

**SOIL INVESTIGATION REPORT**  
**FOR**  
**CONSTRUCTION OF**  
**OHSR**  
**AT**  
**PH SECTION COMPOUND KAYAMKULAM**  
**(Interim Report)**



**CENTRE FOR INDUSTRIAL TRAINING CONSULTANCY &  
SPONSORED RESEARCH**  
**COLLEGE OF ENGINEERING TRIVANDRUM**  
**THIRUVANANTHAPURAM-695016**  
**DECEMBER -2022**

**CENTRE FOR INDUSTRIAL TRAINING CONSULTANCY &  
SPONSORED RESEARCH**

**COLLEGE OF ENGINEERING TRIVANDRUM**

**THIRUVANANTHAPURAM-695 016**

**DEPARTMENT OF CIVIL ENGINEERING**

**SUBSOIL INVESTIGATION REPORT**

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**Name of Client** : PROJECT MANAGER, PROJECT  
DIVISION , KWA , ALAPPUZHA

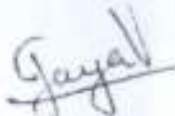
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**Site of Investigation** : CONSTRUCTION OF OHSR AT PH  
SECTION COMPOUND, KAYAMKULAM

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**Period of Investigations** : DECEMBER 2022

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**Job No.** : CET/ITC&SR No. 765/22-23

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**Report No.** : (interim report)

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**Investigation done by** : Dr. JAYA V.



**Principal Investigator**

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## **1. INTRODUCTION**

The Project Manager, Project Division, KWA, Alappuzha requested the College of Engineering Trivandrum to conduct a subsoil investigation for the proposed OHSR at PH Section, Kayamkulam. Accordingly, the investigation was carried out under the guidance of Dr. Jaya V., Professor in Civil Engineering, College of Engineering Trivandrum, Thiruvananthapuram-16. The objectives of the work are to study in detail soil profiles and characteristics of samples collected from two borehole locations to obtain appropriate design parameters for safe and economical foundation design. The details of the subsoil investigation are given below;

## **2. FIELD INVESTIGATION**

Subsoil investigation was conducted using rotary boring rigs. After the site visit, it was decided to have two boreholes at the proposed site for OHSR at PH Section Kayamkulam. The two borehole locations are shown in Annexure I. The procedure of field investigation is as follows;

- a. The borehole is advanced to the depth at which the standard penetration depth has to be performed.
- b. Standard Penetration Tests were conducted at regular interval in three boreholes as per IS: 2131 – 1981.
- c. The bottom of the borehole is cleaned. The split spoon sampler attached to standard drill rods of required length is lowered into the borehole and rested at the bottom.
- d. The split spoon sampler is seated 150 mm by blows of a drop hammer of 63.5 kg falling vertically from a height of 750 mm. Thereafter, the split spoon sampler was further driven 300 mm in two steps each of 150 mm. The number of blows required to effect each 150 mm penetration was recorded. The first 150 mm of drive is considered as the seating drive. The total blows required for the second and third 150 mm of penetration is termed the penetration resistance  $N$ .



If the split spoon sampler is driven less than 450 mm (total), then N-value was taken as the number of blows for the last 300 mm penetration. In case, the total penetration is less than 300 mm for 50 blows, it was entered as rebound in the borelog.

e. The split spoon sampler was then withdrawn and is detached from the drill rods. The split barrel is disconnected from the cutting shoe and the coupling. The soil sample collected inside the barrel is collected carefully and preserved for transporting the same to the laboratory for further tests.

f. Standard penetration tests were conducted at every change in stratum or intervals of not more than 1.50 m whichever was less.

The subsoil investigation was conducted from 08/12/2022 to 14/12/2022. The Bore hole locations are shown in Annexure I. The soil profiles along with standard penetration test results for two bore holes are presented in bore log charts as Annexure II.

Representative samples using split spoon sampler were collected at regular intervals and preserved for conducting various identification tests in the laboratory. Water table in the borehole was carefully observed as per IS: 6935-1989. Table 1 shows the details of borehole numbers, depth of water table and maximum depth of boring drilling.

**Table 1 Depth of Boreholes and Water Table Levels**

Borehole No.	Maximum depth of borehole (m)	Depth of water table below EGL (m)
BH1	50.00	-
BH2	50.00	-

### **3. LABORATORY STUDIES**

The soil samples collected at every 1.5 m intervals from all boreholes were tested in the laboratory for classification. Depending on the type of substrata encountered, appropriate laboratory tests were conducted on soil samples.

#### **4. DESCRIPTION OF SOIL PROFILE AND BORELOG DETAILS**

##### **4.1 Borehole: BH1 -Rotary Drilling**

Top layer of 2.20 m is clayey sand. Layer of fine sand is noted until a depth of 7.20 m and followed by clay with shell dust till 13.40 m. The next layer is lateritic clay with sand extends to 20.30 m. Stiff clay extends until 37.20 m followed by fine sand to depth of 50.00 m. The borehole terminated at 50.00 m in fine sand.

