Capacity of square footing with varying depth of water table at Site-B

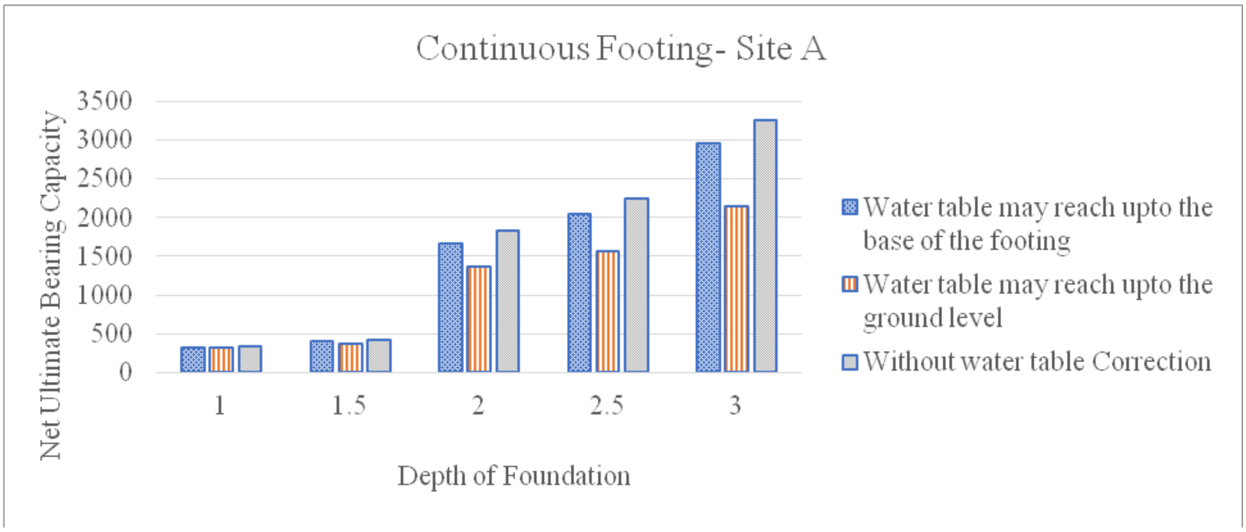

Figure 16: Ultimate Bearing Capacity of continuous footing with varying depth of water table at Site-A

doi no.: 10.2016-56941953; DOI Link :: http://doi-ds.org/doilink/12.2020-12127347/

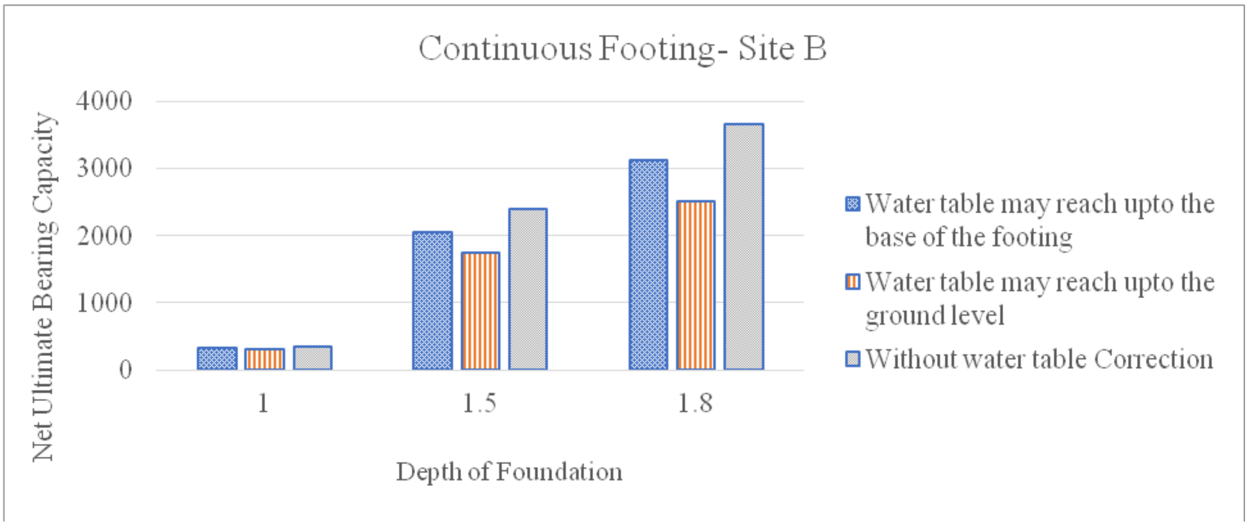

Figure 17: Net Ultimate Bearing Capacity of continuous footing with varying depth of water table at Site-B

