PRE-BID CLARIFICATION NO. 3

COMPANY'S RESPONSE TO BIDDERS' CLARIFICATIONS ON TENDER DOCUMENT FOR HIRING THE SERVICES OF PCC CONTRACTOR FOR SUPPLY / INSTALLATION / CIVIL FOUNDATIONS FOR MISCELLANEOUS EQUIPMENTS & PLANT BUILDING WORKS FOR MELA DEVELOPMENT PROJECT (PCC)

(TENDER ENQUIRY NO. PROC-FC/CB/PROJ/MELA-3368/2018)

Sr. No.	BIDDERS' QUERY	REFERENCE	COMPANY REPLY / CLARIFICATION
1.	Regarding the engineering / design scope; please confirm that the bidder scope is limited to the design work of equipments / items supplied by the bidder only.		Bidders are requested to go through SOW Document attached in the Tender Document (165-2-SPG-130, Rev.0) carefully. Scope written in the SOW document is part of Bidder's Scope.
2.	Please confirm there is no pipeline installation in bidder scope.		There is no pipeline installation in bidder scope. However, installation of Scraper Launcher Skids (as per 165-2-SPM-042, Rev.1) is in Bidder's scope alongwith associated Tie-ins with connecting Mela-Nashpa Trunkline. Bidders are requested to go through Tender Document carefully prior to submitting technical clarifications.
3.	Refer to the Vol-2, page 24/1625, SOW, (Civil, Structural, architectural, plumbing & HVAC works for Control Room extension), it appears that control room building has HVAC, however there is no line item for HVAC in BOQ for pricing. Please confirm.		HVAC (AC split unit) is to be considered with in the buildings. Revised BOQ for pricing will be provided with next Addendum.
4.	Refer to ITB Vol-1, page 192 / 653, item # 22, Demolition work, please specify how much distance (approximately) to dispose of the demolished concrete.		Disposition of demolished concrete will be located at Mela Project Site within area of plot plan.
5.	Refer to ITB Vol-1, page 193 / 653, item # 26, DRILLING OF HOLES AND FIXING OF REBARS WITH EPOXY, please clarify the scope.		Existing Control Room will be extended for which epoxy of rebars will be required for building connectivity. In this regards, contractor to provide unit rate of "drilling of holes and fixing of rebars with epoxy" in BOQ Item No. 4.20 (165-2-BQC-002, Rev. 0).

Sr. No.	BIDDERS' QUERY	REFERENCE	COMPANY REPLY / CLARIFICATION
6.	Refer to ITB Vol-2, page 25 / 1625, (Contractor shall use the above mentioned technical requirements as minimum and shall remain responsible for verification of design data). We understand that bidder responsibility is to execute the work according to client provided IFC drawings and there is no design verification required. Please confirm.		Contractor shall be responsible for the verification of design data for the equipment / material which are to be supplied by Contractor. Further, Contractor to verify the IFC drawings with the actual site conditions and the actual equipment available at site (its own supplied equipment as well as Owner Supplied equipment) prior to Construction. Further, Bidders are requested to go through SOW Document attached in the Tender Document (165-2-SPG-130, Rev.0) carefully. Scope written in the SOW document is part of Bidder's Scope.
7.	Please confirm bid validity is 250 days or 280 days from the bid submission date.		Each bid shall be valid for minimum 250 days from the date of opening of technical bids and should be accompanied with an upfront Bid Bond in the form of pay order/demand draft or bank guarantee issued by a scheduled bank of Pakistan operating in Pakistan for an amount of PKR Fifteen (15) million as Bid Bond with technical bid and valid for 280 days from the date of opening of technical bids.
8.	Please confirm if the project execution area consist of hard / rocky or soft soil.		For sub-soil condition of "project execution area", please refer attached as Attachment-I soil report (**GI for Allied facilities at Mela Oilfield**).
9.	Please specify the nearest civil query (sand/crush etc.) location.		Civil query (sand/ crush etc) will be located at Mela Project Site within area of plot plan.

ATTACHMENT – I

GI FOR ALLIED FACILITIES AT MELA OILFIELD

March 19, 2018 Ref: GT-12-2017-Final

M/s. Oil & Gas Development Company Limited

Office of the Party Chief Engineering Field Party No. 3
Islamabad
Tel: 03005550946

Email: partychiefefp3@ogdcl.com

Kind Attention: Mr. Farhat Ullah Khan

Subject: **Draft Geotechnical Report of Soil Investigation for Proposed Installation of Condensate stabilization Unit, Compressor And Allied Facilties at Mela**

Dear Sir,

Geoarts Private Limited is pleased to submit here with soft copy of report of geotechnical investigation performed for the above captioned project.

Kindly review and feedback to prepare the final report.

Very truly yours,

Eng. Munawar I. Saleem
Director Technical
Mobile : 0333 4232790
0341 6988889
Office Phone: 042 35424032

Email: misaleempk@yahoo.com

DRAFT

TABLE OF CONTENT

DRAFT

TABLE OF CONTENT (CONTD)

APPENDICES

DRAFT

EXECUTIVE SUMMARY

This report presents the preliminary results and findings of the subsurface geotechnical investigation conducted for the **Error! Reference source not found.**

This report presents details of the geotechnical investigation carried out for the subject project, and provides an evaluation of the subsurface conditions encountered at the investigated boreholes and test pits. The recommendations given in this report based on the interpretation of field and laboratory test results, and on the state-of-the-art knowledge in geotechnical engineering, design and construction.

The proposed site is located along the Kohat road about 2km from Shakardara in the north direction in Mela Oil Field. At the time of investigation site was approximately flat with no significant level difference.

To carry out the safe and economical foundation design, geotechnical investigations were conducted on the site. The investigations consist of execution of boreholes and test pits at the specified locations. Soil samples were collected from designated depths from borehole and test pits. Selected soil samples were subjected various laboratory tests for evaluation of classification, strength and chemical characteristics of the subsurface strata.

In general the subsurface conditions revealed by the boreholes indicating that the site is underlain by hard silty clay/lean clay extending to 2.0 to 3.0m depth below existing ground level. This is followed by reddish brown, very weak to weak Claystone/ Shale completely to highly weathered and fractured which was continued down to the maximum depth investigated.

During drilling activities groundwater was not encountered in any of the drilled boreholes or in the excavated test pits down to the maximum depth investigated.

Analysis and calculation were made based on the outcome of the field investigation and laboratory testing, it is found that the net allowable bearing pressure is 123.5 kPa. It shall be noted that improved ground condition (0.5m replacement below the foundation) was considered on the analysis and bearing capacity calculation.

It shall be ensured during construction that the bottom of footing is well compacted before laying down the structural foundation. Backfilling shall be carried out in thin sub layers not exceeding 25 centimeters thick. Each sub layer shall be well compacted.

1.0 INTRODUCTION

DRAFT

1.1 General

This report presents the results and findings of the subsurface geotechnical investigation conducted for the **Error! Reference source not found.**This investigation was based on the agreement between **Error! Reference source not found.**, and Geoarts Private Limited, the geotechnical firm.

The total field work was consisted to drill four (4) boreholes to a depth range 15m below existing ground level, excavation of two (2) test pits to 2.0m depth. Execution of electrical resistivity and down the hole seismic test.

Disturbed and undisturbed samples were collected and transported to Geoarts laboratory at Lahore for further examination and testing.

In order to design the earthing system for the electrical installations and to determine the dynamic properties, the measurement of electrical resistivity values and compression and shear wave velocity profile of the subsurface material are required, therefore two (2) electrical resistivity tests and one (1)downhole seismic test was carried out at the site proposed for the compression plant.

The investigations were carried out according to Geoarts proposal Ref. PS 012 dated 8th December, 2017 in accordance with the specifications provided by the client.

This report presents details of the geotechnical investigation carried out for the subject project, and provides an evaluation of the subsurface conditions encountered at the investigated boreholes and test pits. The recommendations given in this report based on the interpretation of field and laboratory test results, and on the state-of-the-art knowledge in geotechnical engineering, design and construction.

1.2 Project Description

The proposed site is located along the Kohat road about 2km from Shakardara in the north direction in Mela Oil Field. At the time of investigation site was approximately flat with no significant level difference.

1.3 Objectives of Investigations

The geotechnical investigation were undertaken to meet the following objectives.

DRAFT

1. To define the subsurface conditions at the specified site area.
2. To reveal the groundwater table within the specified depth.
3. To determine the bearing capacity, settlement/swelling characteristics by performing relevant laboratory test.
4. To decide/conclude the appropriate type/depth of foundation required.
5. To establish the design parameters to be used in structural design of foundation.
6. To identify and solution of excavation problems.
7. To confirm the existence of any cavity and any other geological hazard.

1.4 Scope of Work

1. Demarcation of all the locations supposed to be investigated in accordance with the drawing provided by the client.
2. Drilling and sampling of four (4) boreholes to a depth of 15m below existing ground level.
3. Performing Standard Penetration Test at every 5ft depth interval or change of strata.
4. Performance of two (02) electrical resistivity test
5. Performance of one (01) down hole test.
6. Execution of required/relevant laboratory tests for selected representative samples to determine the pertinent engineering and index properties as well as the chemical properties by using the relevant ASTM/BS standards.
7. Analyzing the field and laboratory tests data, furnishing the relevant structural design parameters and submit an interpretive report.

2.0 SITE DESCRIPTION AND SEISMICITY

2.1 Site Description

The proposed site is located along the Kohat road about 2km from Shakardara in the north direction in Mela Oil Field.

2.2 Seismicity

As per Building Code of Pakistan project site lies in Zone 2B and Peak Ground Acceleration (PGA) value is 0.16 to 0.24g for this zone as per Building Code of Pakistan Seismic Provision 2007. Seismic zoning map as given in this code is shown in Figure No 2.

DRAFT

3.0 FIELD EXPLORATION

3.1 Drilling of Boreholes

The field work was conducted during the period 31st January to 12th February 2018 and consisted of the drilling of four (04) boreholes. All the were drilled to 15m depth exiting ground level by using straight rotary drilling method. The location of boreholes is shown in Figure-1.

The SPT was performed at every 1.0 m interval starting from existing ground level using a split barrel sampler, 50 mm outside diameter, 35 mm inside diameter and about 600 mm in length, which is connected to a string of drill rods. The sampler is driven into the bottom of the borehole by means of 65 kg hammer falling freely along a guide from a height of 760 mm onto an anvil on top of the drill rods. The sampler is driven to an initial penetration of 15 cm to by-pass sludge and disturbed soils at the bottom of the borehole. It is then further driven 30 cm and number of blows for the last 30 cm penetration is known as the standard penetration resistance (N) value of the soil.

In general estimates of density and consistency of the soils given on the boring logs are based on the results of the standard penetration test recommended by Terzaghi.

The correlation between the penetration resistance and the consistency of the clay is regarded as crude approximation and should be supported by other field and / or laboratory tests. However, quite reliable for sands with the necessary corrections for groundwater and overburden pressure. The presence of gravel tends to show an increase in the number of blows for the SPT which is not a true reflection of the actual density.

Core samples were obtained from the boreholes. Samples were obtained using double tube core barrel. Coring was performed in accordance to ASTM D 2133. The samples recovered were examined, described and classified by our geotechnical engineer, placed in proper sequence in the wooden boxes and taken to our laboratories for testing.

Field work was carried out under the close supervision of an experienced Geologist from Geoarts. All the samples recovered from the boreholes are visually examined, described, packed and transported to Geoarts laboratory in Lahore.

DRAFT

The depth of the boreholes, the description, depths of strata encountered, list of samples taken for testing and other observations on the accompanying borehole log sheets presented in Appendix B. Following table is indicating the coordinates and elevations of boreholes area wise.

Table: 1

Sr. No.	BH No	Easting	Northing	Elevation (m)
1	BH – 1	734770	3681233	563.0
2	BH – 2	734712	3681294	563.0
3	BH – 3	734703	3681219	562.0
4	BH – 4	734711	3681200	563.0

3.2 Test Pits

Total of two (02) no. test pits were excavated to 2.0m depth. The excavation was done by using mechanical excavator and generally test pits were on plan profile to 1.5m x 1.5m to the depths mentioned above. Test pit records, and logs are presented in Appendix 'B' of this report and following table is indicating the location and coordinates of test pits.

The subsurface soil strata encountered in the test pits were described by our geotechnical engineers. In addition, the materials recovered were examined and described. The dimensions and configurations of the exposed foundations in each test pit were determined and photographed.

Following table is indicating the coordinates and elevations of test pits.

Table: 2

Sr. No.	Test Pit No	Easting	Northing	Elevation (m)

DRAFT

1	TP- 1	734734	3681269	564.0
2	TP- 2	734710	3681192	565.0

3.3 Sampling

3.3.1 Disturbed Samples

Disturbed but representative soil samples were retrieved from all the drilled boreholes at regular intervals (according to the scope of work) using split spoon samplers (with open shoe) while conducting the standard penetration test (SPT). From test pits bulk samples were collected in addition to small samples for sieve analysis and Atterberg Limits. These samples were tested in the laboratory for Optimum Moisture Content – Maximum Dry Density Relationship (OMC - MDD), California Bearing Ratio (CBR), and Grain size distribution was carried out on selected samples. All the samples recovered from boreholes and test pits were visually inspected and classified as per ASTM D-2488 were properly labeled, preserved in polythene bags and placed in plastic jars.

.

3.3.2 Undisturbed Samples

Undisturbed samples were retrieved from the test pits in the shape of block samples. The samples recovered were examined, described and classified by our geotechnical engineer, then placed in proper sequence in the wooden boxes and taken to our laboratories for testing.

3.4 In-Situ Testing

3.4.1 Standard Penetration Test

To assess the compactness/denseness of subsurface material Standard Penetration Tests (SPTs) were performed at 1.0m interval. These tests were performed in accordance with ASTM D-1586 using a split spoon sampler of 35mm inner dia. 51.8 mm outer dia. The sampler is driven at the required depth in the boreholes by means of 65 kg hammer falling freely along a guide rod from a height of 760mm onto an anvil fixed on top of the drill rods. The SPT blows counts were recorded for penetration of 45 cm of the SPT sampler. The number of blows required to drive the sampler through the last 30cm penetration is known as the standard penetration resistance (N) value of the soil. All the N values have been shown on the respective borehole logs.

DRAFT

Table No. 3
CORRELATION OF SPT VALUES WITH RELATIVE DENSITY / CONSISTENCY

SOIL TYPES	SOIL CONDITION	" N " VALUES (BLOWS / 300 mm)
COHESISIVE SOIL (CLAY AND SILT)	Very Soft	less than 2
	Soft	2 – 4
	Medium Stiff	4 – 8
	Stiff	8 – 15
	Very Stiff	15 – 30
	Hard	> 30
GRANULAR SOIL (SAND AND GRAVEL)	Very Loose	0 – 4
	Loose	4 – 10
	Medium Dense	10 -30
	Dense	30 -50
	Very Dense	> 50

3.4.2 Field Density

Field density test was performed by using core cutter in accordance with ASTM D 2937. For determination of the dry density of the soil, the cutter was pressed into the soil mass so that it was filled with the soil. The cutter filled with the soil was lifted up. The mass of the soil in the cutter was determined. The dry density is obtained as

$$\rho = \frac{\gamma}{1+w} = \frac{(M/V)}{1+w}$$

Where M= mass of the wet soil in the cutter
V= internal volume of the cutter
w= water content.

Detail results have been presented in Appendix C and the table No. 5 presents the test pit details along with density and compaction results for the three tests.