##### **4.2 Borehole: BH2 -Rotary Drilling**

Top layer of 2.60 m is clayey sand. Layer of fine sand is noted until a depth of 7.30 m and followed by clay with shell dust till 13.10 m. The next layer is lateritic clay with sand extends to 20.60 m. Stiff clay extends until 32.70 m followed by fine sand to depth of 41.30 m. The borehole terminated at 50.00 m in fine to medium sand.

#### **5. DESIGN CONSIDERATIONS AND RECOMMENDATIONS**

Cast in situ Concrete Pile is recommended for the proposed Water Tank by considering the structural load and soil profile details observed in two boreholes. The recommended pile depth and carrying capacity of the piles are shown in Table 2 below. All the salient provisions and specifications of IS: 2911-2010 (Code of practice for design and construction of pile foundation) shall be closely adhered to.

The pile capacities recommended in Table 2 should be validated through a full-scale pile load test as per IS code provisions. The structural capacity of the piles shall be adequate. If the pile tips are terminated before the recommended depths the capacities will be lower and a chance of exceeding permissible settlement of foundation will be there. A minimum of two piles should be provided in a group.

Proper monitoring of the following points is essential during the construction of piles. The density of drilling mud shall be maintained as per standards and regular monitoring is required during construction. The cleaning of boreholes shall be ensured before the concreting of the pile. Lining may be provided during drilling if required due to the collapse of side soil. Close monitoring and documentation of the consumption of aggregates, reinforcement and cement shall be made. Details of chisel energy, depths achieved and time rate of progress shall be monitored and documented.

Pile termination at hard stratum shall be judiciously decided based on the acquired data during piling operations in conjunction with the details contained in this report.

Table 2 Recommended Pile Capacities as per IS:2911-2010

Borehole No	Depth of Pile (m)	Diameter of Pile (m)	Vertical Capacity (t)
BH1&BH2	42.00	0.60	70.00
		0.75	82.00
		0.80	94.00
		0.90	105.00
		1.00	115.00

General Notes: (i) Recommendations made are specific for the proposed site and imposed loads. (2) The Recommendations are based on the site investigation in two boreholes at the proposed water tank location. All depths shown in the bore log are from the existing ground level at the time of exploration. The existing ground level shall be recorded at a permanent datum using digital surveying before the start of work/excavations at the site.

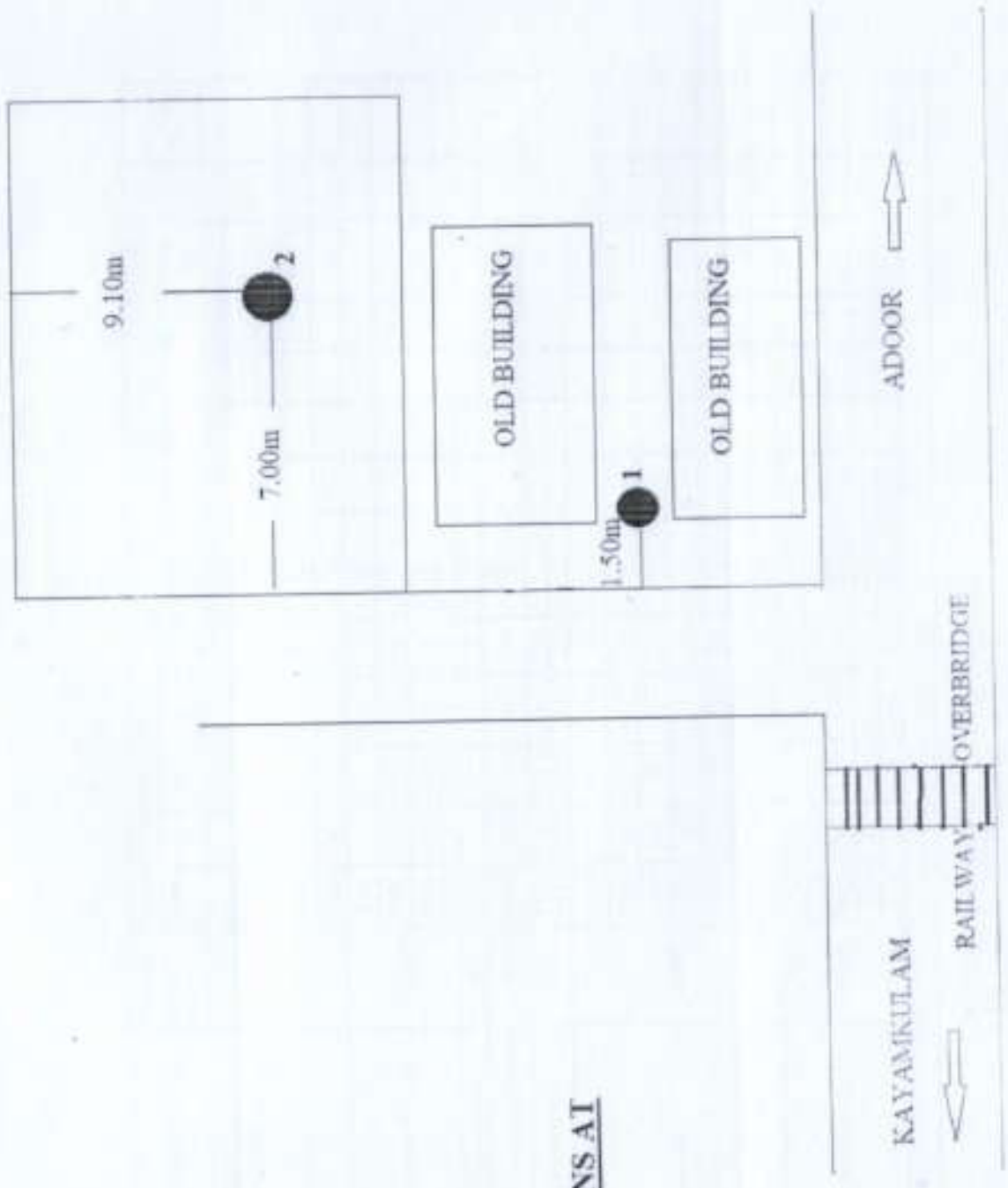
(3) If any variation in the soil profile is met with during execution, fresh recommendations may be obtained from the Consultants or any qualified and experienced Geotechnical Engineer.

