



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

GEOTECHNICAL INVESTIGATION REPORT

NAME OF CUSTOMER

Wapcos Limited
Bhopal

NAME OF WORK

Sub Soil Investigation for different ULBs under the project "Project Development and Management Consultant (PDMC) for Atal Mission for rejuvenation and urban Transformation (AMRUT) including project management of other Notified scheme in Project - Package-II, M.P."

NAME OF AGENCY

REFERENCE NO.

WAP-BPL/AMRUT-MP/2016 Dtd. 12/11/2016

REPORT NO.

MCS/VDR/SOIL/2016-17/20161231-1

Date: 31/12/2016

TRF NO.

SOIL/20161216-3





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

INDEX

SR. NO.	CONTENT	PAGE NO.
1	Preamble	3
2	Site Condition	3
3	Nature of Investigation	3
4	Laboratory Tests	4
5	Design Procedures	5
6	Summary of Analysis	6
7	Note	7
8	Conclusion & Recommendations	8
9	Annexure - Test Procedures	9
10	References	12
11	Borelog	13
12	Result Sheet	20



D:\MCS - SOIL REP - 16-17\Soil-20161216-3 Wapcos Ltd., Bhopal, Ujjain - BH-7nos

2



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

1.0 PREAMBLE

Manglam Consultancy Services, Vadodara have carried out the Geo technical Investigation. The scope of work is field sampling, field tests, necessary laboratory tests and finally analyzing the sub soil characteristics and safe Bearing Capacity of the soil of the proposed site.

The objective of the geotechnical investigation was to explore the sub soil profile up to predetermined depth and to work out the bearing capacity of the soil beneath at a required foundation depth for the proposed type of foundation. Following pages represents the conceptual investigation and analysis based on the geotechnical investigation and study and presenting the same as a detailed report.

The detailed scope of work was as per the details given by the Engineer in-charge of the project. A complete geotechnical investigation work was undertaken to obtain the required subsurface information to study and define the nature and properties of soil, under the proposed structures. Such details are derived through following steps:

- By making borehole and collecting disturbed and undisturbed soil samples.
- Performing required in situ tests (SPT Test).
- Conducting laboratory tests to classify and to determine the engineering properties of soil.

An analysis was made to derive the allowable bearing capacity, taking into considerations the anticipated settlements and the present soil conditions with future possibilities. Based on such analysis of the soil properties, the conclusions are made regarding the precautions and protective measures to be taken, if found necessary. This report has been prepared after a careful study of the field testing and laboratory test results. The type and depth of foundation are suggested.

2.0 SITE CONDITION : At the site under investigation, as per the client details it is proposed project of different ULBs under the project "Project Development and Management Consultant (PDMC) for Atal Mission for rejuvenation and urban Transformation (AMRUT) including project management of other Notified scheme in Project - Package-II, M.P." at Ujjain, Madhya Pradesh (M.P.).

2.1 LOCATION : Site is located at Ujjain, Madhya Pradesh (M.P.).

2.2 GROUND WATER TABLE: Ground Water table was not encountered during the exploration work.

3.0 NATURE OF INVESTIGATION:

3.1 BOREHOLES:

Depth of investigation, No. of borholes & the locations were suggested by engineer incharge of project. Seven boreholes were made by machine boring below existing Ground Level. Boring was carried out in accordance with IS: 1892 and the undisturbed soil samples were collected in thin walled tube sampler as per IS: 2132 – 1986 were sealed packed and brought to our laboratory at Vadodara for further investigations.





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

3.2 SAMPLING:

During the advancement of the boring Disturbed and Undisturbed samples are collected at every 1.5m interval or at the change of strata whichever occurs earlier. Along with the samplings, field Standard Penetration Tests is conducted to correlate the strata denseness & stiffness. Detail procedures are explained in Annexure-I.

Field observation of the soil profile in all the Seven boreholes are given in following table as mention below.

3.3 SUB SOII PROFILE:

BH No./ Location	Strata	Th. of Layer in m	Description
BH-1 (Shanti Palace)	0.00 - 4.50	4.50	Filled up material
	4.50 - 8.00	3.50	Yellow silty clay of high plasticity
BH-2 (Industrial Area)	0.00 - 2.50	2.50	Black silty medium to coarse gravels with sand
	2.50 - 4.00	1.50	Black poorly graded gravels
	4.00 - 5.00	1.00	Pieces of Rock
BH-3 (Khamed Gau Bahdhi)	0.00 - 4.00	4.00	Yellow silty clay of high plasticity
	4.00 - 8.50	4.50	Grayish yellow silty clay of high plasticity with few gravels
	8.50 - 11.50	3.00	Blackish yellow silty clay of high plasticity with white nodules
	11.50 - 13.00	1.50	Yellowish gray clayey medium to coarse sand with gravels
BH-4 (Rudra Sagar)	13.00 - 14.00	1.00	Yellowish black poorly graded medium to coarse sand with gravels
	0.00 - 2.50	2.50	Brownish black silty clay of high plasticity
	2.50 - 4.00	1.50	Blackish gray silty clay of high plasticity
	4.00 - 5.00	1.00	Blackish yellow silty clay of high plasticity
	5.00 - 7.00	2.00	Yellow silty clay of high plasticity
BH-5 (Ram ghat)	7.00 - 8.00	1.00	Yellow silty clay of high plasticity with gravel
	0.00 - 2.00	2.00	Gray silty clay of high plasticity
	2.00 - 4.00	2.00	Black poorly graded medium to fine sand with gravels
BH-6 (Kaliyatha)	4.00 - 5.00	1.00	Pieces of Rock
	0.00 - 4.00	4.00	Yellow silty clay of intermediate plasticity
BH-7 (Bigipura Ring Road)	4.00 - 5.00	1.00	Yellow clayey medium to coarse sand with few gravel
	0.00 - 2.50	2.50	Brownish yellow silty clay of intermediate palstiicty with gravel
	2.50 - 4.00	1.50	Blackish yellow clayey coarse sand with gravels
	4.00 - 7.50	3.50	Yellow clayey medium to coarse sand with gravel

* Detail Borelog is given at Page No. 13 & 19.