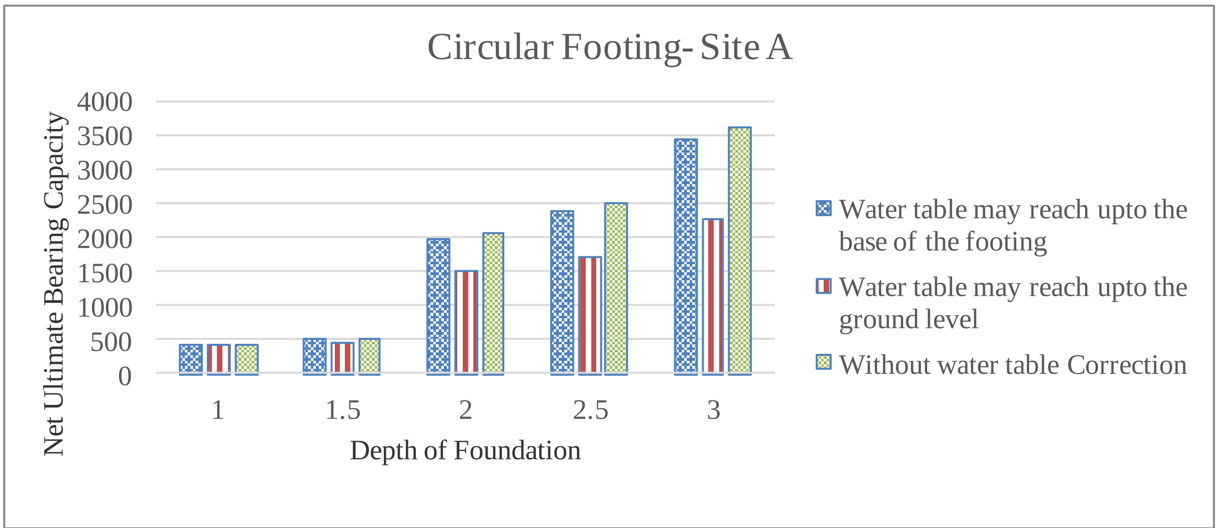

Figure 18: Net Ultimate Bearing Capacity of circular footing with varying depth of water table at Site-A

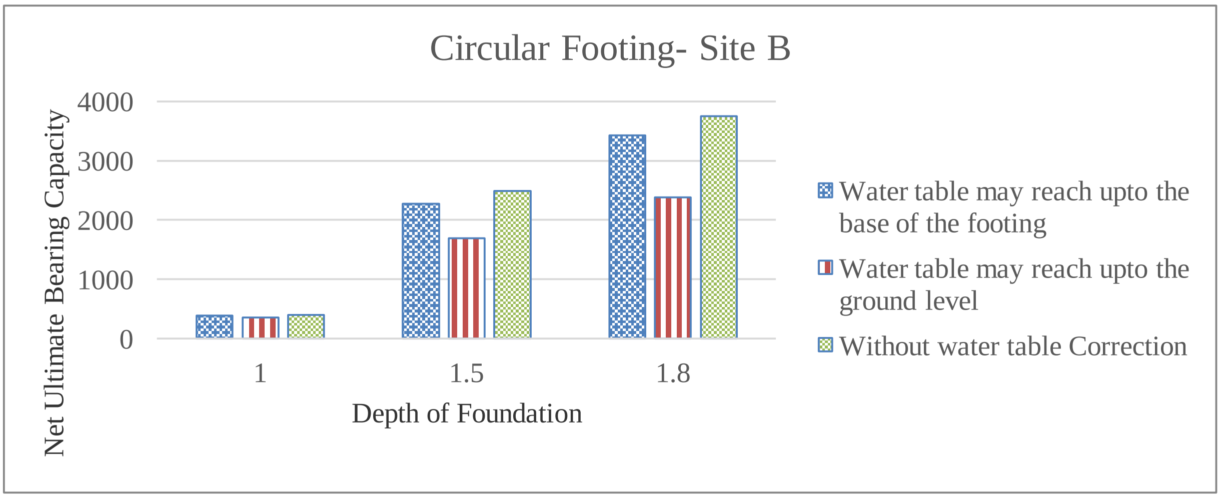

Figure 19: Net Ultimate Bearing Capacity of circular footing with varying depth of water table at Site-B

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IV. CONCLUSION

Bearing capacity is very important parameter in the field of geotechnical engineering. The values of bearing capacity are not the same when determined from various methods. It can be concluded that the value of the bearing capacity obtained from IS code is usually higher than that obtained from Terzaghi's method. It was clear that the Site-B had higher values of bearing capacities than that at Site-B. This was due to the reason that Site-B had higher angle of internal friction at shorter depth. And this might be also be the reason that the investigation at Site-B was not done as deep as at Site-A. We can also conclude that the more the water table rises, the bearing capacity of the soil decreases. Therefore, before the construction of any structure at any site, the depth of the water table should be checked should be lowered suitably if required.

Nomenclature

IS code	Indian Standard code
c	Cohesion (kN/m2)
c'	Apparent cohesion (kN/m2)
Ø	Angle of inernal friction
Ø'	Apparent angle of internal
MDD	Maximum Dry Density
OMC	Optimum Moisture Content (%)
q_{nc}	Net ultimate bearing capacity
q_u	Ultimate bearing capacity

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