VOLUME: II-G/1

SECTION-II

SPECIFIC DESIGN REQUIREMENTS [CIVIL]

1.00.00 INTRODUCTION

This section outlines the followings:

a) A brief description of Soil Characteristics.

b) Design considerations for Reinforced Concrete Structures.

c) Design considerations for Foundations.

d) Roads.

2.00.00 GEO-TECHNICAL SYSTEM

Detail soil investigation, as required, to be carried out for foundation design of various facilities.

Soil characteristics and parameters to be adopted in final design, the contractor is required to do detail geotechnical investigation work as part of the contract to verify/generate data so required. The contractor shall conduct all the Field and Laboratory tests as mentioned in Vol-II-G2A – Section: II

It should be noted that nothing extra (both time & cost) whatsoever on account of variation between soil data annexed in this specification and that found by detailed geotechnical investigation to be carried out by contractor shall be payable.

The contractor shall use Geotechnical recommendations available in the tender document for various locations, depths and widths for reference for estimation purpose. Moreover, contractor is at liberty to carryout suitable number of borehole tests at site to assess the Net Safe Bearing Capacity values / Pile capacity for design of foundation prior to quote. After contract award, the contractor shall conduct detailed Geo-technical investigation. After completion of detailed Geo-technical investigation, the draft Geo-technical investigation report shall be submitted to owner/consultant for review/Approval. During the review/Approval, The recommendations furnished by contractor will be compared to the recommendations available in the tender document for various locations and depths. During the review, owner/consultant will offer their suggestions/remarks on the contractor`s draft Geotechnical investigation report, If any. The design, type, size, depth of the foundation / pile, Net safe bearing capacity / Pile capacity values shall be based on the approved soil investigation report of the Contractor/Owner's soil recommendations(Available in the Tender document) whichever is conservative.

The design of foundation open/ pile shall be carried out by Limit State or working stress method as per the provisions of IS-456 / IS-2911 & other applicable IS codes.

.

Contour plan details & approximate grade levels will be supplied with contract drawing along with plant +- 0.0m & UTM co-ordinate.

Technical specification for Geotechnical Investigation presented in Vol-II-G2A – Section: II to be referred.

3.00.00 LOADS

All structures and portions thereof shall conform to the latest revision of relevant Indian Standard specifications and also to the various other technical requirements.

Before proceeding with the submission of civil & structural design of structures for approval, the contractor shall get the approval for the loads not pertaining to Civil & Structural (such as technological structures, mechanical equipment & supports, electrical equipment& supports, C&I equipment& supports, other miscellaneous equipment& Supports, etc.) from respective mechanical / electrical and C&I divisions. Civil & structural design & subsequent Civil/Structural drawings shall be reviewed by the Client/Consultant only after the approval of loads/load data as mentioned above.

Any structure, which carries Indian Railway Loading or is situated in vicinity of Railway lines, the design has to conform to the Indian Railway Standard Specifications and approval must be obtained from Railway Authority including the clearance etc.

All structures shall be designed to sustain within the stress limitation as specified in the Code, all dead loads plus assigned live, equipment, wind, seismic or other design loads.

a) Dead Loads

Dead load shall include the weight of all structural components and architectural appurtenances incorporated in the structures plus hung loads and any other permanent, externally applied load. This should also include equipment dead load. The content of tanks, Ash storage bins shall be measured at full capacity for this purpose. The piping loads, Cable tray loads, Hung loads and the contents of tanks, silos, hoppers and bins shall be listed separately so that they can be excluded from dead load when dead loads are acting as stabilizing loads for uplift..

The following unit weight of material shall be considered for computation of loads. Loads given in IS:875 (part-I) shall be made use of for material not listed below.

Materials		Unit weight
Plain cement concrete	:	24.0 kN/cum
Reinforced cement concrete	:	25.0 kN /cum
Structural steel	:	78.5 kN /cum
Brick work	:	19.0 kN /cum
Cement plaster	:	21.0 kN /cum
Floor Finish	:	24.0 kN /cum
Coal	:	12.0 kN /cum
Fly Ash	:	16.0 kN /cum
Bottom Ash	:	16.0 kN /cum

For R.C.C roof wherever Solar panels are placed: DL of Solar panel shall be considered as per Manufacturer recommendation. In addition to other DL specified above

b) Live Loads

Live loads in different areas shall include dust loads, minor equipment loads, cable trays, small pipe racks/hangers, operation/maintenance loads etc. The loads considered shall not be less than those specified in IS: 875 (Part II).

The loads listed hereunder are minimum loads for the areas involved. If actual expected load is more than the specified minimum load, then actual load is to be considered. Special use areas shall be investigated and loading revised upward as necessary.

Hung loads shall be based on minimum loading equivalents of 1.0 kN/sq.m for piping and 0.5 kN/sq.m for electrical, ventilation and air conditioning. Loadings resulting from concentrations of facilities in specific areas shall be substituted where listed base loading is excluded.

Sl No	Building/Structure	Live Load
i)	**All Buildings**	
	a). Roofs	
	Inaccessible roof (Flat)	1.5 kN/sq.m+ hung loads, if any + 0.5 kN/sq.m(dust load).
	Accessible roof where equipment are placed	5 kN/sq.m+ hung loads, if any+ 0.5 kN/sq.m(dust load).
	Accessible roof Accessible roof Without equipment , and roofs with solar panel without any equipment	1.5 kN/sq.m+ hung loads, if any + 0.5 kN/sq.m(dust load).

Sl No	Building/Structure	Live Load
	Inclined roof	Asper IS: 875 (Part 2)
	b) Stairs, Balconies& Platforms	5.0 kN/sq.m
	c) Corridors	5.0 kN/sq.m
	d)Removable gratings, chequered plates, walkways etc	5.0 kN/sq.m
	e) Office, Laboratory, Conference rooms :and other non-plant areas etc.	5.0 kN/sq.m
Note: Dust load values mentioned above shall be considered along with dead load while calculating lump mass for seismic load combinations		
ii)	**Bunker Building**	
	a) Ground Floor	25.0 kN/sq.m
	b) Bunker Feeding Floor	15 kN/sq.m+ hung loads + 0.5 kN/sq.m(dust load).
iii)	**Power House Building**	
	a) Ground Floor Unloading Bay	50 kN/sq.m
	Other areas	25 kN/sq.m
	b) Mezzanine Floor	15 kN/sq.m plus hung loads
	c) Operating Floor Equipment Lay-down Area	35 kN/sq.m plus hung loads or actual load furnished by equipment supplier whichever is higher
	Rotor Removal Area	50 kN/sq.m plus hung loads or actual load furnished by equipment supplier whichever is higher. Rotor removal area beams shall also be checked for half the rotor load at the center of the beam

Sl No	Building/Structure	Live Load
	Other Areas in Turbine Hall	25 kN/sq.m plus hung loads
	All other Areas in Operating Floor except Turbine Hall	15kN/sq.m plus hung loads
	d)Cable Spreader Floor	7.5 kN/sq.m plus hung loads
	e) All other floors	10 kN/sq.m plus hung loads
	f) Due to anchoring of conductors on any "A" row column	2 x 20 = 40 kN (Twin ACSR Moose Conductor) and 10 kN (Shielding Wires) or Actual load furnished by equipment supplier.
iv)	**Auxiliary Buildings**	
	a) Ground Floor	10 kN/sq.m
	b) Cable Spreader Floor	7.5 kN/sq.m
	c) Pump House Operating Floor	15kN/sq.m/ As supplied by Pump manufacturer, whichever is higher
	d) Office Floor	5 kN/sq.m
	e) Switchgear room	15 kN/sq.m
	f) All other Floors	10 kN/sq.m
v)	**Non-Plant Buildings**	
	a) Floors with equipment	10 kN/sq.m
	b) All other floors	5 kN/sq.m
vi)	**CoalHandling structures**	
	a) Flat accessible roofs	1.5 kN/sq.m+ 1 kN/sq.m dust load.
Sl No	**Building/Structure**	**Live Load**

	b) Flat inaccessible roofs	0.75 kN/sq.m+ 1 kN/sq.m dust load
	c) Inclined roof	In accordance with IS 875 For live load + 0.25kN/sq.m For dust load.
	d) All TPS and Crusher house floors	7.5 kN/sq.m
	e) Switch gear and MCC floor	15 kN/sq.m
	f) Walkways of Gallery	3 kN/sq.m or a concentrated load of 2 kN at center + dust load of 1 kN/sq.m

Note: Dust load values mentioned above shall be considered along with dead load while calculating lump mass for seismic load combinations.

vii) Underground Structures/Trenches/pits

Minimum surcharge shall be 20 kN/sq.m. For structures in vicinity of roads and heavy vehicular movement surcharge shall be considered as applicable as per loading specified elsewhere in this specification. Trenches/pits inside building shall be designed for a surcharge equal to Live Load intensity of Ground Floor or 15 kN/sq.m whichever is greater. In Boiler area, Power House area and other outdoor areas in BTG area, the minimum surcharge shall be 20 kN/sq.m.

viii) Covers for Trenches / Channels

At road crossings and entrance of the buildings wherever vehicle/crane movement expected, the covers shall be designed for vehicular movements as per IRC standards.

Trench cover at entry to building and road crossings shall be designed for live load of 100 kN at centre. Trench cover at other location shall be designed with a surcharge of 15 kN/m^2 or a concentrated load of 500kg at centre which is worst.

ix) **Roads**

Design of roads shall be in accordance with Indian Road Congress standard.

x) **Road Culverts and its allied structures including Road Crossing of Trenches.**

At all road crossings RCC box culverts along with manholes on both sides shall be used. Such road culverts and its allied structures & Road Crossing of Trenches shall be designed for Class `AA' loading (wheeled and tracked both) and to be checked for Class `A' loading as per IRC standards.

xi) **Railway Supporting Structures, Rail Culverts**

Railway supporting structures and rail culverts shall be designed as per Railway Bridge Rules.

Reduction in Live load as per provision of IS:875 shall not be permitted.

The areas covered with equipment shall be designed on the basis of weight of equipment (flooded/operating) in addition to an uniform live load of 5.0 kN/sq.mor specifically defined live load whichever is greater.

Foundations and fixing arrangements for items of equipment, which generates vibration, if any shall be designed to prevent transfer of such vibrations to the adjoining structures. For loads caused by moving equipment over the floor for installation, consideration shall be given to the shoring of beams and floor, from floors below.

For loads caused by moving equipment over the floor for installation, consideration shall be given to the shoring of beams and floor, from floors below.

c) Equipment Loads

i) Loadings (both static and dynamic) of major and minor equipment, including boiler, Turbine-Generator, BFP,PA, FD, ID, seal air fans, Coal Mill, Feed water heater, De-aerator etc. obtained from the manufacturer's certified drawings of the specified equipment to be furnished.

ii) All equipment, tank and piping design loadings shall include Hydraulic Testing loads.

iii) Air and gas duct loadings shall include weight of insulation, duct attachments, dust accumulation loads, seismic, wind and other loads as applicable.

iv) Crane girders and supporting columns shall be designed for vertical and horizontal forces (including impact forces) as developed from the crane weights and wheel loads.

Unless otherwise specified, the vertical and horizontal loadings shall conform to the applicable sections of the IS specifications.

v) Weight of equipment, ducts, tanks, pipes, conduits etc. supported by structure shall include maximum possible loading conditions i.e. flooded material contents and associated impacts, test loadings, anchorage and constraint effects.

vi) All structural components shall be designed to accommodate anticipated concentrated loads which shall or may be applied during the life of the plant.

Where both concentrated and uniform loads cannot act simultaneously, the structure or component shall be analyzed for both conditions of loading and shall be designed for most critical condition.

vii) Jet forces resulting from guillotine type pipe ruptures shall be considered in the design, if it is of high magnitude. Jet force to be considered shall be equal to the product of the pipe cross section and the internal design pressure applied on an area equal to the pipe cross section.

vii) Lay down areas in the Turbine Hall shall be investigated for concentrated loads resulting from equipment components to be stored during erection and maintenance operation. Where live load allowance is inadequate to permit storing of such equipment components, the design live load shall be increased to permit such use or the area shall be restricted by identifying lay down areas for specific components, each area to be identified by permanent marking.

d) Wind Loading

Wind loading shall be in accordance with Indian Standard Code IS:875 (Part 3) (Latest Revision) for a basic wind speed of 44 m/sec. upto a height of 10 metres above mean ground level. Terrain Category-2 shall be considered for all structures.

Risk coefficient (k1) shall be considered as 1.07 for all structures. Thek2, k3, k4 factors shall be considered as per IS: 875(part 3 latest revision).

e) Seismic Loading

The lateral forces shall be established in accordance with the recommendations of IS:1893 (Latest Version only). The site falls in Zone-III as identified in the map in IS:1893 and hence seismic forces would be considered accordingly for the structures and buildings. Importance factor shall be taken as 1.75.

Seismic Load shall be considered in all three directions for analysis and design of all the buildings & Structures even if it is not warranted as per

IS-1893.

For all the buildings & structures, Response Spectrum Method shall be used for the calculation of seismic forces. Material damping factor and number of modes to be considered for the analysis shall be as per recommendation in the code referred above. The number of modes to be considered in the analysis shall be such that at least 95% of the modal mass is excited.

f) Temperature Loads

The structures shall be designed to withstand stresses due to fifty (50) percent of the total temperature variation. The total temperature variation for temperature loading should be taken as two thirds (2/3) of the average annual variation in temperature. The average maximum annual variation for this purpose shall be taken as the difference between the mean daily minimum temperature during the coldest month of the year and mean daily maximum temperature during the hottest month of the year.

Mean Daily minimum ambient temperature during coldest month of the year = 7.6°C

Mean Daily maximum ambient temperature during hottest month of the year = 47.5°C

Expansion and contraction due to changes of temperature of materials of a structure shall be considered and adequate provision shall be made for the effects produced as per provision in the relevant IS codes.

g) Steam Piping Load

Minimum intensity of steam piping load shall be 6.0 kN/sq.mfor the areas at different levels through which steam piping is routed. However, the loading shall be checked as per static/dynamic analysis for steam piping or load data supplied by piping vendor and the worst loading shall be considered in design. Horizontal anchor loads, if any, shall also have to be considered in design.

h) Earth Pressure Load

Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable).

However, for the design of sub-structure of pump house and underground liquid storage tanks earth pressure at rest shall be considered with coefficient of earth pressure at rest shall not be less than 0.50.

In addition to earth pressure and ground water pressure, etc., surcharge load shall also be considered for the design of all underground structures including channels, sumps, cable & pipe trenches, etc., to take into account the vehicular traffic in the vicinity of the structure. Intensity of Surcharge Load for all underground structures and foundations shall be considered as 2.0t/sq.m in general unless mentioned otherwise.

i) Crane, Monorail & Elevator Loads

Crane girders and supporting columns shall be designed for vertical and horizontal forces (including impact forces) as per crane vendor's data. All lifting beams and monorails shall have their design loads increased for impact factor as mentioned hereinafter. For frame analysis, the lateral crane surge shall be applied on one side of the frame at a time and in either direction.

Impact Factor

Loads for cranes, hoists and elevators shall be taken as per IS:875/IS:807 (Latest Revision). The minimum impact factor to be used in design shall be as follows:

Crane loads

a) For vertical force, an impact factor of 25% of the maximum crane wheel load for crane girder 10% for column and foundation.

b) A lateral crane surge of 10% of the weight of the trolley plus lifted load applied at the top of each rail.

c) A horizontal surge of 5% of the maximum static wheel loads of the crane applied at the top of the rail in longitudinal direction.

Monorail loads

a) Impact factor of 10% of lifted load of hoist for monorail and support design.

b) Impact factor of 25% of the lifted load for electrical pulley and support design

Elevator

A 100% of the lifted load including elevator live load plus the cab weight for the elevator support beams.

j) Construction Loads

The integrity of the structures shall be maintained without use of temporary framing struts or ties and bracing as far as possible. However, construction or crane access considerations may dictate the use of temporary structural systems. Special studies shall be made and documented to ensure stability and integrity of the structures during any periods involving use of temporary bracing systems.

k) Other Loads

Stresses imparted to structures due to differential settlements, variation of water table, erection and maintenance load, creep and shrinkage shall also be considered in design of all structures.

All Power House Columns adjacent to first row of Boiler columns shall be designed for an additional load of 500 kN to account for piping/cable rack loads. However, after finalization of all the Pipe/Cable racks adjacent to first row of Boiler columns, the Main power house shall be analyzed and designed again for the actual loads. If warranted, any design changes shall be incorporated by the contractor during the course of the engineering without any cost implication to the Owner.

All Power House Columns along the transformer yard, shall be designed for an additional load of 50KN/m for horizontal pipe / cable rack in addition to conductor pull load from substation.However, after finalization of all the Pipe/Cable racks the transformer yard, the Main power house shall be analyzed and designed again for the actual loads. If warranted, any design changes shall be incorporated by the contractor during the course of the engineering without any cost implication to the Owner.

All structures situated in the vicinity of railway lines shall be designed conforming to the Indian Railway Standard Specification.

l) Thrust Load

Thrust blocks shall be designed against the thrust load from pipe lines considering the test pressure in the pipe lines and as per the relevant IS Code with adequate factor of safety.

3.01.00 **Stability of Structures**

Design shall be checked against buoyancy due to the ground water (Ground water table shall be considered at Plant Finished Grade Level) during construction and maintenance stages for structures like underground tanks, pits trenches, basements, etc. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loading and surcharge. For purpose of calculating downward load due to any overburden, only the mass located vertically above the

projected area shall be taken into consideration.
All building sub-structures including pump houses shall be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads. Factor of safety for these cases shall be taken as mentioned in IS:456 and other relevant IS codes. However, following minimum factor of safety shall be followed.

a) Factor of safety against overturning due to wind, seismic or other lateral load shall be 1.5 minimum.

b) Factor of safety against sliding shall be 1.5 minimum.

c) Factor of safety against uplift due to hydrostatic forces shall be 1.2 and due to any other loads shall be 1.5.

Stability of the structure shall also be investigated for loading conditions during construction, repair or other temporary measures. Lower factor of safety may be used for such loading conditions as per relevant IS codes.

In case where dead load provides the restoring force, only 0.90 times characteristic dead load shall be considered. Imposed loads shall not be considered as restoring force.

Ground water table shall be considered at Plant Finished Grade Level for design of foundations and all underground structures.

3.02.00 **Load Combinations**

Buildings and structures shall be designed to resist the load stated in the previous section acting in the following combinations.

While designing consideration shall be given to the following load combinations:

i) DL + LL

ii) DL + LL + PL + Equip ± TL

iii) DL + LL + PL + Equip + Cb + CtLA ± CS ± TL

iv) DL + LL + PL + Equip + Cb + CtLB ± CS ± TL

v) 0.9DL ± EL (for DL only) ± TL

vi) 0.9DL ± WL1 ± TL

vii) 0.9DL ± WL2 ± TL

viii) DL + *LL + PL + Equip + Cb + Ct ± EL ± TL

(* Appropriate portion of LL which is considered for working out EL shall only be taken)

ix) DL + LL + PL + Equip + Cb + CtL1 $\pm$ (CS1+WL1) $\pm$ TL

x) DL + LL + PL + Equip + Cb + CtL1 $\pm$ (CS1+WL2) $\pm$ TL

Where the above loads are:

DL = Dead load of structures, floors, walls etc.

LL = General live load on floors

PL = Pipe Load

Equip = Equipment loads

Cb = CraneBridge

Ct = Crane trolley positioned at middle of bridge

CtLA = Crane trolley + Load near one row

CtLB = Crane trolley + Load near other row

CtL1 = Crane trolley + Half load lifted at centre of bridge

CS = Crane surge for full load

CS1 = Crane surge for half load lifted

WL1 = Wind load with internal suction

WL2 = Wind load with internal pressure

EL = Earthquake load

TL = Temperature load

Appropriate impact factor shall be considered as per IS:875 (Part 2) (Latest Revision) while calculating crane loads.

In calculating wind loads, appropriate internal thrust / suction shall be considered along with external pressures as per IS:875 (Part 3) (Latest Revision). All possible load conditions considering external and internal pressures shall be considered in analysis and design for the combinations as stated above to assess worst effect on whole structure as well as its components.

Seismic Load shall be considered in all three directions for analysis and design of all buildings &Structures even if it is not warranted as per IS-1893.

The above mentioned load combinations are for general guidance. However, applicable load factors & load combinations (for both serviceability & strength) shall be as per IS:875 (Part 5),IS-456, IS-13920 & IS-1893 all parts (Latest Revisions).

Appropriate allowable increase in permissible stresses as per IS codes, may be taken only under normal loads along with wind and seismic conditions. However, members which are designed primarily to resist wind, no increase in permissible stresses shall be permitted.

Load Combinations for Underground Structures

Following loading conditions shall be considered in addition to the loading from super structure for the design of sub-structure of pump house, channels, sumps, tanks, reservoirs, trenches and other under-ground structures.

Only liquid pressure from inside and no earth pressure and ground water pressure, and surcharge pressure from outside (applicable only to the structures which are liable to be filled with water or any other liquid).

Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

Base slab & intermediate piers of the pump house shall be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water table. Intermediate dividing piers of pump sumps and partition walls in channel shall be designed considering water on one side only and the other side being empty for maintenance.

Design shall also be checked against buoyancy due to ground water (Ground water table shall be considered at Plant Finished Grade Level) during construction and operation stage. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loading and surcharge. For purpose of calculating downward load due to any overburden, only the mass located vertically above the projected area shall be taken into consideration.

3.03.00 Design Concepts

Wind and seismic forces shall not be considered to act simultaneously.

For the design of main plant structures during seismic condition, the tank shall be considered full up to operating level. For other load combinations, tank in flooded condition shall be considered.

`Lifted Load’ of crane shall not be considered during seismic condition.

For analysis &design of all underground structures/foundations, ground water table shall be considered at the Finished Ground Level.

If R.C.C. floors and roofs except those cast over metal decking are assumed to act as diaphragm transmitting lateral loads to braced bays then main beams/girders shall be provided with shear connectors. However, whenever large/more number of cutouts is provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab. Shear connectors shall also be provided over beams having R.C.C. slab on one side and opening /chequered plate / grating on other side.

For R.C.C. roofs cast over metal decking, horizontal bracings must be provided below slab to transfer horizontal force to columns.

Roof decking sheets shall be designed as per IS:801 to carry the self-load, dead load due to RCC slab and finishes and imposed load. The deflection of metal deck shall be limited as per BS:5950. Suitable shear studs shall be provided as per BS:5950 on the top of roof beam.

In Turbine Bay, horizontal wind girders between A-row and B-row columns must be provided below Mezzanine and Operating floor at gable ends to transmit wind load from gable columns.

PTFE (Poly tetra Fluoroethylene) bearing shall be provided where horizontal loads not to be transferred.

For calculation of seismic load, equipment load shall be considered as Dead Load.

Ultrasonic pulse velocity tests shall be carried out for the top decks of all machine foundations viz. FD Fan, Mill foundations, TG deck along with substructure, Boiler Feed Pump foundations, etc., to ascertain the homogeneity & integrity of concrete.

Whenever any structure under this contract shall carry or receive additional load from the work of any other contract, the structures under this contract shall be provided with sufficient margin to carry the above load, details of which shall be finalized during detail engineering.

Gratings / chequered plates shall not be considered as restraining members for compression flange of beams/girders. Diaphragm action shall also be not considered in design. Adequate horizontal bracings to be provided.

4.00.00 DESIGN OF REINFORCED CONCRETE STRUCTURES

a) Reinforced Concrete Structures shall be designed in accordance with the requirements of IS-456 (Latest Revision), IS-13920, IS-1893 (Latest revision)& IS-875 (Latest Revision) or as specified in this specification for all possible combination of loads, e.g. dead load, live load, crane loads, wind or seismic loads, soil loads and surcharge loads etc. Ductile Detailing as per IS-13920 and IS:4326 shall be adopted. Curtailment in reinforcement shall not be allowed for RCC slabs.

The following grades of concrete as per IS-456 shall generally be used.

Sl. No.	Class	Grade of conc.	Min. cement content Kg/cum	Max. free water cement ratio
1.	i) Plain cement concrete used for screeds and fill between two foundations one above other at different levels	M15	240	0.6
	ii) Lean concrete below all foundations, plinth beams, drains, pits, etc.	M10	-	-
2.	i) Plinth protection.	M20	300	0.55
	ii) Grade slab, RCC drains and trenches, Paving, RCC Manholes and Chambers	M30	330	0.55
	iii) Precast cover slab	M25	-330	-45
3.	i) Reinforced concrete for super structure and foundation	M30	330	0.45
	ii) Reinforced concrete for water retaining structure	M30	330	0.45
	iii) RCC roads (Main road & approach road)	M30	330	0.5
4.	Pre-cast concrete	M30	300	0.5
5.	Reinforced concrete for deck & substructure of all heavy & vibrating equipment such as TG foundation, TG Top Deck, Crusher, ID, FD fan, STG, BFP, Mill & Fan Foundations, Cooling tower basin	M35	340	0.45
6.	TG Top Deck	M35	340	0.45
7.	Piles	M30	400	0.5
8.	For Chimney refer the respective section.			

b) Reinforcing bars shall be TMT CRS (corrosion resistant steel) bars of minimum grade Fe 500 conforming to IS-1786 (Latest Revision) and Mild Steel bars conforming to IS: 432 (Grade I)(Latest Revision) of vendor approved by Owner/consultant. Fe 500D / Fe 550 or higher grade reinforcement bars may be used for construction but for design of primary reinforcement, the grade shall be restricted to Fe 500 only& for design of secondary reinforcement (stirrups & ties), the grade shall be restricted to Fe 415 only. Test certificate for reinforcement steel shall be obtained from recognized agency, before using by the contractor. If the steel is purchased by the contractor, Engineer may desire to check the testing of the same & the contractor shall arrange it in approved laboratory at his own cost.

c) Ordinary Portland cement namely Grade 43 conforming to IS: 8112 (Latest Revision) shall be used for construction of all RCC structures and foundations. Higher grade 53 may be used in the work but the design restricted to Grade43 only.

d) The design of R.C.C- Structures shall be carried out by limit state or working stress method as per the provisions of IS-456 (Latest Revision).Working stress method using IS-456 shall be followed wherever mentioned in the specification. Otherwise limit state method shall be followed for all other structures.

e) All Concrete tanks/liquid retaining structures/liquid conveying structures shall be designed in accordance with the recommendation of IS-3370 (Latest Revision) as un-cracked section.

f) Grouting material:

Grouting shall be done with Conbextra GP-2 or equivalent for Equipment foundations and Conbextra GP-1 or equivalent for all structural column bases. For pipe-supports grouting shall be done with 1:1:2 cement-sand - 6mm down stone chips. Grouting thickness shall be as per manufacturer's recommendation subject to a minimum of 25mm for equipment foundations Grouting thickness shall be 50mm minimum for all structural columns.

g) For reinforcement detailing IS:5525(Latest Revision), IS: 13920 (latest revision) and SP:34 shall be followed.

h) The walls shall be provided with reinforcement on both faces for sections 150 mm or more, even if not required from design consideration.

i) Liquid Retaining Structures

All RCC liquid retaining/conveying structures shall be leak proof and designed as un-cracked section in accordance with IS:3370 (Latest Revision).