END OF REPORT

*Gayal*



BORE HOLE LOCATIONS AT  
KAYAMKULAM  
(not in scale)





**BORE LOG**

Project : Proposed OHSR

Site : Kayambulam

Bore Hole No: 1

Type of Boring: Rotary Drilling

Date of commencement 08-12-2022

Date of completion- 10-12-2022

Ground Water Level:-

Depth below EGL (m)	Profile	Visual Description of soil	Thickness of layers (m)	Standard Penetration Test Data						Graphical representation of N-value	water content (%)	sand (%)	silt and clay (%)
				Depth (cm)	15	30	45	N Value					
0.00									0-10				
2.20		Clayey sand	2.20	1.50	2	3	4	7	10-20				
				3.00	9	9	10	19	30-40				
		Fine sand	5.00	4.50	3	4	4	8	40-50				
				6.00	4	6	8	14	>50				
7.20				7.50	1	1	1	2					
				9.00	2	1	2	3					
		Clay with sand and shell dust	6.20	10.50	1	2	1	3					
				12.00	1	2	3	5					
13.40				13.50	3	4	5	9					
14.80		Lateritic clay with sand	1.40	15.00	8	10	12	22					
16.60		Lateritic clay with sand and pebbles	1.80	17.00	4	5	6	11					
20.30		Lateritic clay with sand	3.70	19.00	6	8	14	23					
				21.00	9	12	16	28					
				23.00	9	14	19	33					
				25.00	10	13	17	30					
				27.00	10	14	21	35					
				30.00	7	9	11	20					
				33.00	8	10	13	23					
				36.00	8	9	12	21					
				39.00	14	23	27	>50	Balance-3 cm				
				42.00	16	30	20	>50	Balance-8 cm				
				45.00	20	37	33	>50	Balance-11 cm				
				48.00	18	31	18	>50	Balance-9 cm				
				50.00	21	34	16	>50	Balance-10 cm				

Bore Hole Terminated at 50.00 m depth

**BORE LOG**

Project : Proposed OHSK  
 Site : Kayarukulam  
 Bore Hole No: 2

Date of commencement 12-12-2022  
 Date of completion- 14-12-2022  
 Ground Water Level:-

Depth below FGL(m)	Profile	Visual Description of soil	Thickness of layers (m)	Standard Penetration Test Data					Cuspidal representation of N-value	water content (%)	sand (%)	silt and clay (%)
				Depth (m)	15	30	45	"N" Value				
0.00								0-10				
2.60		Clayey sand	2.60	3.50	2	2	2	10-20				
7.30		Fine sand	4.70	3.00	8	10	12	20-30				
				4.50	9	12	15	30-40				
				6.00	7	9	10	40-50				
				7.50	1	0	1	>50				
13.10		Clay with sand and shell dust	5.80	9.00	1	1	1					
14.60		Latent clay with sand	1.50	10.50	1	1	2					
18.20		Latent clay with sand and pebbles	3.60	12.00	1	2	2					
20.60		Latent clay with sand	2.40	13.50	7	9	9					
				15.00	8	13	10					
				17.00	8	10	11					
				19.00	6	7	8					
				21.00	7	10	12					
				23.00	9	15	18					
				25.00	8	13	16					
				27.00	8	10	11					
				29.00	7	9	10					
32.70		Stiff clay	12.10	33.00	18	37	33	Balance-12 cm				
				36.00	19	36	34	Balance-11 cm				
				39.00	16	30	20	Balance-8 cm				
				42.00	19	34	16	Balance-10 cm				
				45.00	21	38	12	Balance-11 cm				
				48.00	18	41	9	Balance-13 cm				
50.00		Fine to medium sand	6.70	50.00	20	34	11	Balance-12 cm				

Bore Hole Terminated at 50.00 m depth