Table No. 4

DRAFT

TP. No.	Depth (m)	Field Bulk Density (g/cm^3)	Moisture Content (%)	Field Dry Density (g/cm^3)
TP-1	0.5	1.991	2.5	1.942
	1.0	1.925	3.0	1.868
	1.5	1.998	4.2	1.917
	2.0	2.135	5.5	1.908
TP-2	0.5	2.104	1.9	2.085
	1.0	1.958	3.2	1.897
	1.5	1.995	4.0	1.918
	2.0	2.060	5.0	1.962

3.4.3 Electrical Resistivity Test

The electrical resistivity measurements of the subsurface material were taken in the field by resistivity measuring instrument Terrameter SAS-1000 of ABEM, Sweden and using the Wenner electrode array. The Terrameter directly records the value of V/I in ohms. In order to study the variation of resistivity with depth, Vertical Electric Sounding (VES) technique was employed. In this technique, apparent resistivity values are obtained for various depths by increasing the current electrodes spacing at the ground surface, keeping the centre of electrode array fixed at the observation point. Following table is indicating the coordinates and elevation of the resistivity locations.

Table: 3

Sr. No.	ERT	Easting	Northing	Elevation (m)
1	ERT-1	734734	3681269	564.0
2	ERT-2	734710	3681192	565.0

Following table is indicating the earth resistivity values.

Table: 4

DRAFT

Observation Point No.	Depth (m)	Layer Thickness (m)	True Resistivity (ohm – m)
ERS - 1	0.0 – 1.3	1.30	38.8
	1.3 – 10.5	9.20	5.9
	10.5 – 18.0	7.50	28.4
	18.0- 30.0	12.0	2.2
ERS - 2	0.0 – 1.7	1.70	18.7
	1.7 – 3.2	1.50	1.4
	3.2 – 30.0	26.80	7.0

3.4.4 Downhole Seismic Test

In order to determine the shear wave and compressional wave velocities of the subsurface material at the site downhole seismic testing was performed at site. For this purpose a borehole was drilled up to 15 meters depth and three inches diameter PVC casing was installed in the borehole. The annular space between the borehole and PVC casing was grouted with cement –bentonite slurry.

In downhole seismic testing, time for body waves to travel between the ground surface and points within the subsurface material are measured. Wave velocities are calculated from the corresponding travel times once the travel distance has been determined. Based on the downhole seismic test the following table is indicating the dynamic parameters to be used for foundation design.

Table: 5

Depth (m)	V_p (m/sec)	V_s (m/sec)	Bulk Density (g/cc)	Mass Density (g/cc)	Shear Modulus (Kg/cm^2)	Poisson's Ratio	Young's Modulus (Kg/cm^2)
0.0 – 3.0	706	299	1.9	0.0019368	1731.52	0.39	4816.10
3.0 – 13.0	2258	656	2.0	0.0020387	8773.41	0.45	25511.48

4.0 LABORATORY TESTING

4.1 General

Samples retrieved from boreholes and test pits were examined in the field and then transported to our laboratories for relevant test. Laboratory testing program were prepared by the geotechnical engineer and was submitted for execution to our laboratory. Following test were carried out to determine the required index and engineering properties.

DRAFT

Table No. 5
LABORATORY TESTS

Sr.No.	Type of Test	No of Test	Test Method
1	Sieve Analysis	7	ASTM D-422
2	Atterberg Limits	4	ASTM D-4318
3	Specific gravity	4	ASTM D-854
4	Consolidation test	2	ASTM D-2435
5	Modified Compaction	2	ASTM D-1557
6	CBR	2	ASTM D-1883
7	Uniaxial Compression Test	3	ASTM D-5731
8	Chemical Analysis	4	BS 1377 Part 3

4.2 LABORATORY TEST RESULTS

The laboratory test results are presented in **Appendix C**. of this report; however brief description is given below.

4.2.1 Grain Size Analysis

Particle size distribution analysis has been carried out in accordance with ASTM D422 and classifications are made on the basis of ASTM D 2487. Range of test results is given below and details have been presented in **Appendix C.**

No. of Samples	Passing sieve 2 micron	
Seven (7)	Maximum	90
	Minimum	54
	Average	67

4.2.2 Atterberg Limits

Atterberg limits test has been carried out in accordance with ASTM D 4318 and classifications are made on the basis of ASTM D 2487. Range of test results is given below and details have been presented in **Appendix C.**

No. of Samples		Atterberg Limits	
Nine (9)		Liquid Limit	Plasticity Index
	Maximum	25	10
	Minimum	30	5

	Average	27	8

4.2.3 Specific Gravity

Specific gravity test has been carried out in accordance with ASTM D 854. Range of test results is given below and details have been presented in **Appendix C.**

No. of Samples	Specific Gravity	
Four (4)	Maximum	2.66
	Minimum	2.59
	Average	2.63

4.2.4 Proctor Test

Proctor test has been carried out in accordance with ASTM D 1557. Range of test results is given below and details have been presented in **Appendix C.**

No. of Samples	Range	Maximum Dry Density (lb/ft^2)	Optimum Moisture Content (%)
Two (2)	Maximum	126.406	10.34
	Minimum	126.109	10.22
	Average	1.806	10.86

4.2.5 California Bearing Ratio

Proctor test has been carried out in accordance with ASTM D 1883. Range of test results is given below and details have been presented in **Appendix C.**

No. of Samples		CBR Values	
		95% Compaction	100% Compaction
Two (2)	Maximum	8.56	12.53
	Minimum	7.70	11.28
	Average	8.13	11.905

4.2.6 Consolidation Test

Consolidation test has been carried out on two samples and details have been presented in **Appendix C.**

4.2.7 Point Load Test

DRAFT

Point Load test has carried out in accordance with ASTM D 5731 on three samples and found the range of unconfined compressive strength (after conversion) is 3.37 to 8.0 MPa. Details have been presented in **Appendix C.**

4.2.8 Chemical Analysis

Direct shear test has been carried out in accordance with BS 1377 Part 3. Range of test results is given below and details have been presented in **Appendix C.**

No. of Samples		Chemical Analysis		
		Sulphate (%)	Chloride (%)	pH
Two (2)	Maximum	0.071	0.0047	7.0
	Minimum	0.012	0.0031	6.8
	Average	0.0402	0.00422	6.9

5.0 SUBSURFACE CONDITIONS

5.1 Ground Materials

The drilled boreholes show that there are general similarities and continuities of the subsurface materials in spite of some localized variation in its textural properties. The geological description of the subsurface materials at the drilled boreholes and excavated test pits with the approximate average depths at which they were encountered are provided on logs of boreholes **Appendix B**, and are as follows:

In general the subsurface conditions revealed by the boreholes indicating that the site is underlain by hard silty clay/lean clay extending to 2.0 to 3.0m depth below existing ground level. This is followed by reddish brown, very weak to weak Claystone/ Shale completely to highly weathered and fractured which was continued down to the maximum depth investigated.

5.2 Ground Water

During drilling activities groundwater was not encountered in any of the drilled boreholes or in the excavated test pits down to the maximum depth investigated.

6.0 FOUNDATION RECOMMENDATION

6.1 General

DRAFT

It is understood that all the structures will be designed on shallow foundations. Shallow foundations are a type of foundation that transfers building load to the very near the surface, rather than to a subsurface layer. Shallow foundations typically have a depth to width ratio of less than 1.
Exact loads and foundation sizes are not available at the time of preparation of this report.

6.2 Foundation Design Criteria

In designing foundations, the engineer must satisfy two independent foundation stability requirements, which must be met simultaneously:

- There should be an adequate safety against shear failure within the soil mass. (The working loads should not exceed the allowable bearing capacity of the soil being built upon).

- The probable maximum settlements of the soil under any part of the foundations must be limited to safe and tolerable limits.

6.3 Type of Foundation

From the disclosed subsurface conditions and keeping in view the nature of project isolated/raft foundations are recommended for the proposed structure. The foundations for the proposed structure can be placed at least 1.0m below the existing ground level at the time of soil investigation provided the site will be prepared as per following practice.

- The foundation area should be excavated 0.5m below the bottom of foundation.
- Extra excavation of 0.5m should be backfilled by using select fill material A-3 or better as per AASTHO soil classification.
- This select fill should be compacted in layers appropriate to the type and size of compaction equipment.
- The compaction must be verified by achieving 75% relative density in accordance with ASTM D-4253 & ASTM D-4254 or 95% of modified proctor density in accordance with ASTM D-1557.
- Degree of compaction must be verified prior to blinding.

6.4 Net Allowable Bearing Pressure & Settlement

The net allowable bearing pressure for shallow foundations was calculated as follows.

DRAFT

Bearing Capacity Calculation for Isolated footing

Ultimate Bearing Capacity	$q_{ult} = S_c C N_c$		
Shape Factor	Sc =	1.3	For Square footing
Cohesion	C = Cu =	50	From Ref. at 1
Terzaghi Bearing Capacity Equation	Nc =	5.7	For Φ = 0, Cohesive Soil
	q_{ult} =	370.5	Kpa
Safe Bearing Capacity	$q_{safe} = q_{ult}/FOS = q_{ult}/3$	123.5	KPa
Assumed load of structure	P =	300	KN
Optimum square footing size	$B = P/q_{safe}$ =	2.43	m

Use 2.45m X 2.45m square footing for assumed load of 300 KN and above calculated q_{safe}

CALCULATION FOR NET PRESSURE ON SOIL WITH VARYING FOUNDATION SIZES

Unit weight of concrete	γ_c	25 KN/m^3
Unit weight of soil	γ_s	18 KN/m^3
Assumed thickness of isolated footing	T	1 m

Depth of footing D 1 m

Footing Width, B (m)	Total load on foundation soil, A = P + (γ_c x T x B^2) , (KN)	Weight of soil removed, B = D x B^2 x γ_s , (KN)	Net load on foundation, C = A - B , (KN)	Net contact pressure, q_{net} = C/B^2 , (Kpa)	Comparison with safe bearing capacity
1	325	18	307	307	unsafe
1.5	356.25	40.5	315.75	140.3333	unsafe
2	400	72	328	82	safe
2.45	450.0625	108.045	342.0175	56.97918	safe
3	525	162	363	40.33333	safe
3.5	606.25	220.5	385.75	31.4898	safe

Depth of footing D 1.5 m

Footing Width, B (m)	Total load on foundation soil, A = P + (γ_c x T x B^2) , (KN)	Weight of soil removed, B = D x B^2 x γ_s , (KN)	Net load on foundation, C = A - B , (KN)	Net contact pressure, q_{net} = C/B^2 , (Kpa)	Comparison with safe bearing capacity
1	325	27	298	298	unsafe
1.5	356.25	60.75	295.5	131.333333	unsafe
2	400	108	292	73	safe
2.45	450.0625	162.0675	287.995	47.9791753	safe
3	525	243	282	31.3333333	safe
3.5	606.25	330.75	275.5	22.4897959	safe

Ref:1, Table 5.3 "Clay strength from SPT data" from "Handbook og geotechnical investigations and design tables" by Burt Look 2007

GEOARTS PVT [LTD.]

(GT-12-2017-Draft)

Bearing Capacity Calculation for Raft footing

Ultimate Bearing Capacity	$q_{ult} = S_c C N_c$		
Shape Factor	Sc =	1.3	Considering square shape raft with equal length and width
Cohesion	C = Cu =	50	From Ref. at 1
Terzaghi Bearing Capacity Equation Factor	Nc =	5.7	For Φ = 0, Cohesive Soil
	q_{ult} =	370.5	Kpa
Safe Bearing Capacity	$q_{safe} = q_{ult}/FOS = q_{ult}/3$	123.5	KPa
Assumed load of structure	P =	5000	KN

	Square shape raft Footing Width, B (m)	Pressure on foundation, qg = P/(B x B), Kpa	Comparison with safe bearing capacity
Considering square shape raft, i.e. weight of soil removed = weight of structure + foundation	5	200	unsafe
	7.5	88.88888889	safe
	10	50	safe
	12.5	32	safe
	15	22.22222222	safe

Ref:1, Table 5.3 "Clay strength from SPT data" from "Handbook og geotechnical investigations and design tables" by Burt Look 2007

Note : Charts for Contact Pressure vs Width of footing (Isolated and Raft) have been presented in appendix A

The settlement has been calculated based on theory of elasticity using the following equation:

$$\delta_d = \frac{q^{/} \text{ x } B}{E_u} I_0 I_1$$

(Foundation Design Principles & Practices by Donald P. Coduto, 1994)

Where:

δ_d : distortion settlement

$q^{/}$: net bearing pressure

B : footing width.

I_0, I_1 : Influence factors

E_u : undrained modulus of elasticity of soil

The allowable bearing capacity of shallow foundations will be limited to settlement tolerance either supported by natural material or compacted fill. Typically, total settlement for isolated and raft foundations should not exceed 25mm and 50mm respectively. Differential settlement will not exceed the 75% of total settlement. The Structural engineer will decide the design settlement value.

DRAFT

Table No.7
SETTLEMENT CALCULATION

Structure	BH- No.	Depth of Foundation Below Existing Ground Level	Type of Foundation	Size of Foundation (m)	Settlement
Compressor	BH – 1	1.0	Raft	**3 x 3**	< 25
				6 x 6	< 25
		1.5		**3 x 3**	< 25
				6 x 6	< 25
Generator	BH - 2	1.0	Raft	**3 x 3**	< 25
				6 x 6	< 25
		1.5		**3 x 3**	< 25
				6 x 6	< 25
Condensate Stabilizer	BH -3	1.0	Isolated	**1 x 1**	< 15
				2 x 2	< 15
		1.5		**1 x 1**	< 15
				2 x 2	< 15
Sludge Catcher Area	BH- 4	1.0	Isolated	**1 x 1**	< 15
				2 x 2	< 15
		1.5		**1 x 1**	< 15
				2 x 2	< 15

Note: Above mentioned recommendations are based upon the subsurface strata below the foundations should not be in contact with seepage water. Extra care should be taken to minimize percolation of water to the material below the foundations to avoid differential settlement.

DRAFT

6.5 Modulus of Sub Grade Reaction

Modulus of sub grade (K_s) reaction is estimated by using the following equation.

$$\boldsymbol{K_s = 40 * (FS) * q_a KN/m^3}$$

(Foundation Analysis & Design by Joseph e. Bowles, Fifth Edition 1999)

Where:
K_s= modulus of sub grade reaction
FS=factor of safety
q_a=allowable bearing pressure

6.6 Excavations

Excavate the whole site up to required depth. Excavation operation on most areas of the site will be in clayey silt/silty clay with occasional concretions. Mechanical excavators may be used to remove soil. To minimize the stability problems, the temporary excavation sides should be cut at a face inclination not steeper than two horizontal to one vertical (2H: 1V) for the firm to stiff, occasionally very stiff material. If these side slopes cannot be achieved for insufficient lateral distance or for any other reason, temporary lateral support (shoring) system may be necessary.

6.7 Engineering Fill

The proposed site's ground surface is generally flat except slight undulated in the western side.
For intended fill areas, it is recommended to use controlled / select fill to support the proposed substation building foundations, slab on grade, concrete sidewalk / pavement, and asphalt surface / binder courses. The on-site cohesive material deposits cannot be used as engineering fill. Borrow material can be used as engineering fill as per project specification. General fill may be used in non structural areas subject to approval of Engineer.
The material and compaction procedures of a structural fill to be used shall in general be as follows:

1. The materials to be used shall meet the requirements of "Select fill" and "General fill" as per OGDCL project specification. General fill material shall comply with

2. All topsoil, organic matter, debris, rubbles, and other deleterious materials if any; should be stripped and removed from the intended fill areas prior to grading.
3. The exposed subgrade surface shall be graded and thoroughly compacted by large heavy compaction equipment and inspected by qualified geotechnical personnel or civil engineer. Any loose or soft areas identified should be excavated to the level of competent soil.
4. The fill materials must be placed in loose lifts not exceeding 300mm. Each layer shall be compacted to a minimum of 75% relative density (as per ASTM D-4253 & D-4254) for free draining soils containing less than 15% by weight finer than 75 micron sieve or 95% of the maximum density (as per ASTM D-1557) for soil containing more than 15% by weight passing 75 micron sieve. The moisture content shall be uniform through the layer and it shall be as close as practicable (about±2) to the optimum moisture content.
5. All fill placement and compaction operations must be supervised on a full-time basis by qualified geotechnical personnel to approve fill material and ensure the specified degrees of compaction have been achieved.
6. In the construction phase the contractor shall perform the verification tests for CBR, compaction and others quality control tests on the structural fill material.
7. Material with sulfate and chloride content greater than existing soil shall not be used.