All water retaining / storage structures shall be designed assuming liquid up to the height of wall irrespective of provision of any over flow arrangement.

All underground structures and water retaining structure etc. shall be provided with integral water proofing admixture and non-shrink polymeric water proof grouting compound by injection from inside/outside along with application of two coats of acrylic polymer modified cementitious compound for water proofing coating as per approved manufacturer's specifications on outside surface.

Internal surface of all water retaining structures shall have 20 mm thick plaster (1:3) admixture with approved quality water proofing compound. 10 mm thick plaster (1:3) to be provided below roof slab of water retaining structure.

Foundations below ground level coming on direct contact with soil shall be treated with two (2) coats of hot bitumen (85/25) over a coat of primer except for foundations requiring water proofing / hydro-insulation for ingress of sub-soil water.

Storm water drains shall not be provided with bituminous paint and weep holes also shall not be provided in storm water drains.

5.00.00 FOUNDATION DESIGN

The design of foundation open / pile shall be carried out by Limit State or working stress method as per the provisions of IS-456(latest revision).

The foundation shall be placed on firm and incompressible virgin strata with adequate bearing capacity. For open foundation depth of footing shall be not less than 1.0m below virgin soil. However, Open foundations in filled-up soil may also be considered for the foundations of very small structures having net SBC requirement of 5 T/sq.m and below at the discretion of Owner / consultant with the minimum depth of foundation as 1.5M from FGL& with a permissible total settlement of 25mm.The contractor shall carry out confirmatory SBC report and submit for approval before submitting design and drawings in filled up soil. However maximum SBC allowed in filled up soil is 5T/m2 only.

For analysis & design of all foundations, ground water table shall be considered at the Finished Ground Level.

Foundation shall be checked for safety against overturning, sliding and uplift considering ground water table at the Finished Ground Level. Loss of contact for foundations is not permitted.

Crushers for both Coal and Limestone shall be on VIS

RCC deck of any vibrating equipment may be supported on vibration isolation system consisting of steel helical spring units and viscous dampers which in turn will be supported on RCC foundation system.

ID, PA & FD fans are to be provided as per manufacturer's proven practice.

The concrete foundation for supporting the turbine generator will be completely isolated from the building floors for vibration control. The foundation for Turbo-generator shall rest on suitable vibration isolation system consisting of springs and visco dampers (supplied by owner approved vendor).

The foundation for Boiler Feed Pumps / motors shall rest either on suitable vibration isolation system consisting of springs or on solid concrete foundation if the pumps / motors are placed on ground floor. In case, the Boiler Feed Pumps / motors are erected on elevated floor (above ground floor), foundations shall rest only on suitable vibration isolation system consisting of springs.

For booster fans, the supports shall be on VIS.

Pile foundation, if adopted, shall be designed in accordance with IS:2911(Part-I / Sec-I, II and III) (Latest Revision).

The type, size, depth of the foundation / pile shall be based on the approved soil investigation report of Contractor/Owner's soil investigation report whichever is conservative

5.01.00 **Foundations**

Top of RCC columns/ pedestals for the steel columns (Boiler, PowerHouse Columns, Bunker columns, ESP columns, etc.) shall generally be kept at a lower level so that the column base plates together with gussets and stiffeners remain below the finished floor level. Foundation levels of some columns shall have to be suitably lowered to accommodate underground services, pits, trenches, etc.

Common foundation should be provided for columns both side of the expansion joint and shall be designed for loading on both columns.

Foundations for Buildings and structures shall be designed to resist forces and moments, caused by vertical loads and by wind or seismic loads, based on static and dynamic analysis done for those structures. The foundation sections shall be sized and reinforced adequately for moments and shear stresses.

5.02.00 **Heavy and rotating Equipment Foundations**

Loadings (both static and dynamic) of major equipment such as Turbine Generator, Boiler feed pump, Mill, FD & ID fans, Crusher, etc. shall be obtained from the manufacturer's certified drawings of the specified equipment. RCC decks of FD, ID , PA fan, Turbine Generator, Boiler Feed Pump / motors &Crushers, shall be supported on vibration isolation system consisting of steel helical spring units and viscous dampers shall be completely isolated from the building floors which in turn will be supported on RCC foundation system. The foundations for Turbine Generator to rest on suitable vibration isolation system consisting of springs and damper.

The concrete foundation for supporting the turbine generator will be completely isolated from the building floors for vibration control. The foundation for Turbo-generator shall rest on suitable vibration isolation system consisting of springs and visco dampers (supplied by owner approved vendor).

The foundation for Boiler Feed Pumps / motors shall rest on vibration isolation system consisting of springs.

For static and dynamic analysis of machine foundation following data shall be furnished by the equipment manufacturer.

a) Loading diagram showing static and dynamic loads and points of application of loads.

b) Operating speed of m/c; Critical speed of m/c.

c) Weight of rotating parts; maximum eccentricity of rotating mass from the geometric axis of rotation.

d) Location of C.G. of machines in all three axes.

e) Mass Moment of Inertia.

f) Allowable amplitude/velocity of vibration at machine bearing points.

g) Temperatures in various areas during operation.

Design of foundations for major equipment shall be done in accordance with relevant parts of IS-2974 (Latest Revision). Unbalanced loads for normal operating condition as given by machine manufacturer and/or VDI 2060 whichever is more shall be used for calculating dynamic response. The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. While designing following aspects shall also be taken care of.

i) Foundations shall be isolated from adjacent structures for vibration control and it shall be designed to meet the manufacturer's deflection criteria and other manufacturer's recommendations.

ii) The turbine generator pedestals shall be designed to meet the manufacturer's deflection criteria and other recommendations.

ii) Natural frequencies of structures and components shall be away from the running speed of equipment by at least 20% generally but for important ones it shall be away by at least 30%. However, frequency separation criteria and amplitude criteria as laid down in IS:2974(Latest Revision) and/or DIN 4024 and/or VDI 2056 and/or as required by the machine manufacturer, whichever is more stringent shall also be satisfied. A fatigue factor of 2.0 shall be considered for dynamic forces / due to normal unbalance. For design of foundation of large fans, heavy & rotating fan foundations etc. provision shall be kept in the foundation for addition of mass/area for retuning of the foundations, if required at a later date.

All block foundations resting on soil shall be designed using the elastic half space theory or Barkan's theory. The mass of the RCC block shall not be less than three times mass of the machine and the CG of the combined mass of foundation and equipment should pass through the CG of the base area with tolerance not more than 5%.

For the foundations supporting minor equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structures, floors, etc. suitable vibration isolation shall be provided by means of springs, neoprene pads, etc. and such vibration isolation system (VIS) shall be designed suitably.

Wherever RCC top deck is designed with VIS for machine foundations, the design of the RCC top deck shall be designed and vetted by the reputed VIS manufacturer like GERB. However the overall responsibility of the overall structure including foundation lies with the EPC contractor.

Analysis and design of the Steam Turbine-Generator (STG) foundation, FD & ID fans, Boiler Feed Pumps & Crushers foundations shall be carried out in accordance with relevant codes IS: 2974 Part-3 (Latest Revision) and IS: 456 (Latest Revision) and/or manufacturer’s requirements. The loads to be considered for static analysis and design shall consist of dead weight of the machine and foundation, machine power torque, condenser loads under normal operating condition, Equivalent static load due to machine unbalance, thermal elongation forces, forces due to one sided operation of the condenser, forces due to condensate pump failure, vacuum loads, forces due to piping, frictional forces at machine sole plate level for turbine, generator and condenser, temperature distribution under operating condition, failure loads of turbine (blade unbalance/loss of blade/bowed rotor), failure loads of generator (short circuit loads), seismic loads due to generator, turbine and condenser and erection loads.

In case of machines supported on VIS with springs and viscous dampers it shall be ensured that not more than 5% of the dynamic loads are transmitted to the substructure. Necessary provisions of DIN 4024 shall be adhered to while designing the substructure. Substructure shall be designed for static loads. The vibration isolation system shall consist of helical spring units and viscous dampers supporting the RCC inertia block which support the machine. The spring units shall conform to DIN 2089 and DIN 2096.

For all equipment foundations supported on VIS system, the stiffness of the supporting substructure shall be at least ten (10) times that of spring elements as per DIN 4024.

While performing dynamic analysis of fan, TG & BFP foundation, effect of soil contributing to dynamic properties shall be considered.

Wherever VIS is provided for equipment inside the Power Plant – The Civil Design document / drawings for the RCC Top deck above the VIS supporting the equipment shall be vetted / designed by the VIS spring manufacturer and the same shall be submitted to NLC / Consultant by the contractor for approval during detailed engineering. However the overall responsibility for the structural safety, rigidity & soundness of the entire structure lies with the contractor.

5.03.00 **Open Foundations**

In case open foundations are adopted, the following shall be adhered to:

a) Minimum width of foundation shall be 1.0 m.

b) Minimum depth of foundation shall be 1.0 m below NGL.

c) It shall be ensured that all foundations of a particular structure/ buildings/facility shall rest on one bearing stratum, i.e. either overburden or rock.

d) Wherever the intended bearing structure is weathered rock but the actual stratum encountered during foundation excavation consists of both overburden soil and weathered rock at founding level, under such cases either the foundation shall be lowered completely into the weathered rock or the overburden soil upto the weathered rock level shall be removed and built up through PCC up to designed foundation level.

e) The net allowable bearing pressure values to be adopted for design upon Owner's approval shall correspond to total permissible settlement as mentioned under para "permissible settlement of foundations" or the permissible settlement from functional requirement, whichever is more stringent.

Permissible settlement of foundations:

Maximum allowable total settlement for all foundations of any structure/ facility should be restricted to 25 mm except as listed below.

For all non-plant buildings as mentioned in the following list, Maximum allowable total settlement should be restricted to 40 mm for all foundations.

- Canteen
- Fire Station
- Weigh-bridge
- Time office and Security Complex including Gate-I
- Watch Tower
- Workshop
- First Aid Centre
- Permanent Stores
- Construction Store
- Hydrogen and Carbon-di-oxide Cylinder Storage Building

- Cycle/ Scooter/car stand at the main gate

5.04.00 Pile Foundations

In case piles are adopted, following shall be adhered to:

a) The pile foundation shall be of RCC, Cast-in-situ bored, precast/cast-in-situ driven pile as per IS: 2911 (Latest Revision). Bored piles shall be installed by using rotary hydraulic rig. Three-stage flushing of pile bore shall be ensured, by airlift technique or any other internationally accepted method duly approved by the Owner.

b) The minimum diameter of pile shall be 450mm for cast-in-situ and 300mm for precast piles. The uplift and lateral load capacity shall be established by field test.

c) Only straight shaft piles shall be used. Minimum cast length of pile above cut-off level shall be 1.0 m.

d) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter like (SPT &SCPT value, set criteria etc.), reinforcement for job as well as test piles, etc.) for Owner's approval.

e) The piling work shall be carried out in accordance with IS: 2911 (Relevant part) (Latest Revision) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Owner's approval.

f) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be as under:

   Vertical
Lateral } Minimum of 2 Nos. in each mode.
Uplift

   For large size projects (for piles more than 1 000 numbers), a minimum of two tests for first 1 000 piles and additional one test for every additional 1 000 piles and part thereof

   The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of compression test the method of loading shall be cyclic as per IS: 2911 (relevant part) (Latest Revision).

g) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under:

   i) Vertical -2.0 % of the total number of piles provided.
   ii) Lateral -2.0 % of the total number of piles provided.

The routine tests on piles shall be conducted up to test load of one and half times the allowable pile capacity. The Owner shall approve piles for routine load tests. Routine load tests may be done by conventional method as per IS: 2911 (Part-4) (Latest Revision).

In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required, without additional cost to the Owner.

h) Testing of piles and interpretation of pile load test results shall be carried out as per IS: 2911 (Part-4) (Latest Revision). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory/ institute prior to their use. Additional measurement for pile movement shall also be done.

i) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the piles for routine load test and not intended to replace the use of static load testing.

5.05.00 **Other Requirements**

i) In case of high ground water table, for excavations comprehensive dewatering arrangement shall be required. Scheme for dewatering and design with all computations and back-up data of dewatering and sheet pilling shall be submitted for Owner's information.

ii) The founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches/channels.

iii) Excavation for open foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil at founding level during excavation, the same shall be removed and compensated by PCC of Grade M 10. The foundation pits shall be maintained dry during the complete construction period by means of suitable dewatering systems.

iv) Backfilling, around foundations and bottom of pipes, thrust blocks, etc. shall be carried out with approved material in layers not exceeding 30 cm thickness and each layer shall be compacted to 90% standard proctor density for cohesive soil and to 75% of relative density for non-cohesive soils. Where ever necessary Sand filling shall be used for back filling.

v) Excess/surplus excavated material (debris and other unusable materials as decided by owner) shall be disposed of by the Contractor as per the instructions of the Owner upto a lead of about 5 km spread in .layers not exceeding 30 cm thickness and each layer shall be compacted to 90% standard proctor density for cohesive soil and to

75% of relative density for non-cohesive soils.

vi) CBR tests for rigid / concrete pavement design shall be carried out by Contractor after earth filling has been completed, if applicable.

vii) The storage tanks shall rest on flexible tank pad resting on an open foundation / pile foundation. The tank pad shall be made of two layers. The first layer shall be thoroughly compacted fill of gravel, coarse sand or other suitable material topped with minimum 75mm thick compacted crushed stone, screenings, fine gravel, clean sand or similar material mixed in hot asphalt (80 / 100 bitumen or equivalent 8 to 10% by volume), rolled and compacted. The second layer shall be with minimum 25 thick premix carpet with 12 mm and down broken stone chips and 80/100 grade hot bitumen. The tank pad shall be laid by an expert agency approved by owner/consultant having wide experience in execution of similar works. The tank pad shall be made up from founding level to the required level by controlled compaction in layers of 200 mm to achieve a relative density of 85% using suitable compaction equipment approved by the Owner. In addition to the above, in case of an open/shallow foundation, a ring wall shall be provided adjacent to the tank wall for retaining the fill below tank. The foundation system shall be designed as per the provisions of IS: 803. The tank shall have a flexible bottom plate, which shall establish complete bearing with the foundation fill.

6.00.00 GENERAL REQUIREMENTS

6.01.00 Minimum Thickness of Structural Elements

The following minimum thickness shall be followed:

Pile caps	1.5 times the dia of pile
Suspended floor / slab / walkways / canopy slabs, etc. (Thickness of roof slab and intermediate floors shall be measured excluding trough depth of metal deck sheet)	150 mm
Ground floor slab/Grade slab (non-suspended)	150mm or as per design requirements whichever is higher
Water Retaining slabs / walls	200 mm
Walls of Cable / pipe trenches / underground pits / Launder walls and base slab	150 mm
Drain walls and base slab upto 500mm depth	125mm
Drain walls and base slab morethan 500mm depth	150 mm
All footings (including raft foundations)	300 mm

Parapets	125 mm
Sunshades at edge	75 mm
Pre-cast louvers / fins	50 mm
Pre-cast trench cover slabs / floor slabs / louvers	100 mm
Paving (except for RCC Roads)	150mm or as per design requirements whichever is higher
Basement walls and base slab	250 mm
Silo / bin walls	200 mm
Underground reservoir	
Below ground (Walls and base)	250 mm
Above ground (Walls)	200mm
RCC Roads	250mm

The above are minimum requirement only unless otherwise mentioned elsewhere in the specification.

From fire resistance point of view minimum thickness of reinforced concrete members shall be as per Fig 1 or Table 16a of IS 456 (Latest Revision) or specified above, whichever is higher.

6.02.00 **Minimum Heights for Pedestals/Encasements of Steel Columns**

Pedestals to Steel Columns for building structures:

In case the top of pedestal is kept at a lower level so that the column base plate together with gussets and stiffeners remain below finished floor level (FFL) the column bases as well as the column sections shall be encased in concrete above FFL as per following unless otherwise specified.

a) Open area : 300 mm above paved level

b) Covered area : 300 mm above FFL

Stair and ladder pedestal shall be kept 200 mm above the finished floor level.

Pedestals to Steel Columns for Equipment structure:

a) Equipment in open area : as required (300mm min)

b) Equipment in covered area : as required (150 mm min)

c) Structures and equipment supplied by vendor	:	as per vendor's data subject to minimum as specified above

6.03.00 **Ground floor slab-on-grade**

Ground floor slab-on-grade shall be minimum M-30 grade RCC construction laid over minimum 100mm thick lean concrete of Grade M10. Minimum consolidated 230mm thick graded BG stone or laterite (63mm down size) soling with interstices filled with sand/gravel and compacted mechanically, shall be provided as sub-base below lean concrete. The sub-base shall be laid over rammed and compacted minimum 300 mm thick (Min. 90% Proctor density) sub-grade.

The ground floor slab shall be of minimum 150mm thick or as per design requirement (whichever is higher) with double layer reinforcement (top & bottom)of 10mm (minimum) dia at the rate of 200 (maximum) c/c both ways with 50 mm thk IPS floor finish.

For Toilet Floor shall be 100 thick PCC (M25) with 50 thick floor finish as per system requirement .

6.04.00 **Stairs, Platforms, Handrails**

All internal stairs, platforms and walkways shall either be of RCC or Structural Steel with minimum 8mm thick chequered plate construction. All outdoor stairs, platforms and walkways shall either be of RCC or Structural Steel with GI grating made of minimum 40 x 6 mm Flats. S.S handrails shall be provided for TG building and service building

All handrails (For steel structures and RCC structures)made of MS Galvanized hand railings with 40 mm NB (medium) main posts and 40 mm NB (medium) as horizontal rails as per IS:1161(Latest Revision) with GI toe guard min 6 mm thick & min 150 mm wide shall be provided including throughout staircase and landing.

7.00.00 ROADS

Geometric design of road shall be done in accordance with Indian Road Congress Standard. The ruling gradient for roads in longitudinal direction shall be 1 in 30. Normally roads shall have much flatter gradient. Transverse camber of 1 in 40 shall be provided.

A detailed CBR test, shall be carried out as per the procedure outlined in IS-2720 (Part-XVI)(Latest Revision). CBR test shall be carried out in remoulded soil samples under soaked condition.

All roads shall have hard shoulder on either side of carriageway. Shoulders shall have sufficient load bearing capacity to support loaded trucks. A flatter slope of 1 in 30 shall be provided on shoulders.

Only RCC box culverts shall be provided for drainage and for all the underground conduits at road crossings. Level crossings shall be provided where a Railway siding line crosses the road. All culverts shall be designed for IRC class "AA" loading and checked for class A loading.

At all road crossings RCC box culverts along with manholes (if required) on both sides shall be used. Such road culverts and its allied structures including R.C.C. Road Crossing of Trenches shall be designed for Class `AA' loading (wheeled and tracked both) and to be checked for Class `A' loading as per IRC standards.

For RCC roads the cross section as per Clause No 2.07.00/Vol II-G2/Part A/Section X shall be followed.

8.00.00 DRAINAGE

Open RCC rectangular drains shall be provided for storm water. However, perforated RCC cover slabs (minimum 50mm thick or as per design, whichever is higher) with GI gratings at 4m interval shall be provided for drains in Boiler, Transformer and Switch yard areas. The thickness of sides & bottom of drains shall be minimum 125 mm or as per design considerations whichever is higher. Drains shall have minimum 600mm base width. RCC box culverts shall be provided for road and rail crossing. Drains shall be provided on both sides of the roads. For depth more than 500mm drain, minimum 150mm wall thickness with double layer reinforcement shall be provided.

Inside surface of the drain will have smooth neat cement finish over with screed concrete. Invert of the drain shall be decided in such a way that the water can easily be discharged to the recommended nearest outfall outside the plant boundary. The minimum slope of the drain shall be 1:1000 longitudinally to take care of the silting problems. It is recommended to maintain the maximum velocity within 1.2 m/sec.

9.00.00 TRANSFORMER TRACK & JACKING PAD

Lay out of transformer track and jacking pads shall be as shown in appropriate drawing.

Transformer track shall be designed as beam on elastic foundation. For this, appropriate soil investigation / test shall be carried out to establish design parameters. Grade of concrete, reinforcement etc. shall be as specified earlier.

10.00.00 MISCELLANEOUS DESIGN / CONSTRUCTION CRITERIA

1) All RCC/Steel buildings shall be provided with RCC Plinth beams connected to RCC Columns/Pedestals. All masonry walls from ground floor shall be placed on reinforced concrete plinth beams connected to RCC Columns/Pedestals. However, light internal partitions may be placed

on ground floor slab. The plinth beam shall be partially above FGL and partially below FGL. Minimum embedment of the plinth beam below Finished Ground level (FGL) shall be 300 mm. All RCC/Steel buildings shall be provided with Wall/Tie beams at every 2.5 metre height of brick wall.

2) The steel column base plate along with stiffening gusset plates shall not be protruded above floor level for main plant area. The column base assemblies shall be encased with concrete M20 upto floor level.

3) For exposed areas the columns shall have a minimum encasing of 300 mm above paved level in main plant area.

4) Ramps for building entrance shall be cast in situ RCC slab and the slope of ramps shall not be more than 1 (vertical) to 8(horizontal).

5) Minimum 100 mm thick lean concrete M10 shall be provided below all underground structure, trenches etc., to provide a base for construction.

6) All buildings shall have RCC/steel framed super structure. All walls shall be non-load bearing infilled panel walls.

7) Duct banks consisting of PVC/GI conduits for cables shall be provided with reinforced concrete encasing of M25grade. The minimum depth of top of duct bank from grade level shall be 500mm.

8) Angles 50 x 50 x 6 mm (min.) with lugs shall be provided for edge protection all round of cut-outs/opening in floors, edge of drains supporting grating covers, edges of RCC cable/pipe trenches, manholes supporting covers, supporting edges of pre-cast covers. RCC stairs/ steps and any other places where breakage of corners of concrete is expected.

9) Trenches located outside building shall project at least 100mm above the finished formation level so that no storm water shall enter into the trench. Trenches and drains shall not be clubbed together by providing a common wall. The bottom of the trench shall be sloped suitably for draining out the collected water into the sump pit. The pre-cast covers shall be of minimum M-25grade and shall not weight more than 65 kg. Lifting hooks shall be provided in the pre-cast covers. The minimum drainage slope along line shall be 1 in 1000.

10) All underground concrete structure such as basement, sumps water-retaining structure shall be designed for water tightness.

11) The concrete surface of foundations in contact with earth shall be provided with two coats of hot bituminous painting (85/25) conforming to IS:702 @ 1.2kg/sq.m in each coat) over a coat of bitumen primer except where special water proofing is specified for specific structures mentioned elsewhere.

12) All joints, including construction and expansion joints for the water retaining structure and others below subsoil water level shall be made water tight by using PVC ribbed water stops with central bulb. The minimum thickness of PVC water stops shall be 6 mm and minimum width shall be 230mm.

13) All mild steel parts used in the water retaining structures shall have anticorrosive epoxy based paint or equivalent.

14) Anti-termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors, switchyard area etc., as per IS-6313 (Latest Revision) and other relevant standards.

15) Concrete hume pipes for underground service(sewage line) shall of class NP3 as per IS-458 (Latest Revision).

16) For all buildings suitable arrangements for draining out of water collected from equipment, blowdowns, leakages, floor washing, fire-fighting etc., shall be provided for each floor.

17) All RCC walls and slabs shall have two layers of reinforcement for section having thickness 150 mm and above.

18) All gratings shall be made of 40x6 thick GI flat unless noted elsewhere in the specification. Stairs treads made of grating shall be provided with non-skid abrasive nosing.

19) NOT USED.

20) Unless stated elsewhere specifically in this specification, the finished floor level of any building shall be at least 500 MM above the finished grade level and 800mm above FGL for electrical buildings. The finished paving level shall be at least 300mm above FGL for Boiler Area and switchyard area.

21) For RCC buildings of more than 15M shorter span steel roof truss/girders maybe provided to support the concrete roof on permanently colour coated (on exposed face) galvanized M.S. troughed metal decking over concrete columns. Gable and side cladding will be constructed with fly ash brick masonry.

22) Sealing of joints shall be done by two part polysulphide sealant and shall be from approved manufacturer conforming to IS: 12118 (Latest Revision). Material shall consist of polysulphide polymer and a curing agent. Clear cover to reinforcement shall be as per IS:456 for moderate exposure condition. However, for concrete in contact with soil and water it shall not be less than 50 mm.

23) Generally foundation for buildings & equipment shall not be structurally connected to ground floor slab.

24) Allowable differential settlement between two foundations shall be as per IS:1904 (latest). Foundations for structures and equipment shall be proportioned to resist the worst conditions of loadings and shall be generally designed as per the provisions of IS:1904.

25) For equipment foundations, the total and differential settlements that are likely to occur shall be assessed. Design of such foundations will restrict expected settlements to within limits required for proper operation of the plant.

26) Machine foundations shall be separated from adjacent building column foundations by a minimum gap of 25 mm to avoid propagation of vibrations into the buildings.

27) For all settlement sensitive equipment and structures, due care shall be taken during designing of structures and foundations to limit the settlement as required for efficient functioning.

28) In general, for fixing of gates/screens with the RCC wall/slab, anchor fasteners or any other anchors shall not be used. The fixing shall be done with cast-in situ bolts/pockets/inserts in RCC.

29) If any similar design criteria mentioned elsewhere in this specification contradict the above, the stringent of the criteria shall be adopted for design.

1.00.00	**GEO-TECHNICAL INVESTIGATION & FOUNDATION SYSTEM**
1.01.01	Customer (NLC) has provided Soil investigation report of the proposed site and the same is attached as Annexure-I in tender specification as a reference for the bidders. BHEL is carrying out detailed geo-technical investigation in the proposed IDCT area. Approved Geotechnical Investigation report of IDCT area shall be furnished after completion of the work by BHEL. The geotechnical data attached in tender specification shall be solely for the purpose of guidance to the bidder. BHEL/owner does not take any responsibility about the accuracy and applicability of the geo-technical data furnished herewith. The onus of correct assessment/interpretation and understanding of the existing sub-strata conditions is on the bidder. Any variation in the data between the one furnished and to that found during execution of the work at site shall not constitute a valid reason in affecting the terms & conditions of this bid and the bidder shall note that nothing extra will be payable on this account. The bidder shall fully satisfy himself about the nature of sub-strata expected to be encountered including the type of foundation, ground water table and construction methodology to be adopted etc prior to the submission of the bid.
1.01.02	Detailed geo-technical Investigation report shall be made available to the successful bidder during contract engineering stage. If the bidder desires to carry out additional geo-technical investigation he/she may do so with prior information/permission of BHEL/owner at no extra cost to BHEL/owner. No extension in time schedule shall be permitted on this account. The bidder shall obtain approval on the agency for conducting geo-technical investigation work, field and laboratory testing schedule proposed by the bidder etc from BHEL/owner before undertaking the geo-technical investigation work. However, the net safe bearing capacity (SBC) of shallow foundation/safe load carrying capacity of pile foundation to be adopted for the design of foundations during detailed engineering shall be limited to the values mentioned elsewhere in the specification and any value of net SBC/pile capacity higher than the one indicated shall not be accepted. However, bidder shall note that the net safe bearing capacity and foundation depth/ safe load carrying capacity of pile to be adopted for design during detailed engineering stage shall be got approved by BHEL/owner.
1.02.00	**Foundation System** Suitable foundation system (open/pile) shall be adopted as per tender specification.

