

REPORT ON GEOTECHNICAL INVESTIGATION
FOR
CONSTRUCTION OF JIPMER URBAN HEALTH CENTRE
AT
KURICHIKUPPAM, PUDUCHERRY

BY

R AND D & CONSULTANCY CENTRE
GEOTECHNICAL ENGINEERING LABORATORY
DEPARTMENT OF CIVIL ENGINEERING
PONDICHERRY ENGINEERING COLLEGE



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GEOTECHNICAL INVESTIGATION REPORT
FOR CONSTRUCTION OF JIPMER URBAN HEALTH CENTRE
AT KURICHIKUPPAM, PUDUCHERRY.

INTRODUCTION:

Geotechnical investigation for construction of Urban Health Centre, G+2 story framed structure for JIPMER Urban Health Centre at Kurichikuppam was carried out at the request of Senior Manager (Civil) HLL Lifecare Limited, JIPMER Projects, Puducherry. This geotechnical Investigation was carried out to ascertain the soil profile, type of foundation and its capacity. This report presents sub soil condition, test results, bore log, and suitable recommended foundation for the soil conditions.

SITE CONDITION

The site for the above said investigation was located at Sardar Valabai Patel Road, between the street of HMKasim Road and Nethaji Subash Chandra Bose salai (Gingee Salai) Puducherry. Site plan and the location of the Borehole made for the Geotechnical Investigation is shown in the Fig.1.

GEOTECHNICAL INVESTIGATION

The Geotechnical Investigation for the proposed building was carried out, as per IS 1892 - 1979 (Reaffirmed 1997). Three numbers of bore holes were made at the location in consultation with the clients (Ref Fig.1). The boreholes are of 150mm diameter made by shell and auger method of boring using mechanical rig. While boring disturbed samples (DS) were collected for every 0.5m. UDS samples were collected wherever possible using 100mm dia, 450mm long sampling tube. Details of UDS sample collected are marked in Borelog. For every 1.5meter depth Standard Penetration test (SPT) was conducted, as per IS 2131 : 1997. Bore hole was made upto 20m. Bore log with complete details of soil stratification and SPT results are presented in Bore logs 1 to 3.



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LABORATORY TESTS AND RESULTS

On the disturbed soil samples (DS) collected, soil tests to determine the Index properties were conducted as per the relevant IS code of practice. The results are presented in Tables 1 & 2. The shear strength properties are presented in Table 3 to 5. Chemical Soil test on Ground Water is presented in Table 6. The soil was classified as per IS: 1498 - 1997 and mentioned in the Bore log.

TABLE 1 Particle Size Analysis Results

Bore Hole 1					
Depth (m)	Gravel %	Sand %			Silt and Clay %
		Course sand	Medium Sand	Fine sand	
1.5	1.41	1.77	23.32	54.06	19.43
4.5	3.8	1.90	29.75	41.14	23.42
7.5	0.70	1.40	11.89	75.52	10.49
9.5	0	2.83	9.70	19.47	68.00
14	8.72	1.36	39.45	34.40	16.06
18.5	0.00	1.52	4.23	7.25	87.00

Bore Hole 2					
Depth (m)	Gravel %	Sand %			Silt and Clay %
		Course sand	Medium Sand	Fine sand	
1.5	0.43	1.74	54.35	34.35	9.13
4.0	0.00	11.37	14.89	22.74	51.00
5.5	0.00	6.03	12.30	25.67	56.00
6.5	1.86	1.12	41.26	46.84	8.92
9.5	0.00	9.01	11.52	19.47	60.00
14.0	1.03	0.34	25.43	35.05	38.14
18.5	0.00	4.25	8.29	12.46	75.00

Bore Hole 3					
Depth (m)	Gravel %	Sand %			Silt and Clay %
		Course sand	Medium Sand	Fine sand	
1.5	11.43	2.29	19.43	36.00	30.86
3.5	0.00	12.51	17.35	22.14	48.00
6.5	0.00	6.75	9.37	11.88	72.00
9.5	0.00	5.75	12.88	21.37	60.00
14.0	2.12	0.53	60.32	29.10	7.94
18.5	0.00	4.91	8.66	18.43	68.00



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TABLE 2: Free Swelling, Liquid Limit, Plastic Limit, Plasticity Index, Consistency Index