6.8 Concrete protection

It should be noted that chemical reactions affecting durability of concrete are accelerated by higher temperatures. Also extreme temperature fluctuation causes expansion and contraction in concrete elements. To deal with any possible unsatisfactory performance of aggregate a special care should be taken in selection of fine and coarse aggregates.

All the construction practices including selection of cement type etc. shall be in accordance with project specification.

Foundation and other embedded portions of structures shall be protected from bottom and all external surfaces from hazardous effects of chemicals in soil by applying suitable water proofing membrane or coat. Extra care is required in design and construction of foundation to eliminate the possibility of concrete deterioration and corrosion of steel.
Chemical test results of soil indicated that sulphate and chloride contents are observe to be nominal, therefore it is recommended to use ordinary Portland cement.

6.9 Drainage System

6.9.1 General

Surface water drainage can be very beneficial, especially for areas which receive heavy amounts of annual rainfall (hydrological study is outside scope of work).
There are many different types of surface water drainage available for both personal and commercial use. Typically, the most common types of surface water drainage systems are french drains, storm drains and soakaways. Following is the brief introduction of these methods.

6.9.2 Different Drainage system

French Drains

French drains are primarily used in applications that involve smaller amounts of water, are best installed at the bottom of a slope. Basically, the French drain consists of a gravel or stone-filled trench, with a perforated pipe buried beneath. The gravel or stone serves as a way to capture flowing water while also re-directing the water down to a perforated pipe. This works because there is space between each piece of gravel or stone, allowing an area for water to travel. The water flows down to the bottom of the trench, where it enters through the holes of a perforated pipe. The pipe then re-directs the water to a drainage outlet. A drainage outlet can be installed in a variety of places, such as larger bodies of water or man-made reservoirs. In many applications, the nearest paved road or unoccupied area is used as a drainage outlet.

Storm Drains

Storm drains are meant to redirect and distribute large amounts of water. Whichever drainage system is employed, however, depends entirely upon the type of property, its weather patterns, and the time and money willing to be invested into installation. Storm drains are common and mostly found in the streets of cities and suburbs. These can capture more water than a French drain due to their wider, grated opening. Water is often redirected into storm water drains using channels or the natural slope of a road or street. Water that enters a storm drain travels through an underground concrete pipe and into a larger body of water.

Soakaways

Soakaways are used for the disposal of water to ground. The installation of soakaways, the design of soakaways and the construction of soakaways are governed by the Environment Agency. The size of soakaway required is dependent upon the permeability of the ground, therefore the slower the drainage the larger the soakaway area needs to be. Volume of water discharged also dictates the size of soakaway. In very poor ground conditions some soakaways may be installed to act as a filter bed / filter soakaway prior to discharge to a drainage ditch or water course. Important factors to remember with soakaways.

- All soakaways will fail at some stage
- All soakaways to be designed in accordance with Environment Agency regulations
- Supervision from independent soil agency
- All soakaways to be designed with building regulations
- Soakaways come in various designs to suit different requirements
- Unless mains drains are available your drainage will need a soakaway

There is a minimum design requirement for a soakaway serving a rainwater down pipe as set out in building regulations. However in a storm water soakaway design, catchment area, ground permeability and frequency and strength of storm need to be taken into account. Cost is always a governing factor in storm soakaway designs, especially for domestic soakaways. However should a surface / storm water soakaway fail it is not an initial health hazard, which would be the case with a foul water drainage soakaway
In view of the unfavorable influences of the moisture variation on foundation soils, it is recommended that all precautions shall be taken to observe that the moisture of subsurface soils is not unduly disturbed. For this keep all the plantation and greenery minimum 2m away from the building periphery. Water lines should, if possible, be kept away from the foundations.

Drainage Conclusion

Following are the conclusions of the above descriptions of drainage.

- Generally groundwater conditions vary with the tidal, seasonal and climatic conditions and this must be reinvestigated prior to excavation and construction.
- As per groundwater conditions at the time of construction, concrete protection and drainage shall be decided accordingly.
- Drainage system must be designed by qualified drainage Engineer.

6.10 Quality control

Quality control testing shall be performed by independent testing laboratory. For engineering fill, the testing laboratory has to conduct all necessary tests for the classification of soil, chemical analysis and compactions tests.

For concrete, the testing laboratory shall conduct all necessary field tests on fresh concrete (slump test, air content and temperature) and take samples of concrete for compression strength test and density of the hardened concrete.

DRAFT

7.0 LIMITATIONS

The analyses, conclusion, and recommendations of this report were based on the subsoil investigation data from four (04) boreholes, two (02) test pits. Should there be any major difference in the subsoil condition observed during excavation and construction; our office must be notified to rectify the recommendations.

Should you need any additional information, please feel free to contact us.

Respectfully Submitted

Eng. Munawar I. Saleem
Director Technical
20th November, 2017

DRAFT

ABBREVIATIONS

BH	Borehole	Rec.	Rock Core Recovery
TP	Test Pit	RQD	Rock Quality Designation
GW	Well graded GRAVEL	GM	Silty GRAVEL
GP	Poorly graded GRAVEL	GC	Clayey GRAVEL
SM	Silty SAND	SP	Poorly graded SAND
SC	Clayey SAND	SW	Well graded SAND
ML	Inorganic SILT of low plasticity	MH	Inorganic SILTof high plasticity
CL	Inorganic CLAY of low plasticity	CH	Inorganic CLAY of high plasticity
LL	Liquid Limit	PI	Plasticity Index
PL	Plastic Limit	NP	Non Plastic
		R	Refusal
ppm	Part per million		
TDS	Total dissolved solids		
pH	Hydrogen ion concentration		
ASTM	American Society for Testing and Materials		

DRAFT

REFERENCES

1/ ASTM (Annual Book of ASTM Standards, 1996) Section 4, Volume 04, 08; Soil and Rock (1).Volume 04, 02; Concrete and aggregates.

2/ Bowles, J.E., Foundation Analysis and Design, McGraw - Hill Book Co., 1982, P., 816.

3/ NAVFAC DM-7.3 (Soil Dynamics, Deep Stabilization and Special Geotechnical Construction), Design Mannual 7.3, Department of the Navy, USA. Alex. Virg. April 1983.

4/ Peck, R. B. , Hanson, W.E., and Thournburn, T.H., Foundation Engineering, 2 nd edition, John Wiley, New York, 1967, P., 310.

5/ Tomlinson, M. J., Foundation Design and Construction, Longman Group Ltd., 5th edition, EL BS. 1994. P., 842.

6/ Baraja M. Das, Principles of Foundation Engineering, 4th Edition, 1999.

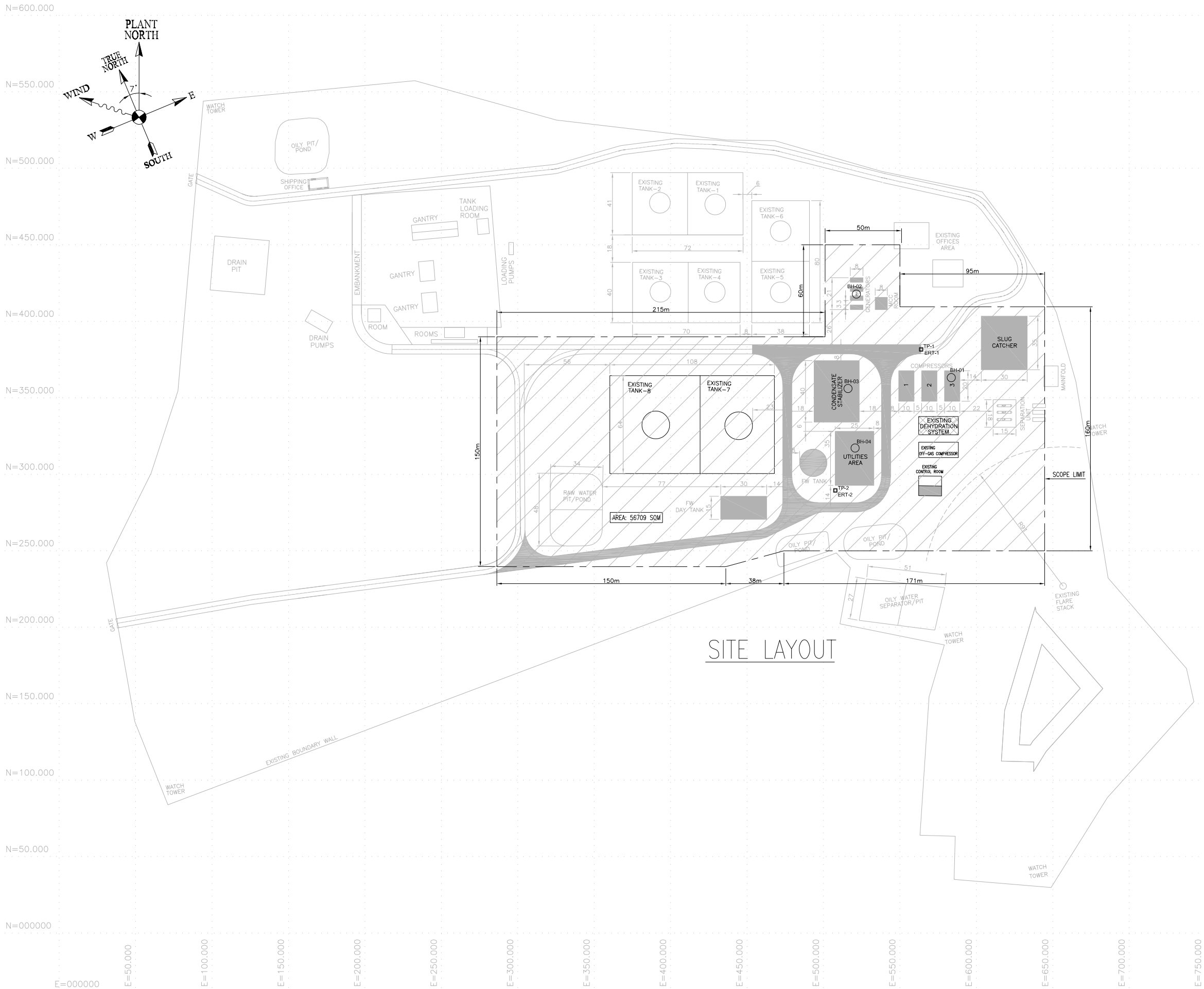
7/ Donald P. Coduto, Foundation Design, Principles and Practices, 1994.