ANNEXURE -I

REPORT ON GEOTECHNICAL INVESTIGATION

FOR

PROPOSED THERMAL POWER PLANT PROJECT (3 X 800 MW)

AT

SAMBALPUR, ORISSA

FOR

M/s. NLC INDIA LIMITED
OFFICE OF THE GENERAL MANAGER/CIVIL
CTO BUILDING/BLOCK – 1/ NEYVELI – 607 801/TAMIL NADU
INDIA

JOB NO.	: 30796
REPORT NO.	: 0704
DATE	: 13.11.2018

SKM Geosurvey
ISO 9001: 2015 CERTIFIED ORGANIZATION
BK-130, SALT LAKE, SECTOR-II, KOLKATA- 700091

PREFACE

Geotechnical investigation of sub soil was carried out for the proposed Thermal Power Plant Project (3 x 800 MW) at Sambalpur area in Odisha State. Objective of the investigation was to determine sub-soil parameters for assessing load carrying capacity of foundation for design and construction of the proposed structure.

Soil Investigation work was started at this site by M/s SKM Geosurvey on issue of letter of award having Ref No: Tender/T.No.13/2017-18/LOA/GMC/2017 by M/s NLC India Limited dated 16th October 2017. Field work was started on 18th December 2017 and completed on 24th February 2018.

The report has been prepared after in-depth study of data collected from field and laboratory tests and deals with geotechnical aspects of the sub-soil. Section-I of this report covers the field work. Results of laboratory tests and a discussion thereon are presented in Section-II. Section-III deals with an engineering appraisal and a recommendation for a suitable foundation for the proposed structures.

SECTION - I

1.0 INTRODUCTION

On instruction from M/s NLC India Limited, geotechnical investigation was carried out for the proposed Thermal Power Plant Project (3 x 800 MW) at Sambalpur area in Odisha State. Objective of the investigation was to determine sub-soil conditions at site and to determine a suitable foundation system as required for the proposed structure.

2.0 LOCATION

The site is at the Sambalpur, Odisha. The nearest railway station to the site is Jharsuguda situated about 15 km from the site. The site is located within Village Kumbhari and Tareikela. Total site is surrounded by river expect the ash pond area. The site is undulating and covered by grass and a few trees.

3.0 INVESTIGATION SCHEME AND LOCATION OF TESTS

The scheme of Soil Investigation framed by the client comprised a total of thirty (30) boreholes with the explored depth of 8.20m to 19.50m below the E.G.L, ten(10) Electrical Resistivity Test, twenty(20) Dynamic Cone Penetration Test, five(05) nos Plate Load Test, two(02) nos Cyclic Plate Load Test, fifteen(15) nos Trail Pit, tewnty(20) field permeability test, one (01) percolation test in trial pit, one(01) Block Vibration Test and one(01) Cross Hole Seismic Test. The scope of work also included collection of undisturbed soil samples from cohesive deposits, disturbed samples, conducting Standard Penetration Tests in boreholes, carrying out routine laboratory tests on soil samples. On completion of field and laboratory tests, a report on the investigation was to be submitted based on the findings, together with recommendations on foundations. The work was carried out accordingly.

4.0 FIELD WORK

4.1 Boring

The boreholes were sunk by a combination of Mechanical Cable Tools (Shell & Auger) method & Rotary wash boring at lower depths. Flush jointed steel casing tubes were used to prevent side collapse of boreholes in shell and auger method of boring. No casing was provided in the Rotary wash borings since stabilization of hole was made by circulation of bentonite mud. The depth of casings at various stages of sampling, borehole depths, depth of collection of undisturbed soil samples (UDS), description of soil, 'N' values during SPT at various depths and the depth at which ground water was encountered at different locations are shown in the respective bore logs in Appendix-I of this report.

4.2 Sampling

Both disturbed and undisturbed representative soil samples were collected during boring and subsequently sent to laboratory for visual examination and laboratory tests. For undisturbed sampling, 100 mm dia 450 mm long 'open drive' sample tube fitted with cutting shoe was driven into soil through boreholes. Such samplers were fitted with a spring loaded valve system at the top of the sampler to create vacuum during withdrawal after being pushed into soil for holding the sample in tube.

Disturbed samples were collected from the cutting shoe and split spoon sampler.

A Table depicting details of boreholes and samples collected for testing in the laboratory and other tests executed is presented below.

Number of Field Tests and Samples Collected

Test No.	Facility	R.L, (m)	Co-ordinate		Soil Boring (m)	Rock Drilling (m)	Total Depth (m)	S.W.L. (m)	Samples Collected				Field Permeability
			North	East					SPT	UDS	DS	WS	
BH-01	Crusher House	197.210	2411250	808575	12.00	5.00	17.00	4.20	13	3	5	-	2
BH-02	Chimney - 1	197.50	2411030	808685	13.50	5.00	18.50	4.30	15	2	5	-	2
BH-03	Chimney - 2	198.50	2410803	808685	14.50	5.00	19.50	4.50	13	4	4	1	-
BH-04	Boiler – 1/1	194.729	2411130	808970	6.00	5.00	11.00	0.80	5	1	5	-	1
BH-05	Boiler – 1/2	195.568	2411080	809045	6.50	5.00	11.50	0.10	6	-	7	1	-
BH-06	Boiler – 2/1	197.394	2410979	808975	7.00	5.00	12.00	2.35	5	1	5	-	1
BH-07	Boiler – 2/2	197.499	2410929	808950	7.00	5.00	12.00	2.40	5	1	4	1	1
BH-08	Boiler – 3/1	199.264	2410803	809045	12.00	5.00	17.00	3.80	8	2	5	1	1
BH-09	Boiler – 3/2	198.215	2410790	808950	14.50	5.00	19.50	2.85	8	2	7	1	1
BH-10	C-Row-1	195.668	2411175	809057	5.50	5.00	10.50	1.10	5	1	5	-	1
BH-11	C-Row-2	196.621	2410722	809057	11.50	5.00	16.50	3.00	12	2	6	-	2
BH-12	A – Row -1	199.764	2410728	809098	8.00	5.00	13.00	1.60	8	2	3	-	1
BH-13	A – Row -2	196.660	2411175	809098	5.60	5.00	10.60	1.65	6	-	5	1	1
BH-14	TG Deck-1	196.621	2411115	809083	5.32	5.00	10.32	1.50	5	1	5	-	1
BH-15	TG Deck-2	195.857	2411055	809083	3.20	5.00	8.20	0.15	5	-	3	-	1
BH-16	TG Deck-3	199.466	2410803	809083	12.00	5.00	17.00	3.00	11	1	5	-	1
BH-17	Cooling Tower -1	204.919	2410250	809375	12.00	5.00	17.00	4.78	8	3	5	1	1
BH-18	Cooling Tower -2	198.576	2409980	808900	9.00	5.00	14.00	2.30	5	2	5	-	1
BH-19	Cooling Tower -3	199.313	2410380	809083	10.00	5.00	15.00	2.50	7	2	5	-	1
BH-20	Reservoir -1	198.614	2409650	808700	8.00	5.00	13.00	4.20	4	2	5	1	-

Note: *BH = Borehole, ERT=Electrical Resistivity Test, CHST=Crosshole Seismic Test, BVT= Block Vibration Test, TP= Trial Pit, DCPT= Dynamic Cone Penetration Test, UDS = Undisturbed Soil Samples, SPT = Standard Penetration Test, DS = Disturbed Soil Samples other than SPT samples, WS = Water Samples, SWL = Standing water level.*

Number of Field Tests and Samples Collected

Test No.	Facility	R.L, (m)	Co-ordinate		Soil Boring (m)	Rock Drilling (m)	Total Depth (m)	S.W.L. (m)	Samples Collected				Field Permeability
			North	East					SPT	UDS	DS	WS	
BH-21	Reservoir -2	201.101	2409550	809200	8.50	5.00	13.50	4.50	5	2	4	1	-
BH-22	Reservoir -3	201.405	2409125	808900	8.20	5.00	13.20	4.30	5	2	4	-	-
BH-23	CHP-1	200.850	2411450	809100	8.50	5.00	13.50	3.50	6	2	4	1	-
BH-24	CHP-2	197.790	2411560	808950	7.00	5.00	12.00	1.90	5	2	5	-	-
BH-25	Ash Silo	197.000	2411560	808490	12.00	5.00	17.00	3.80	13	3	5	-	-
BH-26	Township	197.230	2411400	810400	6.30	5.00	11.30	1.10	4	2	4	-	-
BH-27	Ash Dyke-1	202.405	2409500	810500	8.50	5.00	13.50	4.70	5	2	4	-	-
BH-28	Ash Dyke-2	201.102	2409050	810850	8.00	5.00	13.00	4.20	5	2	4	-	-
BH-29	Ash Dyke-3	202.925	2408750	810200	8.50	5.00	13.50	4.70	5	2	4	-	-
BH-30	Ash Dyke-4	201.427	2408400	810650	8.20	5.00	13.20	4.15	5	2	4	-	-
ERT-1	Chimney - 1	197.500	2411023	808690	-	-	-	-	-	-	-	-	-
ERT-2	Boiler – 1/1	194.729	2411135	808965	-	-	-	-	-	-	-	-	-
ERT-3	Boiler – 3/1	199.264	2410805	809050	-	-	-	-	-	-	-	-	-
ERT-4	Boiler – 2/1	197.394	2410982	808982	-	-	-	-	-	-	-	-	-
ERT-5	C-Row-2	196.621	2410727	809065	-	-	-	-	-	-	-	-	-
ERT-6	A – Row -1	199.764	2410732	809099	-	-	-	-	-	-	-	-	-
ERT-7	TG Deck-2	195.857	2411060	809080	-	-	-	-	-	-	-	-	-
ERT-8	Cooling Tower -2	198.576	2409983	808900	-	-	-	-	-	-	-	-	-
ERT-9	CHP-1	200.850	2411455	809100	-	-	-	-	-	-	-	-	-
ERT-10	Township	197.230	2411405	810400	-	-	-	-	-	-	-	-	-

Note: BH = Borehole, ERT=Electrical Resistivity Test, CHST=Crosshole Seismic Test, BVT= Block Vibration Test, TP= Trial Pit, DCPT= Dynamic Cone Penetration Test, UDS = Undisturbed Soil Samples, SPT = Standard Penetration Test, DS = Disturbed Soil Samples other than SPT samples, WS = Water Samples, SWL = Standing water level.

Number of Field Tests and Samples Collected

Test No.	Facility	R.L, (m)	Co-ordinate		Soil Boring (m)	Rock Drilling (m)	Total Depth (m)	S.W.L. (m)	Samples Collected				Percolation Test
			North	East					SPT	UDS	DS	WS	
CHST-01	TG Deck-3	199.466	2410806	809090	-	-	25.00	-	-	-	-	-	-
BVT-01	TG Deck-2	195.857	2411055	809083	-	-	2.20	-	-	-	-	-	-
							Total Volume (m^3) (LxBxD)						
TP-01	Crusher House	197.210	2411240	808580	-	-	2x2x4	-	-	02	02	-	-
TP-02	Chimney - 1	197.50	2411020	808690	-	-	2x2x4	-	-	02	02	-	01
TP-03	Chimney - 2	198.50	2410815	808692	-	-	2x2x4	-	-	02	02	-	-
TP-04	Boiler – 1/1	194.729	2411140	808965	-	-	2x2x4	-	-	02	02	-	-
TP-05	Ash Dyke-1	202.405	2409510	810500	-	-	2x2x4	-	-	02	02	-	-
TP-06	Ash Dyke-3	202.925	2408758	810205	-	-	2x2x4	-	-	02	02	-	-
TP-07	CHP-1	200.850	2411457	809105	-	-	2x2x4	-	-	01	03	-	-
TP-08	Boiler – 3/1	199.264	2410810	809050	-	-	2x2x4	-	-	02	02	-	-
TP-09	Reservoir -1	198.614	2409655	808710	-	-	2x2x4	-	-	02	02	-	-
TP-10	C-Row-1	195.668	2411180	809065	-	-	2x2x4	-	-	01	03	-	-
TP-11	Reservoir -2	201.101	2409560	809200	-	-	2x2x4	-	-	02	02	-	-
TP-12	Cooling Tower -2	198.576	2409970	808900	-	-	2x2x4	-	-	02	02	-	-
TP-13	A – Row -2	196.660	2411180	809105	-	-	2x2x4	-	-	-	04	-	-
TP-14	TG Deck-1	196.621	2411125	809070	-	-	2x2x4	-	-	01	03	-	-
TP-15	TG Deck-3	199.466	2410812	809090	-	-	2x2x4	-	-	02	02	-	-

***Note**:* BH = Borehole, ERT=Electrical Resistivity Test, CHST=Crosshole Seismic Test, BVT= Block Vibration Test, TP= Trial Pit, DCPT= Dynamic Cone Penetration Test, UDS = Undisturbed Soil Samples, SPT = Standard Penetration Test, DS = Disturbed Soil Samples other than SPT samples, WS = Water Samples, SWL = Standing water level.

Number of Field Tests and Samples Collected

Test No.	Facility	R.L, (m)	Co-ordinate		Soil Boring (m)	Rock Drilling (m)	Total Depth (m)	S.W.L. (m)	Samples Collected				Field Permeability
			North	East					SPT	UDS	DS	WS	
DCPT-1	Chimney - 2	198.50	2410807	808688	-	-	12.60	-	-	-	-	-	-
DCPT-2	Boiler – 1/1	194.729	2411135	808965	-	-	5.40	-	-	-	-	-	-
DCPT-3	Boiler – 1/2	195.568	2411085	809048	-	-	6.00	-	-	-	-	-	-
DCPT-4	Boiler – 2/1	197.394	2410982	808979	-	-	6.90	-	-	-	-	-	-
DCPT-5	Boiler – 2/2	197.499	2410933	808954	-	-	6.90	-	-	-	-	-	-
DCPT-6	Boiler – 3/1	199.264	2410807	809049	-	-	10.50	-	-	-	-	-	-
DCPT-7	Boiler – 3/2	198.215	2410795	808950	-	-	10.50	-	-	-	-	-	-
DCPT-8	C-Row-1	195.668	2411180	809059	-	-	5.40	-	-	-	-	-	-
DCPT-9	C-Row-2	196.621	2410725	809060	-	-	11.40	-	-	-	-	-	-
DCPT-10	A – Row -1	199.764	2410730	809099	-	-	5.70	-	-	-	-	-	-
DCPT-11	A – Row -2	196.660	2411180	809098	-	-	5.40	-	-	-	-	-	-
DCPT-12	TG Deck-1	196.621	2411120	809086	-	-	4.80	-	-	-	-	-	-
DCPT-13	TG Deck-2	195.857	2411050	809080	-	-	3.30	-	-	-	-	-	-
DCPT-14	TG Deck-3	199.466	2410806	809080	-	-	11.10	-	-	-	-	-	-
DCPT-15	Cooling Tower -1	204.919	2410255	809372	-	-	12.00	-	-	-	-	-	-
DCPT-16	Cooling Tower -2	198.576	2409980	808905	-	-	10.20	-	-	-	-	-	-
DCPT-17	Cooling Tower -3	199.313	2410376	809083	-	-	10.20	-	-	-	-	-	-
DCPT-18	Chimney - 1	197.50	2411025	808688	-	-	11.70	-	-	-	-	-	-
DCPT-19	Crusher House	197.210	2411255	808577	-	-	11.10	-	-	-	-	-	-
DCPT-20	Reservoir -1	198.614	2409655	808703	-	-	8.10	-	-	-	-	-	-

Note: BH = Borehole, ERT=Electrical Resistivity Test, CHST=Crosshole Seismic Test, BVT= Block Vibration Test, TP= Trial Pit, DCPT= Dynamic Cone Penetration Test, UDS = Undisturbed Soil Samples, SPT = Standard Penetration Test, DS = Disturbed Soil Samples other than SPT samples, WS = Water Samples, SWL = Standing water level.

Number of Field Tests and Samples Collected

Test No.	Facility	R.L, (m)	Co-ordinate		Soil Boring (m)	Rock Drilling (m)	Total Depth (m)	S.W.L. (m)	Samples Collected				Field Permeability
			North	East					SPT	UDS	DS	WS	
CPLT-01	Chimney - 2	198.50	2410807	808685	-	-	2.50	-	-	02	-	-	-
CPLT-02	*TG Deck-1*	196.621	2411120	809085	-	-	2.25	-	-	02	-	-	-
PLT-01	Chimney - 1	197.50	2411027	808695	-	-	2.50	-	-	02	-	-	-
PLT-02	TG Deck-3	199.466	2410807	809083	-	-	2.00	-	-	02	-	-	-
PLT-03	Boiler – 2/1	197.394	2410983	808983	-	-	2.50	-	-	02	-	-	-
PLT-04	Boiler – 3/2	198.215	2410785	808942	-	-	2.25	-	-	02	-	-	-
PLT-05	CHP-1	200.850	2411452	809100	-	-	2.50	-	-	02	-	-	-

Note: BH = Borehole, ERT=Electrical Resistivity Test, CHST=Crosshole Seismic Test, BVT= Block Vibration Test, TP= Trial Pit, DCPT= Dynamic Cone Penetration Test, UDS = Undisturbed Soil Samples, SPT = Standard Penetration Test, DS = Disturbed Soil Samples other than SPT samples, WS = Water Samples, SWL = Standing water level.

4.3 Standard Penetration Tests

Standard penetration tests were carried out in soil encountered during boring to determine in-situ consistency and strength characteristics. This was carried out in accordance with IS: 2131. Number of blows (N-value) required driving the 50 mm outer diameter standard split spoon for a penetration of 0.30 m by a 63.5 kg hammer falling freely from a height of 750 mm is given in bore-logs in this report. Graphical view of 'N' value vs. depth is also given in this report.

4.4 Electrical Resistivity Test (ERT)

Electrical Resistivity Tests (ERT) was carried out at ten (10) pre-selected locations following IS: 3043 using Resistivity Meter (Model DDR2, IGIS).

The tests were carried out with four electrode arrangements commonly known as Wenner arrangement in Geophysical Resistivity Survey or Soil Resistivity Survey. In this method all four electrodes are placed in one line, the outer pair of electrodes are used as current electrodes (thorough which current is passed into ground) while the inner pair of electrodes are used for measuring potential difference. Equal spacing between the electrodes 'a' is kept constant and is governed by the depth to which resistivity measurement is desired. Soil conditions, geology of the sub-surface formations and conductivity of sub-surface layers also determine proper electrode spacing. At each location, readings were taken in eight directions North-South, East-West, North East – South West, North West – South East directions. Two sets of observations were taken at each electrode spacing and mean value is taken as representative.

Resistivity is estimated by the following formula:

$$\rho = 2.\ \pi.\ a.\ R$$

Where

ρ = Apparent resistivity (Ohm-m)

a = Distance between two electrodes (m). Resistivity corresponds to a point at the centre of electrode spreads.

R = Observed resistance (Ohm).

In the present study spacing 'a' was kept at 0.50m, 1.0 m, 2.0 m, 3.0m, 4.0m, 5.0 m, 6.0m, 8.0m and 10.0 m respectively.

Tabulated results of resistivity measurements and apparent resistivity are presented in Appendix-II of this report.

4.5 Field Permeability Test

Field permeability tests were carried out by the Falling Head method in cased boreholes. In this test, the casing was filled with water that was then allowed to seep into the soil. The rate of drop of the water level in the casing was observed by measuring the depth of the water surface below the top of the casing. These observations are made until the drop becomes negligible or until sufficient readings have been obtained.

4.6 Dynamic Cone Penetration Test (DCPT)

This test provides an easy but quick means for assessing compactness of soil. Dynamic cone penetration tests (DCPT) were conducted following IS: 4968 (Part-1)-1976 to evaluate penetration resistance of soil. In this test a standard solid steel cone of 63.5 mm diameter and apex angle of 60° attached to drill rods is driven by a 65.0 Kg steel monkey falling freely for a height of 750 mm. Number of blows (N_{cd} or N_{cbr}) required to drive the standard cone per 100 mm penetration is recorded. The results are presented in tabular and graphical form in Appendix-I.

4.7 Block Vibration Test

In order to ascertain dynamic properties of soil (Residual soil), one (01) Block Vibration Test was carried out as per IS: 5249 (Revised).

Basically co-efficient of elastic uniform compression, 'C_u' values are determined along with damping co-efficient of soil by dynamically exciting a concrete block of specific dimensions with a rotating mass type Lazan oscillator, producing varying sinusoidal free force upto 1200 kg following IS: 5249. The eccentric angle between the masses can be varied from 0^0 to 140^0 and the eccentricity can be adjusted with an adjuster circle.

The frequency range can be adjusted commensurate with the size of block to be tested and the type of soil or rock. The oscillator is driven by a 3 HP single-phase D.C. motor with variable speed control. The vibration characteristics are measured with acceleration, velocity and displacement pick-ups. Nature of vibration due to excitation of concrete block is visually observed through an oscilloscope. Detailed processed data for block vibration test conducted at various depths below existing ground level are presented in the Appendix.

Total weight of the machine including mechanical oscillator, D.C. Motor and base plate was 118 Kg (approx.)

4.8 Plate Load Test

Five (05) routine plate load test (RPLT) was conducted at specified location and depth in accordance with IS: 1888. Size of test plate was 60 cm x 60 cm. Load on test plate was applied by hydraulic jack through ball & socket joint reacting against a gravity type kentledge made of R.S. joists, drum sheets and earth filled bags. At first a seating load was applied. Subsequent load increments were applied in stages up to required intensity. Settlement of plate with elapsed time was recorded through multiple dial gauges for every stage of loading and unloading. After reaching final settlement, load was released in stages and settlements were recorded with time. Net settlement of plate sufficiently after completion of unloading was recorded.

The test pit log, load – settlement have been drawn and enclosed in Appendix-I of this report.

4.9 Cyclic Plate Load Test

Altogether two (2) Cyclic Plate Load Tests (CPLT) were conducted on weathered rock at the specified locations at a depth ranging from 2.00m to 2.50m below GL in accordance with IS :1888. Load on test plate was applied by hydraulic jack through ball & socket joint reacting against a gravity type kentledge made of R.S. joists, drum sheets and sand bags. At first a seating load was applied. Subsequent load increments were applied to required intensity and thereafter unloaded in stages. Each cycle of test involved increment of loading to required intensity and subsequently unloaded completely before starting the next load cycle. This procedure was applied for each cycle of loading until application of full test load. Settlement of the test plate vs. time was recorded through multiple dial gauges for every loading and unloading stages. Size of test plate used was (60cm x 60 cm).

Pit log, load – settlement curves for each cycle have been drawn and are presented in Appendix-I of this report.

Pit logs for plate load tests are enclosed in Appendix-I.

4.10 Cross-Hole Seismic Velocity Tests (Chst)

Seismic Cross-Hole tests were carried out at one (1) location. The purpose of the Cross Hole Test was to determine the Compression wave (P-Wave) and Shear wave (S-Wave) and to assess dynamic soil parameters based on the seismic wave velocities.

Seismic Cross Hole Tests use two or more boreholes to measure wave propagation velocities along horizontal paths. In the present investigation, the cross-hole test configuration consists of three holes arrangement in which one contains an impulse energy source called the Source Borehole (s) and other two boreholes are Receiver holes (R-1 and R-2). The three boreholes are at a distance of 2.0m from centre to centre. By fixing both the source and the receivers at the same depth in each borehole, the wave propagation velocity of the materials between the boreholes and the source at that depth has been measured. In the present investigation, the tests were conducted at a starting depth of 2.00m below EGL and thereafter at an interval of 1.0m u to a total depth of 25.0m below EGL.

TEST PROCEDURE

Initially three boreholes of 100mm dia. were done up to the required depth of 25.0m below ground level with a spacing of 2.0m centre to centre. After boring, all the boreholes were cased with 60mm internal diameter and 70mm outer diameter PVC casing and the space between the holes and the casing were properly grouted. The cross-hole seismic system consists of four basic components viz. a Personal Computer (PC) with high-speed data acquisition card, Win Geo acquisition and analysis software and P-SV Electromechanical source and two triaxial Geophone receivers. The present system used is designed and manufactured in accordance with ASTM D4428 – D4428M – 00 Standard methods for Cross Hole Seismic Testing. The complete set up has been manufactured by OLSON ENGINEERING, Inc. USA.

In the source borehole, an electromechanical source P-SV which creates, both downward an upward polarised shear vertical waves (SV) at a given depth was installed and in the receiver holes, triaxial geophones were installed at the same depth of source borehole. The source and the receiver Geophone are separately lowered into the boreholes at the designed depth of test with a dummy inclinometer probe keeping proper orientation of the Receiver Geophone in relation to the source borehole. After the desired depth is reached, the bladder attached to the electromagnetic source piston and the receiver Geophones are inflated with air pressure so that it properly fits on the side of casing. All the communication cables in the source and receivers are connected to the Amplifier module of the Data PC together with trigger cable. There are seven channels in the Module, three for each receiver (total six) and one for trigger.

For data acquisition, the computer is made on and after file and parameter set up, the Impact button of the trigger channel is pushed for up direction and data were recorded by the computer for all the six channels of the two receivers.

After obtaining data, the step is repeated for down direction and thus the data for both direction of Triggering will be obtained for a particular depth. After the data acquisition is completed, for a particular depth, the entire process is repeated for the next depth and the data acquisition was made for the entire 25.0m depth.

The observed values of compression and shear wave velocity at different depth including dynamic soil parameters have been enclosed in the following pages.

4.11 Ground water

Ground water observations were made during the progress of boring. The depths at which ground water was encountered and the standing water levels as observed were recorded in the borehole logs. Whenever ground water was struck, boring was stopped for half an hour to allow water level to stabilise. The depth at which water was struck was measured. After completion of borehole readings of the depth of water level was taken after suitable intervals and then the borehole was backfilled.

SECTION - II

LABORATORY TEST RESULTS AND GROUND CONDITION

5.0 LABORATORY TESTS

Soil samples collected at field were brought to laboratory for necessary testing and rechecking/reviewing the field bore logs. Laboratory tests included liquid limit & plastic limit (IS: 2720 (P-V) – 1973), natural moisture content (IS: 2720 (P-II) – 1973), bulk & dry densities. Grain size analysis (IS: 2720 (P-IV) – 1985) was performed also on cohesive and non-cohesive soils. Triaxial compression tests (IS: 2720 (P-XI) – 1971) as well as unconfined compression (UC) tests (IS: 2720 (P-X) – 1971) were performed to determine the shear strength characteristics. Oedometer tests were carried out to determine consolidation properties.