BH No	DEPTH (m)	Free Swell Index	Index Properties (%)			
			Liquid Limit	Plastic Limit	Plasticity Index	Consistency Index
BH - 1	9.5	30	45	34	11	0.09
	18.5	36	51	25	26	0.04
BH - 2	3.5	30	42	28	14	0.93
	5.5	25	44	31	13	0.62
	9.5	36	44	28	16	0.25
	18.5	70	71	37	34	0.50
BH - 3	3.5	45	29	18	11	0.09
	6.5	33	45	20	25	0.12
	9.5	20	38	15	23	0.04
	18.5	36	52	29	23	0.96

TABLE 3 Water Content, Wet Density & Direct Shear Results (BH -1)

BORE HOLE NO	DEPTH (m)	Water Content (%)	Wet Density (kN/m ³)	Direct Shear Values	
				C - value (kPa)	Φ - value
BH 1	1.5	19	19.0	9.7	30°45'
	4.5	21	16.0	1.2	13°52'
	7.5	23	12.1	2.7	34°29'
	9.5	44	14.2	16.8	5°11'
	14.0	15	12.9	8.2	35°33'
	18.5	50	16.0	22.0	3°8'

TABLE 4 Water Content, Wet Density & Direct Shear Results (BH -2)

B.H No	DEPTH (m)	Water Content (%)	Wet Density (kN/m ³)	Direct Shear Values	
				C - value (kPa)	Φ - value
BH 2	1.5	15	17.4	2.7	35°54'
	3.5	29	19.8	27.5	0°30'
	5.5	36	12.8	8.5	3°39'
	6.5	24	18.9	2.7	34°50'
	9.5	40	12.9	12.2	5°11'
	14.0	76	19.8	17.1	7°17'
	18.5	54	16.2	14.0	2°34'



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TABLE 5 Water Content, Wet Density & Direct Shear Results (BH -3)

B. H No	DEPTH (m)	Water Content (%)	Wet Density (kN/m ³)	Direct Shear Values	
				C - value (kPa)	Φ - value
BH 3	1.5	26	16.6	25.0	5°42'
	3.5	28	19.8	28.1	3°8'
	6.5	42	17.1	19.0	2°34'
	9.5	37	18.3	0	0°0'
	14.0	17	12.2	1.2	36°14'
	18.5	30	15.2	42.4	3°39'

TABLE 6 Soil Chemical Test Results

	Sulphates So ₄ ⁻	Chlorides Cl ⁻
BH - 1	24mg/l	80mg/l
BH - 2	30mg/l	90mg/l
BH - 3	26 mg/l	80mg/l

SUBSOIL CONDITION

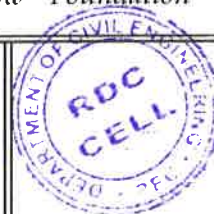
From the field bore log and laboratory test results it is found that the soil layers in all the bore holes are mostly uniform with little variation. The soil layers up to 20m is predominantly sandy soil in combination with clay or silt in layers. SPT values are very low, mostly less than 5 up to 12m. Below this layer for a thickness of 4ms i.e. upto 16m the layer of dense sandy silt formation where N is greater than 50. Below this layer again the soil profile is of silty clay with an average N value of 7. The boreholes were terminated at 20.0m depth.

SAFE BEARING CAPACITY CALCULATIONS

Recommendations for shallow foundation is as per IS: 1904-1985, *Code of practice for design and construction of foundations: General requirements (third revision)*, the Safe Bearing Capacity of soil for shallow foundation was calculated as per IS: 6403 - 1981 *Code of Practice for Determination of Bearing Capacity of Shallow Foundation* and the settlement calculations are as per IS: 8009 (Part - I) - 1976, *Code of practice for calculation of settlements in foundations, Part-I Shallow Foundation Subjected to*



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symmetrical static vertical Loads. IS 2950 (Part 1):1981, Code of practice for design and construction of raft foundations: Part 1 Design (second revision). All the calculations were carried out based on the SPT value observed from the field.

RECOMMENDATIONS

From the field test results and Laboratory test results the following are the recommendations.