DRAFT

APPENDICES

APPENDIX A

FIGURES



SITE LAYOUT

LAYOUT PLAN OF MELA

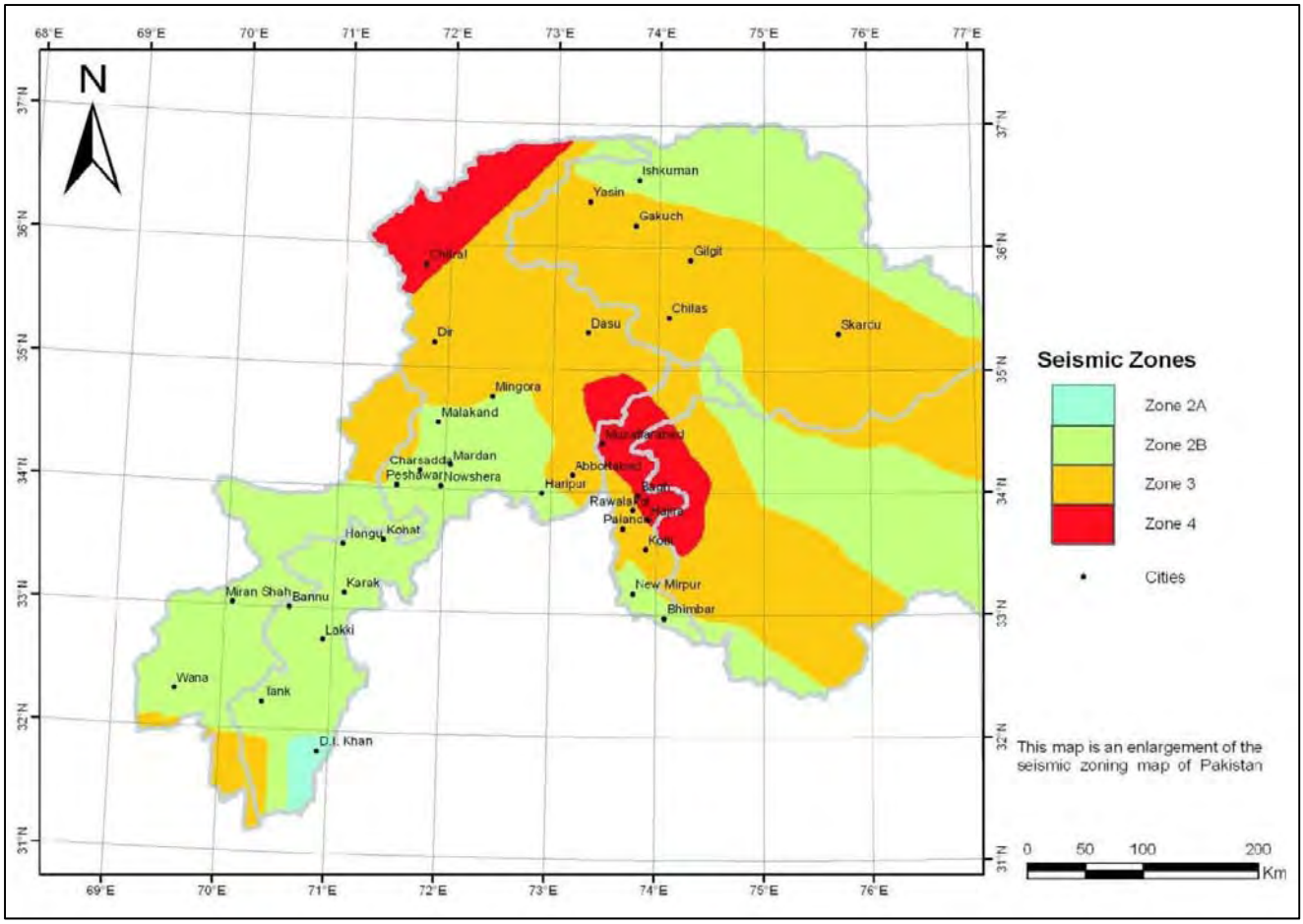
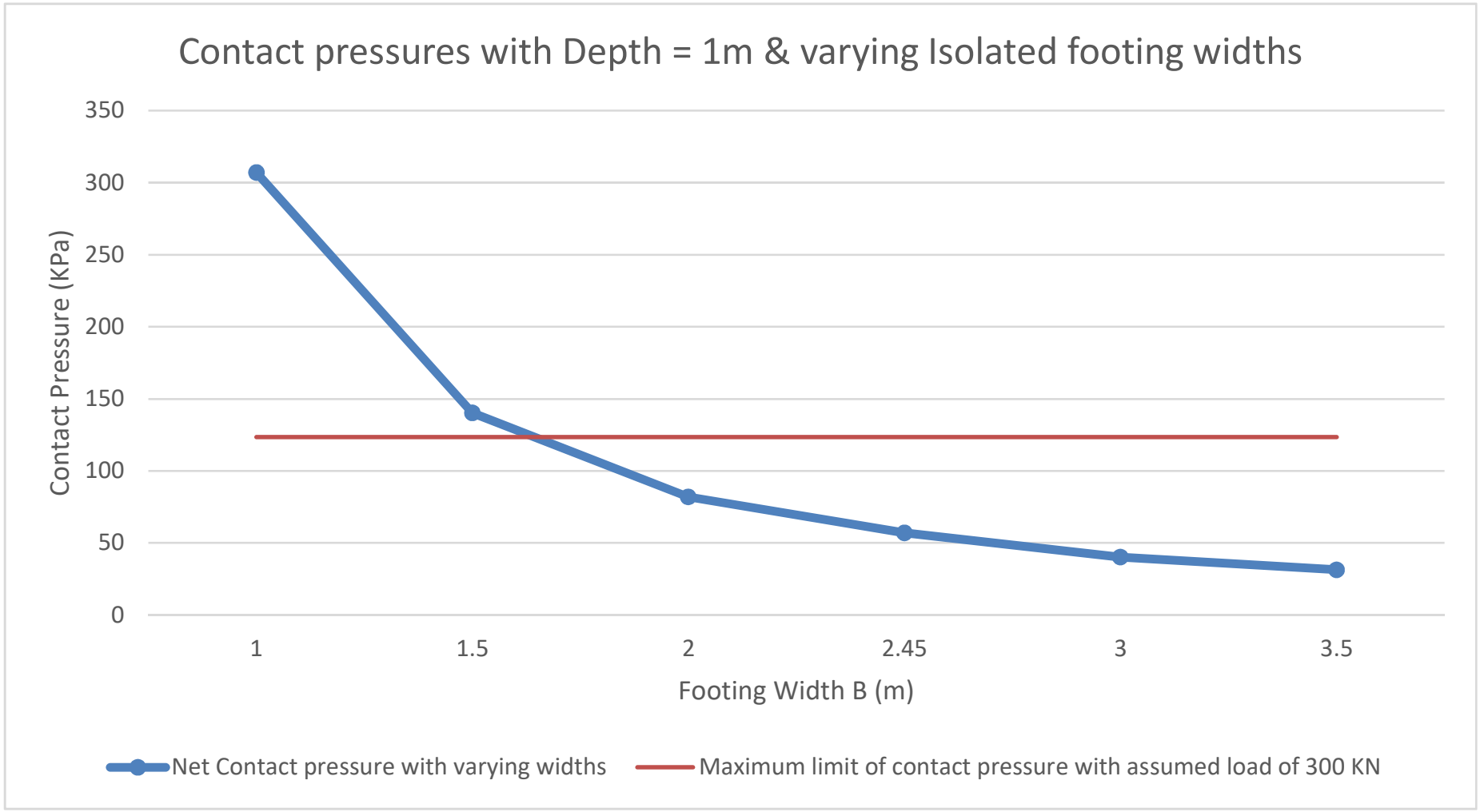
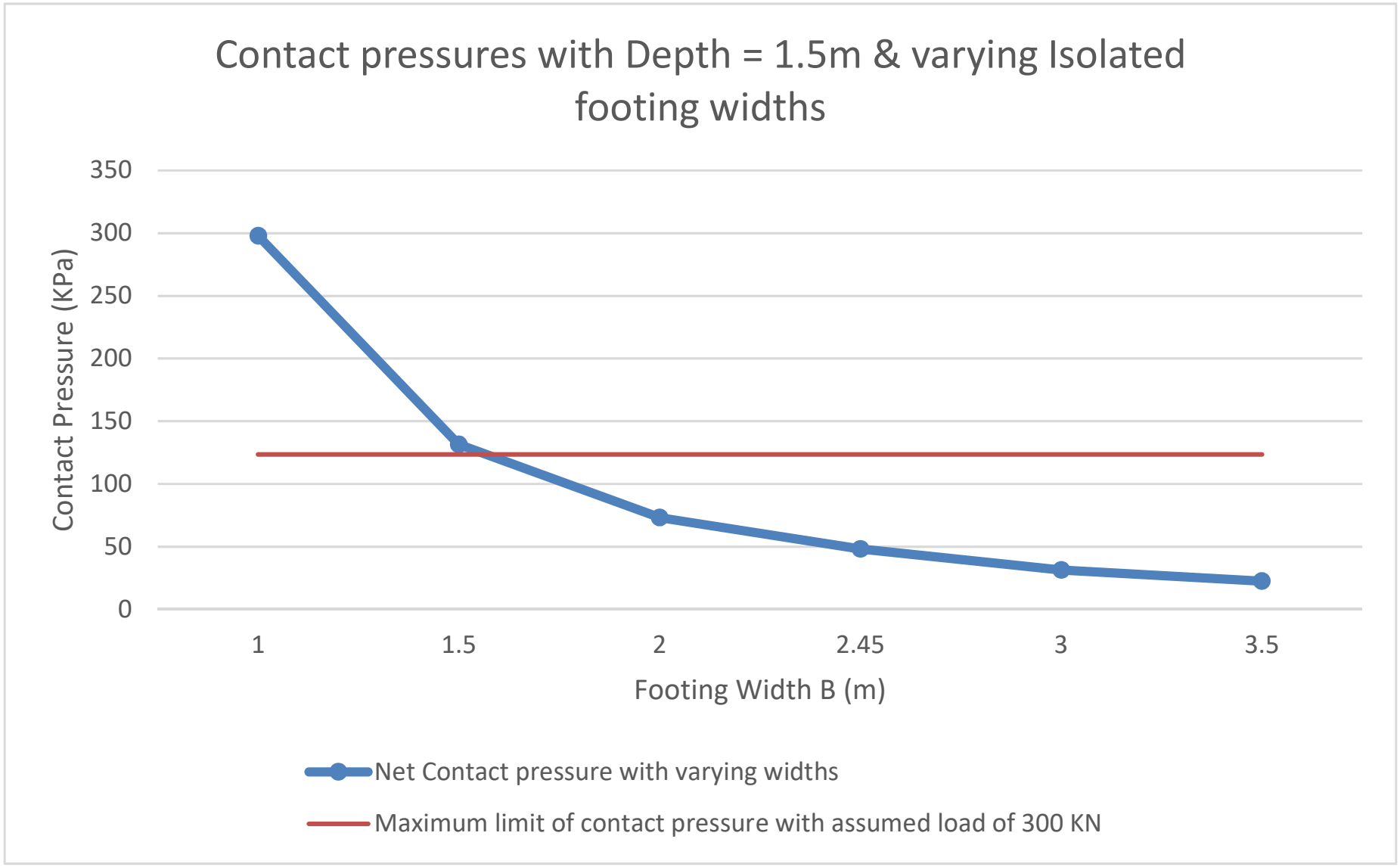
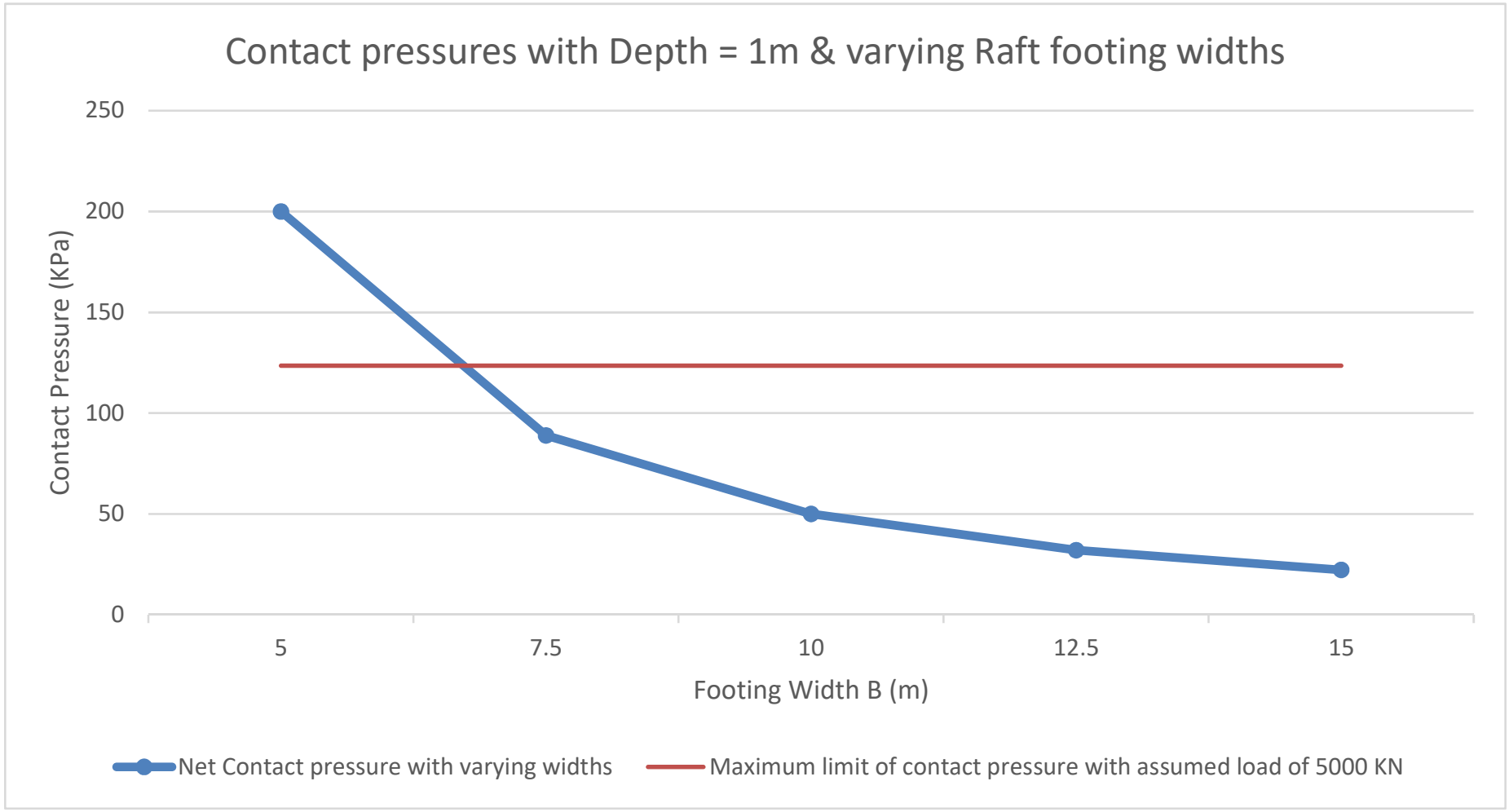
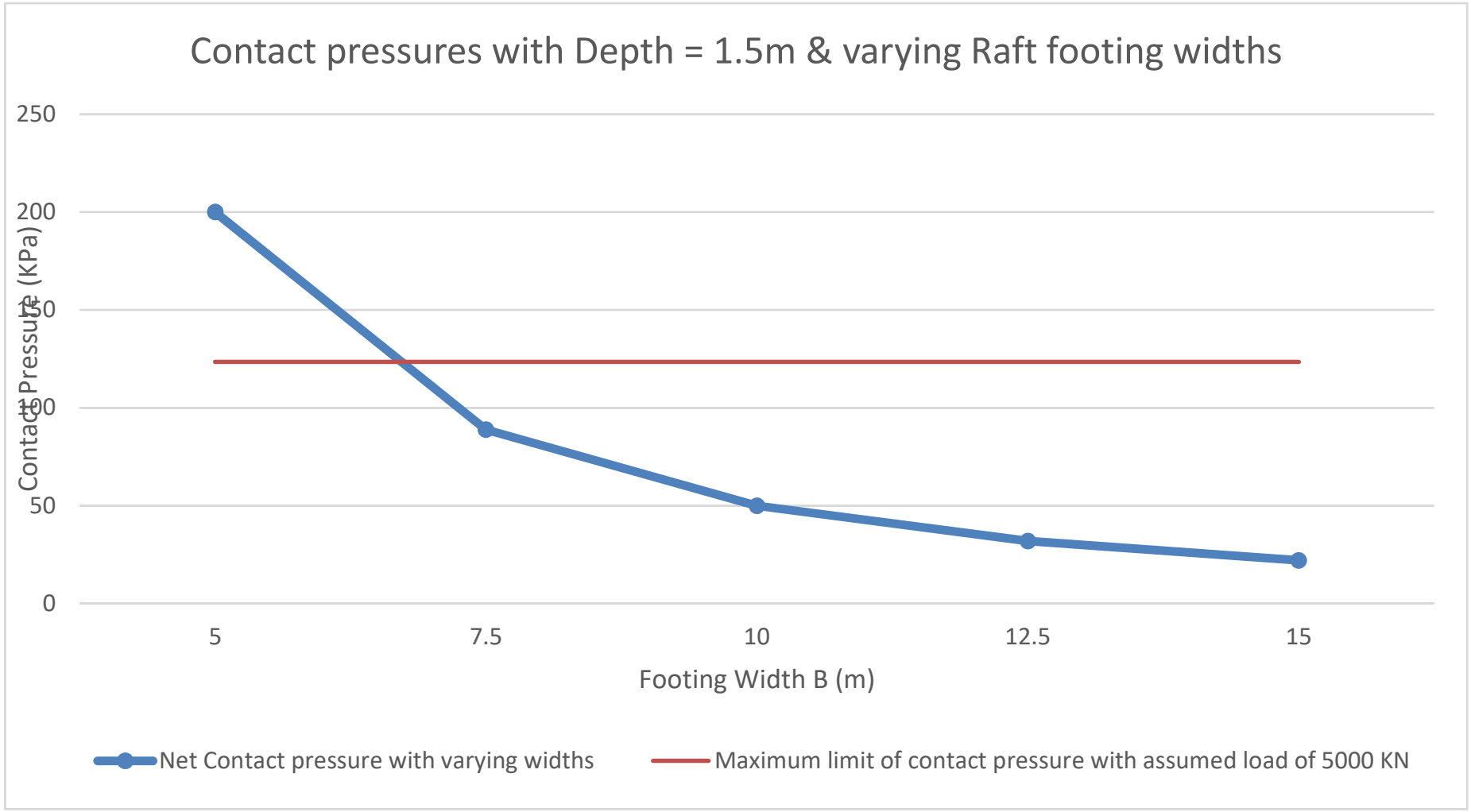


FIGURE 2 : Seismic Zoning Map for Project Site


Contact pressures with Depth = 1m & varying Isolated footing widths
350
300
250
200
150
100
50
0
Contact Pressure (KPa)
1
1.5
2
2.45
3
3.5
Footing Width B (m)
Net Contact pressure with varying widths
Maximum limit of contact pressure with assumed load of 300 KN


Contact pressures with Depth = 1.5m & varying Isolated footing widths
Contact Pressure (KPa)
350
300
250
200
150
100
50
0
1
1.5
2
2.45
3
3.5
Footing Width B (m)
Net Contact pressure with varying widths
Maximum limit of contact pressure with assumed load of 300 KN


Contact pressures with Depth = 1m & varying Raft footing widths
250
200
150
100
50
0
Contact Pressure (KPa)
5
7.5
10
12.5
15
Footing Width B (m)
Net Contact pressure with varying widths
Maximum limit of contact pressure with assumed load of 5000 KN


Contact pressures with Depth = 1.5m & varying Raft footing widths
250
200
150
100
50
0
Contact Pressure (KPa)
5
7.5
10
12.5
15
Footing Width B (m)
Net Contact pressure with varying widths
Maximum limit of contact pressure with assumed load of 5000 KN

APPENDIX B

BOREHOLE & TRIAL PIT LOGS

BOREHOLE NO. BH-01

SHEET 1 OF 1

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Site Incharge ZAFAR IQBAL (GEOLOGIST) Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Contractor GEOARTS PRIVATE LIMITED

Type of boring STRAIGHT ROTARY Drilling Fluid WATER Ground Water Depth NOT ENCOUNTERED

Coordinates N: 3681233 m E: 734770 m Ground Elevation 563.0 m Date 31-01-2018 To 02-02-2018

Depth (m)	Sample No.	Legend	Classification Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ SPT Blows/30cm	Remarks
0.0				Reddish brown, hard, SILTY CLAY/LEAN CLAY, low to medium plasticity.			
1.0	SPT-1		CL-ML			54	
2.0	SPT-2					77	
			CL	Reddish brown, hard, LEAN CLAY, low to medium plasticity.			
3.0	SPT-3			TOP OF BEDROCK		35-50/14	
4.0						50/9	
5.0						Refusal	
6.0							
7.0							
8.0							
9.0							
10.0							

BOREHOLE NO. BH-01

SHEET 2 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 563.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681233 m Date Started 31-01-2018 Ground Water Depth NOT ENCOUNTERED

E: 734770 m Date Completed 02-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Core Recovery: Recovery %	Core Recovery: R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
0.0					TOP OF BEDROCK			
3.0					CLAYSTONE/SHALE: Redish brown, completly weathered, decomposed shale.		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
5.0	1	23	0	C.St	CLAYSTONE/SHALE: Redish brown, weak, completely to highly weathered.			
6.0	2	25	0					
7.0	3	30	0					
8.0	4	20	0					
9.0	5	16	0					
10.0				CL	Reddish brown, LEAN CLAY, medium to high plasticity, moist.			