Chemical tests on ground water and soil sample were conducted to determine pH {(IS: 3025 (P-11)}, chloride {(IS: 3025 (P-32)} and sulphate {(IS: 3025 (P-24)} content.

After completion of tests, the data have been compiled and the field bore-logs have been reviewed and finalised. Final bore-logs have been presented in this report.

Results of all tests have been presented both in tabular and graphical form as applicable and presented borehole-wise. Results of all boreholes are presented in Appendix – II.

6.0 GROUND CONDITION

Four (04) different soil layers were identified and their successions are given below. Cross sections along with ‘N’ values have been drawn to visualise disposition and sequence of different layers together with their consistencies.

The sub-surface stratum has been marked in individual bore log and summary of laboratory test results has been prepared in tabular form along with their description for better understanding of each sub-soil stratum.

7.0 PLATE LOAD TEST RESULTS

Bearing Capacity From Plate Load Tests:

Safe Bearing Capacity (SBC) and settlement of foundation given in the above table have been determined using the following formula for cohesive soil:

$S_f = Sp \times B/b_p$

Where, B = size of footing in metre

b_p = size of test plate in metre

S_f = Settlement of footing in mm

Sp = settlement of test plate in mm

PLT No.	Soil Type	Depth of Test below EGL	Max Load	Settlement (mm)	
		(m)	(Kpa)	Gross	Net
PLT-01	Silty Clay	2.50	801.35	40.16	25.92
PLT-02	Silty Clay	2.00	801.35	31.91	24.96
PLT-03	Silty Clay	2.50	801.35	37.12	22.11
PLT-04	Silty Clay	2.50	801.35	27.18	22.32
PLT-05	Silty Clay	2.50	801.35	27.97	20.00

PLT NO.	Yield Load Intensity (Kpa)	Safe Bearing Capacity (SBC) (Kpa)	Settlement of plate(60cmx60cm) in mm under imposed load equal to the SBC	Settlement of prototype footing in mm of size 3m square under an imposed load equal to SBC
PLT-01	550	275	2.97	14.85
PLT-02	435	218	1.90	9.50
PLT-03	530	265	7.50	37.50
PLT-04	485	240	2.55	12.78
PLT-05	370	185	1.60	8.00

8.0 RESULTS AND DYNAMIC PROPERTIES BASED ON CPLT:

Soil parameters determined from cyclic plate load test are furnished in following table.

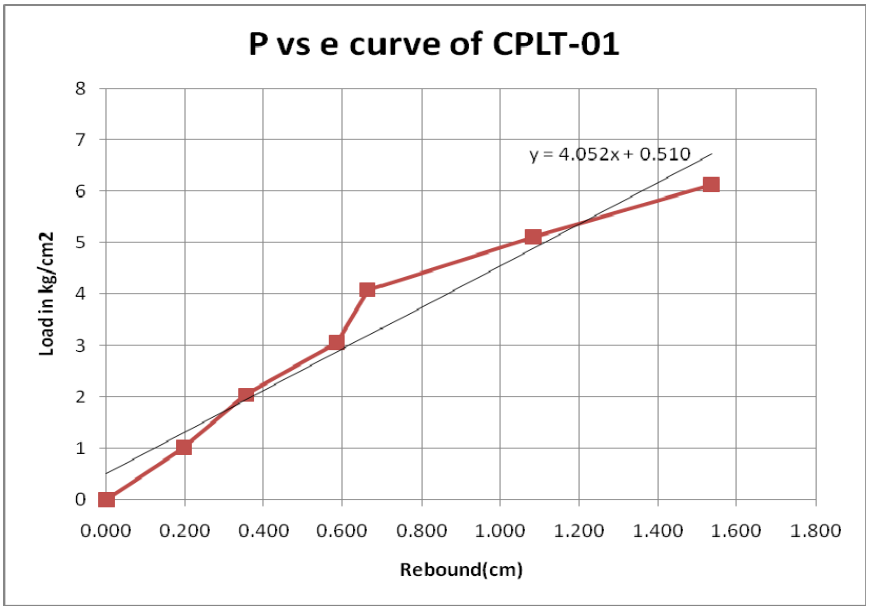
PLT No.	Soil Type	Depth of Test	Max Load	Settlement (mm)	
		(m)	(kPa)	Gross	Net
CPLT-1	Silty Clay/Clayey Silt	2.50	613.80	40.53	25.17
CPLT-2	Sandy Silty Clay	2.25	801.35	43.36	31.20

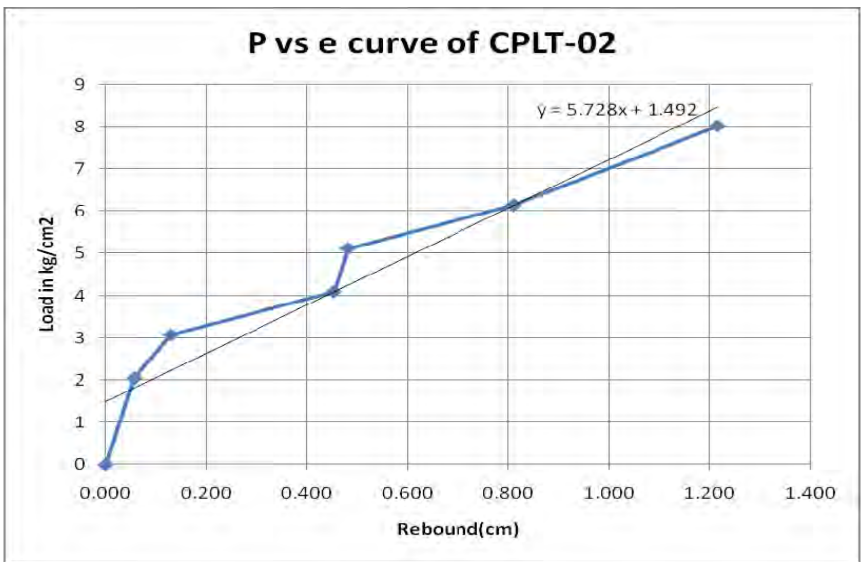
PLT NO.	Yield Load Intensity (Kpa)	Safe Bearing Capacity (SBC) (Kpa)	Settlement of plate in mm under imposed load equal to the SBC	Settlement of prototype footing in mm of size 3m square under an imposed load equal to SBC
CPLT-01	360	180	4.85	24.25
CPLT-02	385	190	2.18	10.90

DYNAMIC PROPERTIES OF SOIL FROM CYCLIC PLATE LOAD TEST

(For foundation with base area of 10 m^2)

Cyclic Plate Load Test No. (Unit)	Coefficient of Elastic Uniform Compression C_u Kg/Cm^3	Coefficient of Elastic Uniform Shear C_τ Kg/Cm^3	Coefficient of Elastic Non-`Uniform Compression C_ϕ Kg/Cm^3	Coefficient of Elastic Non-Uniform Shear C_ψ Kg/Cm^3	Young Modulus E Kg/Cm^2	Shear Modulus G Kg/Cm^2
CPLT-01	0.77	0.44	1.52	0.66	171.58	59.17
CPLT-02	1.09	0.62	2.15	0.93	242.21	83.52


P vs e curve of CPLT-01
y = 4.052x + 0.510
Load in kg/cm2
Rebound(cm)
0
1
2
3
4
5
6
7
8
0.000
0.200
0.400
0.600
0.800
1.000
1.200
1.400
1.600
1.800


P vs e curve of CPLT-02
y = 5.728x + 1.492
Load in kg/cm2
Rebound(cm)
0
1
2
3
4
5
6
7
8
9
0.000
0.200
0.400
0.600
0.800
1.000
1.200
1.400

Calculation of Dynamic soil properties from CPLT-01:

Load vs. elastic rebound curve has been prepared graphically from CPLT test data. The co-efficient of elastic uniform compression (C_u) may now be determined as $C_u = P/S_e$

Where, P = Load on plate in kg/cm^2

S_e = Elastic rebound corresponding to load in cm

From load-elastic rebound graph the slope of the load vs rebound is 4.052 kg/cm^3 which is Cu.

The above result should be represented for foundation base area of $10m^2$ following the general practice of presenting dynamic properties of soils and necessary correction for base area has to be been done following IS: 5249-1992.

$C_{u1} = C_u (A/A_1)^{0.5}$

The relation is valid for small variations in base area of the foundations and may be used for area up to $10m^2$. For actual foundation areas larger than $10m^2$, the value of C_u obtained for $10m^2$ may be used.

For the test plate of size 60cm square,

$A = 0.60 \times 0.60 = 0.36m^2$, $A_1 = 10m^2$, $C_u = 4.052\ Kg/cm^3$

Therefore, the co-efficient of elastic uniform compression (C_{u1}) for $10m^2$ area is evaluated as: $C_{u1} = 4.052 \times (0.36/10)^{0.5} = 0.77\ kg/cm^3$

All the other dynamic properties presented in the above table is calculated based on above result of C_{u1} and following standard relationships presented in IS 5249: 1992.

Coefficient of Elastic Uniform Shear C_τ (kg/cm^3) = C_u/1.5 to 2.0 (Say 1.75) = 0.44 kg/cm^3

Coefficient of Elastic Non-Uniform Compression $C_\varnothing$ (kg/cm^3) = 3.46 C_τ = 1.52 kg/cm3

Coefficient of Elastic Non-Uniform Shear C_ψ (kg/cm^3) = 1.5 C_τ = 0.66 kg/cm^3

Poisson's ratio is considered as = 0.45 (for clayey silt/sandy clayey siltty soil)

Young Modulus E (kg/cm^2) = $\{C_{u1} (1-\mu^2) x A^{0.5}\}/1.13$

= $0.77 \times (1-0.45^2) \times (10 \times 10^4)^{0.5}/1.13$

= 171.58 kg/cm^2

Shear Modulus G (kg/cm^2) = $E/ \{2(1+ \mu)\}$

= 171.58/2(1+0.45)

= 59.17 kg/cm^2

9.0 BLOCK VIBRATION TEST RESULTS

One block vibration tests (BVT-1) was carried out following IS: 5429 on a 1.50 m (L) X 0.75 m (B) x 1.00 m (H) high plain cement concrete block of M15 grade. The test was carried out at 2.20 m depth below EGL.

Measured values of amplitudes for vertical vibration at different operating frequency for each set of eccentric angles have been presented in tabular form and plotted. The resonant frequency of vibration (f_n) and resonant amplitude (X_m) in microns have been evaluated and presented in tabular form.

Resonant Frequency and Amplitude:

Sl. No.	Eccentric Angle (Degrees)	Resonant Frequency (RPM)	Resonant Amplitude (Micron)
1	32	2500	171
2	40	2500	180
3	48	2500	200
4	56	2500	220

9.1 Conclusion and Recommendation

Based on the results of block vibration test following dynamic parameters for sub-soil are suggested for foundation contact area of 10 m^2. Estimated dynamic properties are presented in tabular form here under. *Poisson's ratio for the sub-soil at the test beds may be considered as 0.35*.

Sl. No.	Eccentric Angle (Degree)	For 10 m^2 foundation contact area		
		C_u (Kg/Cm^3)	E (Kg/Cm^2)	G (Kg/Cm^2)
1	32	5.87	439	152
2	40	5.87	439	152
3	48	5.87	439	152
4	56	5.87	439	152

Sample Calculation for Dynamic Properties of Soil from Block Vibration Test (BVT-1).

Coefficient of Elastic Uniform Compression (C_u)

According to IS: 5249-1979; Cl. 5.1.1.3

$$C_u = \frac{4.\pi^2.\ f_{nz}^2\ .M}{A}$$

Where, C_u = Coefficient of Elastic Uniform Compression
f_{nz} = Resonant frequency (CPS)
M = Mass of block, oscillator and motor (Kg Sec^2/Cm)
A = Contact area of the block with soil (Cm^2)

Size of block = 1.5 m x 0.75 m x 1.00 m
Wt. of block = 2.4 x 1.5 x 0.75 x 1.00 = 2.70 T
Wt. of oscillator & motor = 118 Kg = 0.118 T
Total weight = 2.7 + 0.118 = 2.818 T

Total mass: $M = \frac{2.818 \times 10^3}{981} = 2.873$ Kg Sec^2/Cm

Contact Area = 150 x 75 = 11250 Cm^2

$$\therefore \quad C_u = \frac{4.\pi^2.\ 2.873.\ f_{nz}^2}{11250} = 10.08 \times 10^{-3.}\ f_{nz}^2 \quad Kg/\ Cm^3$$

From the test block, for eccentricity of 48^0 and

Resonant frequency (f_{nz}) = 2500 RPM = 41.7 CPS; C_u = 17.50 Kg/ cm^3

Modulus of Elasticity and Shear Modulus (E & G)

According to IS 5249 – 1979, Annex – I

$$E = \frac{C_u (1 - \mu^2)\ \sqrt{A}}{1.13}$$

Considering Poisson's ratio μ = 0.25

$$E = \frac{C_u (1 - 0.35^2)\ \sqrt{(150 \text{ X } 75)}}{} = 82.365\ C_u\ Kg/\ Cm^2$$

1.13

For C_u = 17.50 kg/Cm^3; Elastic modulus E = 1441.39 Kg/ Cm^2.

For C_U = 17.50 kg/Cm^3; $G = \dfrac{E}{2(1+\mu)} = \dfrac{1441.39}{2 \times 1.35}$ = 534 Kg/ Cm ^{2}

Similarly, C_U, E and G - value for the other eccentric angles have been made and presented in the table above.

Correction for Area

According to Cl. 5.1.1.4 of IS: 5249–1979, the value of '$(C_u)_{test}$' obtained from test block of contact area 'A' should be corrected to actual foundation area A_f as below :-

$(C_u)_{Af} = (C_u)_A \times (^A/_{Af})^{0.5}$

This correction is to be done for contact area upto 10.0 M ^{2} and beyond that same correction factor is to be used.

Correction Factor for 10.0 M ^{2} area:

$$\frac{(C_u)_{10.0\,M^2}}{(C_u)_{test}} = \frac{(E)_{10.0\,M^2}}{(E)_{test}} = \frac{(G)_{10.0\,M^2}}{(G)_{test}}$$

$(C_u)_{10.0\,M^2} = (C_u)_{test} \times \{(1.50 \times 0.75)/ 10.0\}^{0.5} = 0.3354 \times (C_u)_{test}$

Hence, for $(C_u)_{test}$ = 17.50 Kg/Cm^3

$\therefore (C_u)_{10.0\,M^2}$ = 5.87 Kg / Cm^3

for $(E)_{test}$ = 1129.35 Kg/Cm^2

$\therefore (E)_{10.0\,M^2}$ = 483 Kg / Cm^2

for $(G)_{test}$ = 451.74 Kg/Cm^2

$\therefore (G)_{10.0\,M^2}$ = 179 Kg / Cm^2

10.0 RESULTS OBTAINED FROM CROSS HOLE SEISMIC TEST

The following table shows the results as obtained from cross hole seismic test for various stratums.

	Depth (m)	Bulk density (KN/m3)	Mass density	Vp (m/s)	Vs (m/s)	Poisson's Ratio	Youngs Modulus (T/m2)	Rigidity Modulus (T/m2)	Bulk Modulus (T/m2)
CHST-01	2.00	18.5	1.89	518	257	0.34	333000	124557	339937
	3.00	18.5	1.89	558	276	0.34	384436	143655	395640
	4.00	18.5	1.89	560	280	0.33	394264	147849	394264
	5.00	19	1.94	565	267	0.36	374517	138072	434178
	6.00	19	1.94	570.6	250	0.38	334392	121050	469192
	7.00	19	1.94	630	260	0.40	365906	130928	594145
	8.00	19.5	1.99	617	146.8	0.47	125940	42837	699605
	9.00	19.5	1.99	1080	558	0.32	1631376	618919	1493306
	10.00	19.5	1.99	1233	645	0.31	2169330	826961	1919367
	11.00	19.5	1.99	1365	630	0.36	2153286	788945	2651732
	12.00	21	2.14	1420	656	0.36	2513680	921209	3088175
	13.00	21	2.14	1511	666	0.38	2619579	949508	3621404
	14.00	23	2.34	1834	980	0.30	5855234	2251702	4883743
	15.00	23	2.34	2018	1074	0.30	7044413	2704378	5941915
	16.00	23	2.34	2239	1197	0.30	8733505	3359287	7274445
	17.00	23	2.34	2311	1373	0.23	10848199	4419772	6628538
	18.00	23	2.34	2365	1292	0.29	10076116	3913667	7895353
	19.00	23	2.34	2345	1324	0.27	10406544	4109934	7412808
	20.00	23	2.34	2466	1364	0.28	11163249	4362019	8441527
	21.00	23	2.34	2536	1417	0.27	11985881	4707589	8801687
	22.00	23	2.34	2469	1369	0.28	11231542	4394057	8433520
	23.00	23	2.34	2480	1310	0.31	10513319	4023476	9055263
	24.00	23	2.34	2536	1417	0.27	11985881	4707589	8801687
	25.00	23	2.34	2675	1503	0.27	13445631	5296351	9714893

Stratum		Description of Soil	N value	NMC (%)	LL (%)	PL (%)	γ_b Kn/m^3	Shear Parameters		(m_v) $m^2/kN \times 10^{-4}$ Range(kPa)		
								C (kPa)	Φ^0	25-50	50-100	100-200
IA	12.50, 2.60	Stiff to very stiff brownish grey sandy silty clay. (CH-CI)	17	21.1	47	18	18.6	57	-	1.5	1.57	1.46
IB							19.0	91	-	1.09	1.20	1.14
II 5.00, 1.00		Medium dense brownish yellow silty sand.	30	-	NP	NP	19.0*	-	33*	E=30 MPa* μ = 0.35		
III 6.10, 0.50		Very dense brownish yellow silty sand with mica flakes.	50	-	NP	NP	19.5*	-	35*	E=45 MPa* μ = 0.35		
IVA 5.10, 0.30		Completely weathered decomposed product of rock.	>100	-	-	-	21*	-	37*	E=70 MPa* μ = 0.30		

Stratum	Description of rock	N Value	Core Recovery (%)	RQD (%)	γ_b Kn/m^3	Rock Strength (MPa)	Modulus of Elasticity (MPa)
IVB 7.50, 1.25	Highly weathered rock	37 to >100	24 to 50	0	23*	3.5	E=140 MPa* μ = 0.30
IVC >5.25	Moderately weathered rock.	>100	50 to 96	28 to 96	24*	6.0	E=360 MPa* μ = 0.30

Average Standing Water Level= BGL-1.54m, RL-197.17,

* Suggested Value

Generalized Soil & Rock Profile With Design Parameters

JOB NO.30796

SECTION – III

11.0 ENGINEERING APPRAISAL AND RECOMMENDATION

The proposed structure for this site will be Thermal Power Project. It is expected to have various types of loading. As known from clients the Finished Ground Level of the site will be 203.00m.

Rocky strata are encountered at an average RL of about 190m. For highly loaded structures requiring high bearing capacity within tight settlement open foundations needs to placed within it. But in this situation the depth of foundations rises to about 13.00m below FGL. A water bearing sandy layer (Stratum-II and III) is also encountered at lower depth hence a suitable and constant dewatering technique should also be applicable during excavation for foundations. Considering the above situations we recommend for bored cast in situ piles for moderately to highly loaded structures and open foundations for lightly loaded structures. Safe carrying capacities of various diameters of bored cast in situ piles and aspect of open foundations are discussed below.

Susceptibility of sub soil strata to liquefaction:

Liquefaction is a phenomenon in which a saturated cohesion less soil looses strength during an earthquake and acquires a degree of mobility sufficient to permit significant movements. When sand is not saturated the earthquake may cause significant compaction and subsidence. In general, fine uniform sands are found to be most susceptible for liquefaction in terms of grain size.

In this connection, liquefaction potential of the subsoil has been studied following Simplified Procedure proposed by Idriss & Boulanger (2004) for sandy soil and from "Evaluating the Potential for Liquefaction or Cyclic Failure of silt and clays" by Boulanger and Idriss (2004) for clayey soil. Sambalpur is considered as to fall under Zone-III as per IS 1893 (Part-1): 2016 "Criteria for Earthquake Resistant Design of Structures". Peak horizontal ground acceleration (a_{max}) has been considered as 0.16g for design basis earthquake. Earthquake magnitude is considered as 7.5 for the analysis.

Under the above condition it was observed that the subsoil is not liquefiable under dynamic earthquake loading.

11.1 OPEN FOUNDATIONS

The safe carrying capacity of open foundations placed at various depths considering the soil parameters provided in the generalised subsoil profile at the end of Section-II of this report and using the thickness of individual boreholes.

However if open foundation is thought of then the Safe Bearing Capacities of open foundations placed within rocky strata is given below in the following table.

AREA	Borehole Considered	Width of square footing(m)	At 3.00m below NGL	At 4.50m below NGL	At 6.00m below NGL	At 8.00m below NGL	At 9.00m below NGL
			Net Allowable Bearing Capacity(kPa) considering shear and allowable settlement of 25mm settlement				
Crusher House	BH-01	<=3	152	165	283	300	300
		>3 to <= 6	85	113	174	256	300
Chimney 1	BH-02	<=3	152	165	283	300	300
		>3 to <= 6	84	111	174	256	300
Chimney 2	BH-03	<=3	152	165	177	194	203
		>3 to <= 6	71	80	90	108	118
Boiler 1	BH-04 & BH-05	<=3	243	300	350	450*	450*
		>3 to <= 6	222	300	350	450*	450*
Boiler 2	BH-06 & BH-07	<=3	243	263	283	600*	600*
		>3 to <= 6	156	211	243	600*	600*
Boiler 3	BH-08 & BH-09	<=3	152	165	283	300	300
		>3 to <= 6	96	146	226	300	300
C-Row 1	BH-10	<=3	243	263	450*	450*	450*
		>3 to <= 6	198	233	450*	450*	450*
C–Row 2	BH-11	<=3	243	263	283	350	350
		>3 to <= 6	144	184	243	350	350
A-Raw 1	BH-12	<=3	243	263	350	350*	350*
		>3 to <= 6	181	233	350	350*	350*
A-Raw 2	BH-13	<=3	350	350	450*	450*	450*
		>3 to <= 6	350	350	450*	450*	450*
TG Deck 1	BH-14	<=3	350	350	450*	450*	450*
		>3 to <= 6	350	350	450*	450*	450*
TG Deck 2	BH-15	<=3	350*	450*	450*	450*	450*
		>3 to <= 6	350*	450*	450*	450*	450*
TG Deck 3	BH-16	<=3	152	263	283	350	350
		>3 to <= 6	112	174	237	350	350
Cooling Tower 1	BH-17	<=3	243	263	283	350	350
		>3 to <= 6	136	176	243	350	350
Cooling Tower 2	BH-18	<=3	243	263	350	350	350*
		>3 to <= 6	163	233	350	350	350*
Cooling Tower 3	BH-19	<=3	243	350	350	350	350
		>3 to <= 6	208	350	350	350	350
Reservoir 1	BH-20	<=3	152	263	283	350	450*
		>3 to <= 6	116	188	243	350	450*
Reservoir 2	BH-21	<=3	152	165	283	300	450*
		>3 to <= 6	118	146	243	300	450*
Reservoir 3	BH-22	<=3	152	263	283	300	450*
		>3 to <= 6	120	207	243	300	450*
CHP 1	BH-23	<=3	152	350	350	350	450*
		>3 to <= 6	134	350	350	350	450*
CHP 2	BH-24	<=3	152	263	350	450*	450*
		>3 to <= 6	139	233	350	450*	450*

Ash Silo	BH-25	<=3	152	165	177	194	300
		>3 to <= 6	82	89	101	153	221
Township	BH-26	<=3	152	165	177	450*	450*
		>3 to <= 6	93	128	152	450*	450*
Ash Dyke 1	BH-27	<=3	152	165	283	300	450*
		>3 to <= 6	96	146	218	256	450*
Ash Dyke 2	BH-28	<=3	152	165	350	450*	450*
		>3 to <= 6	103	146	350	450*	450*
Ash Dyke 3	BH-29	<=3	243	263	350	350	450*
		>3 to <= 6	171	233	350	350	450*
Ash Dyke 4	BH-30	<=3	243	263	350	350	450*
		>3 to <= 6	171	233	350	350	450*

* represents that high bearing capacity is due to high depth of foundation and presence of rock at immediate vicinity designing at such bearing capacity may lead to differential settlement hence a lower value is recommended.

SBC FOR FOUNDATIONS WITH IN ROCKY STRATA

Stratum	Depth of Embedment within this stratum	Net Safe bearing capacity(kPa) for settlement within 12mm
IVA	0.50	350
IVB	0.50	450
IVC	0.50	600

The above SBC mentioned for foundations placed over rocky strata is not dependent on the size of the footings.

11.2 PILE FOUNDATIONS

Safe carrying capacities of various diameter bored cast in situ piles considering individual borehole is given below in the following table. However the same must be verified by carrying out load test at site following IS Code of practices.

The common precautions to be maintained at site:

1) Weight of chisel and capacity of operating winch shall be commensurate with diameter of pile, ultimate crushing strength (UCS) of rock, depth of socketing required in rock etc.

2) The bottom of the pile should be properly cleaned to remove rock debris, pile bore soil etc.