4.0 LABORATORY TESTS:

Following laboratory tests were conducted on the soil samples to determine the physical and engineering properties of undisturbed and disturbed soil samples. Detail procedures are explained in Annexure.

- (A) Field Dry Density & Field Moisture Content
(B) Atterberg's Limit
(C) Particle Size Distribution
(D) Specific Gravity

- (E) Shear Parameters
(F) Swelling Parameter
(G) Consolidation Test

* The test results are given at page No. 20 & 26.

D:\MCS - SOIL REP - 16-17\Soil-20161216-3 Wapcos Ltd., Bhopal, Ujjain - BH-7nos





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

5.0 DESIGN:

Calculations for both Safe Bearing Capacity (SBC) and Safe Bearing Pressure (SBP) are carried out considering shear parameters and consolidation characteristics of the sub strata. Values of SBC & SBP are mentioned below:

5.1 SBC BASED ON SHEAR: The ultimate net bearing capacity is evaluated after taking into consideration of shape factor and depth factor of the foundation in accordance with IS: 6403-1981. The net bearing capacity worked out using the following equation for BH No. 1, 3, 4, 5, 6 & 7.

$$Q = C N_c S_c d_c + q (N_q - 1) S_q d_q + 0.5 B \gamma N_r S_r d_r$$

Where,

C	= Cohesion
q	= Overburden Pressure
γ	= Density
B	= Width of the Footing
N_c, N_q, N_r	= Bearing capacity Factor
S_c, S_q, S_r	= Shape Factor
d_c, d_q, d_r	= Depth Factor

5.2 SAFE BEARING PRESSURE: (IS: 8009 Part I) The Settlement calculation involves many simplifying assumptions.

Settlement may be the result of one or combinations of the following causes:

- Static Loading
- Deterioration of Foundation;
- Mining Subsidence; and
- Shrinkage of soil, vibration, subsidence due to underground erosion and other causes.

Catastrophic settlement may occur, if the static load is excessive. When the load is not excessive, the resulting

- Elastic Deformation or immediate settlement of foundation soil;
- Primary consolidation of foundation soil resulting from the expulsion of pore water,
- Secondary Compression of foundation soil; and
- Creep of the foundation soil.

The total settlement is computed as summation of immediate and secondary settlement.

$$S_t = S_i + S_c$$

Where, S_i is Immediate Settlement

$$S_i = p B \frac{(1 - \mu^2) I}{E}$$

Where,

p	= Foundation Pressure, kg/cm ²
B	= Width of Footing, m
μ	= Poisson's Ratio
I	= Influence Factor
E	= Modulus of Elasticity, kg/cm ²





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

Sc is Secondary Settlement

$$Sc = \frac{Ht}{(1+e_0)} Cc \log_{10} \left(\frac{p_0 + \delta p}{p_0} \right)$$

Where,

Ht = Thickness of Soil Layer, m

Cc = Compression Index

e₀ = Initial Void Ratio

p₀ = Initial Effective Pressure

δp = Increase in effective pressure

5.3 SAFE BEARING PRESSURE: (IS: 6403 & Foundation Design Manual By N.V. Nayak) Approaches based on N-Values of Standard Penetration Test (The Terzaghi-Peck-Approach for footings on sands) The allowable bearing capacity worked out using the following equation for BH No. 2.

$$q_a = 3.35 C_b (N - 3) \left[\frac{B+0.3}{2B} \right]^2 W_y d_t$$

Where,

q_a = Allowable net increase in soil pressure over existing soil pressure for a (total) settlement of 25 mm, in t/m²

C_b = Correction factor similar to that suggested by Peck and Bazara & Nayak

N = Standard penetration blow count corrected for submergence, if applicable, and for overburden pressure.

B = Width of footing, metres.

W_y = Reduction factor for shallow ground water

d_t = Depth factor for Terzaghi-Peck

$$d_t = 1 + \frac{D_f}{B} \leq 2.0$$

However, in this report the soil settlement and shear parameters are considered based on field and laboratory testing and reported, in static load conditions only.

6.0 SUMMARY OF ANALYSIS: On reviewing Based on the field and laboratory test data allowable bearing capacity is derived for isolated footing foundation.

Table No.1 : TABLE of SAFE BEARING CAPACITY

Type of Footing	Location	Depth in m (Below filled up material)	Size in m	Safe Bearing Capacity in T/m ²	Safe Bearing Pressure for 50 mm permissible settlement in T/m ²	Recommended Safe Bearing Capacity in T/m ²
Isolated Footing	BH-1 (Shanti Palace)	2.00	1.00 X 1.00	9.9	+10.0	9.9
		2.50		11.3	+12.0	11.3
		3.00		13.8	+14.0	13.8
		2.00	1.50 X 1.50	9.0	+10.0	9.0
		2.50		10.1	+11.0	10.1
		3.00		12.3	+13.0	12.3