BOREHOLE NO. BH-01

SHEET 3 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 563.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681233 m Date Started 31-01-2018 Ground Water Depth NOT ENCOUNTERED

E: 734770 m Date Completed 02-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Core Recovery: Recovery %	Core Recovery: R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
10.0								
	6	17	10	C.St	CLAYSTONE/SHALE: Redish brown, dry, weak, completely to highly weathered.		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
11.0	7	22	10					
12.0	8	50	12					
13.0	9	35	30					
14.0	10	20	0					
15.0					BOTTOM OF BOREHOLE			

BOREHOLE NO. BH-02

SHEET 1 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Site Incharge ZAFAR IQBAL (GEOLOGIST) Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Contractor GEOARTS PRIVATE LIMITED

Type of boring STRAIGHT ROTARY Drilling Fluid WATER Ground Water Depth NOT ENCOUNTERED

Coordinates N: 3681294 m E: 734712 m Ground Elevation 563.0 m Date 06-02-2018 To 08-02-2018

Depth (m)	Sample No.	Legend	Classification Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ SPT Blows/30cm	Remarks
0.0				Brown, very stiff, SILTY CLAY/CLAYEY SILT, low plasticity, trace concretions, dry.			
1.0	SPT-1		CL-ML			19	
2.0	SPT-2					25	
3.0	SPT-3						50/12
			CL	Brown, hard, LEAN CLAY, low to medium plasticity.			
4.0	SPT-4			TOP OF BEDROCK			Refusal
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							

BOREHOLE NO. BH-02

SHEET 2 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 563.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681294 m Date Started 06-02-2018 Ground Water Depth NOT ENCOUNTERED

E: 734712 m Date Completed 08-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Core Recovery: Recovery %	Core Recovery: R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
0.0					TOP OF BEDROCK			
4.0	1	20	0	C.St	CLAYSTONE/SHALE: Brown, dry, weak, completely to highly weathered and fractured, interbedded with lean clay.		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
5.0	2	22	12					
6.0	3	24	10					
7.0	4	18	10					
8.0	5	20	0					
9.0	6	25	12					
10.0								

BOREHOLE NO. BH-02

SHEET 3 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 563.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681294 m Date Started 06-02-2018 Ground Water Depth NOT ENCOUNTERED

E: 734712 m Date Completed 08-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Core Recovery: Recovery %	Core Recovery: R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
10.0								
	7	30	10	C.St	CLAYSTONE/SHALE: Brown, dry, weak, highly weathered and fractured.		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
11.0	8	35	10					
12.0	9	31	10					
13.0	10	40	20					
14.0	11	35	12					
15.0					BOTTOM OF BOREHOLE			

BOREHOLE NO. BH-03

SHEET 1 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Site Incharge ZAFAR IQBAL (GEOLOGIST) Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Contractor GEOARTS PRIVATE LIMITED

Type of boring STRAIGHT ROTARY Drilling Fluid WATER Ground Water Depth NOT ENCOUNTERED

Coordinates N: 3681219m E: 734703 m Ground Elevation 562.0 m Date 08-02-2018 To 10-02-2018

Depth (m)	Sample No.	Legend	Classification Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ SPT Blows/30cm	Remarks
0.0				Brown, very stiff, SILTY CLAY/CLAYEY SILT, low plasticity, trace sand, trace concretions.			
1.0	SPT-1		CL-ML	Dark brown, hard, SILTY CLAY, low to medium plasticity.		○ 41	
2.0	SPT-2					50/13	
3.0	SPT-3			TOP OF BEDROCK		Refusal	
4.0							
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							

SPT Blows/30cm: 10 20 30 40 50 60 70 80 90 100

BOREHOLE NO. BH-03

SHEET 2 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 562.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681219 m Date Started 08-02-2018 Ground Water Depth NOT ENCOUNTERED

E: 734703 m Date Completed 10-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Core Recovery: Recovery %	Core Recovery: R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
0.0								
					TOP OF BEDROCK			
3.0	1	18	0	C.St	CLAYSTONE/SHALE: Reddish brown, moist, completely to highly weathered and fractured.		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
4.0	2	20	0					
5.0	3	45	17					
6.0	4	30	17					
7.0	5	22	20					
8.0	6	23	12					
9.0	7	28	0					
10.0								

BOREHOLE NO. BH-03

SHEET 3 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 562.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681219 m Date Started 08-02-2018 Ground Water Depth NOT ENCOUNTERED

E: 734703 m Date Completed 10-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Recovery %	R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
10.0								
	8	26	0	C.St	CLAYSTONE/SHALE: Reddish brown, completely to highly weathered and fractured,		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
11.0	9	30	0					
12.0	10	25	24					
13.0	11	35	0					
14.0	12	30	12					
15.0					BOTTOM OF BOREHOLE			

BOREHOLE NO. BH-04

SHEET 1 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Site Incharge ZAFAR IQBAL (GEOLOGIST) Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Contractor GEOARTS PRIVATE LIMITED

Type of boring STRAIGHT ROTARY Drilling Fluid WATER Ground Water Depth NOT ENCOUNTERED

Coordinates N: 3681200 m E: 734711 m Ground Elevation 563.0 m Date 03-02-2018 To 05-02-2018

Depth (m)	Sample No.	Legend	Classification Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ SPT Blows/30cm	Remarks
0.0							
1.0	SPT-1		ML	Reddish brown, very stiff, CLAYEY SILT with gravels, low plasticity.		∘ 29	
2.0	SPT-2		CL	Dark brown, hard, LEAN CLAY, low plasticity.		38-50/11 ∘	
3.0	SPT-3			TOP OF BEDROCK			Refusal
4.0							
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							

SPT Blows/30cm: 10 20 30 40 50 60 70 80 90 100

BOREHOLE NO. BH-04

SHEET 2 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 563.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681200 m Date Started 03-02-2018 Ground Water Depth NOT ENCOUNTERED

E: 734711 m Date Completed 05-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Core Recovery: Recovery %	Core Recovery: R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
0.0					TOP OF BEDROCK			
3.0	1	20	0	C.St	CLAYSTONE/SHALE: Dark brown, completely to highly weathered and fractured.		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
4.0	2	25	12					
5.0	3	18	0					
6.0	4	25	10					
7.0	5	60	45					
8.0	6	25	0					
9.0	7	20	0					
10.0								

BOREHOLE NO. BH-04

SHEET 3 OF 3

BOREHOLE LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Angle (From Vertical) Ground Elevation 563.0 m

Contractor GEOARTS PRIVATE LIMITED Bearing Rock Elevation -

Co-ordinates N: 3681200 m Date Started 03-02-2018 Ground Water Depth NOT ENCOUNTERED

E: 734711 m Date Completed 05-02-2018 Engr./Geol. ZAFAR IQBAL GEOLOGIST

Depth (m)	Core Recovery: Run No.	Recovery %	R.Q.D. %	Symbol	Description of Material	Drilling Fluid Recovery %	Casing and Bit	Remarks
10.0								
	8	30	0	C.St	CLAYSTONE/SHALE: Dark brown, completely to highly weathered and fractured.		100MM DIAMETER CASING PIPE NQ CARBITE 76 CM	
11.0	9	25	22					
12.0	10	18	15					
13.0	11	30	10					
14.0	12	26	10					
15.0					BOTTOM OF BOREHOLE			

Test Pit No. TP-1

Sheet 1 OF 1

TESTPIT LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Site Incharge ZAFAR IQBAL GEOLOGIST Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Contractor GEOARTS PRIVATE LIMITED

Coordinates N: 3681269 m E: 734734 m Ground Elevation 564.0 m Date 08-02-2018 TO 08-02-2018

Depth in meter	Elevation in meter	Legend	USCS Classification Symbol	Description of Material	Sample Type/No.	Field Density Test: Dry Density kN/m3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	Remarks
0.0			ML	Dark brown, CLAYEY SILT with gravel and cobbles.	BS-01						
0.5											
1.0			CL-ML	Dark brown, SILTY CALY with gravel and cobbles, trace boulders.							
1.5											
2.0				BOTTOM OF TESTPIT							

Test Pit No. TP-2

Sheet 1 OF 1

TESTPIT LOG

Job No. GT-12-2018 Project INSTALLATION OF CONDENSATE STABILIZATION UNIT, COMPRESSOR AND ALLIED FACILITIES Location MELA OIL FIELD

Site Incharge ZAFAR IQBAL GEOLOGIST Client OIL AND GAS DEVELOPMENT COMPANY LIMITED Contractor GEOARTS PRIVATE LIMITED

Coordinates N: 3681192 m E: 734710 m Ground Elevation 565.0 m Date 09-02-2018 TO 09-02-2018

Depth in meter	Elevation in meter	Legend	USCS Classification Symbol	Description of Material	Sample Type/No.	Field Density Test: Dry Density kN/m3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	Remarks
0.0				Dark brown, SILTY CLAY/CLAYEY SILT with gravel and cobbles.							
0.5											
1.0			CL-ML	Dark brown, SILTY CALY with gravel and cobbles, trace boulders.	BS-01						
1.5											
2.0				BOTTOM OF TESTPIT							

APPENDIX C

LABORATORY TEST RESULTS

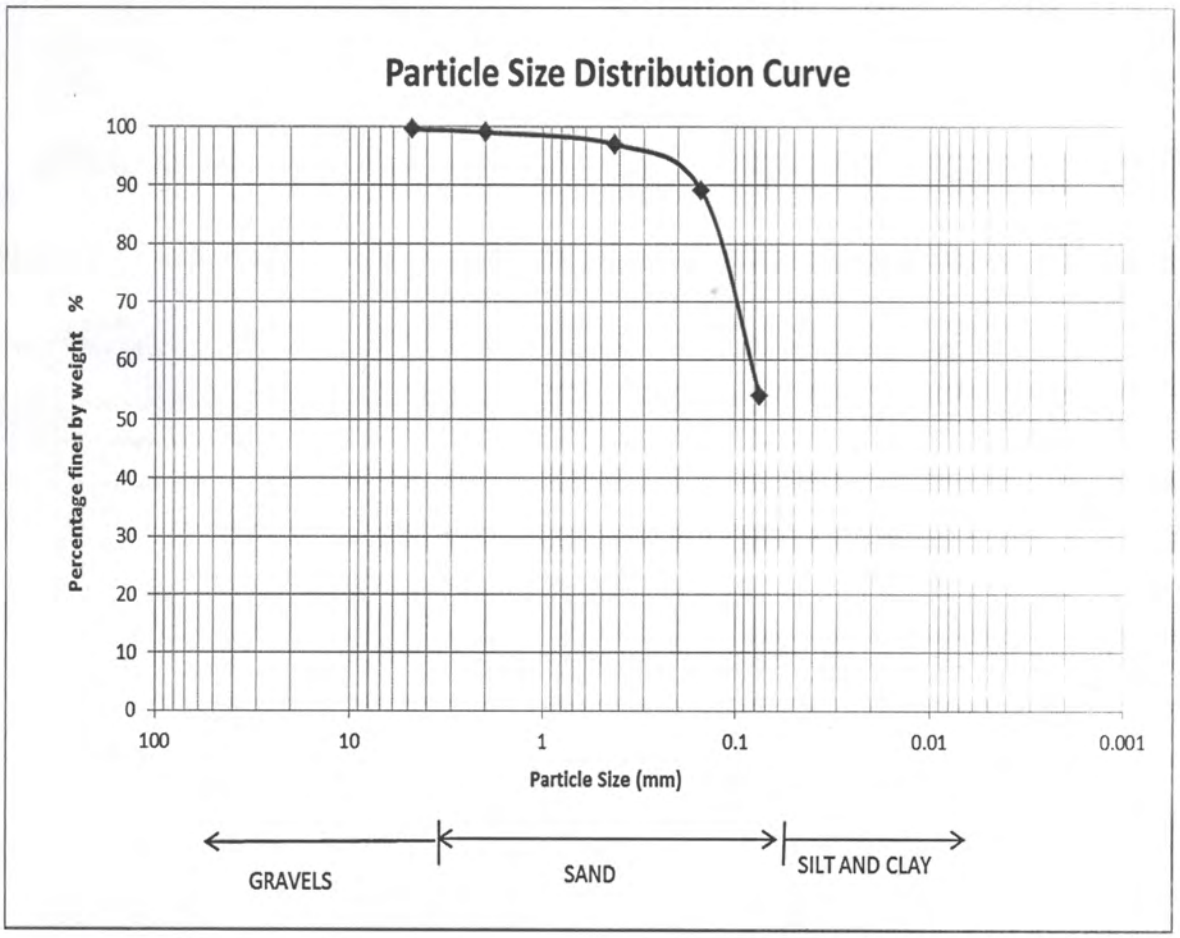
S&T Lab.

PARTICLES SIZE ANALYSIS

Name of Project : Mela Oil Field Shakardara Kohat, KPK.

Bore Hole No: B H-01 **Depth:** 1.0 m.

Gravels	%	0.0
Sand	%	46.0
Silt & Clay	%	54.0



Lab.Technicain

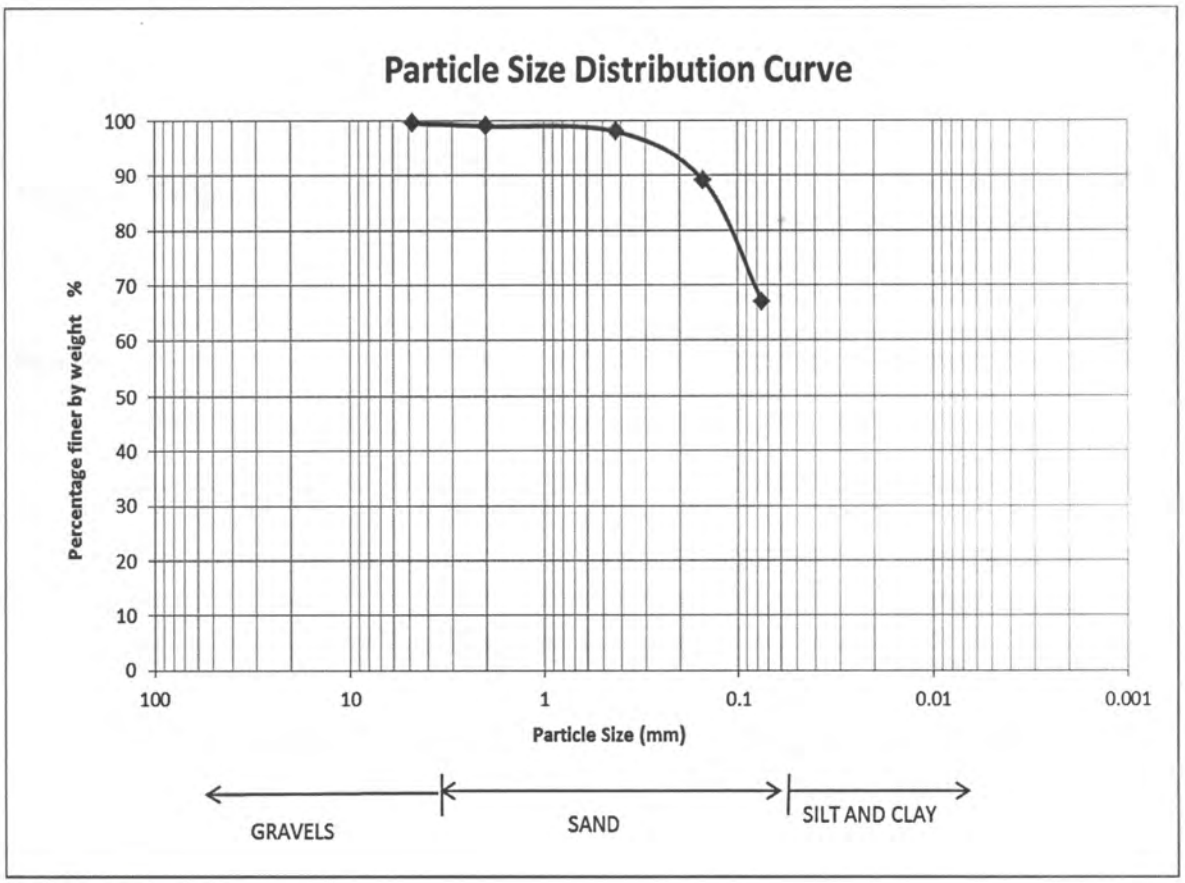
Ch. Masood Ahamd
Material Engineer
Science And Technology Labs
Lahore

PARTICLES SIZE ANALYSIS

Name of Project : Mela Oil Field Shakardara Kohat, KPK.