AREA	Borehole Considered	Diameter of pile(mm)	PILE TIP RESTING WITHIN ROCK						PILE TIP RESTING WITHIN SOIL				Free Head		Fixed Head	
			Safe Vertical Capacity(KN)		Rock Socketting within Rocky Stratum	Length of Rock Socketting (m) D = Diameter	Bored Length(m)	Shaft Length(m)	Safe Vertical Capacity(KN)		Bored Length(m)	Shaft Length(m)	Depth of fixity (m)	Lateral Capacity (KN)	Depth of fixity (m)	Lateral Capacity (KN)
			Compression	Tension					Compression	Tension						
Crusher House	BH-01	500	1150	500	IVA	6.50	18.50	17.00	450	250	12.00	10.50	3.95	19	4.57	48
		600	1750	750		6.50	18.50	17.00	650	300	12.00	10.50	4.74	22	5.49	58
		750	3000	1100		6.50	18.50	17.00	1000	400	12.00	10.50	5.92	28	6.86	72
Chimney 1	BH-02	500	1200	550	IVA	6.50	20.00	18.50	450	250	12.00	10.50	3.95	19	4.57	48
		600	1800	800		6.50	20.00	18.50	650	300	12.00	10.50	4.74	22	5.49	58
		750	3100	1200		6.50	20.00	18.50	1000	400	12.00	10.50	5.92	28	6.86	72
Chimney 2	BH-03	500	1200	550	IVA	6.50	21.00	19.50	300	200	12.00	10.50	3.95	19	4.57	48
		600	1800	800		6.50	21.00	19.50	375	250	12.00	10.50	4.74	22	5.49	58
		750	3100	1200		6.50	21.00	19.50	500	350	12.00	10.50	5.92	28	6.86	72
Boiler 1	BH-04 & BH-05	500	1050	450	IVB	3 x D	8.50	7.00	Rocky strata is encountered at shallow depth.				3.95	19	4.57	48
		600	1450	700		3 x D	9.00	7.50					4.74	22	5.49	58
		750	2200	1050		3 x D	9.50	8.00					5.92	28	6.86	72
Boiler 2	BH-06 & BH-07	500	1050	500	IVC	2 x D	8.00	6.50					3.95	19	4.57	48
		600	1500	650		2 x D	8.50	7.00					4.74	22	5.49	58
		750	2300	1000		2 x D	9.00	7.50					5.92	28	6.86	72
Boiler 3	BH-08 & BH-09	500	1350	700	IVB	3 x D	18.50	17.00	500	300	12.00	10.50	3.95	19	4.57	48
		600	1900	1000		3 x D	19.00	17.50	700	350	12.00	10.50	4.74	22	5.49	58
		750	2900	1500		3 x D	19.50	18.00	1100	450	12.00	10.50	5.92	28	6.86	72
C-Row 1	BH-10	500	1050	450	IVB	3 x D	7.00	5.50	Rocky strata is encountered at shallow depth.				3.95	19	4.57	48
		600	1450	650		3 x D	7.50	6.00					4.74	22	5.49	58
		750	2300	1000		3 x D	8.00	6.50					5.92	28	6.86	72
C–Row 2	BH-11	500	1100	500	IVB	3 x D	17.00	15.50	500	200	10.50	9.00	3.54	26	4.1	67
		600	1700	700		3 x D	17.50	16.00	750	250	10.50	9.00	4.1	35	4.75	89
		750	2950	1000		3 x D	18.00	16.50	1100	325	10.50	9.00	4.9	49	5.67	127
A-Raw 1	BH-12	500	1100	550	IVB	3 x D	11.50	10.00	350	150	8.00	6.50	3.95	19	4.57	48
		600	1550	700		3 x D	12.00	10.50	500	175	8.00	6.50	4.74	22	5.49	58
		750	2400	1100		3 x D	12.50	11.00	700	200	8.00	6.50	5.92	28	6.86	72
A-Raw 2	BH-13	500	1050	450	IVB	3 x D	7.00	5.50	Rocky strata is encountered at shallow depth.				3.54	26	4.1	67
		600	1450	650		3 x D	7.50	6.00					4.1	35	4.75	89
		750	2300	1000		3 x D	8.00	6.50					4.9	49	5.67	127
TG Deck 1	BH-14	500	1050	450	IVB	3 x D	7.00	5.50					3.54	26	4.1	67
		600	1450	650		3 x D	7.50	6.00					4.1	35	4.75	89
		750	2300	1000		3 x D	8.00	6.50					4.9	49	5.67	127
TG Deck 2	BH-15	500	950	400	IVB	3 x D	5.00	3.50					2.75	55	3.19	142
		600	1350	550		3 x D	5.50	4.00					3.19	74	3.69	190
		750	2150	900		3 x D	6.00	4.50					3.81	105	4.41	272
TG Deck 3	BH-16	500	1250	650	IVB	3 x D	15.50	14.00	450	200	10.00	8.50	3.95	19	4.57	48
		600	1750	900		3 x D	16.00	14.50	650	250	10.00	8.50	4.74	22	5.49	58
		750	2700	1350		3 x D	16.50	15.00	1000	300	10.00	8.50	5.92	28	6.86	72
Cooling Tower 1	BH-17	500	1300	700	IVB	3 x D	16.00	14.50	450	200	10.00	8.50	3.95	19	4.57	48
		600	1800	900		3 x D	16.50	15.00	650	250	10.00	8.50	4.74	22	5.49	58
		750	2700	1350		3 x D	17.00	15.50	1050	350	10.00	8.50	5.92	28	6.86	72
Cooling Tower 2	BH-18	500	1150	550	IVB	3 x D	11.00	9.50	400	150	9.00	7.50	3.95	19	4.57	48
		600	1600	750		3 x D	11.50	10.00	500	200	9.00	7.50	4.74	22	5.49	58
		750	2500	1150		3 x D	12.00	10.50	800	250	9.00	7.50	5.92	28	6.86	72

AREA	Borehole Considered	Diameter of pile(mm)	PILE TIP RESTING WITHIN ROCK						PILE TIP RESTING WITHIN SOIL				Free Head		Fixed Head	
			Safe Vertical Capacity(KN)		Rock Socketting within Rocky Stratum	Length of Rock Socketting (m) D = Diameter	Bored Length(m)	Shaft Length(m)	Safe Vertical Capacity(KN)		Bored Length(m)	Shaft Length(m)	Depth of fixity (m)	Lateral Capacity (KN)	Depth of fixity (m)	Lateral Capacity (KN)
			Compression	Tension					Compression	Tension						
Cooling Tower 3	BH-19	500	1200	600	IVB	3 x D	12.00	10.50	450	200	10.00	8.50	3.95	19	4.57	48
		600	1650	800		3 x D	12.50	11.00	650	250	10.00	8.50	4.74	22	5.49	58
		750	2550	1200		3 x D	13.00	11.50	950	300	10.00	8.50	5.92	28	6.86	72
Reservoir 1	BH-20	500	1100	550	IVB	3 x D	10.00	8.50	250	150	8.00	6.50	3.95	19	4.57	48
		600	1550	700		3 x D	10.50	9.00	300	175	8.00	6.50	4.74	22	5.49	58
		750	2400	1100		3 x D	11.00	9.50	400	225	8.00	6.50	5.92	28	6.86	72
Reservoir 2	BH-21	500	1100	550	IVB	3 x D	10.50	9.00	250	150	8.50	7.00	3.95	19	4.57	48
		600	1550	700		3 x D	10.50	9.00	300	175	8.50	7.00	4.74	22	5.49	58
		750	2400	1100		3 x D	11.00	9.50	400	225	8.50	7.00	5.92	28	6.86	72
Reservoir 3	BH-22	500	1100	550	IVB	3 x D	10.00	8.50	250	150	8.50	7.00	3.95	19	4.57	48
		600	1550	700		3 x D	10.50	9.00	300	175	8.50	7.00	4.74	22	5.49	58
		750	2400	1100		3 x D	11.00	9.50	400	225	8.50	7.00	5.92	28	6.86	72
CHP 1	BH-23	500	1150	550	IVB	3 x D	10.50	9.00	400	150	8.50	7.00	3.95	19	4.57	48
		600	1550	750		3 x D	11.00	9.50	500	200	8.50	7.00	4.74	22	5.49	58
		750	2450	1150		3 x D	11.50	10.00	750	250	8.50	7.00	5.92	28	6.86	72
CHP 2	BH-24	500	1100	500	IVB	3 x D	9.00	7.50	200	100	7.00	5.50	3.95	19	4.57	48
		600	1500	700		3 x D	9.50	8.00	250	150	7.00	5.50	4.74	22	5.49	58
		750	2350	1050		3 x D	10.00	8.50	350	175	7.00	5.50	5.92	28	6.86	72
Ash Silo	BH-25	500	1150	550	IVA	6.50	18.50	17.00	500	250	12.00	10.50	3.95	19	4.57	48
		600	1750	750		6.50	18.50	17.00	700	300	12.00	10.50	4.74	22	5.49	58
		750	3000	1100		6.50	18.50	17.00	1100	400	12.00	10.50	5.92	28	6.86	72
Township	BH-26	500	1050	500	IVB	3 x D	9.00	7.50	180	120	7.00	5.50	3.95	19	4.57	48
		600	1500	650		3 x D	9.50	8.00	230	140	7.00	5.50	4.74	22	5.49	58
		750	2350	1050		3 x D	10.00	8.50	300	180	7.00	5.50	5.92	28	6.86	72
Ash Dyke 1	BH-27	500	1100	550	IVB	3 x D	10.50	9.00	220	150	8.50	7.00	3.95	19	4.57	48
		600	1550	700		3 x D	11.00	9.50	280	180	8.50	7.00	4.74	22	5.49	58
		750	2400	1100		3 x D	11.50	10.00	370	225	8.50	7.00	5.92	28	6.86	72
Ash Dyke 2	BH-28	500	1100	550	IVB	3 x D	10.00	8.50	225	150	8.00	6.50	3.95	19	4.57	48
		600	1550	700		3 x D	10.50	9.00	300	175	8.00	6.50	4.74	22	5.49	58
		750	2400	1100		3 x D	11.00	9.50	400	225	8.00	6.50	5.92	28	6.86	72
Ash Dyke 3	BH-29	500	1100	550	IVB	3 x D	10.50	9.00	375	150	8.50	7.00	3.95	19	4.57	48
		600	1550	700		3 x D	11.00	9.50	500	175	8.50	7.00	4.74	22	5.49	58
		750	2400	1100		3 x D	11.50	10.00	700	225	8.50	7.00	5.92	28	6.86	72
Ash Dyke 4	BH-30	500	1100	500	IVB	3 x D	10.00	8.50	375	150	8.00	6.50	3.95	19	4.57	48
		600	1550	700		3 x D	10.50	9.00	500	175	8.00	6.50	4.74	22	5.49	58
		750	2400	1100		3 x D	11.00	9.50	700	225	8.00	6.50	5.92	28	6.86	72

12.0 CHEMICAL ACTION

Results of chemical tests on water and soil samples of the site did not indicate aggressiveness to concrete. Therefore, no special treatment is called for. However, concrete used in construction of foundation should be in line with the provisions of IS: 456 – 2000 with proper control on water – cement ratio. The concrete should be dense.

13.0 Excavations and Dewatering:

Temporary excavation in this terrain would not be problematic and may be carried out providing normal slope between 1V: 1H to 1V: 1.5H, depending on the depths and sizes of the cuts. However, stability of the unsupported slope will depend on the duration of exposure of the cut to the environment. With time, desiccation/shrinkage cracks may appear at the unsupported slope and block failure may occur. Therefore, it is suggested that deep cuts having reasonable long period of exposure to the atmosphere may be adequately supported by properly designed shoring system.

Ground water table at the site was encountered at a level close to the Existing Ground Level. Therefore, inflow of ground water into deep cuts is anticipated. However, pumping from sumps may be adequate for dewatering purpose.

14.0 Suitability of subsoil for construction of Roads & Embankments and for Area Filling:

In the context of this chapter, it would be appropriate to consult relevant guidelines of Indian Roads Congress (IRC) and Specifications of the Ministry of Road Transport and Highways, Government of India for various necessary details for design, construction and testing criteria for construction of embankment.

Special consideration should be made as per IRC guidelines for high embankments.

14.1 COEFFICIENT OF EARTH PRESSURE:

Rankine active (K_a) and passive (K_p) earth pressure coefficients may be obtained from the following equations.

$K_a = (1 - \sin\phi)/(1 + \sin\phi)$ and

$K_p = (1 + \sin\phi)/(1 - \sin\phi)$

The at rest earth pressure coefficient (K_0) may be determined from the Jacky's formula which in simplified form may be represented as

$K_0 = 1 - \sin\phi$

In case of clayey deposits in undrained condition, the Rankine active and passive pressure coefficients may be considered as

$K_a = K_p = 1.0$

The earth pressure at rest for clayey deposits may be considered within 0.5 to 1.0. For normally consolidated clay it may be considered as 0.75 while for over consolidated clay it may be considered as 1.00 (Foundation Design and Construction by M. J. Tomlinson).

Strata wise earth pressure coefficients are presented below.

Strata	Coefficient of earth pressure		
	Active (K_a)	Passive (K_p)	At – rest (K_0)
I	0.75	1.00	1.00
II	0.45	0.29	3.39
III	0.43	0.27	3.70
IVA	0.40	0.25	4.02

Earth pressure for Stratum-IVB & IVC is not included above due to the fact that earth pressure of rocks do not follow either the Rankine or the Coulomb failure wedge. These can only be evaluated based on actual fieldtests.

15.0 GENERAL RECOMMENDATIONS

a. Any soft / loose patch / pockets in foundation bed should be excavated and replaced with lean concrete.

b. The surface of the excavated area should not be left exposed and immediate mud mat must be carried out.

c. The ingress of water will not be problematic however if dewatering is required, it may be carried out by using normal pump and sump.

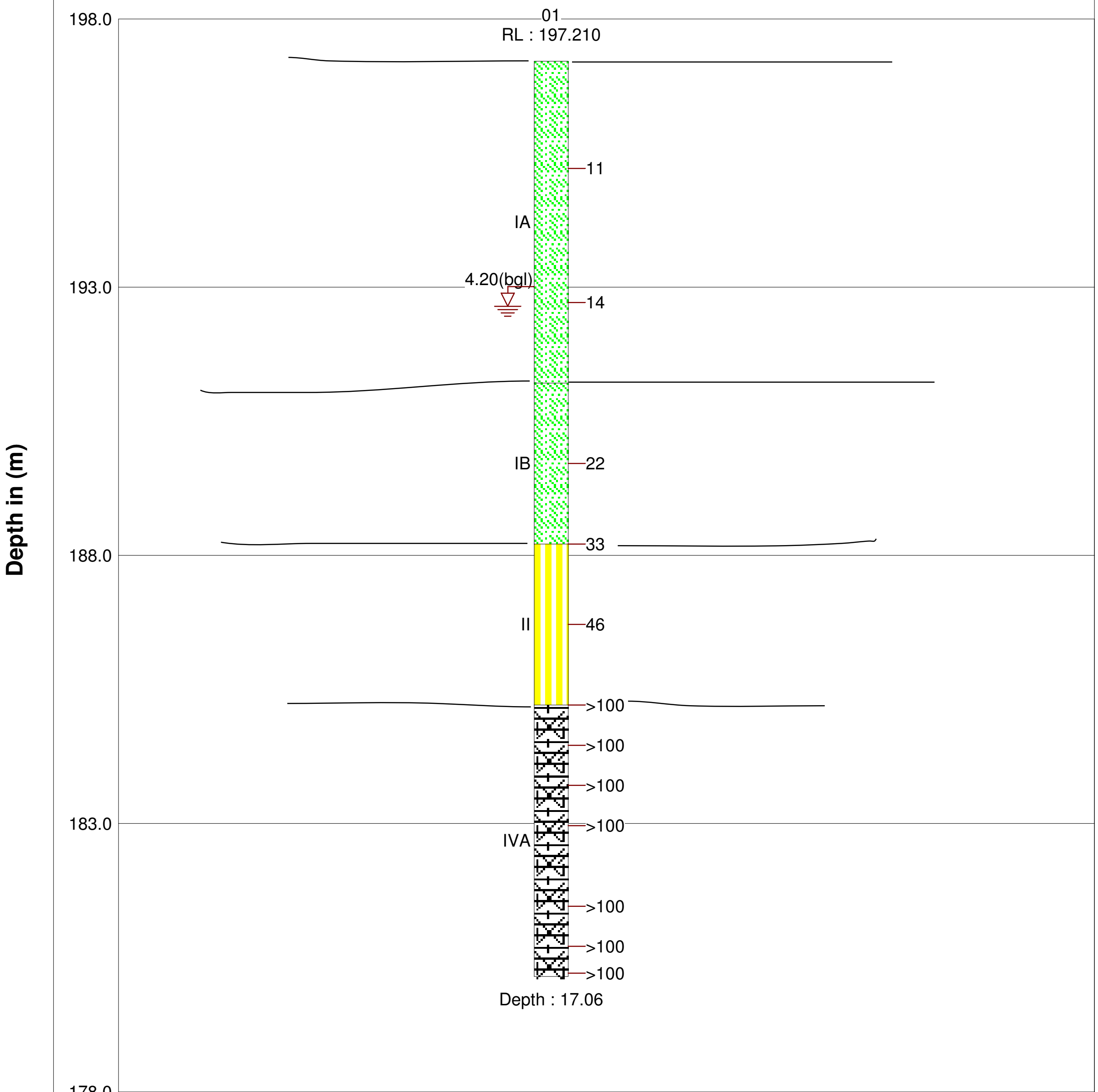
d. It is suggested to carry out the excavation and sub-structures work in the dry season, if possible. Special care needs to be taken during excavation for foundations so that the founding stratum does not get disturbed by excavation process and especially by ground/seepage water.

e. All foundation design should be carried out as per latest BIS code of practices.

f. The foundation bed should be properly shaped, levelled and properly compacted before laying the mud mat and the mud mat should also be compacted.

g. Initial and routine load test of piles should be carried out to as per IS code of practices.

J.Pal
B.Tech, M.E (Geo-tech)



LEGENDS

- Stiff to very stiff brownish grey sandy silty clay. [IA]
- Stiff to very stiff brownish grey sandy silty clay. [IB]
- Medium dense brownish yellow silty sand. [II]
- Completely weathered decomposed product of rock. [IVA]

N Values Shown Thus :—>100

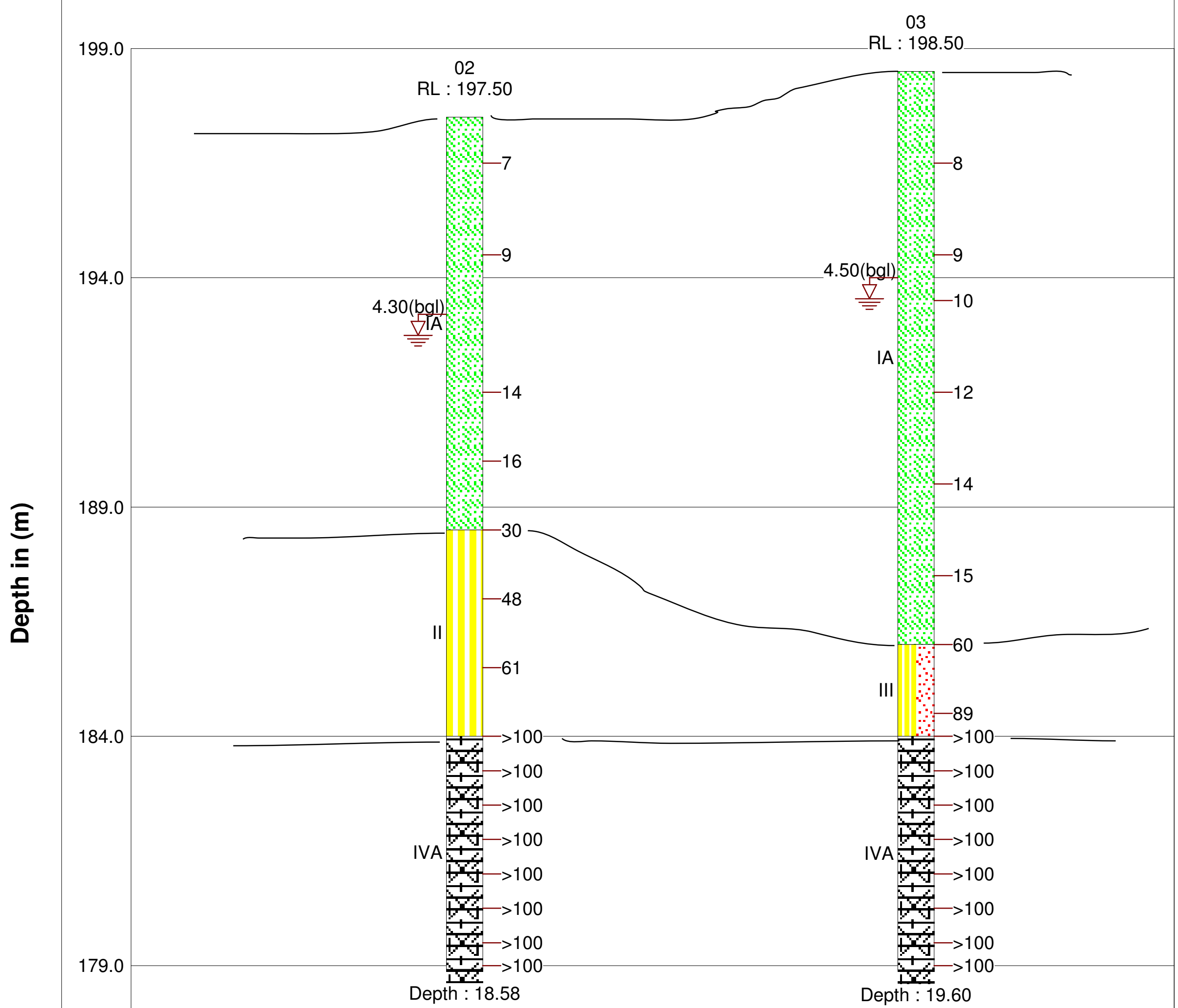
TCR:RQD Values Shown Thus: 0:0

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

Stiff to very stiff brownish grey sandy silty clay. [IA]

Medium dense brownish yellow silty sand. [II]

Very dense brownish yellow silty sand with mica flakes. [III]

Completely weathered decomposed product of rock. [IVA]

N Values Shown Thus :—>100

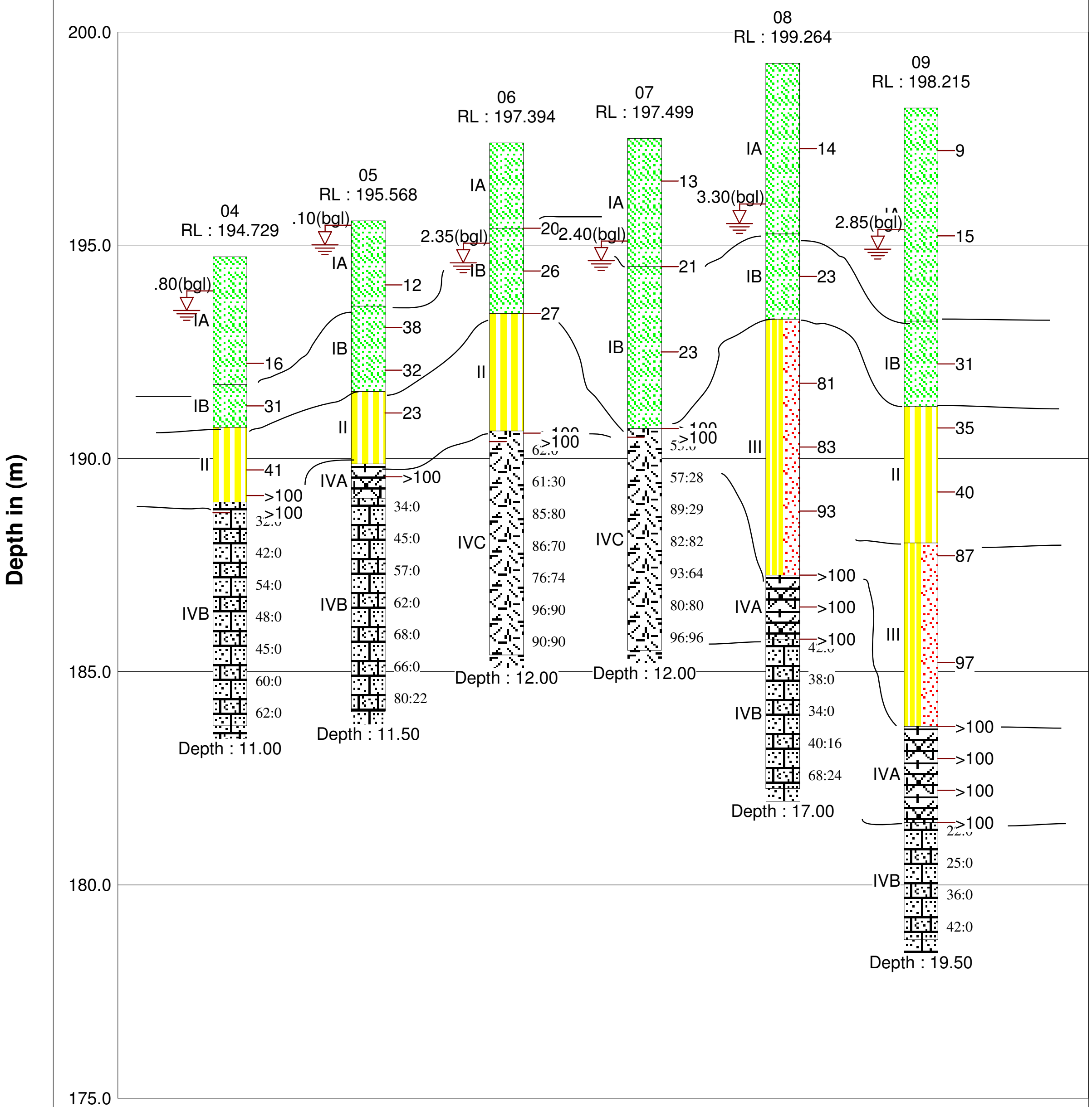
TCR:RQD Values Shown Thus: 0:0

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

- Stiff to very stiff brownish grey sandy silty clay. [IA]
- Stiff to very stiff brownish grey sandy silty clay. [IB]
- Medium dense brownish yellow silty sand. [II]
- Very dense brownish yellow silty sand with mica flakes. [III]
- Completely weathered decomposed product of rock. [IVA]
- Highly weathered rock [IVB]
- Moderately weathered rock. [IVC]

N Values Shown Thus :—>100

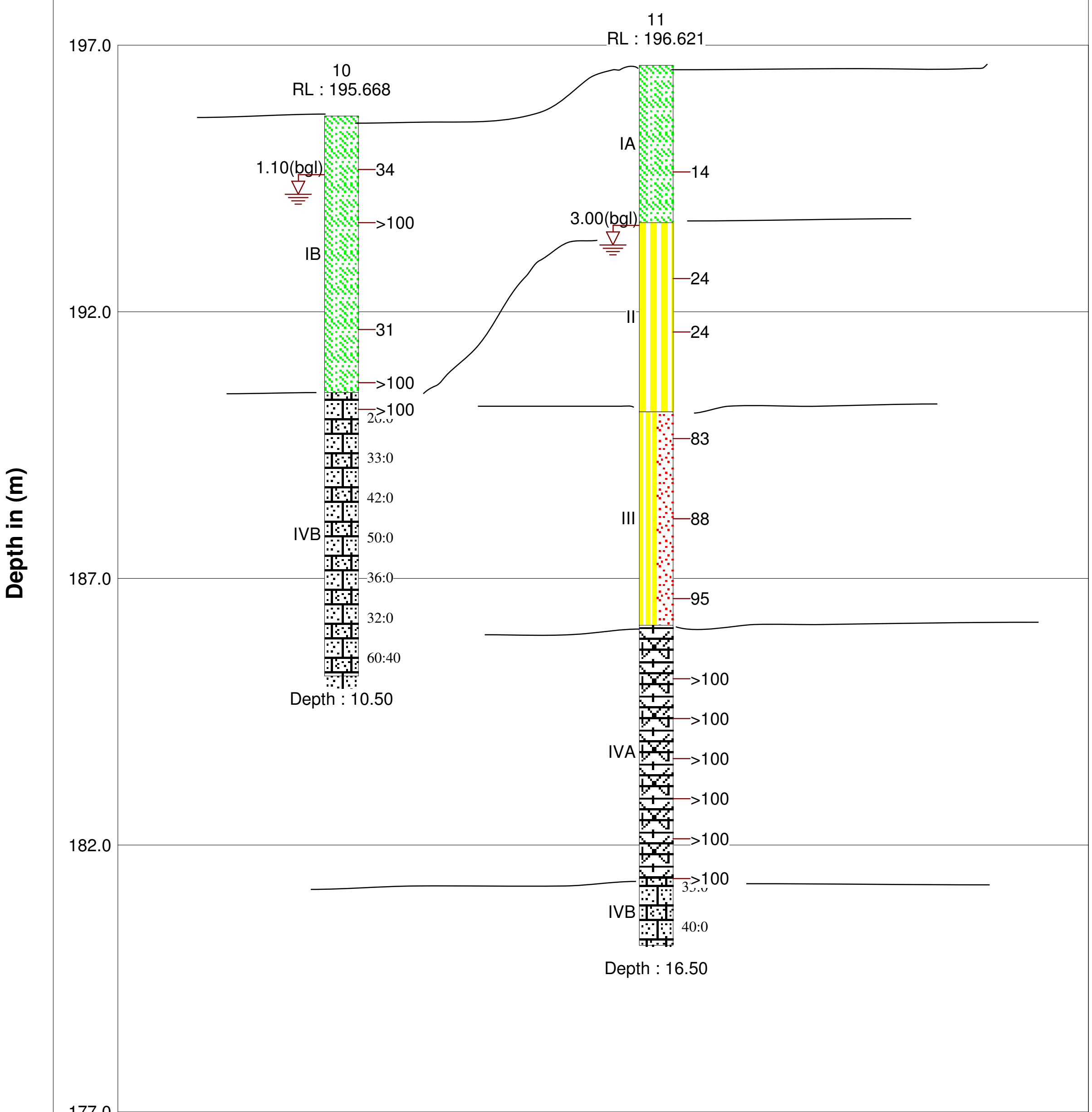
TCR:RQD Values Shown Thus: 42:0

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

Stiff to very stiff brownish grey sandy silty clay. [IA]