D:\MCS - SOIL REP - 16-17\Soil-20161216-3 Wapcos Ltd., Bhopal, Ujjain - BH-7nos



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

Type of Footing	Location	Depth in m	Size in m	Safe Bearing Capacity in T/m ²	Safe Bearing Pressure for 50 mm permissible settlement in T/m ²	Recommended Safe Bearing Capacity in T/m ²	
Isolated Footing	BH-3 (Khamed Gau Bahdhi)	2.00	1.00 X 1.00	11.3	+12.0	11.3	
		2.50		12.7			
		3.00		18.4			
		BH-4 (Rudra Sagar)	2.00	1.50 X 1.50	10.3	+11.0	10.3
			2.50		11.3		
			3.00		16.2		
	BH-5 (Ram Ghat)		2.00	1.00 X 1.00	11.6	+12.0	11.6
			2.50		13.0		
			3.00		15.1		
		BH-6 (Kaliyatha)	2.00	1.50 X 1.50	10.6	+11.0	10.6
			2.50		11.5		
			3.00		13.3		
	BH-7 (Bigipura Ring Road)		2.00	1.00 X 1.00	14.6	+15.0	14.6
			2.50		16.5		
			3.00		18.3		
		BH-8 (Industrial Area)	2.00	1.50 X 1.50	13.3	+14.0	13.3
			2.50		14.7		
			3.00		16.2		
	BH-9 (Kaliyatha)		2.00	1.00 X 1.00	13.1	+14.0	13.1
			2.50		15.6		
			3.00		+18.0		
		BH-10 (Bigipura Ring Road)	2.00	1.50 X 1.50	12.1	+13.0	12.1
			2.50		14.1		
			3.00		+18.0		
	BH-11 (Bigipura Ring Road)		2.00	1.00 X 1.00	12.7	+13.0	12.7
			2.50		15.1		
			3.00		+18.0		
		BH-12 (Bigipura Ring Road)	2.00	1.50 X 1.50	11.7	+12.0	11.7
2.50			13.6				
3.00			+18.0				
BH-13 (Bigipura Ring Road)	2.00		1.00 X 1.00	12.7	+13.0	12.7	
	2.50			15.1			
	3.00			+18.0			
	BH-14 (Bigipura Ring Road)	2.00	1.50 X 1.50	11.7	+12.0	11.7	
		2.50		13.6			
		3.00		+18.0			

Type of Footing	Location	Depth in m	Size in m	Safe Bearing Pressure for 50 mm permissible settlement in T/m ²	Allowable Bearing Capacity in T/m ²	
Isolated Footing	BH-2 (Industrial Area)	2.00	1.00 X 1.00	+15.0	15.0	
		2.50		+18.0		
		3.00		+20.0		
		BH-2 (Industrial Area)	2.00	1.50 X 1.50	+15.0	15.0
			2.50		+18.0	
			3.00		+20.0	

7.0 NOTE:

- 1) Least value among the SBC & SBP values shall be considered in design of foundations.
- 2) Water table considered in evaluation of SBC/ABP.



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

8.0 CONCLUSION & RECOMMENDATION:

- 1) The present report covers the Geo-technical investigation carried out for Seven boreholes at Ujjain, Madhya Pradesh (M.P.).
- 2) Based on proposed type of project, borelog data, laboratory test results RCC Isolated Footing is suggested for structure with safe bearing capacity considering factor of safety 2.5 as shown in table no.1.
- 3) Safe bearing pressure calculated for 50mm permissible limit as per IS 8009 (Part-I). The calculation SBP is based on assumption there is no change in soil strata below the depth of investigation.
- 4) Suitability of soil for back-filling the top layer of soil is filled up material in BH No.1 and silty clay of intermediate to high plasticity in BH No. 3, 4, 5, 6 & 7, which is not suitable for back filling.
- 5) Suitability of soil for back-filling the top layer of soil is silty medium to coarse gravels in BH No.2, which is suitable for back filling.
- 6) The above report is based on strata encountered up to the depth of investigation.
- 7) The above recommendations are based on the collected field data, laboratory test results conducted on the soil samples recovered from the test locations. However during excavation of foundations, if the actual sub-soil condition vary from what it has been represented in this report, the client/agency may be referred to us for further suggestion/Modifications.
- 8) Water table is considered in evaluation of ABP as permanent water table was not traced out at the time of investigation but normally in monsoon water get accumulated near foundation hence necessary action to prevent water percolating near foundation to be considered. It also require to make necessary arrangement to flow domestic as well as rain water away from foundation.
- 9) It was not mentioned by client regarding type of structure hence SBC/ABP is worked out by considering isolated footing hence if any change in the type of foundation you are requested to contact undersign.
- 10) Looking to the test results majority of borehole consists clay of high plasticity. Such type of soil swells when wet and shrink while dry hence it required treatment to minimize swelling & shrinkage effect.

**** End Of Report ****

Note:

- 1) The test reports shall not be reproduced, without written approval of the laboratory
- 2) Manglam consultancy services is not responsible for any kind of interpretation of test results.
- 3) The results/report is not used for publicity.
- 4) "The tests marked as * are not accredited by NABL"

gorji
Tested By

For Manglam Consultancy Services



8



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

9.0 ANNEXURE:

9.1 SAMPLING:

9.1.1 Disturbed Soil Samples: Disturbed samples were collected during the boring and also from the split spoon sampler. The samples recovered were logged, labeled and placed in polythene bags and sent to laboratory for testing. The samples collected at every 1.50m depth.

9.1.2 Undisturbed Soil Samples: Undisturbed soil samples were collected in 75mm diameter Shelby tubes at every 1.5m depth at the site location. The sampler used for the sampling had smooth surface and appropriate area ration and cutting edge angle thereby minimizing disturbance of soil during sampling. The samples were sealed with wax, labeled and transported to our laboratory at Vadodara for testing. Sampler was coupled together with a sampler head to form a sampling assembly. The sampler head provide a non-flexible connection between the sampling tube and the drill rods. Vent holes are provided in the sampler head to allow escape of water from the top of sampler tube during penetration. Coating of oil is applied on both sides to obtain the undisturbed samples in best possible manner. The sampler was then lowered inside the borehole on a string of drill rods and was driven to pre-determined level. On completion of driving the sampler was first rotated within the borehole to shear the soil sample at bottom and then pulled out. The disturbed material in the upper end of the tube, if any, is completely removed before applying wax for sealing. The soil at the lower end of the tube is trimmed to about 10 to 15 mm. After trimming, both ends are sealed with wax applied in such a way that will prevent the soil from giving up from its sample. The polythene bags cover both the ends. The identification mark was then made on each sample.