Bore Hole No: B H-01 **Depth:** 2.0 m.

Gravels	%	0.0
Sand	%	33.0
Silt & Clay	%	67.0



Lab.Technicain

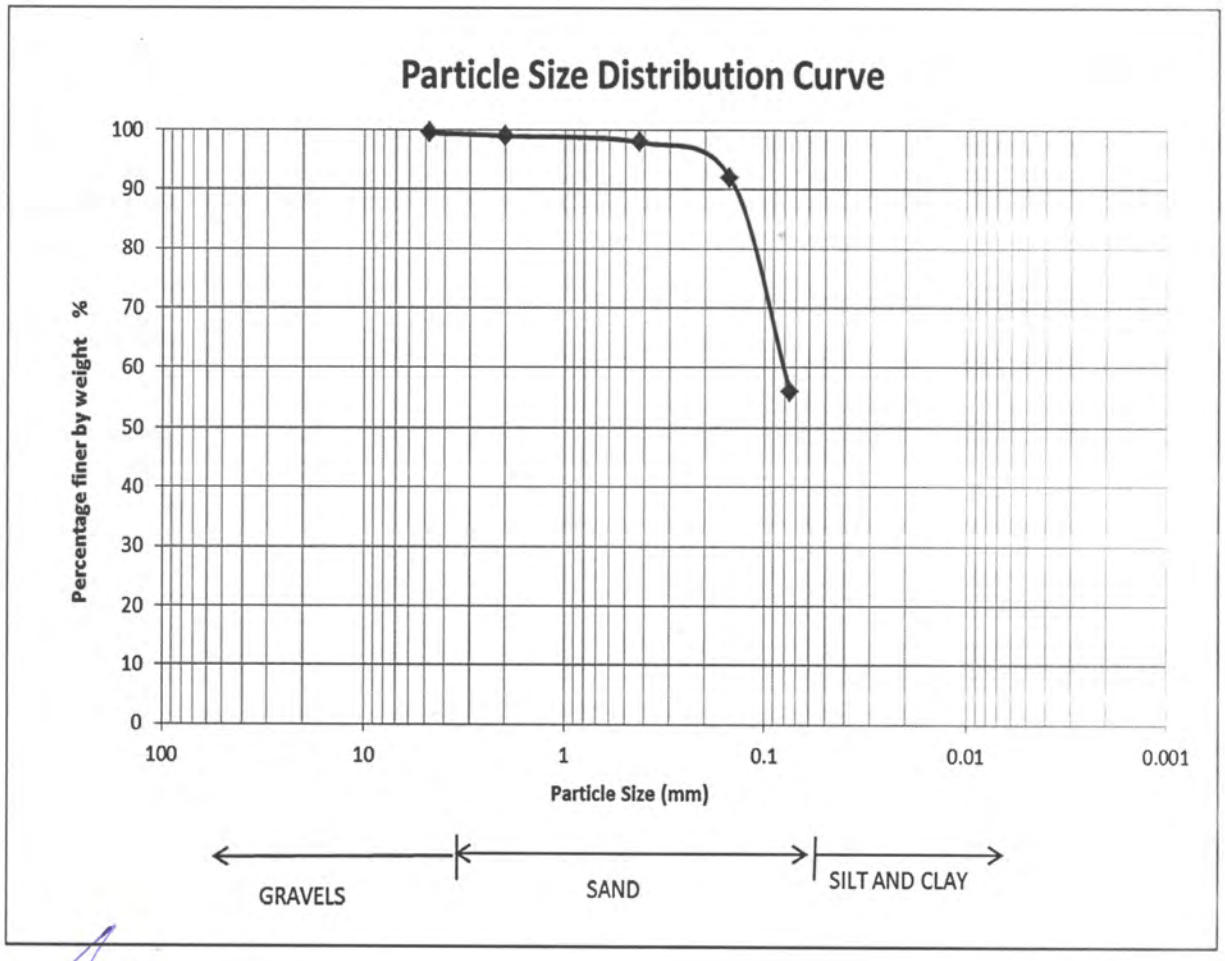
Ch. Masood Ahamd
Material Engineer

PARTICLES SIZE ANALYSIS

Name of Project : Mela Oil Field Shakardara Kohat, KPK.

Bore Hole No: B H-01 **Depth:** 3.0 m.

Gravels	%	0.0
Sand	%	44.0
Silt & Clay	%	56.0



Lab.Technicain

Ch. Masood Ahamd
Material Engineer

Science And Technology Lab's
Lahore

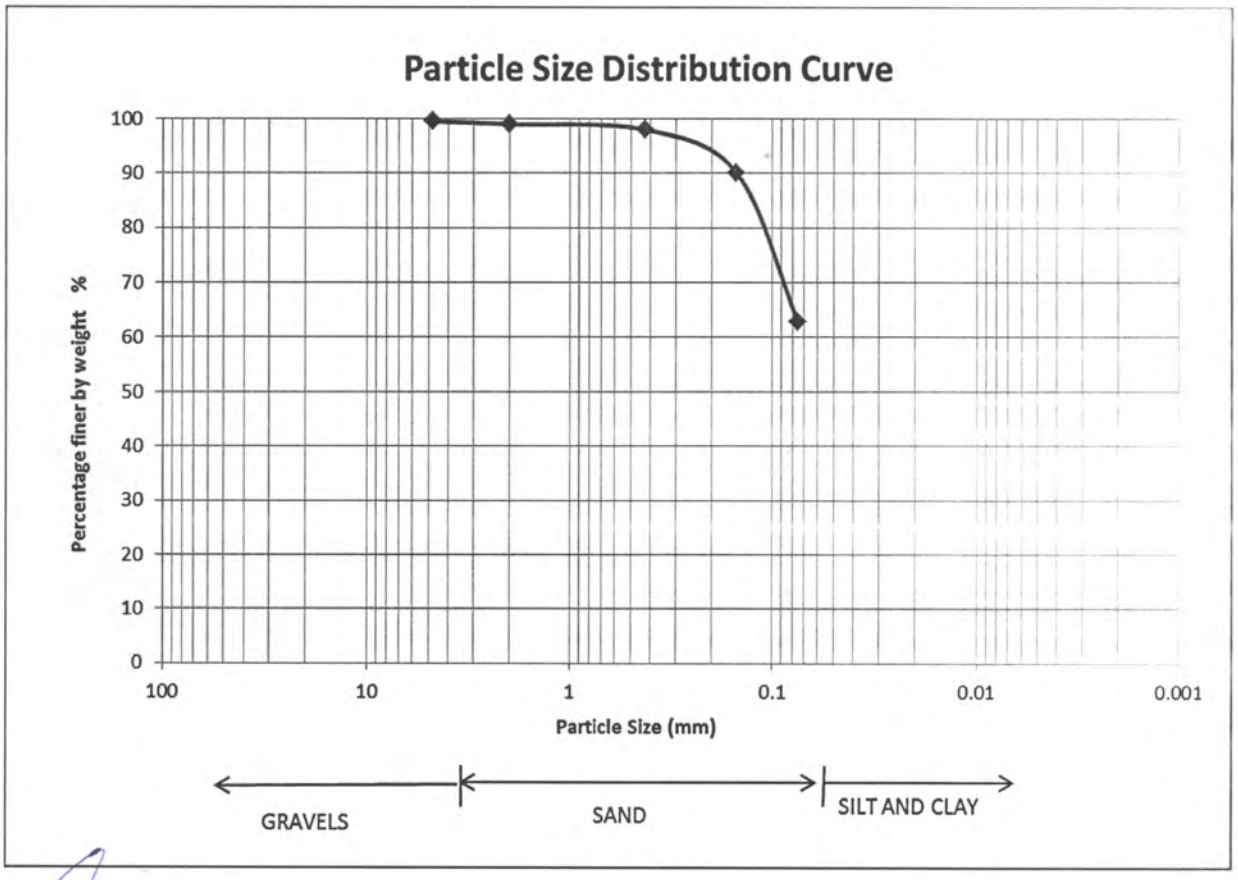
S&T Lab.

PARTICLES SIZE ANALYSIS

Name of Project : Mela Oil Field Shakardara Kohat, KPK.

Bore Hole No: B H-02 **Depth:** 1.0 m .

Gravels	%	0.0
Sand	%	37.0
Silt & Clay	%	63.0



Lab.Technicain

Ch. Masood Ahamd
Material Engineer

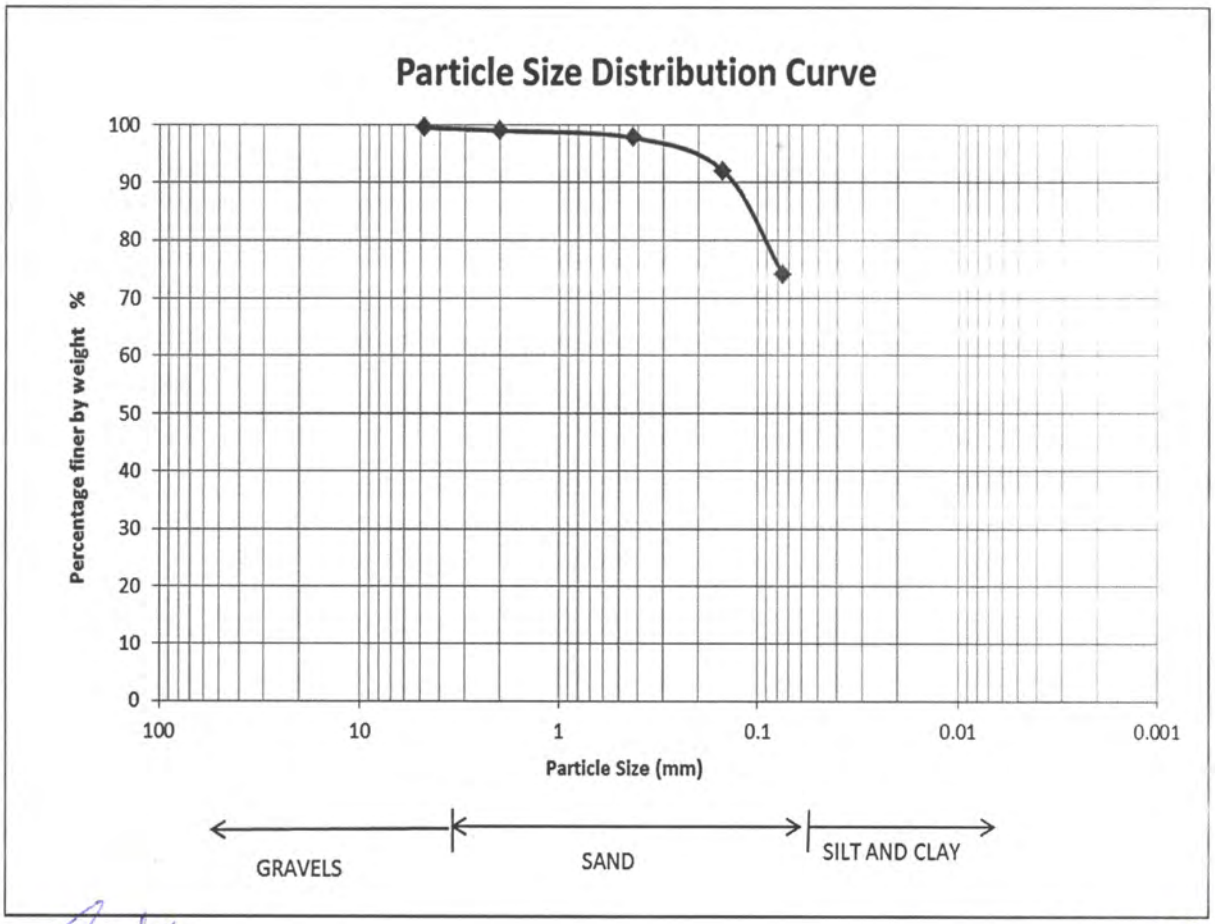
Science And Technology Labs
Lahore

PARTICLES SIZE ANALYSIS

Name of Project : Mela Oil Field Shakardara Kohat, KPK.

Bore Hole No: B H-02 **Depth:** 2.0 m.

Gravels	%	0.0
Sand	%	26.0
Silt & Clay	%	74.0



Lab.Technicain

Ch. Masood Ahamd
Material Engineer

Science And Technology Lab's
Lahore

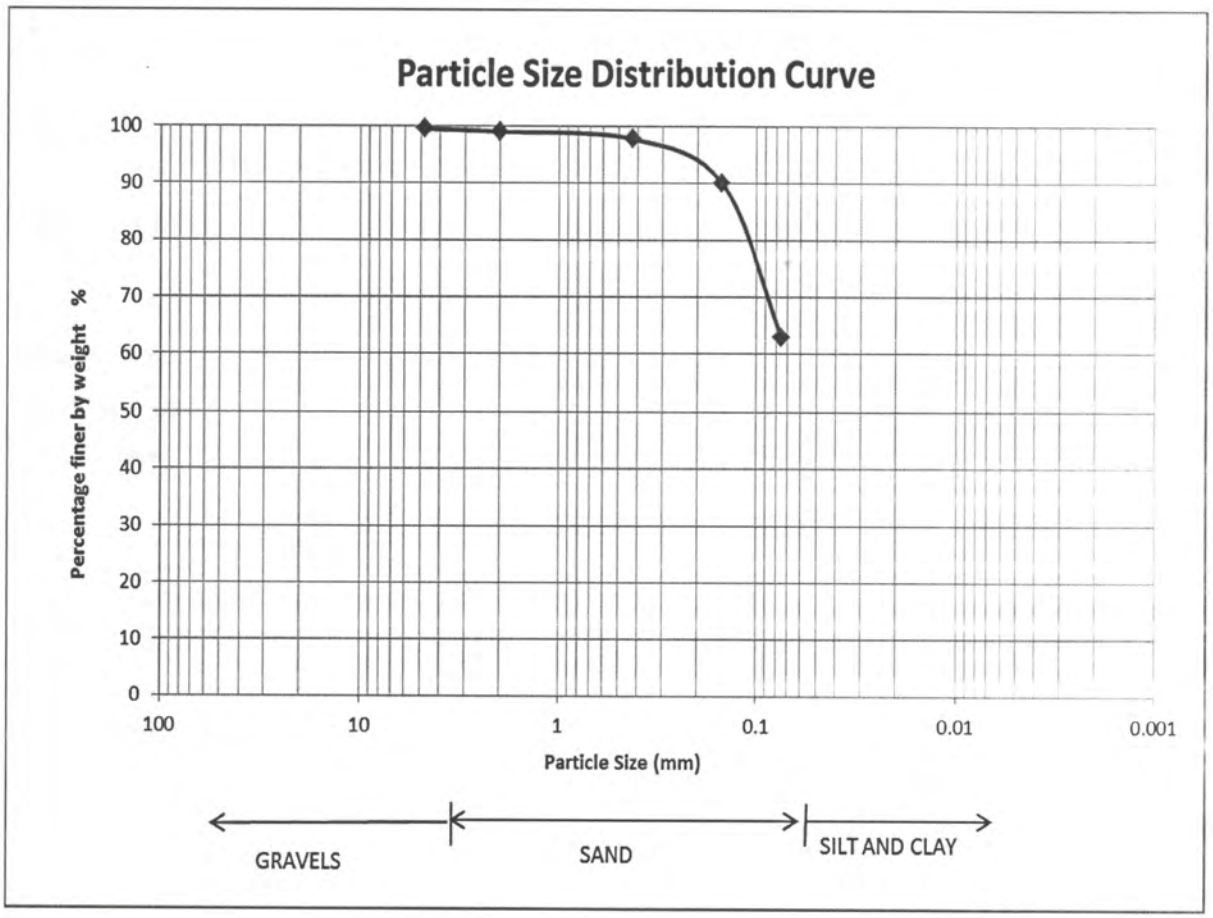
S&T Lab.