Stiff to very stiff brownish grey sandy silty clay. [IB]

Medium dense brownish yellow silty sand. [II]

Very dense brownish yellow silty sand with mica flakes. [III]

Completely weathered decomposed product of rock. [IVA]

Highly weathered rock [IVB]

N Values Shown Thus :—>100

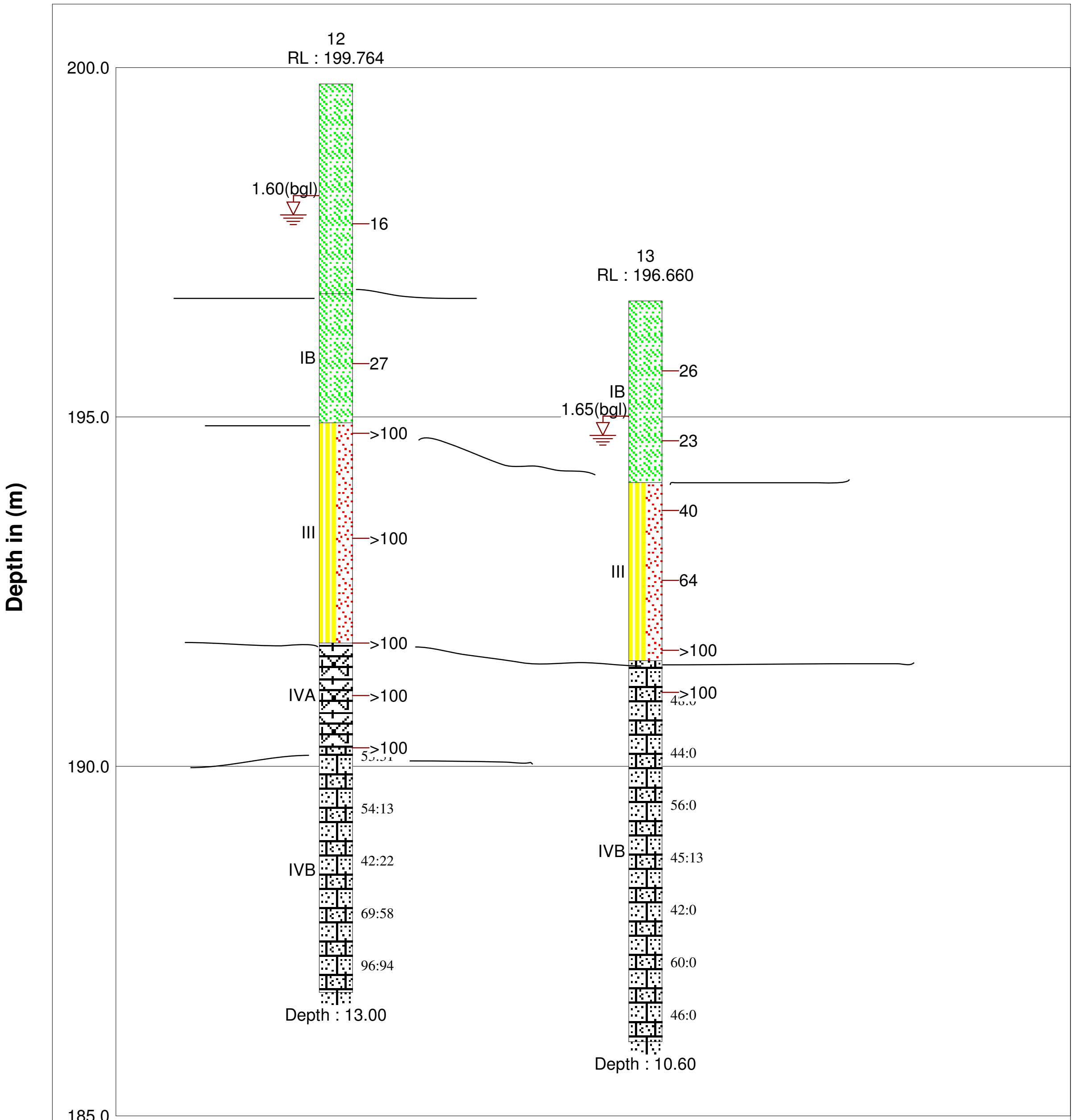
TCR:RQD Values Shown Thus: 40:0

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

Stiff to very stiff brownish grey sandy silty clay. [IA]

Stiff to very stiff brownish grey sandy silty clay. [IB]

Very dense brownish yellow silty sand with mica flakes. [III]

Completely weathered decomposed product of rock. [IVA]

Highly weathered rock [IVB]

N Values Shown Thus :—>100

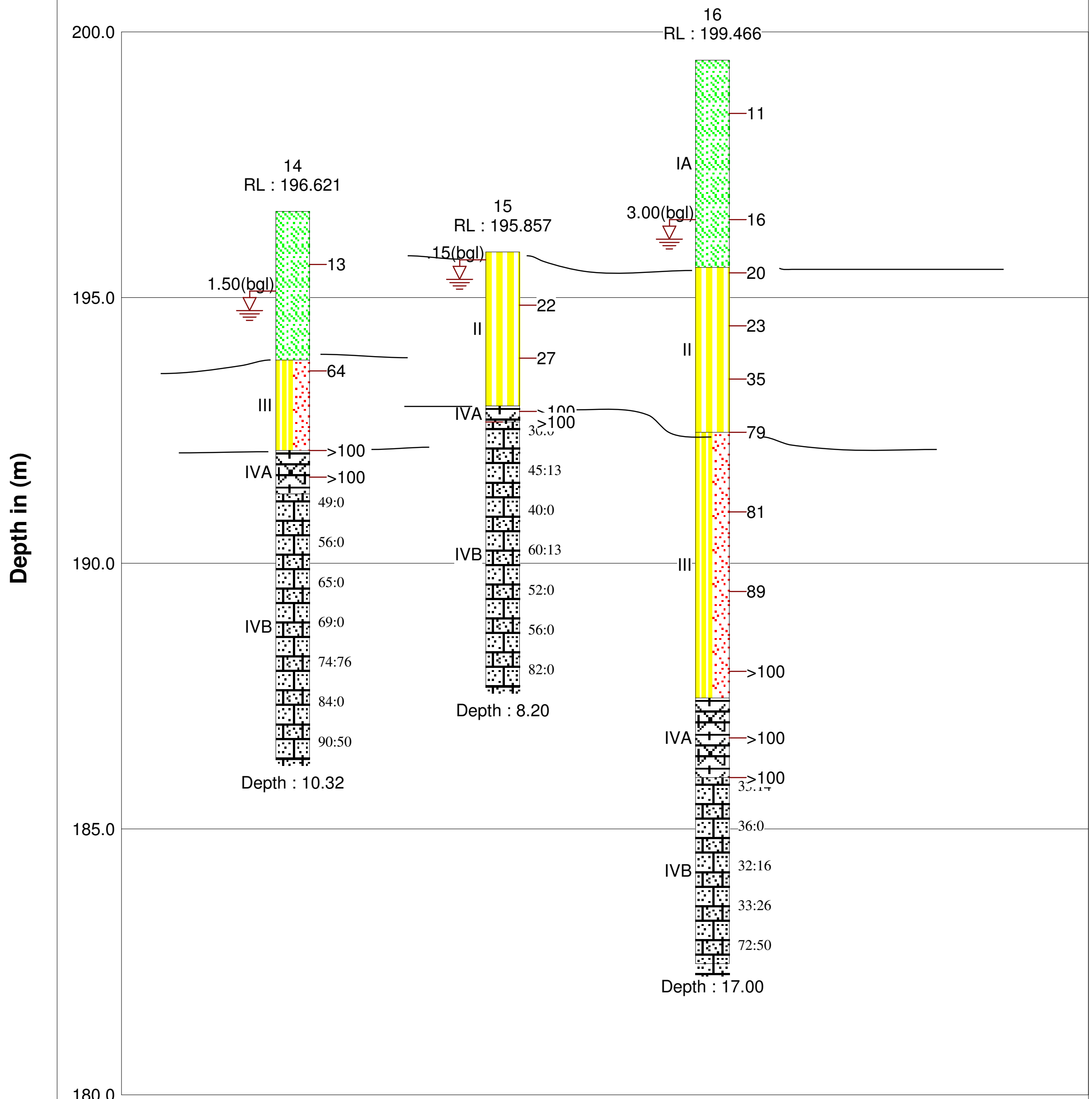
TCR:RQD Values Shown Thus: 46:0

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

Stiff to very stiff brownish grey sandy silty clay. [IA]

Medium dense brownish yellow silty sand. [II]

Very dense brownish yellow silty sand with mica flakes. [III]

Completely weathered decomposed product of rock. [IVA]

Highly weathered rock [IVB]

N Values Shown Thus :—>100

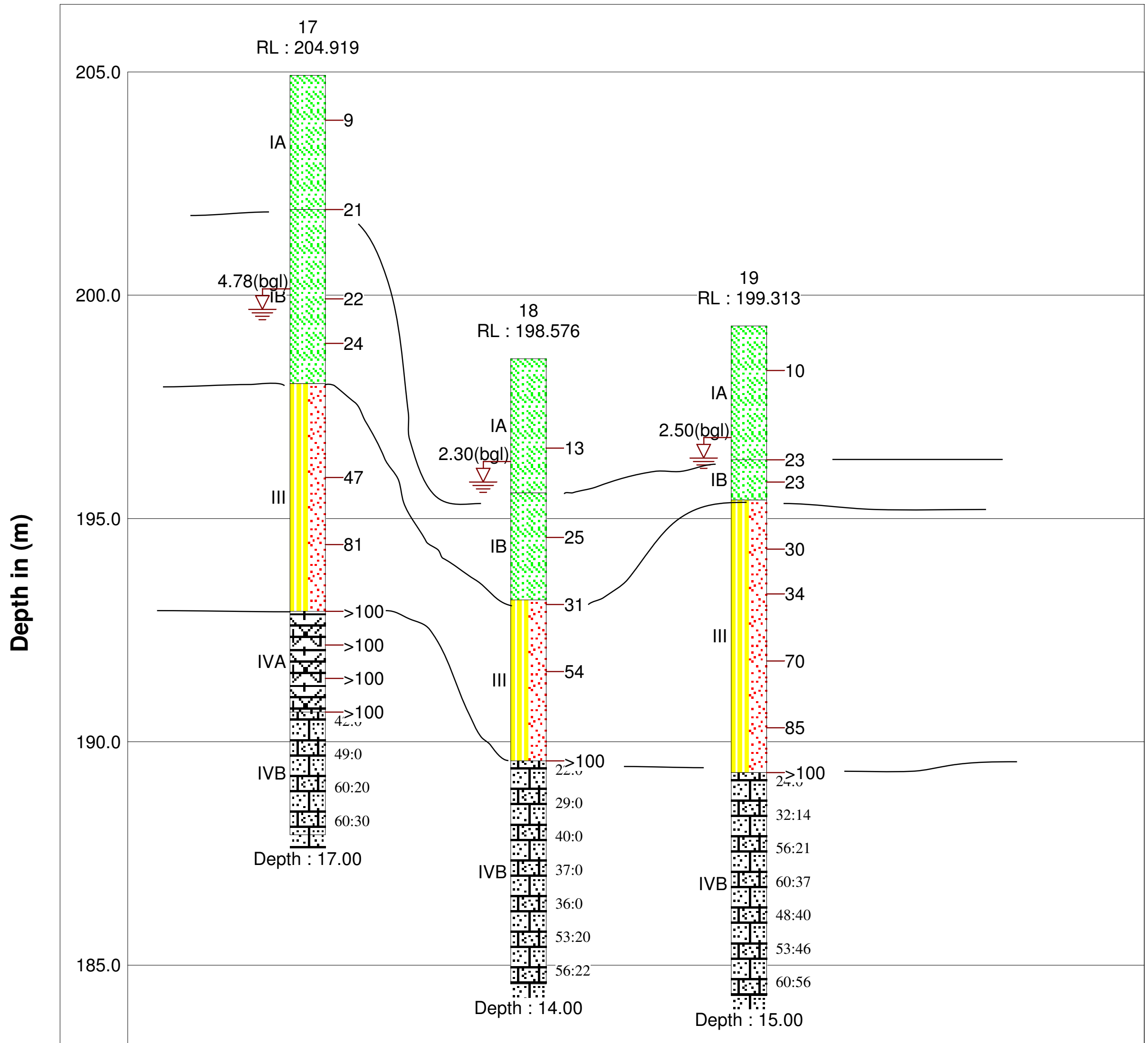
TCR:RQD Values Shown Thus: 72:50

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

- Stiff to very stiff brownish grey sandy silty clay. [IA]
- Stiff to very stiff brownish grey sandy silty clay. [IB]
- Very dense brownish yellow silty sand with mica flakes. [III]
- Completely weathered decomposed product of rock. [IVA]
- Highly weathered rock [IVB]

N Values Shown Thus :—>100

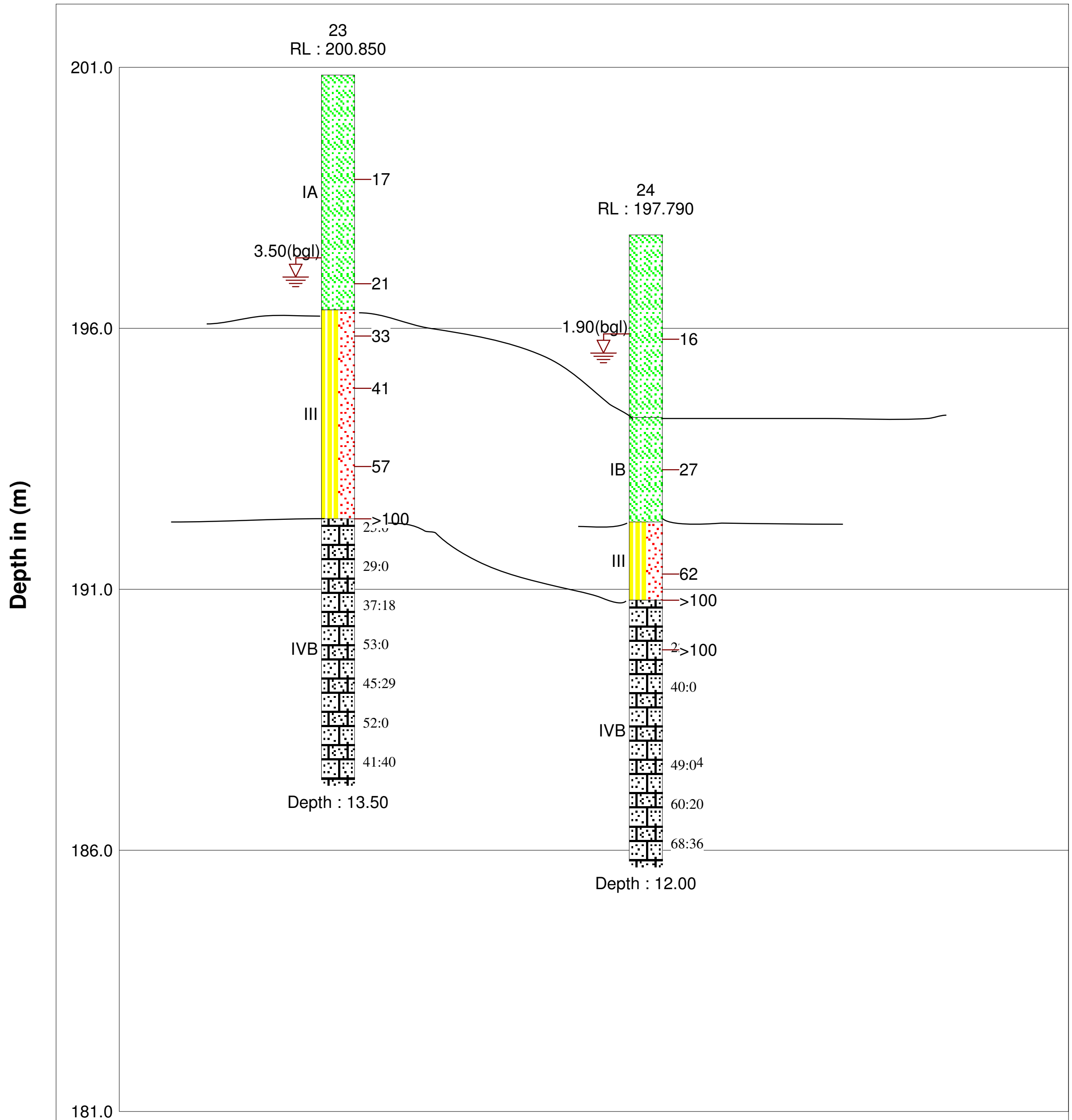
TCR:RQD Values Shown Thus: 60:56

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

Stiff to very stiff brownish grey sandy silty clay. [IA]

Stiff to very stiff brownish grey sandy silty clay. [IB]

Very dense brownish yellow silty sand with mica flakes. [III]

Highly weathered rock [IVB]

N Values Shown Thus :—>100

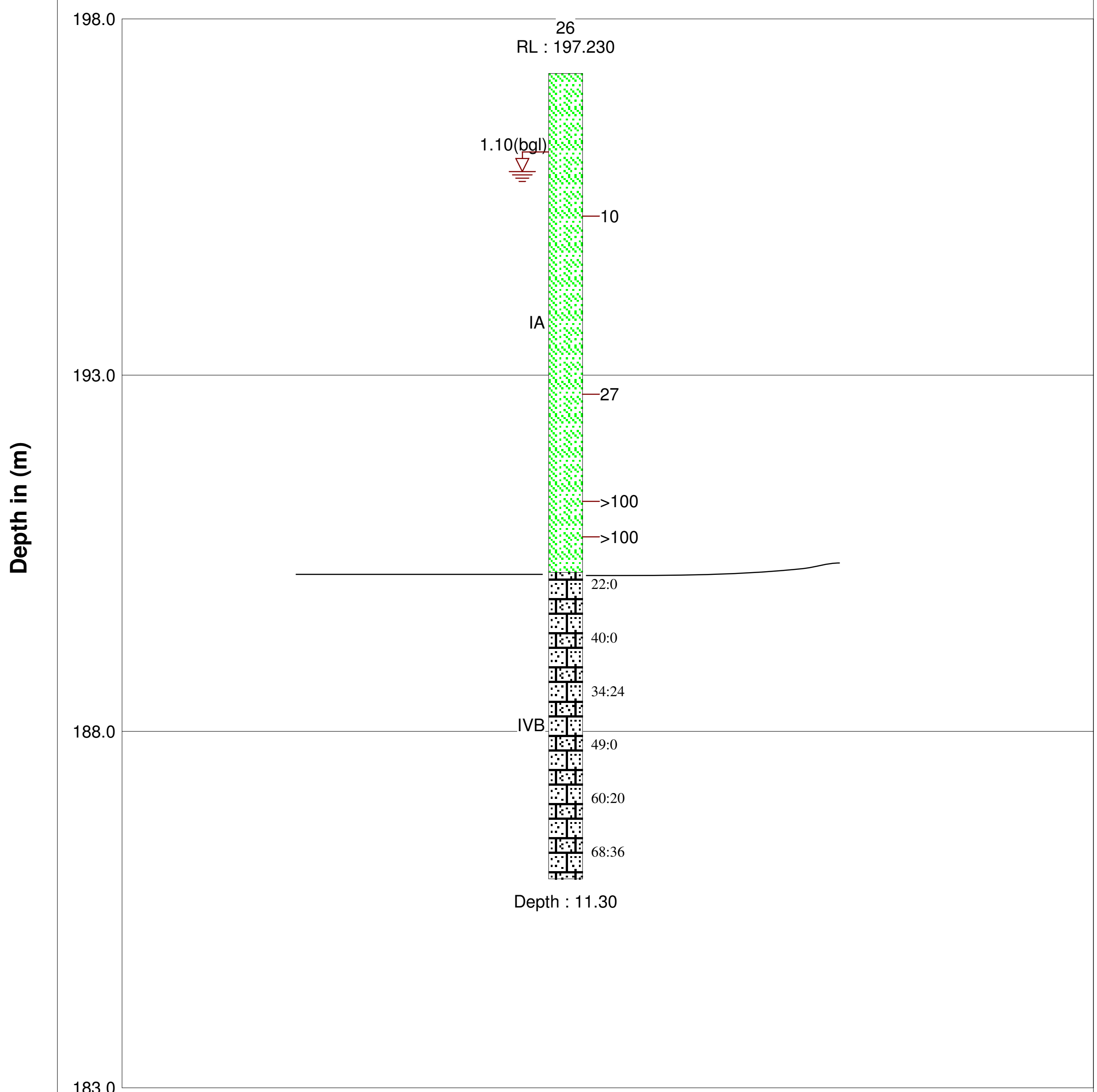
TCR:RQD Values Shown Thus: 68:36

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

Stiff to very stiff brownish grey sandy silty clay. [IA]

Highly weathered rock [IVB]

N Values Shown Thus :—>100

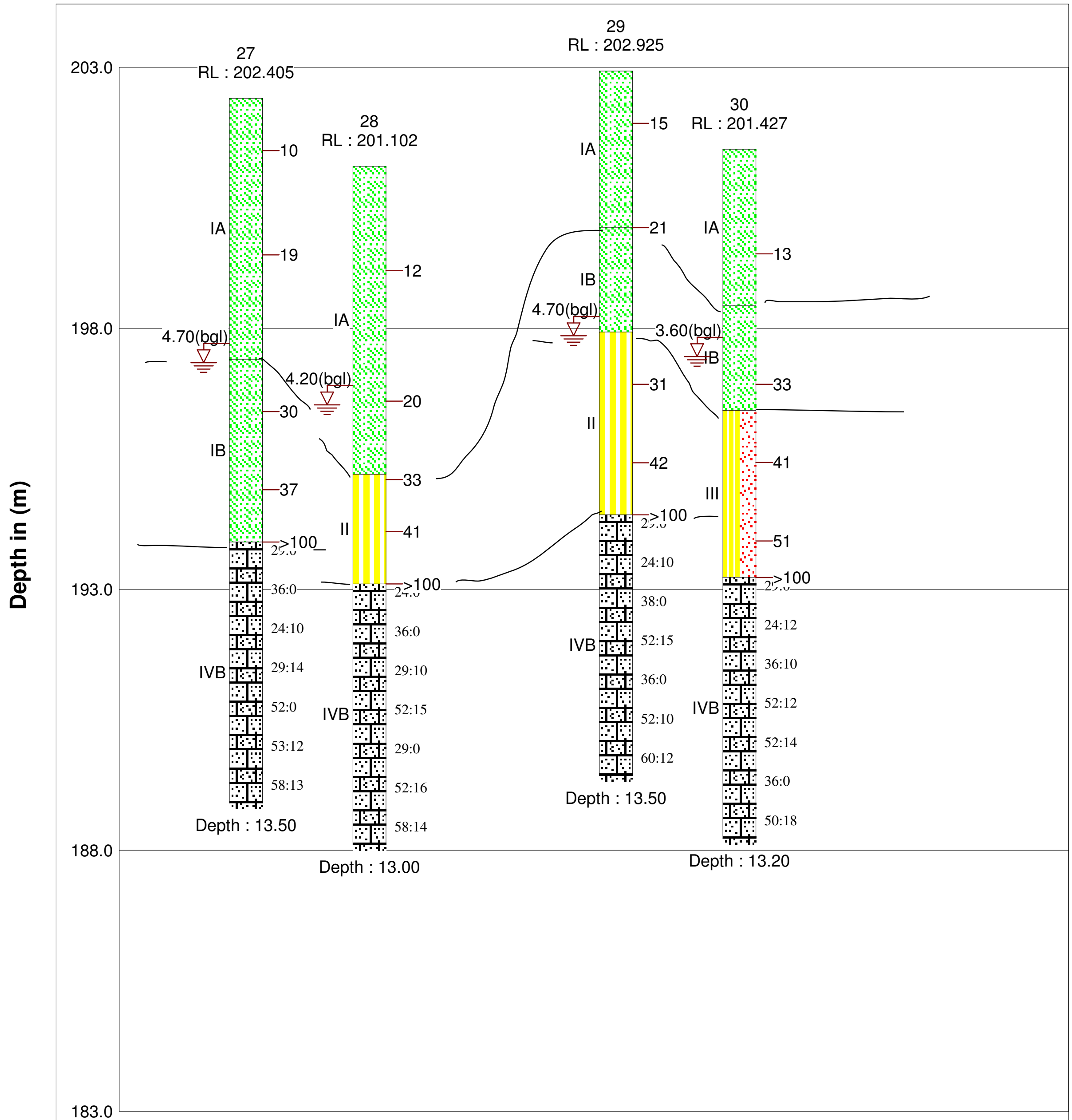
TCR:RQD Values Shown Thus: 68:36

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet



LEGENDS

- Stiff to very stiff brownish grey sandy silty clay. [IA]
- Stiff to very stiff brownish grey sandy silty clay. [IB]
- Medium dense brownish yellow silty sand. [II]
- Very dense brownish yellow silty sand with mica flakes. [III]
- Highly weathered rock [IVB]

N Values Shown Thus :—>100

TCR:RQD Values Shown Thus: 50:18

Standing Water Level : 10(bgl) (RL)