9.1.3 Standard Penetration Test: SPT is conducted in accordance with IS: 2131-1981 in bores holes at every change of strata or at an interval of 1.50m depth in uniform strata. The test gives N-value; the blow counts of last 30cm of penetration of the split spoon sampler with 65kg. Hammer falling freely from 75cm height. The rods to which the sampler is attached for driving are straight, tightly coupled and straight in alignment. There after the split spoon sampler is further driven by 30cm. The number blows required to drive each 15cm penetration is recorded. The first 15cm penetration is termed as a seating value. The last 30cm penetration termed as 'N' Value. Respective tables and bore logs in the report shows the detail of N value.

9.2 LABORATORY TEST PROCEDURES:

9.2.1 Field Dry Density & Field Moisture Content: Field dry density and Field moisture content were carried out in accordance with I.S. 2720 (Part-2 – 1983). The field density is found out by following equation. The value of F.D.D. & F.M.C. is shown in summary table.

Field Density (bulk) = Weight of soil mass / Volume of soil mass

And Field Dry Density = Bulk Density / (1 + w), Where w is field moisture content.

9.2.2 Atterberg's Limit (IS 2720 Part-5): Liquid limit and Plastic limits are carried out for the determination of different characteristic of soil. The tests performed in accordance with I.S.2720 P-5-1985 by using con penetrometer. Liquid limit and plastic limit of soils are both depend up on the amount and type of clay in a soil and form the basis for the soil classification system for cohesive soils based on the Plasticity index. The liquid limit of the soil with corresponds to the moisture content of a paste which would give 20mm penetration of the cone is determined by using following formula.

$$WL = W_x / (0.65 + 0.0175 * X)$$

Where,

X = Penetration of cone in the sample

W_x = Moisture Content of the soil sample at the respective penetration

D:\MCS - SOIL REP - 16-17\Soil-20161216-3 Wapcos Ltd., Bhopal, Ujain, Gandhinagar



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

For Plastic Limit, a soil sample weighing at least 20 gm of the soil sample passing 425 micron IS sieve is thoroughly mixed with water such that it can be easily molded with fingers. A ball is formed with about 8 to 10 gm of this soil and is rolled between the fingers and the glass plate with just sufficient pressure to roll the mass into a thread of uniform diameter of 3mm throughout its length. The soil is kneaded to a uniform mass and rolled again. The process is continued until the thread crumbles. The pieces of crumbled soil thread are collected for moisture content determination and reported as plastic limit. Values of LL, PL & PI are shown in summary 1.

9.2.3 Particle Size Distribution (IS 2720 Part-4): The sieve analysis is carried out in accordance with IS. The results are shown in the summary-1.

9.2.4 Specific Gravity (IS 2720 Part-3): In order to determine specific gravity of soil particles these tests were conducted on Selected samples in 50ml volumetric density bottle using procedure described in IS. The value of Specific Gravity is shown in summary -2.

9.2.5 Direct Shear Test (IS 2720 Part-13): Direct shear test is carried out using shear box with the specimens (60mm x 60mm). Specimen with plain grid plate at the bottom of the specimen and plain grid plate at the top of the specimen is fitted into position in the shear box housing and assembly placed on the load frame. The serrations of the grid plates are kept at the right angle to the direction of shear. Loading pad is placed on top grid plate. The required normal stress is applied and the rate of longitudinal displacement / shear stress application so adjusted that no drainage can occur in the sample during the test (1.25mm/min). The upper part of the shear box is raised such that a gap of about 1mm is left between the two parts of the box. Test is conducted by applying horizontal shear load to failure or to 20 percent longitudinal displacement whichever occurs first. Test is repeated on identical specimens. The shear parameters obtained from the shear stress Vs normal stress plot. Direct Shear Test is conducted on remolded samples at FDD & FMC.

9.2.6 Consolidation Test (IS 2720 Part-15): Test was carried out on undisturbed soil specimen in order to determine the settlement characteristics of soil at different depths. Sample is extruded to the consolidation ring of 60mm dia. The edge is trimmed carefully such that the sample flushes with the top and bottom edges of the ring. The thickness of the specimen is measured and the weight is recorded. The bottom porous stone is then centered on the base of the consolidation cell. The specimen is placed centrally between the bottom porous stone and the upper porous stone. A filter paper is provided in-between specimen and porous stones. The consolidometer is placed in position in the loading device and suitably adjusted. Dial gauge is clamped into position for recording the relative movement between the base of the cell and the loading cap. A seating pressure of 0.05 kg / sq. cm is applied to the specimen. The cell is kept filled with water. After 24 hrs the test is continued using a loading sequence on the soil specimen of 0.25, 0.50, 1.00, 2.00, 4.00 & 8.00 kg / sq. cm. For each loading increment after application of load, readings of the dial gauge is taken using time sequence 0, 0.25, 1.00, 2.25, 2, 6.25, 9, 16, 25, 36, 49 ... upto 24 hrs. From the observations of all incremental pressure, void ratio versus log (pressure) curve is obtained. The slope of the straight line portion shows compression index C_c and the rate of longitudinal displacement / shear stress application so adjusted that no drainage can occur in the sample during the test (1.25mm/min). The upper part of the shear box is raised such that a gap of about 1mm is left between the two parts of the box. Test is conducted by applying horizontal shear load to failure or to 20 percent longitudinal displacement whichever occurs first. Test is repeated on identical specimens. The shear parameters obtained from the shear stress Vs normal stress plot. Direct Shear Test is conducted on remolded samples at FDD & FMC.