1. From the bore log it is observed that the soil layer up to 6m is loose Silty Sand. Considering the in-situ conditions and type of proposed structure shallow foundation – **Isolated Footing** is recommended.
2. For Isolated footing, the recommended foundation depth is **1.5m** below the existing ground level.
3. Considering the state of soil it is recommended that the allowable safe bearing capacity for the Isolated footing is **60 kpa (6 t/m²)** for a total settlement of 45mm.
4. As the "N"- SPT Value upto 6m depth is less than 5, The SBC for the entire layer can be considered as **60 kpa (6 t/m²)** for a total settlement of 45mm.
5. Considering the type of structure G+2, on proportioning of footing, if the footings overlaps **Strip Raft Footing** may be adopted.
6. For strip raft footing, the recommended foundation depth is **1.50m** below the existing ground level.
7. The recommended that the **allowable safe bearing capacity** for the Isolated footing is **70 kpa (7 t/m²)** for a total settlement of 50mm.
8. For the sub structure (RCC) the environmental exposure condition may be considered as "mild" and all the precaution as laid by the relevant code for the design of structure may be adopted.


(Dr.G.Gerald Moses)
Head of the Department
Professor and Head
Department of Civil Engineering
Pondicherry Engineering College
Puducherry - 605 014



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Name of the Work : Geotechnical Investigation for the Proposed construction of JIPMER Urban Health Centre (G+2) at Kuruchikuppam, Puducherry.

BORE LOG - 1

Project No:			Date:	04.11.2015		Location	JIPMER,Kuruchikuppam,Pdy.							
BH. No :		1	GWT (m):	1.40		Graphical Representation of Standard Penetration Test Data (N)							Description /consistency	
Depth of boring (m) : 20.0														
Depth Below GL	Soil stratum	Classification of soil	Thickness of Layer (m)	Depth of Sampling(m)		N Value	10	20	30	40	50			
				UDS	DS									
1.0		Silty Sand (SM)	2.90		0.5	5								Medium
					1.0									
					1.5									
2.0					2.0	3								Loose
					2.5									
3.0		Silty Sand (SM) (Pastic Silt)	4.10		3.0	2 _(50cm)								Loose
					3.5									
4.0					4.0	2 _(50cm)							Loose	
				4.5										
5.0				5.0	2							Loose		
				5.5										
6.0				6.0	4							Loose		
				6.5										
7.0	Silty Sand (SM)	1.20		7.0	8							Medium		
				7.5										
8.0				8.0	4								Medium	
	Sandy Silt (MI - SP)	1.80		8.5										
9.0				9.0	2							Soft		
				9.5										
10.0				10.0										



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BORE LOG - 1

Project No:			Date:	05.11.2015		Location		JIPMER, Kuruchikuppam, Pdy.																				
BH. No :		1		GWT (m):	1.40		Graphical Representation of												Description /consistency									
Depth of boring (m) :				20.0		Standard Penetration Test Data (N)																						
Depth Below GL		Soil stratum	Classification of		Thickness of Layer (m)															Depth of Sampling(m)								
							UDS	DS	N Value	10	20	30	40	50														
11.0			Sandy Silt (MI - SP)	2.40	*		10.5	1 _(30cm)							Soft													
							11.0																					
							11.5																					
12.0											12.0	6						Medium										
								12.5																				
								13.0																				
13.0			Silty Sand (SM - SP)	4.10				13.5	2 _(45cm)							Loose												
							14.0																					
							14.5																					
14.0											15.0	50						Very Dense										
											15.5																	
											16.0																	
15.0										16.5	5 _(5cm I)						Stiff											
										17.0																		
							17.5																					
16.0			Silty Clay (CM - CH)	3.50			18.0	8						Stiff														
						18.5																						
						19.0																						
17.0										19.5	11					Very Stiff												
										20.0																		



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Name of the Work : Geotechnical Investigation for the Proposed construction of JIPMER Urban Health Centre (G+2) at Kuruchikuppam, Puducherry.

BORE LOG - 2

Project No:	AAL692/2015		Date:	06.11.2015		Location	JIPMER,Kuruchikuppam,Pdy.							
BH. No :	2		GWT (m):	1.25		Graphical Representation of							Description /consistency	
Depth of boring (m) :			20.0											
Depth Below GL	Soil stratum	Classification of soil	Thickness of Layer (m)	Depth of Sampling(m)		Standard Penetration Test Data (N)								
						N Value	10	20	30	40	50			
				UDS	DS									
1.0		Sand (SP)	2.50		0.5	4						Loose		
					1.0									
					1.5									
2.0					2.0									
					2.5	4							Loose	
3.0		Sandy Clay (Cl - S)	3.75	⊗	3.0									
					3.5	4								
4.0				4.0										
				4.5	2 _(50cm)									Soft
5.0				5.0										
	*			5.5	2 _(30cm↓)									Soft
6.0				6.0										
				6.5	4									Loose
7.0	Sand (SP)	1.45		7.0										
				7.5	2								Loose	
8.0				8.0										
	Sandy Silt (MI - S)	2.30	*	8.5	2 _(15cm↓)								Soft	
9.0				9.0										
			*	9.5	2 _(15cm↓)									Soft
10.0				10.0										