CROSS SECTION OF SOIL PROFILE

Job No.: 30796

Sheet

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 01**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 2**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808575, N2411250**		**R.L. : 197.210**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 20.08.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
0.50 - 0.50	D	177120					Stiff greyish brown silty clay with occasionally a few nodules observed.	IA	
1.00 - 1.45	U	177121	0.90						
1.50 - 1.50	D	177122	0.90						
2.00 - 2.45	P	177123	1.90	11					
2.50 - 2.50	D	177124	1.90						
3.00 - 3.45	U	177125	2.90						
3.50 - 3.50	D	177126	2.90						
4.50 - 4.95	P	177127	4.40	14					
6.00 - 6.45	U	177128	5.90			6.00		191.21	
6.50 - 6.50	D	177129	5.90				Very stiff greyish brown silty clay with occasionally a few nodules observed.	IB	
7.50 - 7.95	P	177130	7.40	22					
9.00 - 9.45	P	177131	8.90	33		9.00		188.21	
10.50 - 10.95	P	177132	10.40	46			Dense to very dense yellowish grey silty sand with a few mica.	II	
12.00 - 12.35	P	177133	11.90	>100		12.00		185.21	
12.75 - 12.88	P	-	12.20	>100					
13.50 - 13.62	P	-	12.20	>100					
14.25 - 14.35	P	-	12.20	>100					
15.75 - 15.83	P	-		>100			Completely weathered yellowish grey decomposed product of rock.	IVA	
16.50 - 16.57	P	-		>100					
17.00 - 17.06	P	-		>100					
							Continued		

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
12.00 - 12.75	NIL	NIL	NO	Yelllowish grey	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
21.02.2018	17.00	4.00
22.02.2017	17.00	4.20
23.02.2018	17.00	4.20

Remarks:

S.W.L. (m)
4.20
(BGL)
193.01
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 01**
Boring Diameter : 150 mm & NX		**Sheet : 2 of 2**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808575, N2411250**	**R.L. : 197.210**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 20.08.2018**

DRILLING						Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value					
12.75 - 13.50	NIL	NIL	NO	Yelllowish grey	-					
13.50 - 14.25	NIL	NIL	NO	Yelllowish grey	-					
14.25 - 15.00	NIL	NIL	NO	Yelllowish grey	-				IVA	
15.00 - 15.75	NIL	NIL	NO	Yelllowish grey	-					
15.75 - 16.50	NIL	NIL	NO	Yelllowish grey	-					
16.50 - 17.00	NIL	NIL	NO	Yelllowish grey	-					
							17.06	End of BoreHole	180.15	

Water Level Observation			Remarks:	S.W.L. (m)	
Date	Time (Hrs.)	W.L.(m) B.G.L.		4.20 (BGL) 193.01 (RL)	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
				D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 02**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 3**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E208625, N2411030**		**R.L. : 197.50**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 19.02.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
0.50 - 0.50	D	160121							
1.00 - 1.45	P	160122	0.90	7					
1.50 - 1.50	D	160123	1.90						
2.00 - 2.45	U	160124	1.90						
2.50 - 2.50	D	160125	1.90						
3.00 - 3.45	P	160126	2.90	9			Stiff greyish brown silty clay with occasionally a few nodules observed.	IA	
3.50 - 3.50	D	160127	2.90						
4.50 - 4.95	U	160128	4.40						
5.00 - 5.00	D	160129	4.40						
6.00 - 6.45	P	160130	5.90	14					
7.50 - 7.95	P	160131	7.40	16					
						9.00		188.50	
9.00 - 9.45	P	160132	8.90	30					
10.50 - 10.95	P	160133	10.40	48			Dense to very dense yellowish grey silty sand with a few boulder from 10.00m to 12.50m depth.	II	
12.00 - 12.45	P	160134	11.90	61					
						13.50		184.00	
13.50 - 13.60	P	160135	13.40	>100					
14.25 - 14.38	P	-	13.70	>100					
15.00 - 15.12	P	-	13.70	>100					
15.75 - 15.87	P	-	13.70	>100					
16.50 - 16.61	P	-		>100			Completely weathered yellowish grey decomposed product of rock.	IVA	
17.25 - 17.34	P	-		>100					
18.00 - 18.09	P	-		>100					
18.50 - 18.58	P	-		>100					

Continued

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
19.02.2018	17.00	3.20
20.02.2018	17.00	4.30
21.02.2018	17.00	4.30

Remarks:

S.W.L. (m)
4.30
(BGL)
193.20
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

D.D.
Supervisor

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.		Site : Sambalpur	BH : 02
Boring Diameter : 150 mm & NX			Sheet : 2 of 3
Casing Diameter : 150 mm & NX		Co-Ordinate :E208625, N2411030	R.L. : 197.50
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
		Orientation : Vertical	Date : 19.02.2018

DRILLING						Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value					
13.50 - 14.25	NIL	NIL	NO	Greyish Yellow	-					
14.25 - 15.00	NIL	NIL	NO	Greyish Yellow	-					
15.00 - 15.75	NIL	NIL	NO	Greyish Yellow	-					
15.75 - 16.50	NIL	NIL	NO	Greyish Yellow	-				IVA	
16.50 - 17.25	NIL	NIL	NO	Greyish Yellow	-					
17.25 - 18.00	NIL	NIL	NO	Greyish Yellow	-					
18.00 - 18.50	NIL	NIL	NO	Greyish Yellow	-					
							18.58	End of BoreHole	178.92	

Water Level Observation			Remarks:	S.W.L. (m)	
Date	Time (Hrs.)	W.L.(m) B.G.L.		4.30 (BGL) 193.20 (RL)	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
				D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur		BH : 03
Boring Diameter : 150 mm & NX			Sheet : 1 of 2
Casing Diameter : 150 mm & NX	Co-Ordinate :E808685, N241080.30		R.L. : 198.50
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		Date : 21.01.2018

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
Depth (m)	Type	No.							
0.50 - 0.50	D	100868					Stiff brownish grey to dark grey silty clay with occasionally black spots and a few small nodules.	IA	
1.00 - 1.45	U	100869	0.90						
1.50 - 1.50	D	100870	0.90						
2.00 - 2.45	P	100871	1.90	8					
2.50 - 2.50	D	100872	1.90						
3.00 - 3.45	U	100873	2.90						
3.50 - 3.50	D	100874	2.90						
4.00 - 4.45	P	100875	3.90	9					
5.00 - 5.45	P	100876	4.90	10					
6.00 - 6.45	U	100877	5.90						
7.00 - 7.45	P	100878	6.90	12					
8.00 - 8.45	U	100879	7.90						
9.00 - 9.45	P	100880	8.90	14					
11.00 - 11.45	P	100881	10.90	15					
12.50 - 12.95	P	100882	12.40	60		12.50	Very dense brownish grey silty sand with a few nodules and clay lump observed.	186.00 III	
14.00 - 14.45	P	100883	13.90	89					
14.50 - 14.75	P	100884	13.90	>100		14.50	Completely weathered whitish grey decomposed product of rock.	184.00 IVA	
15.25 - 15.35	P	-	17.40	>100					
16.00 - 16.09	P	-	17.40	>100					
16.75 - 16.83	P	-	17.40	>100					
17.50 - 17.60	P	-	17.40	>100					
18.25 - 18.34	P	-	17.40	>100					

Continued

Water Level Observation		
Date	Time (Hrs.)	W.L.(m) B.G.L.
23.01.2018	17.00	5.50
24.01.2018	16.50	4.60
25.01.2018	17.00	4.50
26.01.2018	17.00	4.50

Remarks:

S.W.L. (m)

4.50 (BGL)

194.00 (RL)

D.D.

Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 03**
Boring Diameter : 150 mm & NX			**Sheet : 2 of 2**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808685, N241080.30**		**R.L. : 198.50**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 21.01.2018**

Sample In-situ Tests: Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
19.00 - 19.05	P	-	17.40	>100					
19.50 - 19.60	P	-	17.40	>100				IVA	
						19.60	End of BoreHole	178.90	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
14.50 - 15.25	NIL	NIL	NO	Whitish grey	-
15.25 - 16.00	NIL	NIL	NO	Whitish grey	-
16.00 - 16.75	NIL	NIL	NO	Whitish grey	-
16.75 - 17.50	NIL	NIL	NO	Whitish grey	-
17.50 - 18.25	NIL	NIL	NO	Whitish grey	-
18.25 - 19.00	NIL	NIL	NO	Whitish grey	-
19.00 - 19.50	NIL	NIL	NO	Whitish grey	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)

4.50
(BGL)

194.00
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D.
Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 04**
Boring Diameter : 150 mm & NX		**Sheet : 1 of 4**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808970, N241130**	**R.L. : 194.729**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 13.11.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)
0.50 - 1.00	D	100900				
1.00 - 1.00	D	100901	0.90			
1.50 - 1.95	U	100902	1.40			
2.00 - 2.00	D	100903	1.40			
2.50 - 2.95	P	100904	2.40	16		
3.00 - 3.00	D	100905	2.40			3.00
3.50 - 3.95	P	100906	3.40	31		
4.00 - 4.00	D	100907	3.40			4.00
5.00 - 5.45	P	100908	4.90	41		
5.60 - 5.80	P	100909	5.50	>100		5.75
6.00 - 6.05	P	100910	5.50	>100		
						11.00

Depth (BGL) (m)	Description	R.L.(M)
0.00 - 3.00	Stiff brownish grey silty clay to clayey silt with silt lamination and shale rock fragments below 3.00m depth.	IA
3.00		191.73
3.00 - 4.00	Very stiff brownish grey silty clay to clayey silt with silt lamination and shale rock fragments below 3.00m depth.	IB
4.00		190.73
4.00 - 5.75	Dense brownish grey silty sand.	II
5.75		188.98
5.75 - 11.00	Highly to moderately weathered dark grey rock with water mark and occasionally silty sand lamination observed.	IVB
11.00	End of BoreHole	183.73

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
6.00 - 6.75	32	NIL	NO	Dark yellowish grey	-
6.75 - 7.50	42.67	NIL	NO	Dark yellowish grey	-
7.50 - 8.25	54.67	NIL	NO	Dark yellowish grey	-
8.25 - 9.00	48.00	NIL	NO	Dark yellowish grey	-
9.00 - 9.75	45.33	NIL	NO	Dark yellowish grey	-
9.75 - 10.50	60.00	NIL	NO	Dark yellowish grey	-
10.50 - 11.00	62.00	NIL	NO	Dark yellowish grey	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
0.80
(BGL)
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 05**
Boring Diameter : 150 mm & NX		**Sheet : 1 of 5**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809045.00, N2411080.00**	**R.L. : 195.568**
Boring Equipment : Mechanical Cable Tools/NX Drilling.	**Orientation : Vertical**	**Date : 23.12.2017**

Sample In-situ Tests: Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	100451					Stiff brownish grey to dark grey silty clay to clayey silt with high % silt lamination and concreation with high % shale fragments at lower depth.	IA
1.00 - 1.00	D	100452						
1.50 - 1.95	P	100453	1.40	12				
2.00 - 2.00	D	100454	1.90			2.00		193.57
2.50 - 2.95	P	100455	2.40	38			Very stiff brownish grey to dark grey silty clay to clayey silt with high % silt lamination and concreation with high % shale fragments at lower depth.	IB
3.00 - 3.00	D	100456	2.90					
3.50 - 3.95	P	100457	3.40	32				
4.00 - 4.00	D	100458	3.90			4.00		191.57
4.50 - 4.95	P	100459	4.40	23			Medium dense brownish yellow residual soil comprised of clayey silty sand.	II
5.00 - 5.00	D	100460	4.90					
5.50 - 5.50	D	100461	5.40			5.70		189.87
6.00 - 6.30	P	100462	5.90	>100	23.12.2017 6.00	6.50	Completely weathered dark grey decomposed product of rock,	IVA 189.07

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value	Depth (BGL) (m)	Description	R.L.(M)
6.50 - 7.25	34.66	NIL	NO	Dark grey	-		Highly to moderately weathered dark grey rock.	IVB
7.25 - 8.00	45.33	NIL	NO	Dark grey	-			
8.00 - 8.75	57.33	NIL	NO	Dark grey	-			
8.75 - 9.50	62.66	NIL	NO	Dark grey	-			
9.50 - 10.25	68.00	NIL	NO	Dark grey	-			
10.25 - 11.00	66.67	NIL	NO	Dark grey	-			
11.00 - 11.50	80.00	22.00	NO	Dark grey	-	11.50	End of BoreHole	184.07

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
28.12.2017	17.00	0.20

Remarks:

S.W.L. (m) **0.10** **(BGL)** **(RL)**

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

D.D.
Supervisor

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur
Boring Diameter : 150 mm & NX	BH : 06
Casing Diameter : 150 mm & NX	Sheet : 1 of 6
Boring Equipment : Mechanical Cable Tools/NX Drilling.	Co-Ordinate :E808975, N241097.90
	R.L. : 197.394
	Orientation : Vertical
	Date : 16.01.2018

Sample In-situ Tests

Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)
0.50 - 0.50	D	105111			
1.00 - 1.45	U	105112	0.90		
1.50 - 1.50	D	105113	0.90		
2.00 - 2.45	P	105114	1.90	20	
2.50 - 2.50	D	105115	1.90		
3.00 - 3.45	P	105116	2.90	26	
3.50 - 3.50	D	105117	2.90		
4.00 - 4.45	P	105118	3.90	27	
5.00 - 5.00	D	105119	3.90		
6.80 - 6.92	P	105120	6.50	>100	
7.00 - 7.05	P	105121	6.90	>100	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
7.00 - 7.75	62.67	NIL	NO	Greyish yellow	-
7.75 - 8.50	61.33	30.67	NO	Greyish yellow	-
8.50 - 9.25	85.33	80.00	NO	Greyish yellow	-
9.25 - 10.00	86.66	70.66	NO	Greyish yellow	-
10.00 - 10.75	76.00	74.67	NO	Greyish yellow	-
10.75 - 11.50	96.00	90.00	NO	Greyish yellow	-
11.50 - 12.00	90.00	90.00	NO	Greyish yellow	-

Depth (BGL) (m)	Description	R.L.(M)	Log
	Stiff brownish grey to dark grey silty clay to clayey silt with high % silt lamination and concreation with high % shale fragments at lower depth.	IA	
2.00		195.39	
	Very stiff greyish brown clayey silt with grey patches and high % of nodules and low % of sand.	IB	
4.00		193.39	
	Medium dense greyish brown silty sand.	II	
6.75		190.64	
	Moderately to slightly weathered greyish yellow rock.	IVC	
12.00	End of BoreHole	185.39	

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
20.01.2018	17.00	2.35

Remarks:

S.W.L. (m)

2.35

(BGL)

195.04

(RL)

D.D.

Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 07**
Boring Diameter : 150 mm & NX		**Sheet : 1 of 7**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808950, N2410929**	**R.L. : 197.499**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 18.01.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
0.50 - 0.50	D	105101					Stiff greyish brown silty clay with grey patches and high % of nodules.	IA	
1.00 - 1.45	P	105102	0.90	13					
1.50 - 1.50	D	105103	0.90						
2.00 - 2.45	U	105104	1.90						
2.50 - 2.50	D	105105	1.90						
3.00 - 3.45	P	105106	2.90	21		3.00		194.50	
4.00 - 4.00	D	105107	2.90				Very stiff greyish brown silty clay with grey patches and high % of nodules.	IB	
5.00 - 5.45	P	105108	4.90	23					
6.80 - 6.89	P	105109	6.50	>100		6.80		190.70	
7.00 - 7.05	P	105110	6.90	>100			Moderately to slightly weathered greyish yellow rock.	IVC	
						12.00	End of BoreHole	185.50	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
7.00 - 7.75	53.33	NIL	NO	Greyish yellow	-
7.75 - 8.50	57.33	28.00	NO	Greyish yellow	-
8.50 - 9.25	89.33	29.33	NO	Greyish yellow	-
9.25 - 10.00	82.67	82.67	NO	Greyish yellow	-
10.00 - 10.75	93.33	64.00	NO	Greyish yellow	-
10.75 - 11.50	80.00	80.00	NO	Greyish yellow	-
11.50 - 12.00	96.00	96.00	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
20.01.2018	17.00	2.40

Remarks:

S.W.L. (m) **2.40** **(BGL)** **195.10** **(RL)**

D.D. Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.		**Site : Sambalpur**	**BH : 08**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 8**
Casing Diameter : 150 mm & NX		**Co-Ordinate :E809045.00, N2410803.00**	**R.L. : 199.264**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
		Orientation : Vertical	**Date : 08.11.2017**

Sample In-situ Tests: Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	100967					Stiff greyish brown silty clay with grey patches and high % of nodules.	IA
1.00 - 1.45	U	100968	0.90					
1.50 - 1.50	D	100969	0.90					
2.00 - 2.45	P	100970	1.90	14				
2.50 - 2.50	D	100971	1.90					
3.00 - 3.45	U	100972	2.90					
4.00 - 4.00	D	100973	2.90			4.00		195.26
5.00 - 5.45	P	100974	4.90	23			Very stiff brownish grey to yellowish brown lateric clay to sandy silty clay with high % of nodules upto 3.00m depth and sand % increse at lower depth.	IB
6.00 - 6.00	D	100975	5.90			6.00		193.26
7.50 - 7.95	P	100976	7.40	81			Very dense greyish brown silty sand with mica.	III
9.00 - 9.45	P	100977	8.90	83				
10.50 - 10.95	P	100978	10.40	93				
12.00 - 12.22	P	100979	11.90	>100		12.00		187.26
12.75 - 12.80	P	-	11.90	>100			Completely weathered greyish yellow decomposed product of rock.	IVA
						13.50		185.76
							Highly to moderately weathered greyish yellow rock.	IVB
							Continued	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
12.00 - 12.75	NIL	NIL	NO	Greyish yellow	-
12.75 - 13.50	NIL	NIL	NO	Greyish yellow	-

Sample In-situ Tests

Depth (m)	Type	No.	Casing Depth(M)	N - Value
13.50 - 13.56	P	-	11.90	>100

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
13.50 - 14.25	42.67	NIL	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
10.01.2018	17.00	3.40

Remarks:

S.W.L. (m): **3.30 (BGL)** **195.96 (RL)**

D.D. Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 08**
Boring Diameter : 150 mm & NX		**Sheet : 2 of 8**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809045.00, N2410803.00**	**R.L. : 199.264**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 08.11.2017**

DRILLING						**Date and Depth (m)**	**Depth (BGL) (m)**	**Description**	**R.L.(M)**	**Log**
From To (m)	**TCR %**	**RQD %**	**Water Loss**	**Color of Ret. Water**	**N Value**					
14.25 - 15.00	38.67	NIL	NO	Greyish yellow	-					
15.00 - 15.75	34.67	NIL	NO	Greyish yellow	-				IVB	
15.75 - 16.50	40.00	16.00	NO	Greyish yellow	-					
16.50 - 17.00	68.00	24.00	NO	Greyish yellow	-					
							17.00	End of BoreHole	182.26	

Water Level Observation			**Remarks:**	**S.W.L. (m)**	
Date	**Time (Hrs.)**	**W.L.(m) B.G.L.**		**3.30 (BGL)**	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample
				195.96 (RL)	P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
				D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 09**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808950.00, N2410790.00**		**R.L. : 198.215**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 12.01.2018**

Sample In-situ Tests: Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)
0.50 - 0.50	D	100875			
1.00 - 1.45	P	100876	0.90	9	
1.50 - 1.50	D	100877	0.90		
2.00 - 2.45	U	100878	1.90		
2.50 - 2.50	D	100879	1.90		
3.00 - 3.45	P	100880	2.90	15	
3.50 - 3.50	D	100881	2.90		
4.50 - 4.95	U	100882	4.40		
6.00 - 6.45	P	100883	5.90	31	
7.50 - 7.95	P	100884	7.40	35	
8.50 - 8.50	D	100885	7.40		
9.00 - 9.45	P	100886	8.90	40	
10.00 - 10.00	D	100887	9.90		
10.50 - 10.95	P	100888	10.40	87	
13.00 - 13.45	P	100889	12.90	97	
14.50 - 14.75	P	100890	14.40	>100	
15.25 - 15.31	P	-	14.70	>100	
16.00 - 16.09	P	-	14.70	>100	

Depth (BGL) (m)	Description	R.L.(M)
	Stiff greyish brown lateritic clay with high % of small nodules and and black spots, sand % increased after 4.70m depth.	IA
5.00		193.22
	Very stiff greyish brown lateritic clay with high % of small nodules and and black spots, sand	
7.00		191.22
	Dense yellowish grey clayey sand with high % of grey patches and silt lamination.	II
10.20		188.02
	Very dense brownish yellow silty sand with mica.	III
14.50		183.72
	Completely weathered greyish yellow decomposed product of rock.	IVA
16.75	Continued	181.47

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
14.50 - 15.25	NIL	NIL	NO	Greyish yellow	-
15.25 - 16.00	NIL	NIL	NO	Greyish yellow	-
16.00 - 16.75	NIL	NIL	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)

2.85 (BGL)

195.37 (RL)

D.D. Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 09**
Boring Diameter : 150 mm & NX			**Sheet : 2 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808950.00, N2410790.00**		**R.L. : 198.215**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 12.01.2018**

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
Depth (m)	Type	No.							
16.75 - 16.82	P	-	14.70	>100			Highly weathered greyish yellow rock.	IVB	
						19.50	End of BoreHole	178.72	

DRILLING					
From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
16.75 - 17.50	22.67	NIL	NO	Greyish yellow	-
17.50 - 18.25	25.33	NIL	NO	Greyish yellow	-
18.25 - 19.00	36.00	NIL	NO	Greyish yellow	-
19.00 - 19.50	42.67	NIL	NO	Greyish yellow	-

Water Level Observation		
Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)

2.85
(BGL)

195.37
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH** : 10	
Boring Diameter : 150 mm & NX		**Sheet : 1 of 9**	
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809057, N2411175.00**	**R.L.** : 195.668	
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical	**Date** : 02.01.2018	

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
Depth (m)	**Type**	**No.**							
0.50 - 0.50	D	100471							
1.00 - 1.45	P	100472	1.40	34					
1.50 - 1.50	D	100473	1.40						
2.00 - 2.45	P	100474	1.90	>100					
2.50 - 2.50	D	100475	1.90				Very stiff to hard yellowish brown silty clay to sandy clayey silt with silt lamination and grey patches, grass roots found upto 0.50m depth and boulder zone found 2.00m to 2.60m depth.	IB	
3.00 - 3.45	U	100476	2.90						
3.50 - 3.50	D	100477	2.90						
4.00 - 4.45	P	100478	3.90	31					
4.50 - 4.50	D	100479	3.90						
5.00 - 5.20	P	100480	4.90	>100					
5.50 - 5.54	P	100481	5.40	>100		5.18		190.49	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value	Depth (BGL) (m)	Description	R.L.(M)
5.50 - 6.25	26.67	NIL	NO	Dark yellowish grey	-			
6.25 - 7.00	33.33	NIL	NO	Dark yellowish grey	-			
7.00 - 7.75	42.67	NIL	NO	Dark yellowish grey	-		Highly weathered brown to dark grey rock with water mark and occasionally silt sand lamination found from 7.00m depth.	IVB
7.75 - 8.50	50.67	NIL	NO	Dark yellowish grey	-			
8.50 - 9.25	36.00	NIL	NO	Dark yellowish grey	-			
9.25 - 10.00	32.00	NIL	NO	Dark yellowish grey	-			
10.00 - 10.50	60.00	40.00	NO	Dark yellowish grey	-	10.50	End of BoreHole	185.17

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
03.01.2018	17.00	0.80
04.01.2018	17.00	1.10

Remarks:

S.W.L. (m)

1.10
(BGL)

194.57
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

D.D.
Supervisor

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 11**	
Boring Diameter : 150 mm & NX		**Sheet : 1 of 9**	
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809057.00, N2410722.00**	**R.L. : 196.621**	
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical	**Date : 11.01.2018**	

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
0.50 - 0.50	D	100851					Stiff to very stiff brownish grey to yellowish brown lateric clay to silty sandy clay with high % of nodules (small) upto 3.40m depth and sand % increase from 4.00m depth.	IA	
1.00 - 1.45	U	100852	0.90						
1.50 - 1.50	D	100853	0.90						
2.00 - 2.45	P	100854	1.90	14					
2.50 - 2.50	D	100855	1.90						
3.00 - 3.45	U	100856	2.90			2.95		193.67	
3.50 - 3.50	D	100857	2.90				Medium dense to dense brownish yellow clayey silty sand.	II	
4.00 - 4.45	P	100858	3.90	24					
4.50 - 4.50	D	100859	3.90						
5.00 - 5.45	P	100860	3.90	24					
7.00 - 7.45	P	100861	6.90	83		6.50		190.12	
8.50 - 8.95	P	100862	8.40	88			Very dense brownish yellow silty sand with mica.	III	
10.00 - 10.45	P	100863	9.90	95					
11.50 - 11.75	P	100864	11.40	>100		10.50		186.12	
12.25 - 12.34	P	-	11.70	>100			Completely weathered greyish yellow decomposed product of rock.	IVA	
13.00 - 13.08	P	-	11.70	>100					
13.75 - 13.82	P	-	11.70	>100					
14.50 - 14.56	P	-	11.70	>100			Continued		

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
11.50 - 12.25	NIL	NIL	NO	Greyish yellow	-
12.25 - 13.00	NIL	NIL	NO	Greyish yellow	-
13.00 - 13.75	NIL	NIL	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
12.01.2018	17.00	3.20
13.01.2018	17.00	3.00

Remarks:

S.W.L. (m)
3.00
(BGL)
193.62
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D.
Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 11**	
Boring Diameter : 150 mm & NX		**Sheet : 2 of 9**	
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809057.00, N2410722.00**	**R.L. : 196.621**	
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical	**Date : 11.01.2018**	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
13.75 - 14.50	NIL	NIL	NO	Greyish yellow	-
14.50 - 15.25	NIL	NIL	NO	Greyish yellow	-

Sample In-situ Tests

Depth (m)	Type	No.	Casing Depth(M)	N - Value
15.25 - 15.30	P	-	11.70	>100

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
15.25 - 16.00	33.33	NIL	NO	Greyish yellow	-
16.00 - 16.50	40.00	NIL	NO	Greyish yellow	-

Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
			IVA	
	15.25		181.37	
		Highly weathered greyish yellow rock.	IVB	
	16.50	End of BoreHole	180.12	

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)	
3.00 (BGL) 193.62 (RL)	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur	BH : 12	
Boring Diameter : 150 mm & NX		Sheet : 1 of 9	
Casing Diameter : 150 mm & NX	Co-Ordinate :E809098.00, N2410728.00	R.L. : 199.764	
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical	Date : 09.01.2017	

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value
0.50 - 0.50	D	100977		
1.00 - 1.45	U	100978	0.90	
1.50 - 1.50	D	100979	0.90	
2.00 - 2.45	P	100980	1.90	16
2.50 - 2.50	D	100981	1.90	
3.00 - 3.45	U	100982	2.90	
3.50 - 3.50	D	100983	2.90	
4.00 - 4.45	P	100984	3.90	27
5.00 - 5.25	P	100985	4.90	>100
6.50 - 7.20	P	100986	6.40	>100
8.00 - 8.10	P	100987	7.90	>100
8.75 - 8.84	P	-	8.20	>100

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.00 - 8.75	NIL	NIL	NO	Greyish yellow	-
8.75 - 9.50	NIL	NIL	NO	Greyish yellow	-