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

9.2.6 Consolidation Test (IS 2720 Part-15): Test was carried out on undisturbed soil specimen in order to determine the settlement characteristics of soil at different depths. Sample is extruded to the consolidation ring of 60mm dia. The edge is trimmed carefully such that the sample flushes with the top and bottom edges of the ring. The thickness of the specimen is measured and the weight is recorded. The bottom porous stone is then centered on the base of the consolidation cell. The specimen is placed centrally between the bottom porous stone and the upper porous stone. A filter paper is provided in-between specimen and porous stones. The consolidometer is placed in position in the loading device and suitably adjusted. Dial gauge is clamped into position for recording the relative movement between the base of the cell and the loading cap. A seating pressure of 0.05 kg / sq. cm is applied to the specimen. The cell is kept filled with water. After 24 hrs the test is continued using a loading sequence on the soil specimen of 0.25, 0.50, 1.00, 2.00, 4.00 & 8.00 kg / sq. cm. For each loading increment after application of load, readings of the dial gauge is taken using time sequence 0, 0.25, 1.00, 2.25, 2, 6.25, 9, 16, 25, 36, 49 ... upto 24 hrs. From the observations of all incremental pressure, void ratio versus log (pressure) curve is obtained. The slope of the straight line portion shows compression index C_c .

9.2.7 Free Swell Test (IS 2720 Part-40): In order to determine the swelling characteristics of the soil, differential free swell test is carried out. An oven dried soil sample, 10 gm passing through 425 micron is poured in two 100 ml graduated cylinder. One cylinder was filled with distilled water and in kerosene up to 100 ml mark. After the removal of entrapped air, sample was allowed sufficient time to attain equilibrium state of volume. The final volume of soil in each cylinder was recorded.

$S_p = \text{Free Swell}$

$$S_p = \frac{\text{Soil volume in water} - \text{Soil volume in kerosene}}{\text{Soil volume in kerosene}}$$





Manglam Consultancy Services

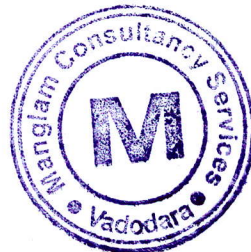
(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TRF NO. SOIL/20161216-3

10.0 REFERENCE:

- 1) Geotechnical Engineering – P Purushothama Raj.
- 2) Physical and Geotechnical Properties of Soil – Joseph E. Bowles
- 3) Engineering Soil Testing – P.K. Jain
- 4) Design Aids in Soil Mechanics and Foundation Engineering – Shenbaga R. Kaniraj
- 5) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996.
- 6) Principles of Soil Mechanics and Foundation Engineering – V.N.S. Murthy
- 7) Soil Testing for Engineers – T William Lambe
- 8) IS: 2720 (Part I, II, III, IV, V, VI, X, XI, XIII, XV, XXI, XXII, XXIII & XXXX)
- 9) IS: 2720 (Part XVII, XXXVI, XII)
- 10) IS: 6403 – 1981, 1892 – 1979, 1498 – 1970, and 2131 - 1981
- 11) IS: 8009 (Part –I) – 1976, (Part – II) 1980.
- 12) IS: 1904 – 1986.
- 13) Foundation Design Manual, N. V. Nayak, 5th Edition, 1996
- 14) Pile Design, Poulos and Davis
- 15) Soil Mechanics and Foundation Engineering, K.R. Arora, Standard Publishers Distributors, Fourth Edition, 1997.





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

- Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
- Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

BORE LOG

TRF No. : SOIL/20161216-3

Type of Boring : Machine Drilling

Water Table : Not Observed

Location : at Shanti Palace, Ujjain, Madhya Pradesh (M.P.).

Borehole No. : 1

Diameter of Boring : 100 mm

Depth of Boring : 8.00 m

Depth in m	Description of Strata	Legend	Stratum Thickness in m	Sampling		SPT Value 'N'	SPT Curve
				Type	Depth in m		
0.00	Filled up material	F.M.	4.50	DS	0.00	4	
0.50					0.50		
1.00					1.00		
1.50					1.50		
2.00					2.00		
2.50					2.50		
3.00					3.00		
3.50					3.50		
4.00					4.00		
4.50					4.50		
5.00	Yellow silty clay of high plasticity	CH	3.50	SPT	5.00	6	
5.50					5.50		
6.00					6.00		
6.50					6.50		
7.00					7.00		
7.50					7.50		
8.00					8.00		
8.00					8.00		

Abbreviation:

DS- Disturb Sample

UDS- Undisturb Sample

SPT- Standard Penetration Test

** End of Borelog **





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

BORE LOG

TRF No. : SOIL/20161216-3

Type of Boring : Machine Drilling

Water Table : Not Observed

Location : at Industrial Area, Ujjain, Madhya Pradesh (M.P.).

Borehole No. : 2

Diameter of Boring : 100 mm

Depth of Boring : 5.00 m

Depth in m	Description of Strata	Legend	Stratum Thickness in m	Sampling		SPT Value 'N'	SPT Curve
				Type	Depth in m		
0.00	Black silty medium to coarse gravels with sand	GM	2.50	DS	0.00	56	<p>SPT Curve SPT Value 0 50 100 150</p> <p>Depth, m</p>
0.50					0.50		
1.00					1.00		
1.50					1.50		
2.00					1.50		
2.50	SPT	2.00	100				
3.00	Black poorly graded gravels	GP	1.50	DS	2.50	100	
3.50					3.00		
4.00					SPT		
4.50	Pieces of Rock	Rock	1.00	DS	4.00	100	
5.00					SPT		5.00

Abbreviation:

DS- Disturb Sample

UDS- Undisturb Sample

SPT- Standard Penetration Test

** End of Borelog **





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

BORE LOG

TRF No. : SOIL/20161216-3

Type of Boring : Machine Drilling

Water Table : Not Observed

Location : at Khamed Gau Bahdhi, Ujjain, Madhya Pradesh (M.P.).