PARTICLES SIZE ANALYSIS

Name of Project : Mela Oil Field Shakardara Kohat, KPK.

Bore Hole No: B H-03 **Depth:** 1.0 m.

Gravels	%	0.0
Sand	%	37.0
Silt & Clay	%	63.0



Lab.Technicain

Ch. Masood Ahamd
Material Engineer

Science And Technology Lab's
Lahore

Client: Oil and Gas Development Company Limited

Project: Installation of Condensate Stabilization Unit

Location: Mela Oil Field

Report Ref: GT-12-2017

ATTERBERG LIMITS

Sample No	Depth	Liquid Limit	Plastic Limit	Plasticity Index
BH-1	1.0	25	20	5
BH-2	2.0	27	18	9
BH-3	3.0	30	20	10
BH-4	3.0	26	19	7

Client: Oil and Gas Development Company Limited

Project: Installation of Condensate Stabilization Unit

Location: Mela Oil Field

Report Ref: GT-12-2017

SPECIFIC GRAVITY TEST

Sample No	Depth (m)	Specific Gravity
BH-1	4.0	2.66
BH-2	3.0	2.62
BH-3	2.0	2.64
BH-4	3.0	2.63

GEOTECHNICAL ENGINEERING LABORATORY
CIVIL ENGINEERING DEPARTMENT
UNIVERSITY OF ENGINEERING AND TECHNOLOGY, LAHORE

CONSOLIDATION TEST

Sample TP-2, UDS

Project: Mela Oil Field Shakardara Kohat, KPK

Initial

Ring dia =	50	mm	Gs=	2.68	
Ring ht =	19	mm	e_o=	0.636	
Volume =	37.306	cc	S_o=	26.30	%
wt of ring=	58.89	gm	Hs=	11.61	mm
ring+soil =	123.82	gm			
m.c. =	6.24	%			
Bulk den =	17.1	kN/m^3			
Dry dens=	16.1	kN/m^3			

Final

Ring dia =	50	mm	Gs=	2.68	
Soil ht =	15.15	mm	e_f =	0.304	
Volume =	29.75	cc	S_f =	123.60	%
wt of ring=	58.89	gm	Hs=	11.61	mm
ring+soil =	127.85	gm			
f.m.c. =	14.04	%			
Bulk den =	22.7	kN/m^3			
Dry dens=	19.9	kN/m^3			

Load	Pressure	D Reading	Change	Acc Cha	Ht of sam	Strain	Void Ratio	C_c	m_v	$E = 1/m_v$
kg	kPa	*0.01mm	mm	mm	mm	%	e		m^2/MN	MPa
0.0	0.0	800.0	0.000	0.000	19.00	0.00	0.636			
0.5	27.5	777.0	0.230	0.230	18.77	1.21	0.616			
1.0	54.9	720.0	0.570	0.800	18.20	4.21	0.567	0.1630	1.106	0.9
2.0	109.9	640.0	0.800	1.600	17.40	8.42	0.498	0.2288	0.776	1.3
4.0	219.8	550.0	0.900	2.500	16.50	13.16	0.421	0.2574	0.436	2.3
8.0	439.5	486.0	0.640	3.140	15.86	16.53	0.366	0.1831	0.155	6.4
16.0	879.0	409.0	0.770	3.910	15.09	20.58	0.299	0.2202	0.093	10.7
32.0	1758.1	347.0	0.620	4.530	14.47	23.84	0.246	0.1773	0.038	26.6
8.0	439.5	356.0	0.090	4.440	14.56	23.37	0.254			
2.0	109.9	374.0	0.180	4.260	14.74	22.42	0.269			
0.5	27.5	393.0	0.190	4.070	14.93	21.42	0.285			
0.0	0.0	415.0	0.220	3.850	15.15	20.26	0.304			

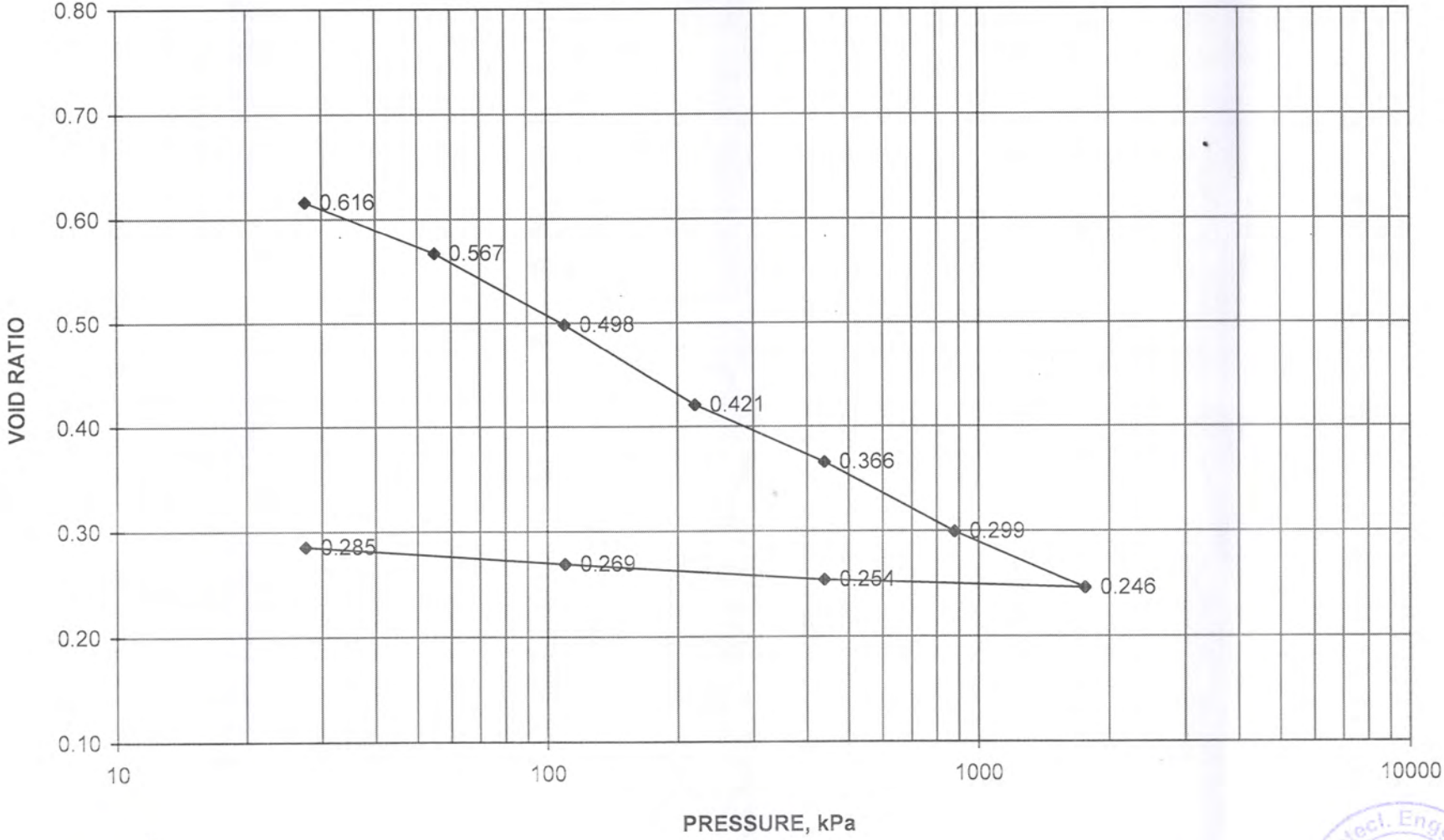
Prepared By:

Checked By:

16.3.10

UNIVERSITY OF ENGINEERING AND TECHNOLOGY, LAHORE

CONSOLIDATION TEST



Prepared By:

Checked By:

16.3.18

GEOTECHNICAL ENGINEERING LABORATORY
CIVIL ENGINEERING DEPARTMENT
UNIVERSITY OF ENGINEERING AND TECHNOLOGY, LAHORE

CONSOLIDATION TEST

Sample TP-1, UDS

Project: Mela Oil Field Shakardara Kohat, KPK

Initial						**Final**					
Ring dia =	50	mm	Gs=	2.66		Ring dia =	50	mm	Gs=	2.66	
Ring ht =	19	mm	e_o=	0.580		Soil ht =	15.44	mm	e_f =	0.284	
Volume =	37.306	cc	S_o=	47.39	%	Volume =	30.32	cc	S_f =	210.47	%
wt of ring=	71.35	gm	Hs=	12.02	mm	wt of ring=	71.35	gm	Hs=	12.02	mm
ring+soil =	140.64	gm				ring+soil =	146.10	gm			
m.c. =	10.34	%				f.m.c. =	22.48	%			
Bulk den =	18.2	kN/m^3				Bulk den =	24.2	kN/m^3			
Dry dens=	16.5	kN/m^3				Dry dens=	19.7	kN/m^3			

Load	Pressure	D Reading	Change	Acc Cha	Ht of sam	Strain	Void Ratio	C_c	m_v	$E = 1/m_v$
kg	kPa	*0.01mm	mm	mm	mm	%	*e*		m^2/MN	MPa
0.0	0.0	800.0	0.000	0.000	19.00	0.00	0.580			
0.5	27.5	775.0	0.250	0.250	18.75	1.32	0.559			
1.0	54.9	731.0	0.440	0.690	18.31	3.63	0.523	0.1216	0.854	1.2
2.0	109.9	671.0	0.600	1.290	17.71	6.79	0.473	0.1658	0.582	1.7
4.0	219.8	601.0	0.700	1.990	17.01	10.47	0.415	0.1934	0.340	2.9
8.0	439.5	526.0	0.750	2.740	16.26	14.42	0.352	0.2072	0.182	5.5
16.0	879.0	447.0	0.790	3.530	15.47	18.58	0.287	0.2183	0.096	10.4
32.0	1758.1	371.0	0.760	4.290	14.71	22.58	0.223	0.2100	0.046	21.7
8.0	439.5	381.0	0.100	4.190	14.81	22.05	0.232			
2.0	109.9	399.0	0.180	4.010	14.99	21.11	0.247			
0.5	27.5	422.0	0.230	3.780	15.22	19.89	0.266			
0.0	0.0	444.0	0.220	3.560	15.44	18.74	0.284			

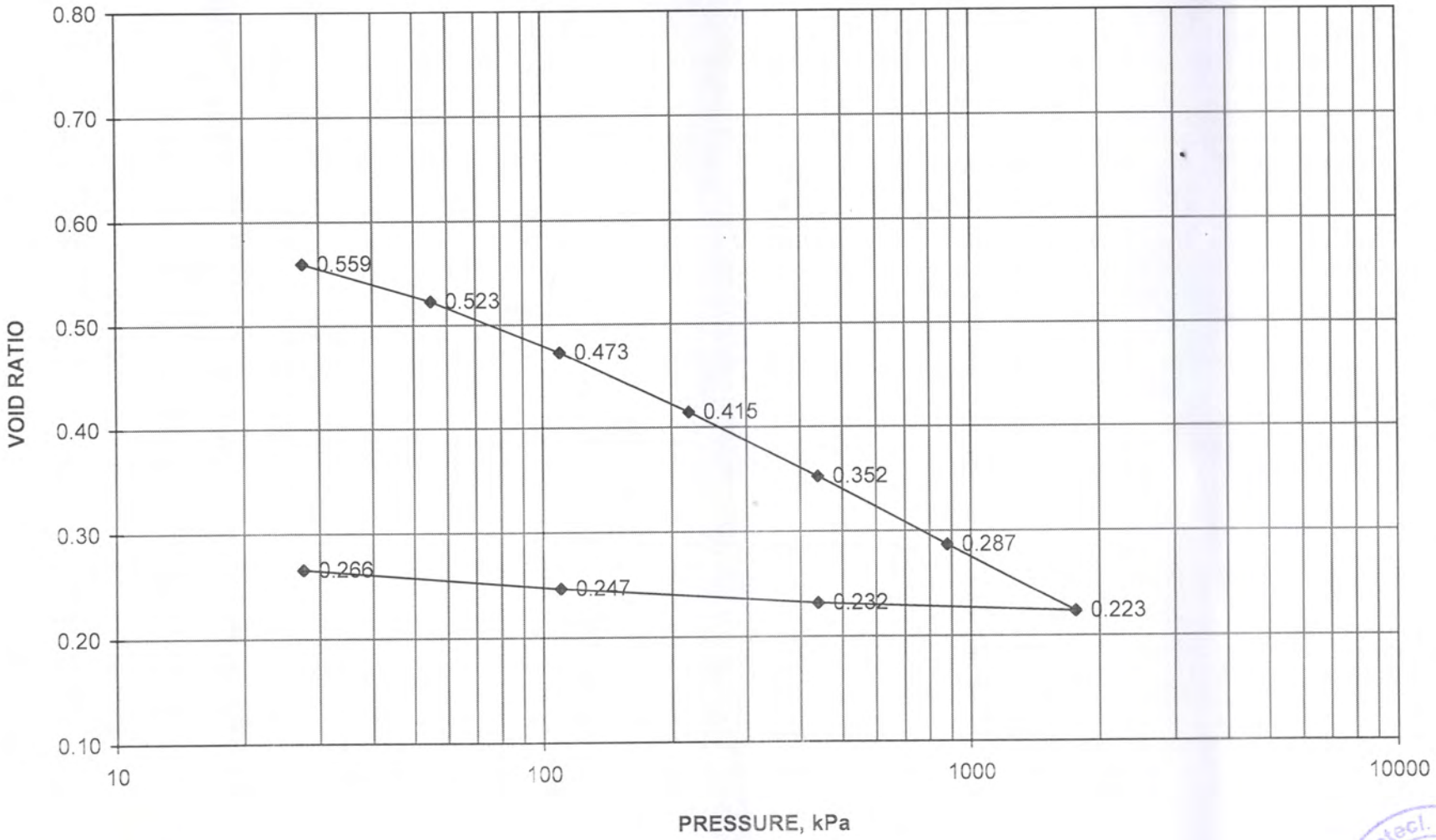
Prepared By:

Checked By:

16.3.10

UNIVERSITY OF ENGINEERING AND TECHNOLOGY, LAHORE

CONSOLIDATION TEST



Prepared By:

Checked By:

16.3.18

Laboratory Compaction Characteristics of Soil
(ASTM D-1557)

Client	Oil & Gas Development Company Limited	S. O. No.		Sample No	TP - 1
Project	Installation of Condensate Stabilization Unit		Date Sampled	9-Feb-18	
			Date Tested	15-Feb-18	
Location	Mela		Sampled By	Usman	
Sample Description			Tested By	Tanveer	

Type of Test	MODIFIED PROCTOR			Ht. of Mold (cm)	11.66	No. of Layers	5
Method	A	Vol. of Mold (cft)	0.075	Dia. Of Mold (cm)	10.11	No. of Blows per Layer	25

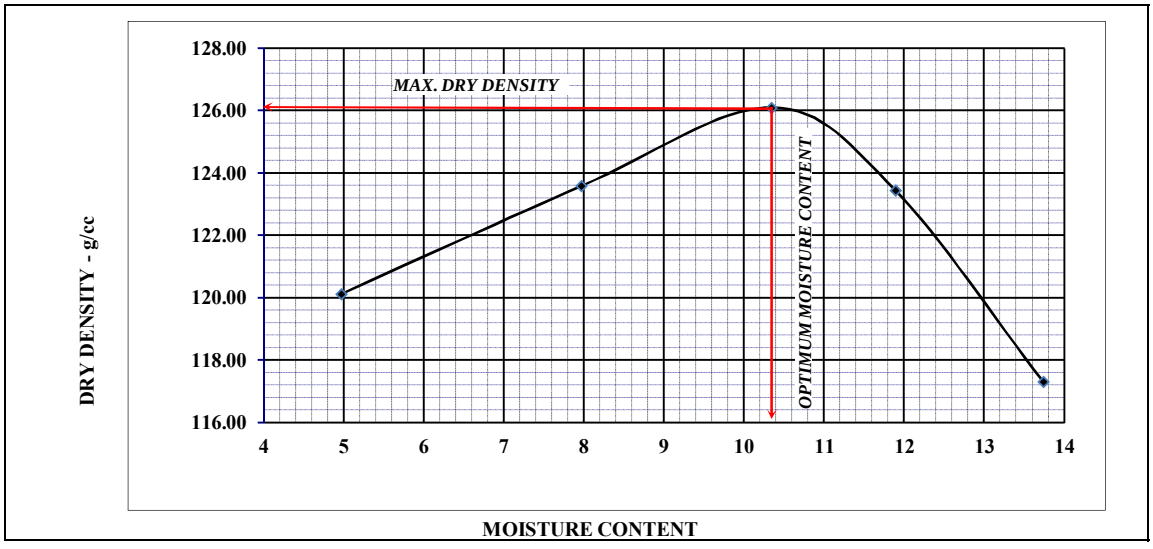
Wet & Dry Density Determination

Weight of Wet Soil + Mold (g)	8350	8600	8795	8760	8600
Weight of Wet Soil (g)	4300	4550	4745	4710	4550
Weight of Mold (g)	4050	4050	4050	4050	4050
Dividing Factor	34.1	34.1	34.1	34.1	34.1
Wet Density (lb/cft)	126.1	133.4	139.1	138.1	133.4
Dry Density (g/cc)	120.1	123.6	126.1	123.4	117.3

Water Content

Can No.	A	B	C	D	
Weight of Can + Wet Soil (g)	220.2	152.0	198.6	188.0	188.0
Weight of Can + Dry Soil (g)	211.2	143	182.8	171.0	168.8
Weight of Can (g)	30.0	30	30.0	28.0	29.0
Weght of Dry Soil (g)	181.2	113.0	152.8	143.0	139.8
Weight of Water (g)	9	9.0	15.8	17.0	19.2
Water Content (%)	4.97	7.96	10.34	11.89	13.73

Result:	Max. Dry Density (lbs/cft)	126.109	Optimum Moisture Content (%)	10.34



Laboratory Compaction Characteristics of Soil
(ASTM D-1557)

Client	Oil & Gas Development Company Limited	S. O. No.		Sample No	TP - 2
Project	Installation of Condensate Stabilization Unit		Date Sampled	9-Feb-18	
			Date Tested	15-Feb-18	
Location	Mela		Sampled By	Usman	
Sample Description			Tested By	Tanveer	

Type of Test	MODIFIED PROCTOR			Ht. of Mold (cm)	11.66	No. of Layers	5
Method	A	Vol. of Mold (cft)	0.075	Dia. Of Mold (cm)	10.11	No. of Blows per Layer	25

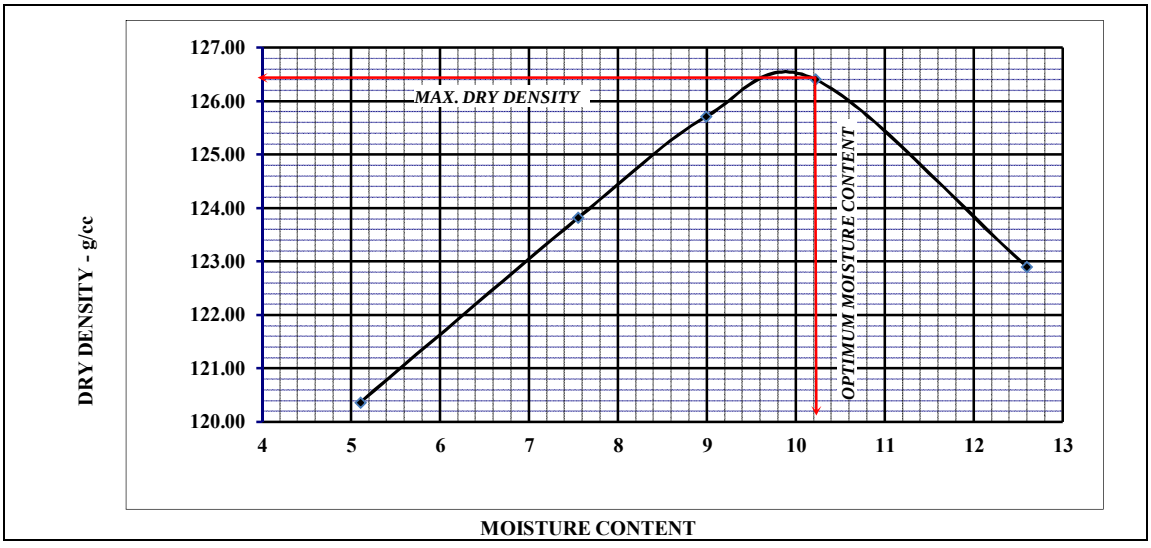
Wet & Dry Density Determination

Weight of Wet Soil + Mold (g)	8364	8591	8722	8801	8769
Weight of Wet Soil (g)	4314	4541	4672	4751	4719
Weight of Mold (g)	4050	4050	4050	4050	4050
Dividing Factor	34.1	34.1	34.1	34.1	34.1
Wet Density (lb/cft)	126.5	133.2	137.0	139.3	138.4
Dry Density (g/cc)	120.4	123.8	125.7	126.4	122.9

Water Content

Can No.	A	B	C	D	
Weight of Can + Wet Soil (g)	223.6	158.2	204.6	193.0	187.2
Weight of Can + Dry Soil (g)	214.2	149.2	190.2	177.7	169.5
Weight of Can (g)	30.0	30	30.0	28.0	29.0
Weght of Dry Soil (g)	184.2	119.2	160.2	149.7	140.5
Weight of Water (g)	9.4	9.0	14.4	15.3	17.7
Water Content (%)	5.10	7.55	8.99	10.22	12.60

Result:	Max. Dry Density (lbs/cft)	126.406	Optimum Moisture Content (%)	10.22



CALIFORNIA BEARING RATIO OF LABORATORY COMPACTED SOIL
(ASTM D-1883)

Client	Oil & Gas Development Company Ltd	Sample No.	TP - 1
Project	Installation of Condensate Stabilization Unit	Date Sampled	9-Feb-18
		Date Tested	15-Feb-18
Location	Mela	Sampled By	Usman
S. O. No.		Tested By	Tanveer

Compaction Data

Maximum Dry Density (g/cc)	126.109	Optimum Moisture Content (%)	10.34

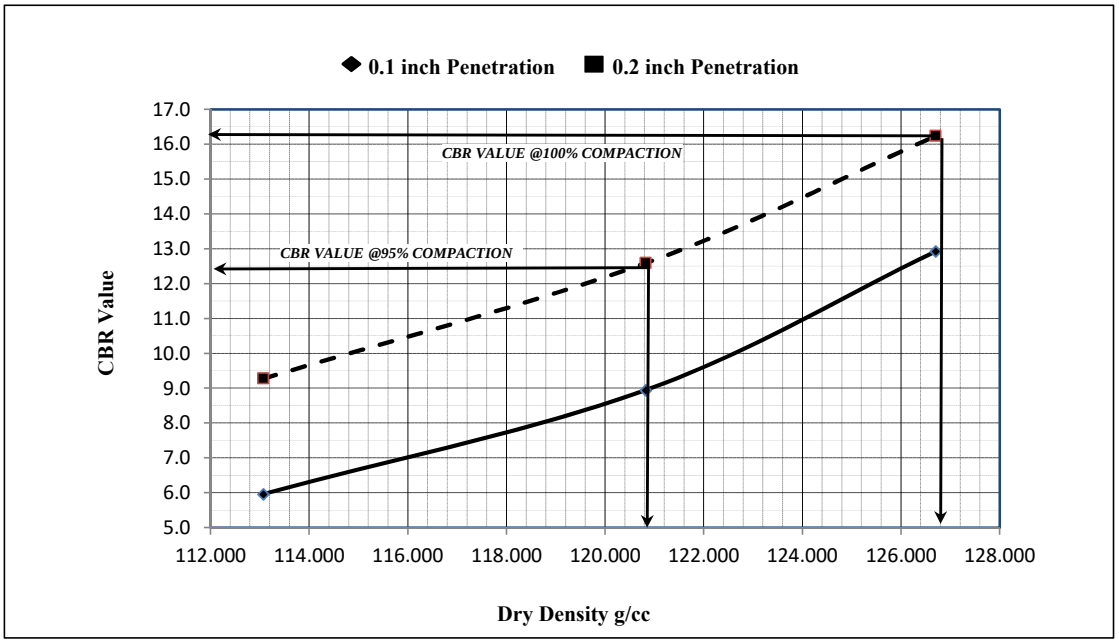
CBR Data

Test No.	1	2	3
No. of Blows per Layer	10	30	65
Corrected CBR Value at 0.1" Penetration	6.0	8.9	12.9
Corrected CBR Value at 0.2" Penetration	9.3	12.6	16.2
Dry Density (g/cc)	113.068	120.819	126.700
Moisture Content (%)	10.24	10.20	10.19

CBR Value

Dry Density at 95% Compaction	119.804
Dry Density at 100% Compaction	126.109

CBR Value at 95% Compaction	8.56
CBR Value at 100% Compaction	12.53



CALIFORNIA BEARING RATIO OF LABORATORY COMPACTED SOIL
(ASTM D-1883)

Client	Oil & Gas Development Company Ltd	Sample No.	TP-2
Project	Installation of Condensate Stabilization Unit	Date Sampled	9-Feb-18
		Date Tested	15-Feb-18
Location	Mela	Sampled By	Usman
S. O. No.		Tested By	Tanveer

Compaction Data

Maximum Dry Density (g/cc)	126.406	Optimum Moisture Content (%)	10.22

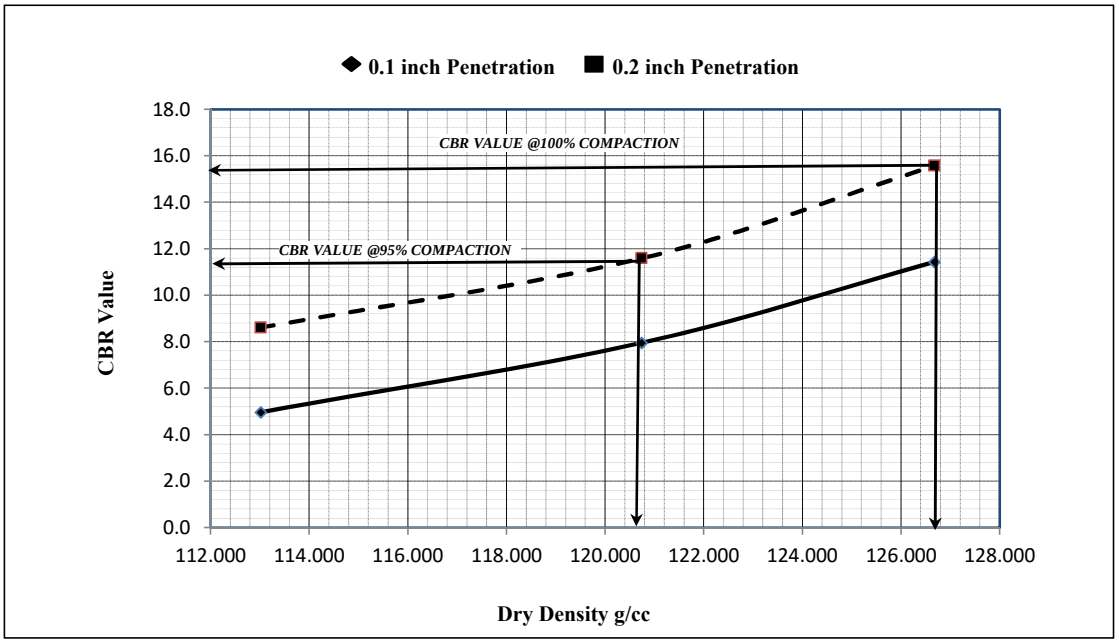
CBR Data

Test No.	1	2	3
No. of Blows per Layer	10	30	65
Corrected CBR Value at 0.1" Penetration	5.0	8.0	11.4
Corrected CBR Value at 0.2" Penetration	8.6	11.6	15.6
Dry Density (g/cc)	113.014	120.739	126.673
Moisture Content (%)	10.63	10.89	10.90

CBR Value

Dry Density at 95% Compaction	120.086
Dry Density at 100% Compaction	126.406

CBR Value at 95% Compaction	7.70
CBR Value at 100% Compaction	11.28



ENGINEERING GEOLOGY LABORATORY
INSTITUTE OF GEOLOGY, UNIVERSITY OF THE PUNJAB, LAHORE

UNIAXIAL COMPRESSIVE STRENGTH

ISRM1980

NO. OF SAMPLES	3	LAB REF.	2018-134
ROCK TYPE	Shale/ Mudstone	LOCATION	Boreholes
DATE	22/02/2018	CLIENT	Geo Arts (Pvt) Ltd. Lahore
PROJECT	Mela Oil Field	SAMPLE TYPE	Cores

SAMPLE No.	Borhole No.	Depth m	Diameter mm	Length mm	L/D Ratio	LOAD kN	UCS* MPa	FAILURE MODE
1	BH-2	5.0	45.15	76.62	1.7	5.5	3.37	Axial
2	BH-3	7.0	45.23	86.33	1.9	12.5	6.4	Irregular
3	BH-4	11.0	44.97	96.75	2.2	17.5	8.0	Axial
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

*Corrected to account for 50mm diameter and with L/D ratio equal or greater than 2.0

TESTED BY	Luqman Ahmed	CHECKED BY	DR. SOHAIL AKRAM Lab. Incharge

Client: Oil and Gas Development Company Limited

Project: Installation of Condensate Stabilization Unit

Location: Mela Oil Field

Report Ref: GT-12-2017

CHEMICAL ANALYSIS OF SOIL

Sample No	Depth	Sulphate (So_3)	Chloride (Cl_2)	pH
BH-1	1.0	0.071	0.0047	7.0
BH-2	2.0	0.012	0.0039	6.9
BH-3	3.0	0.015	0.0031	6.8
BH-4	3.0	0.063	0.0052	7.0