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Name of the Work : Geotechnical Investigation for the Proposed construction of JIPMER Urban Health Centre (G+2) at Kuruchikuppam, Puducherry.

BORE LOG - 2

Project No:		AAL692/2015		Date:		06.11.2015		Location		JIPMER, Kuruchikuppam, Pdy.									
BH. No :		2		GWT (m):		1.25		Graphical Representation of										Description /consistency	
Depth of boring (m) :				20.0															
Depth Below GL	Soil stratum	Classification of	Thickness of Layer (m)	Depth of Sampling(m)		Standard Penetration Test Data (N)													
				UDS	DS	N Value	10	20	30	40	50								
11.0	Sandy Silt (SP - MI)	2.00	*	10.5	1 _(30cm)									Soft					
11.0																			
11.5																			
12.0	Silty Sand (SM)	4.50		12.0	11									Dense					
12.5																			
13.0																			
13.0				21									Dense						
13.5																			
14.0																			
14.0	68										Very Dense								
14.5																			
15.0																			
15.0	4												Medium						
15.5																			
16.0																			
16.0	Sandy Clay (CH-S) with Wooden Pieces	3.50		16.5	7									Stiff					
17.0																			
17.5																			
17.5				5										Stiff					
18.0																			
18.5																			
18.0																			
19.0																			
19.5																			
20.0																			
20.0																			



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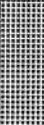


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Name of the Work : Geotechnical Investigation for the Proposed construction of JIPMER Urban Health Centre (G+2) at Kuruchikuppam, Puducherry.

BORE LOG - 3

Project No:	AAL692/2015	Date:	11.11.2015	Location	JIPMER, Kuruchikuppam, Pdy.											
BH. No :	3	GWT (m):	1.30	<div>Graphical Representation of Standard Penetration Test Data (N)</div>										Description /consistency		
Depth of boring (m) :		20.0														
Depth Below GL	Soil stratum	Classification of	Thickness of Layer (m)	Depth of Sampling(m)												
				UDS	DS	N Value	10	20	30	40	50					
1.0		Silty Sand - Filled up Earth	1.50	⊗	0.5	5						Loose				
					1.0											
					1.5											
2.0		Clayey Sand (SP -ML)	3.40	⊗	2.0	4						Loose				
					2.5											
					3.0											
3.0						3.5	4							Loose		
					4.0											
					4.5											
4.0		Sandy Clay (CI - S)	5.10	*	5.0	1 _(30cm↓)						Loose				
					5.5	2 _(30cm↓)					Soft					
					6.0	2										
5.0							6.5						Soft			
					7.0											
					7.5	2 _(15cm↓)					Soft					
6.0						8.0	1 _(15cm↓)						Soft			
					8.5											
7.0						9.0						Medium				
					9.5	4 _(15cm↓)										
8.0						10.0										
9.0																
10.0																



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BORE LOG - 3

Project No:		AAL692/2015		Date:		11.11.2015		Location		JIPMER,Kuruchikuppam,Pdy.										
BH. No :		3		GWT (m):		1.30		Graphical Representation of												Description /consistency
Depth of boring (m) :				20.0																
Depth Below GL		Soil stratum	Classification of	Thickness of Layer (m)	Depth of Sampling(m)		Test Data (N)													
					UDS	DS	N Value	10	20	30	40	50								
11.0		Sandy Silt (MI - S)	2.00	*									10.5	2 _(30cm)						
12.0					11.5	12.0	4													
13.0		13.5	14.0	65 _(30cm)																
14.0					14.5	15.0	34													
15.0		15.5	16.0	6																
16.0					16.5	17.0	8													
17.0		17.5	18.0	8																
18.0					18.5	19.0	8													
19.0		19.5	20.0	8																
20.0																				



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