Borehole No. : 3

Diameter of Boring : 100 mm

Depth of Boring : 14.00 m

Depth in m	Description of Strata	Legend	Stratum Thickness in m	Sampling		SPT Value 'N'	SPT Curve
				Type	Depth in m		
0.00	Yellow silty clay of high plasticity	CH	4.00	UDS SPT	0.00	6	SPT Curve SPT Value
0.50							
1.00							
1.50							
2.00							
2.50							
3.00							
3.50							
4.00							
4.50							
5.00	Grayish yellow silty clay of high plasticity with few gravels	CH	4.50	UDS SPT	4.50	15	SPT Curve SPT Value
5.50							
6.00							
6.50							
7.00							
7.50							
8.00							
8.50							
9.00							
9.50							
10.00	Blackish yellow silty clay of high plasticity with white nodules	CH	3.00	UDS SPT	9.50	30	SPT Curve SPT Value
10.50							
11.00							
11.50							
12.00							
12.50	Yellowish gray clayey medium to coarse sand with gravels	SC	1.50	UDS SPT	11.50	33	SPT Curve SPT Value
13.00							
13.50	Yellowish black poorly graded medium to coarse sand with gravels	SP	1.00	DS	12.50	40	SPT Curve SPT Value
14.00							

Abbreviation:

DS- Disturb Sample

UDS- Undisturb Sample

SPT- Standard Penetration Test

** End of Borelog **

Page 17 of 28



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

BORE LOG

TRF No. : SOIL/20161216-3

Type of Boring : Machine Drilling

Water Table : Not Observed

Location : at Rudra Sagar, Ujjain, Madhya Pradesh (M.P.).

Borehole No. : 4

Diameter of Boring : 100 mm

Depth of Boring : 8.00 m

Depth in m	Description of Strata	Legend	Stratum Thickness in m	Sampling		SPT Value 'N'	SPT Curve
				Type	Depth in m		
0.00	Brownish black silty clay of high plasticity	CH	2.50	UDS	0.00	6	<p>SPT Curve SPT Value</p> <p>0 20</p> <p>0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00</p> <p>Depth, m</p>
0.50					1.00		
1.00					1.50		
1.50					2.00		
2.00					2.50		
2.50	Blackish gray silty clay of high plasticity	CH	1.50	UDS	3.00		
3.00					3.50		
3.50	Blackish yellow silty clay of high plasticity	CH	1.00	UDS	4.00		
4.00					4.50		
4.50	Yellow silty clay of high plasticity	CH	2.00	UDS	5.00		
5.00					5.50		
5.50	Yellow silty clay of high plasticity with gravel	CH	1.00	UDS	6.00		
6.00					6.50		
6.50					7.00		
7.00					7.50		
7.50					8.00		

Abbreviation:

DS- Disturb Sample

UDS- Undisturb Sample

SPT- Standard Penetration Test

** End of Borelog **





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

BORE LOG

TRF No. : SOIL/20161216-3

Type of Boring : Machine Drilling

Water Table : Not Observed

Location : at Ram Ghat, Ujjain, Madhya Pradesh (M.P.).

Borehole No. : 5

Diameter of Boring : 100 mm

Depth of Boring : 5.00 m

Depth in m	Description of Strata	Legend	Stratum Thickness in m	Sampling		SPT Value 'N'	SPT Curve
				Type	Depth in m		
0.00	Gray silty clay of high plasticity	CH	2.00	UDS	0.00	25	
0.50					0.50		
1.00					1.00		
1.50					1.50		
2.00					2.00		
2.50	Black poorly graded medium to fine sand with gravels	SP	2.00	SPT	2.00	68	
3.00					2.50		
3.50					3.00		
4.00	Pieces of Rock	Rock	1.00	DS	3.50	100	
4.50					4.00		
5.00					4.50		
				SPT	5.00		

Abbreviation:

DS- Disturb Sample

UDS- Undisturb Sample

SPT- Standard Penetration Test

** End of Borelog **





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

BORE LOG

TRF No. : SOIL/20161216-3

Type of Boring : Machine Drilling

Water Table : Not Observed

Location : at Kaliyatha, Ujjain, Madhya Pradesh (M.P.).

Borehole No. : 6

Diameter of Boring : 100 mm

Depth of Boring : 5.00 m

Depth in m	Description of Strata	Legend	Stratum Thickness in m	Sampling		SPT Value 'N'	SPT Curve
				Type	Depth in m		
0.00	Yellow silty clay of intermediate plasticity	CI	4.00	UDS	0.00	10	
0.50							
1.00							
1.50							
2.00							
2.50							
3.00							
3.50							
4.00	Yellow clayey medium to coarse sand with few gravel	SC	1.00	UDS	3.00	16	
4.50					3.50		
5.00					4.00		

Abbreviation:

DS- Disturb Sample

UDS- Undisturb Sample

SPT- Standard Penetration Test

** End of Borelog **





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

BORE LOG

TRF No. : SOIL/20161216-3

Type of Boring : Machine Drilling

Water Table : Not Observed

Location : at Bigipura Ring Road, Ujjain, Madhya Pradesh (M.P.).

Borehole No. : 7

Diameter of Boring : 100 mm

Depth of Boring : 7.50 m

Depth in m	Description of Strata	Legend	Stratum Thickness in m	Sampling		SPT Value 'N'	SPT Curve
				Type	Depth in m		
0.00	Brownish yellow silty clay of intermediate palstiicty with gravel	CI	2.50	UDS	0.00	11	<p>SPT Curve SPT Value</p> <p>0 50</p> <p>0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00</p> <p>Depth, m</p>
0.50					0.50		
1.00					1.00		
1.50					1.50		
2.00					2.00		
2.50					2.50		
3.00	Blackish yellow clayey coarse sand with gravels	SC	1.50	UDS	3.00		
3.50					3.50		
4.00					4.00		
4.50	Yellow clayey medium to coarse sand with gravel	SC	3.50	UDS	4.50		
5.00					5.00		
5.50					5.50		
6.00					6.00		
6.50					6.50		
7.00					7.00		
7.50				SPT	7.50	38	

Abbreviation:

DS- Disturb Sample

UDS- Undisturb Sample

SPT- Standard Penetration Test

** End of Borelog **



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

- Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
- Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TEST RESULTS OF SOIL SAMPLES

TRF No. : SOIL/20161216-3
 Material Received : Soil Samples
 Type of Sample : DS/ UDS/SPT

Borehole No. : 1
 Date of Starting : 16/12/2016
 Date of Completion : 30/12/2016

Lab No.	Depth in mt.	Grain Size Analysis %					Atterberg Limits %			I.S. Classifications	*FDD gm/cc	*FMC %	Specific Gravity	Swelling Index %	Shrinkage Limit %	Shear Parameter			Consolidation	
		Gravel	Sand	Silt	Clay	L.L.	P.L.	P.I.	Type							C kg/cm ²	ø Deg.	Cc	Pc	SCL
20161216-3/1/1	1.50 to 1.80	Filled up material																		
20161216-3/1/2	3.00 to 3.30	Filled up material																		
20161216-3/1/3	4.50 to 4.95	Filled up material																		
20161216-3/1/4	6.00 to 6.45	0	21	79	57	20	37	CH	1.57	15.8	2.55	--	--	B	0.15	9	0.297	1.1	--	
20161216-3/1/5	7.50 to 7.95	0	23	77	55	19	36	CH	1.58	15.5	2.56	--	--	B	0.15	10	0.285	1.2	--	
Test Method Specification		IS 2720 Part-4			IS 2720 Part-5			IS 1498	IS 2720 Part-29	IS 2720 Part-3	IS 2720 Part-40	IS 2720 Part-6	IS 2720 Part-11 & 13	IS 2720 Part-15						

**** End of Result Sheet ****

For Manglam Consultancy Services



Tested By



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

- Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
- Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TEST RESULTS OF SOIL SAMPLES

TRF No. : SOIL/20161216-3
 Material Received : Soil Samples
 Type of Sample : DS/ UDS/SPT

Borehole No. : 3
 Date of Starting : 16/12/2016
 Date of Completion : 30/12/2016

Lab No.	Depth in mt.	Grain Size Analysis %				Atterberg Limits %			I.S. Classifications	*FDD gm/cc	*FMC %	Specific Gravity	Swelling Index %	Shrinkage Limit %	Shear Parameter			Consolidation	
		Gravel	Sand	Silt	Clay	L.L.	P.L.	P.I.							Type	C kg/cm ²	ø Deg.	Cc	Pe
20161216-3/3/1	1.50 to 1.95	0	20	80		65	21	44	CH	1.55	16.8	2.53	--	--	B	0.20	8	--	--
20161216-3/3/2	3.00 to 3.45	0	22	78		64	22	42	CH	1.58	16.2	2.56	--	--	B	0.20	11	--	--
20161216-3/3/3	4.50 to 4.95	3	23	74		61	22	39	CH	1.58	15.9	2.57	--	--	B	0.20	12	0.300	0.9
20161216-3/3/4	6.00 to 6.45	1	25	74		57	21	36	CH	1.61	15.5	2.59	--	--	B	0.15	14	--	--
20161216-3/3/5	7.50 to 7.95	1	21	78		60	22	38	CH	1.64	15.7	2.61	--	--	B	0.20	13	0.295	1.2
20161216-3/3/6	9.00 to 9.45	0	22	78		63	21	42	CH	1.65	16.1	2.58	--	--	B	0.20	12	--	--
20161216-3/3/7	10.50 to 10.95	0	23	77		59	22	37	CH	1.65	15.9	2.57	--	--	B	0.15	14	0.275	1.1
20161216-3/3/8	12.00 to 12.45	2	54	44		42	20	22	SC	1.68	15.5	2.63	--	--	B	0.10	28	--	--
20161216-3/3/9	13.50 to 13.70	5	84	11					SP	--	--	--	--	--	--	--	--	--	--
Test Method Specification		IS 2720 Part-4				IS 2720 Part-5			IS 1498	IS 2720 Part-29	IS 2720 Part-3	IS 2720 Part-40	IS 2720 Part-6	IS 2720 Part-11 & 13	IS 2720 Part-15				

** End of Result Sheet **

For Manglam Consultancy Services

(Signature)

Tested By





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TEST RESULTS OF SOIL SAMPLES

TRF No. : SOIL/20161216-3
Material Received : Soil Samples
Type of Sample : DS/ UDS/SPT

Borehole No. : 4
Date of Starting : 16/12/2016
Date of Completion : 30/12/2016

Lab No.	Depth in mt.	Grain Size Analysis %				Atterberg Limits %			I.S. Classifications	*FDD gm/cc	*FMC %	Specific Gravity	Swelling Index %	Shrinkage Limit %	Shear Parameter			Consolidation			
		Gravel	Sand	Silt	Clay	L.L.	P.L.	P.I.							Type	C' kg/cm ²	ø Deg.	Cc	Pe	SCL	
20161216-3/4/1	1.50 to 1.95	0	20	80	80	61	22	39	CH	1.57	16.4	2.55	--	--	B	0.20	8	--	--	--	
20161216-3/4/2	3.00 to 3.45	0	17	83	66	20	20	46	CH	1.57	17.4	2.52	--	--	B	0.20	8	0.335	0.75	--	
20161216-3/4/3	4.50 to 4.95	0	21	79	59	22	22	37	CH	1.58	17.1	2.53	--	--	B	0.15	10	--	--	--	
20161216-3/4/4	6.00 to 6.45	0	17	83	62	20	20	42	CH	1.57	17.3	2.53	--	--	B	0.20	8	0.310	0.90	--	
20161216-3/4/5	7.50 to 7.95	2	23	75	59	21	38	CH	1.60	15.5	2.58	--	--	B	0.15	13	--	--	--	--	
Test Method Specification		IS 2720 Part-4				IS 2720 Part-5			IS 1498	IS 2720 Part-29	IS 2720 Part-3	IS 2720 Part-40	IS 2720 Part-6	IS 2720 Part-11 & 13	IS 2720 Part-15						

** End of Result Sheet **

For Manglam Consultancy Services

[Signature]

Tested By





Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TEST RESULTS OF SOIL SAMPLES

TRF No. : SOIL/20161216-3
Material Received : Soil Samples
Type of Sample : DS/ UDS/SPT

Borehole No. : 5
Date of Starting : 16/12/2016
Date of Completion : 30/12/2016

Lab No.	Depth in mt.	Grain Size Analysis %				Atterberg Limits %			I.S. Classifications	*FDD gm/cc	*FMC %	Specific Gravity	Swelling Index %	Shrinkage Limit %	Shear Parameter			Consolidation		Test Method Specification				
		Gravel	Sand	Silt	Clay	L.L.	P.L.	P.I.							Type	C kg/cm ²	ø Deg.	Cc	Pc		SCL			
20161216-3/5/1	1.50 to 1.95	0	19	81		63	19	44	CH	1.60	17.5	2.55	--	--	B	0.20	10	0.300	1.0	--	--	IS 2720 Part-6	IS 2720 Part-15	
20161216-3/5/2	3.00 to 3.30	7	84	9		NP			SP	--	--	--	--	--	--	--	--	--	--	--	--	--	IS 2720 Part-11 & 13	IS 2720 Part-15
20161216-3/5/3	4.50 to 4.80																							
Test Method Specification		IS 2720 Part-4				IS 2720 Part-5			IS 1498	IS 2720 Part-29	IS 2720 Part-3	IS 2720 Part-40	IS 2720 Part-6	IS 2720 Part-11 & 13			IS 2720 Part-15							

Pieces of Rock

** End of Result Sheet **

For Manglam Consultancy Services

[Signature]
Tested By

Technical Manager
(P. A. Desai / D. H. Shah)
Authorized Signatory

24



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

• Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
• Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TEST RESULTS OF SOIL SAMPLES

TRF No. : SOIL/20161216-3

Material Received : Soil Samples

Type of Sample : DS/ UDS/SPT

Borehole No. : 6
Date of Starting : 16/12/2016
Date of Completion : 30/12/2016

Lab No.	Depth in mt.	Grain Size Analysis %				Atterberg Limits %			I.S. Classifications	*FDD gm/cc	*FMC %	Specific Gravity	Swelling Index %	Shrinkage Limit %	Shear Parameter			Consolidation	IS 2720 Part-15	
		Gravel	Sand	Silt	Clay	L.L.	P.L.	P.I.							Type	C' kg/cm ²	ø Deg.			Cc
20161216-3/6/1	1.50 to 1.95	1	43	56		45	21	24	CI	1.59	15.6	2.6	--	--	B	0.10	16	--	--	--
20161216-3/6/2	3.00 to 3.45	0	36	64		43	22	21	CI	1.61	14.9	2.62	--	--	B	0.10	17	--	--	--
20161216-3/6/3	4.50 to 4.95	2	58	40		36	22	14	SC	1.65	12.4	2.64	--	--	B	0.05	23	--	--	--
Test Method Specification		IS 2720 Part-4				IS 2720 Part-5			IS 1498	IS 2720 Part-29	IS 2720 Part-3	IS 2720 Part-40	IS 2720 Part-6	IS 2720 Part-11 & 13						

** End of Result Sheet **

For Manglam Consultancy Services

[Signature]

Tested By



24



Manglam Consultancy Services

(ISO 9001 CERTIFIED & GOVERNMENT APPROVED LAB)

- Civil Engineering Material Testing • Destructive & Non Destructive Testing • Pile & Load Test
- Geotechnical Exploration • Geo-Physical Survey • Resistivity Survey • TPI • BI & BBD in Highway Testing

TEST RESULTS OF SOIL SAMPLES

TRF No. : SOIL/20161216-3
 Material Received : Soil Samples
 Type of Sample : DS/ UDS/SPT

Borehole No. : 7
 Date of Starting : 16/12/2016
 Date of Completion : 30/12/2016

Lab No.	Depth in mt.	Grain Size Analysis %				Atterberg Limits %			I.S. Classifications	*FDD gm/cc	*FMC %	Specific Gravity	Swelling Index %	Shrinkage Limit %	Shear Parameter			Consolidation	
		Gravel	Sand	Silt	Clay	L.L.	P.L.	P.I.							Type	C kg/cm ²	ø Deg.	Cc	Pe
20161216-3/7/1	1.50 to 1.95	8	35	57	42	22	20	CI	1.60	13.7	2.63	--	--	B	0.10	16	--	--	
20161216-3/7/2	3.00 to 3.45	7	57	36	34	23	11	SC	1.64	10.6	2.64	--	--	B	0.05	22	--	--	
20161216-3/7/3	4.50 to 4.95	5	60	35	33	23	10	SC	1.66	11.2	2.65	--	--	B	0.05	26	--	--	
20161216-3/7/4	6.00 to 6.45	9	60	31	32	23	9	SC	1.70	10.7	2.66	--	--	B	0.05	29	--	--	
Test Method Specification		IS 2720 Part-4				IS 2720 Part-5			IS 1498	IS 2720 Part-29	IS 2720 Part-3	IS 2720 Part-40	IS 2720 Part-6	IS 2720 Part-11 & 13			IS 2720 Part-15		

** End of Result Sheet **

For Manglam Consultancy Services



[Signature]
 Tested By