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value
9.50 - 9.57	P	-	8.20	>100

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
9.50 - 10.25	53.33	31.00	NO	Greyish yellow	-
10.25 - 11.00	54.67	13.33	NO	Greyish yellow	-
11.00 - 11.75	42.67	22.67	NO	Greyish yellow	-

Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
		Stiff grey to yellowish brown silty clay with grey patches a few nodules and high % of big pebbles.	IA	
	3.00		196.76	
		Very stiff grey to yellowish brown silty clay with grey patches a few nodules and high % of big pebbles.	IB	
	4.85		194.91	
		Very dense brown silty sand with mica.	III	
	8.00		191.76	
		Completely weathered brownish yellow decomposed product of rock.	IVA	
	9.50		190.26	
		Highly to moderately weathered greyish yellow rock.	IVB	
		Continued		

Water Level Observation Date	Time (Hrs.)	W.L.(m) B.G.L.	Remarks:	S.W.L. (m)	
				1.60 (BGL) 198.16 (RL)	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
				D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 12**
Boring Diameter : 150 mm & NX		**Sheet : 2 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809098.00, N2410728.00**	**R.L. : 199.764**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 09.01.2017**

DRILLING						Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value					
11.75 - 12.50	69.33	58.67	NO	Greyish yellow	-				IVB	
12.50 - 13.00	96.00	94.00	NO	Greyish yellow	-		13.00	End of BoreHole	186.76	

Water Level Observation			Remarks:	S.W.L. (m)	
Date	Time (Hrs.)	W.L.(m) B.G.L.		1.60 (BGL) 198.16 (RL)	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
				D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 13**
Boring Diameter : 150 mm & NX		**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809098.00, N2411175.00**	**R.L. : 196.660**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 04.01.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	100482						
1.00 - 1.45	P	100483	0.90	26				
1.50 - 1.50	D	100484	0.90				Very stiff mottled brown lateritic clay with high % of nodules _black spots.	IB
2.00 - 2.45	P	100485	1.90	23				
2.50 - 2.50	D	100486	1.90					
3.00 - 3.45	P	100487	2.90	40		2.60		194.06
3.50 - 3.50	D	100488	2.90					
4.00 - 4.45	P	100489	3.90	64			Dense to very dense yellowish grey sandy clayey silt with silt lamination and shale fragments observed.	III
4.50 - 4.50	D	100490	3.90					
5.00 - 5.25	P	100491	4.90	>100				
5.60 - 5.65	P	100492	5.50	>100		5.15		191.51

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
5.60 - 6.35	48.00	NIL	NO	Dark yellowish grey	-
6.35 - 7.10	44.00	NIL	NO	Dark yellowish grey	-
7.10 - 7.85	56.00	NIL	NO	Dark yellowish grey	-
7.85 - 8.60	45.33	13.33	NO	Dark yellowish grey	-
8.60 - 9.35	42.67	NIL	NO	Dark yellowish grey	-
9.35 - 10.10	60.00	NIL	NO	Dark yellowish grey	-
10.10 - 10.60	46.67	0.32	NO	Dark yellowish grey	-

Depth (BGL) (m)	Description	R.L.(M)
5.15 – 10.60	Highly to moderately weathered dark yellowish grey rock with water mark and sand lamination observed.	IVB
10.60	End of BoreHole	186.06

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
1.65
(BGL)
195.01
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D.
Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 14**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809083.00, N2411115.00**		**R.L. : 196.621**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 18.12.2017**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	100551					Stiff greyish brown to mottled brown sandy silty clay with grass roots upto 0.40m and small size nodules quartz boulders found from 1.00m depth.	IA
1.00 - 1.45	P	100552	0.90	13				
1.50 - 1.50	D	100553	0.90					
2.00 - 2.45	U	100554	1.90					
2.50 - 2.50	D	100555	1.90			2.80		193.82
3.00 - 3.45	P	100556	3.60	64			Very dense yellowish brown clayey sandy silt with fine mica flakes, blackish grey spots and silt lamination.	III
3.50 - 3.50	D	100557	3.60					
4.00 - 4.00	D	100558	3.60			4.50		192.12
4.50 - 4.80	P	100559	4.35	>100			Completely weathered dark grey decomposed product of rock with rusty brown patches.	IVA
5.00 - 5.20	P	100560	4.35	>100		5.32		191.30
							Highly to moderately weathered brownish to dark grey rock with water mark.	IVB
						10.32	End of BoreHole	186.30

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
5.32 - 6.07	49.33	NIL	NO	Brownish grey	-
6.07 - 6.82	56.00	NIL	NO	Brownish grey	-
6.82 - 7.57	65.33	NIL	NO	Brownish grey	-
7.57 - 8.32	69.33	NIL	NO	Dark grey	-
8.32 - 9.07	74.66	76.00	NO	Dark grey	-
9.07 - 9.82	84.00	NIL	NO	Dark grey	-
9.82 - 10.32	90.00	50.00	NO	Dark grey	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
22.12.2017	17.00	0.80
23.12.2017	17.00	1.30
24.12.2017	17.00	1.47
25.12.2017	17.00	1.50

Remarks:

S.W.L. (m)
1.50
(BGL)
195.12
(RL)

R.M.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 15**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809083.00, N2411055.00**		**R.L. : 195.857**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 29.12.2017**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
0.50 - 0.50	D	100464							
1.00 - 1.45	P	100465	0.90	22					
1.50 - 1.50	D	100466	0.90				Medium dense light yellowish grey to dark grey clayey sandy silt with silt sand concreation and shale fragments found at 2.50m depth.	II	
2.00 - 2.45	P	100467	1.90	27					
2.50 - 2.50	D	100468	2.40						
3.00 - 3.10	P	100469	2.90	>100		2.90	Completely weathered dark grey decomposed product of rock.	192.96 IVA	
3.20 - 3.25	P	100470	2.90	>100		3.20		192.66	
							Highly weathered to moderately weathered dark grey rock.	IVB	
						8.20	End of BoreHole	187.66	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
3.20 - 3.95	36.00	NIL	NO	Dark grey	-
3.95 - 4.70	45.33	13.00	NO	Dark grey	-
4.70 - 5.45	40	NIL	NO	Dark grey	-
5.45 - 6.20	60	13.00	NO	Dark grey	-
6.20 - 6.95	52	NIL	NO	Dark grey	-
6.95 - 7.70	56	NIL	NO	Dark grey	-
7.70 - 8.20	82	0.28	NO	Dark grey	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
0.15
(BGL)
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D.
Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur		BH : 16
Boring Diameter : 150 mm & NX			Sheet : 1 of 9
Casing Diameter : 150 mm & NX	Co-Ordinate :E809083.00, N2410803.00		R.L. : 199.466
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		Date : 06.01.2018

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
0.50 - 0.50	D	100951							
1.00 - 1.45	P	100952	1.40	11					
1.50 - 1.50	D	100953	1.40						
2.00 - 2.45	U	100954	1.90				Stiff brownish grey lateric clay with high % of nodules and grey patches.	IA	
2.50 - 2.50	D	100955	1.90						
3.00 - 3.45	P	100956	2.90	16					
4.00 - 4.45	P	100957	3.90	20		3.90		195.57	
5.00 - 5.45	P	100958	4.90	23					
5.50 - 5.50	D	100959	4.90				Medium dense brown clayey silty sand with grey silt lamination.	II	
6.00 - 6.45	P	100960	5.90	35					
6.50 - 6.50	D	100961	5.90						
7.00 - 7.45	P	100962	6.90	79		7.00		192.47	
8.50 - 8.95	P	100963	7.90	81					
10.00 - 10.45	P	100964	9.90	89			Very dense greyish brown silty sand with mica.	III	
11.50 - 11.80	P	100965	11.40	>100					
12.75 - 12.87	P	-	12.20	>100		12.00		187.47	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value	Depth (BGL) (m)	Description	R.L.(M)
12.00 - 12.75	NIL	NIL	NO	Yellowish brown	-		Complete weathered yellowish brown decomposed product of rock.	IVA
12.75 - 13.50	NIL	NIL	NO	Yellowish brown	-	13.50		185.97

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Description	R.L.(M)
13.50 - 13.59	P	-	12.20	>100	Highly to moderately weathered brownish yellow rock.	IVB

Continued

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
08.01.2018	17.00	2.50
09.01.2018	17.00	3.00
10.01.2018	17.00	3.00

Remarks:

S.W.L. (m)
3.00
(BGL)
196.47
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 16**
Boring Diameter : 150 mm & NX		**Sheet : 2 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809083.00, N2410803.00**	**R.L. : 199.466**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 06.01.2018**

DRILLING						Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
From To (m)	**TCR %**	**RQD %**	**Water Loss**	**Color of Ret. Water**	**N Value**					
13.50 - 14.25	33.33	14.67	NO	Yellowish brown	-					
14.25 - 15.00	36.00	NIL	NO	Yellowish brown	-					
15.00 - 15.75	32.00	16.00	NO	Yellowish brown	-				IVB	
15.75 - 16.50	33.33	26.67	NO	Yellowish brown	-					
16.50 - 17.00	72.00	50.00	NO	Yellowish brown	-					
							17.00	End of BoreHole	182.47	

Water Level Observation		
Date	**Time (Hrs.)**	**W.L.(m) B.G.L.**

Remarks:

S.W.L. (m)

3.00
(BGL)

196.47
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur	BH : 17
Boring Diameter : 150 mm & NX		Sheet : 1 of 9
Casing Diameter : 150 mm & NX	Co-Ordinate :E809375, N2410250	R.L. : 204.919
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	Date : 01.02.2018

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
Depth (m)	Type	No.							
0.50 - 0.50	D	100514							
1.00 - 1.45	P	100515	0.90	9					
1.50 - 1.50	D	100516	0.90				Stiff brownish grey to yellowish brown silty clay with low % of nodules and a few sand occasionally observed.	IA	
2.00 - 2.45	U	100517	1.90						
2.50 - 2.50	D	100518	1.90						
3.00 - 3.45	P	100519	2.90	21		3.00		201.92	
3.50 - 3.50	D	100520	2.90						
4.00 - 4.45	U	100521	3.90				Very stiff brownish grey to yellowish brown silty clay with low % of nodules and a few sand occasionally observed.	IB	
5.00 - 5.45	P	100522	4.90	22					
6.00 - 6.45	P	100523	5.90	24					
7.50 - 7.95	U	100524	7.40			6.90		198.02	
9.00 - 9.45	P	100525	8.90	47					
10.00 - 10.00	D	100526	8.90				Very dense yellowish grey silty sand with mica.	III	
10.50 - 10.95	P	100527	10.40	81					
12.00 - 12.22	P	100528	11.90	>100		12.00		192.92	
12.75 - 12.87	P	-	12.20	>100					
13.50 - 13.60	P	-	12.20	>100			Completely weathered greyish yellow decomposed product of rock.	IVA	
						14.25		190.67	
							Highly to moderately weathered greyish yellow rock.	IVB	
							Continued		

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
12.00 - 12.75	NIL	NIL	NO	Greyish yellow	-
12.75 - 13.50	NIL	NIL	NO	Greyish yellow	-
13.50 - 14.25	NIL	NIL	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)	
4.78 (BGL) 200.14 (RL)	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 17**
Boring Diameter : 150 mm & NX		**Sheet : 2 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809375, N2410250**	**R.L. : 204.919**
Boring Equipment : Mechanical Cable Tools/NX Drilling.	**Orientation : Vertical**	**Date : 01.02.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value
14.25 - 14.34	P	-	12.20	>100

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
14.25 - 15.00	42.66	NIL	NO	Greyish yellow	-
15.00 - 15.75	49.33	NIL	NO	Greyish yellow	-
15.75 - 16.50	60.00	20.00	NO	Greyish yellow	-
16.50 - 17.00	60.00	30.00	NO	Greyish yellow	-

Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
			IVB	
	17.00	End of BoreHole	187.92	

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m) **4.78 (BGL)** **200.14 (RL)**

D.D. Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 18**	
Boring Diameter : 150 mm & NX		**Sheet : 1 of 9**	
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808900, N2409980**	**R.L. : 198.576**	
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical	**Date : 02.02.2018**	

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	100530						
1.00 - 1.45	U	100531	0.90					
1.50 - 1.50	D	100532	0.90				Stiff brownish grey to yellowish brown laterite with nodules and black spots.	IA
2.00 - 2.45	P	100533	1.90	13				
2.50 - 2.50	D	100534	1.90					
3.00 - 3.45	U	100535	2.90			3.00		195.58
3.50 - 3.50	D	100536	2.90					
4.00 - 4.45	P	100537	3.90	25			Very stiff brownish grey to yellowish brown laterite with nodules and black spots.	IB
4.50 - 4.50	D	100538	3.90					
5.50 - 5.95	P	100539	5.40	31		5.40		193.18
7.00 - 7.45	P	100540	6.90	54			Dense to Very dense whitish yellow silty sand with mica flakes.	III
9.00 - 9.27	P	100541	8.90	>100		9.00		189.58
							Highly to moderately weathered greyish yellow rock.	IVB
						14.00	End of BoreHole	184.58

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
9.00 - 9.75	22.67	NIL	Greyish yellow	NO	-
9.75 - 10.50	29.33	NIL	Greyish yellow	NO	-
10.50 - 11.25	40.00	NIL	Greyish yellow	NO	-
11.25 - 12.00	37.33	NIL	Greyish yellow	NO	-
12.00 - 12.75	36.00	NIL	Greyish yellow	NO	-
12.75 - 13.50	53.33	20.00	Greyish yellow	NO	-
13.50 - 14.00	56.00	22.00	Greyish yellow	NO	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
2.30
(BGL)
196.28
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D. Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 19**	
Boring Diameter : 150 mm & NX		**Sheet : 1 of 9**	
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809083, N2410380.00**	**R.L. : 199.313**	
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical	**Date : 03.01.2018**	

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	100500					Stiff brownish grey to yellowish brown lateric clay to silty sandy clay with high % of nodules in upper reaches and sand % incresed with depth.	IA
1.00 - 1.45	P	100501	0.90	10				
1.50 - 1.50	D	100502	0.90					
2.00 - 2.45	U	100503	1.90					
2.50 - 2.50	D	100504	1.90					
						3.00		196.31
3.00 - 3.45	P	100505	2.90	23			Very stiff brownish grey to yellowish brown lateric clay to silty sandy clay with high % of nodules in upper reaches and sand % incresed with depth.	IB
3.50 - 3.50	D	100506	2.90	23				
						3.90		195.41
4.00 - 4.45	U	100507	3.90				Dense to Very dense brownish yellow silty sand with mica.	III
4.50 - 4.50	D	100508	3.90					
5.00 - 5.45	P	100509	4.90	30				
6.00 - 6.45	P	100510	5.90	34				
7.50 - 7.95	P	100511	6.90	70				
9.00 - 9.45	P	100512	8.90	85				
						10.00		189.31
10.00 - 10.25	P	100513	9.90	>100			Highly to moderately weathered greyish yellow rock.	IVB
						15.00	Continued	184.31

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
10.00 - 10.75	24.00	NIL	Greyish yellow	NO	-
10.75 - 11.50	32.00	14.66	Greyish yellow	NO	-
11.50 - 12.25	56.00	21.33	Greyish yellow	NO	-
12.25 - 13.00	60.00	37.33	Greyish yellow	NO	-
13.00 - 13.75	48.00	40.00	Greyish yellow	NO	-
13.75 - 14.50	53.33	46.67	Greyish yellow	NO	-
14.50 - 15.00	60.00	56.00	Greyish yellow	NO	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
2.50
(BGL)
196.81
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D.
Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 20**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808700, N2409650**		**R.L. : 198.614**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 08.02.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
0.50 - 0.50	D	120100							
1.00 - 1.45	P	120101	0.90	12					
1.50 - 1.50	D	120102	0.90						
2.00 - 2.45	U	120103	1.90				Stiff brownish grey to yellowish brown silty clay with low % of nodules black spots. Note: sand % increase at 6.00m depth.	IA	
2.50 - 2.50	D	120104	1.90						
3.00 - 3.45	P	120105	2.90	19					
3.50 - 3.50	D	120106	2.90						
						4.00		194.61	
4.50 - 4.95	U	120107	4.40						
6.00 - 6.45	P	120108	5.90	40			Very stiff brownish grey to yellowish brown silty clay with low % of nodules black spots. Note: sand % increase at 6.00m depth.	IB	
7.00 - 7.00	D	120109	5.90						
7.50 - 7.70	P	120110	7.40	>100		7.50	Very dense greyish yellow silty sand with mica.	191.11 III	
						8.00		190.61	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.00 - 8.75	24.00	NIL	NO	Greyish brown	-
8.75 - 9.50	29.33	NIL	NO	Greyish brown	-
9.50 - 10.25	22.67	13.00	NO	Greyish brown	-
10.25 - 11.00	36.00	NIL	NO	Greyish brown	-
11.00 - 11.75	53.33	12.00	NO	Greyish brown	-
11.75 - 12.50	52.00	17.00	NO	Greyish brown	-
12.50 - 13.00	38.67	18.00	NO	Greyish brown	-

Depth (BGL) (m)	Description	R.L.(M)
8.00 - 13.00	Highly to moderately weathered greyish yellow rock.	IVB
13.00	End of BoreHole	185.61

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
4.20
(BGL)
194.41
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 21**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E809200, N2409550**		**R.L. : 201.101**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 09.02.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	120110					Stiff dark grey to yellowish brown silty clay with nodules and a few sand.	IA
1.00 - 1.45	P	120111	0.90	10				
1.50 - 1.50	D	120112	0.90					
2.00 - 2.45	U	120113	1.90					
2.50 - 2.50	D	120114	1.90					
3.00 - 3.45	P	120115	2.90	12				
3.50 - 3.50	D	120116	2.90					
4.50 - 4.95	U	120117	4.40					
6.00 - 6.45	P	120118	5.90	23		5.00	Very stiff dark grey to yellowish brown silty clay with nodules and a few sand.	196.10 IB
7.50 - 7.95	P	120119	7.40	32		7.40	Dense yellowish brown silty sand.	193.70 II
8.50 - 8.58	P	120120	8.40	>100		8.40	Highly to moderately weathered yellowish grey rock.	192.70 IVB
						13.50	End of BoreHole	187.60

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.50 - 9.25	29.33	NIL	Greyish yellow	NO	-
9.25 - 10.00	36.00	NIL	Greyish yellow	NO	-
10.00 - 10.75	24.00	10.00	Greyish yellow	NO	-
10.75 - 11.50	29.33	14.00	Greyish yellow	NO	-
11.50 - 12.25	52.00	NIL	Greyish yellow	NO	-
12.25 - 13.00	53.33	12.00	Greyish yellow	NO	-
13.00 - 13.50	38.67	13.00	Greyish yellow	NO	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
4.50 (BGL)
196.60 (RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

D.D. Supervisor

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 22**
Boring Diameter : 150 mm & NX		**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E808900.00, N2409125.00**	**R.L. : 201.405**
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	**Date : 15.02.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	165100					Stiff greyish brown silty clay to sandy clay with nodules silt concreation and sandy clay layer observed from 6.00m depth.	IA
1.00 - 1.45	U	165101	0.90					
1.50 - 1.50	D	165102	0.90					
2.00 - 2.45	P	165103	1.90	9				
3.00 - 3.45	U	165105	2.90					
3.50 - 3.50	D	165106	2.90					
4.50 - 4.95	P	165107	4.40	24		4.00	Very stiff greyish brown silty clay to sandy clay with nodules silt concreation and sandy clay layer observed from 6.00m depth.	197.41 IB
6.00 - 6.45	P	165108	5.90	28				
7.50 - 7.95	P	165109	7.40	34		6.50	Medium dense greyish brown silty sand.	194.91 II
8.20 - 8.30	P	165110	8.10	>100		8.20	Highly to moderately weathered yellowish grey rock.	193.21 IVB
						13.20	End of BoreHole	188.21

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.20 - 8.95	29.33	NIL	NO	Greyish yellow	-
8.95 - 9.70	36.00	NIL	NO	Greyish yellow	-
9.70 - 10.45	24.00	10.00	NO	Greyish yellow	-
10.45 - 11.20	29.33	14.00	NO	Greyish yellow	-
11.20 - 11.95	52.00	NIL	NO	Greyish yellow	-
11.95 - 12.70	53.33	12.00	NO	Greyish yellow	-
12.70 - 13.20	38.67	13.00	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
4.30
(BGL)
197.10
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D.
Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur	BH : 23
Boring Diameter : 150 mm & NX		Sheet : 1 of 9
Casing Diameter : 150 mm & NX	Co-Ordinate :E809100.00, N2411450	R.L. : 200.850
Boring Equipment : Mechanical Cable Tools/NX Drilling.		
	Orientation : Vertical	Date : 03.02.2018

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
Depth (m)	Type	No.						
0.50 - 0.50	D	100250						
1.00 - 1.45	U	100251	0.90					
1.50 - 1.50	D	100252	0.90					
2.00 - 2.45	P	100253	1.90	17				
2.50 - 2.50	D	100254	1.90				Very stiff mottled brown lateritic clay with high % of nodules and black spots.	IA
3.00 - 3.45	U	100255	2.90					
3.50 - 3.50	D	100256	2.90					
4.00 - 4.45	P	100257	3.90	21				
						4.50		196.35
5.00 - 5.45	P	100258	4.90	33				
6.00 - 6.45	P	100259	5.90	41			Dense to very dense yellowish brown silty sand.	III
7.50 - 7.95	P	100260	7.40	57				
8.50 - 8.75	P	100261	8.40	>100		8.50		192.35
							Highly to moderately weathered dark yellow rock.	IVB
						13.50	End of BoreHole	187.35

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.50 - 9.25	25.33	NIL	Darkish yellow	NO	-
9.25 - 10.00	29.33	NIL	Darkish yellow	NO	-
10.00 - 10.75	37.33	18.67	Darkish yellow	NO	-
10.75 - 11.50	53.33	NIL	Darkish yellow	NO	-
11.50 - 12.25	45.33	29.33	Darkish yellow	NO	-
12.25 - 13.00	52.00	NIL	Darkish yellow	NO	-
13.00 - 13.50	41.33	40.00	Darkish yellow	NO	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
3.50
(BGL)
197.35
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

- **Boring Method** : Shell Auger & NX Drilling.
- **Boring Diameter** : 150 mm & NX
- **Casing Diameter** : 150 mm & NX
- **Boring Equipment** : Mechanical Cable Tools/NX Drilling.
- **Site** : Sambalpur
- **Co-Ordinate** :E808950.00, N2411560.00
- **Orientation** : Vertical
- **BH** : 24
- **Sheet** : 1 of 9
- **R.L.** : 197.790
- **Date** : 08.02.2018

Sample In-situ Tests			Casing Depth(M)	N - Value
Depth (m)	Type	No.		
0.50 - 0.50	D	100101		
1.00 - 1.45	U	100102	0.90	
1.50 - 1.50	D	100103	0.90	
2.00 - 2.45	P	100104	1.90	16
2.50 - 2.50	D	100105	1.90	
3.00 - 3.45	U	100106	2.90	
3.50 - 3.50	D	100107	2.90	
4.50 - 4.95	P	100108	4.40	27
5.00 - 5.00	D	100109	4.40	
6.50 - 6.95	P	100110	6.40	62
7.00 - 7.20	P	100111	6.90	>100
7.95 - 8.07	P	-	7.21	>100

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
7.00 - 7.75	NIL	NIL	NO	Greyish yellow	-
7.75 - 8.50	22.67	NIL	NO	Greyish yellow	-
8.50 - 9.95	40.00	NIL	NO	Greyish yellow	-
9.95 - 10.00	34.67	24.00	NO	Greyish yellow	-
10.00 - 10.75	49.33	NIL	NO	Greyish yellow	-
10.75 - 11.50	60.00	20.00	NO	Greyish yellow	-
11.50 - 12.00	68.00	36.00	NO	Greyish yellow	-

Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
		Stiff mottled brown lateritic clay with high % of nodules.	IA	
	3.50		194.29	
		Very stiff mottled brown lateritic clay with high % of nodules.	IB	
	5.50		192.29	
		Dense to very dense clayey sandy silt with a few small quatz pieces.	III	
	7.00		190.79	
		Completely to highly weathered rock.	IVB	
	12.00		185.79	
		End of BoreHole		

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.

Remarks:

S.W.L. (m)
1.90
(BGL)
195.89
(RL)

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

D.D.
Supervisor

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur	BH : 25	
Boring Diameter : 150 mm & NX		Sheet : 1 of 9	
Casing Diameter : 150 mm & NX	Co-Ordinate :E208490.00, N2411560.00	R.L. : 197.00	
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical	Date : 16.02.2018	

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
Depth (m)	Type	No.							
0.50 - 0.50	D	170019							
1.00 - 1.45	U	170020	0.90						
2.00 - 2.45	P	170021	1.90	9					
2.00 - 2.45	P	170022	1.90	9					
2.50 - 2.50	D	170023	1.90						
3.00 - 3.45	U	170024	2.90				Stiff to very stiff greyish brown silty clay with occasionally with a few nodules.	IA	
3.50 - 3.50	D	170025	2.90						
4.50 - 4.95	P	170026	4.40	15					
6.00 - 6.45	U	170027	5.90						
6.50 - 6.50	D	170028	5.90						
7.50 - 7.95	P	170029	7.40	21					
9.00 - 9.45	P	170030	8.90	33		9.00		188.00	
10.50 - 10.95	P	170031	10.40	51			Dense to very dense yellowish grey silty sand with a few mica.	II	
12.75 - 12.88	P	-	12.20	>100		12.00		185.00	
13.50 - 13.62	P	-	12.20	>100					
14.25 - 14.36	P	-	12.20	>100					
15.00 - 15.10	P	-		>100					
15.75 - 15.84	P	-		>100			Completely weathered yellowish grey decomposed product of rock.	IVA	
16.50 - 16.58	P	-		>100					
17.00 - 17.07	P	-		>100					

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
12.00 - 12.75	NIL	NIL	NO	Greyish Yellow	-

Continued

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
17.02.2018	17.00	4.00
18.02.2018	17.00	4.35
19.02.2018	17.00	4.35

Remarks:

S.W.L. (m)
4.35
(BGL)
192.65
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	Site : Sambalpur	BH : 25
Boring Diameter : 150 mm & NX		Sheet : 2 of 9
Casing Diameter : 150 mm & NX	Co-Ordinate :E208490.00, N2411560.00	R.L. : 197.00
Boring Equipment : Mechanical Cable Tools/NX Drilling.	Orientation : Vertical	Date : 16.02.2018

DRILLING						Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)	Log
From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value					
12.75 - 13.50	NIL	NIL	NO	Greyish Yellow	-					
13.50 - 14.25	NIL	NIL	NO	Greyish Yellow	-					
14.25 - 15.00	NIL	NIL	NO	Greyish Yellow	-					
15.00 - 15.75	NIL	NIL	NO	Greyish Yellow	-				IVA	
15.75 - 16.50	NIL	NIL	NO	Greyish Yellow	-					
16.50 - 17.00	NIL	NIL	NO	Greyish Yellow	-					
							17.07	End of BoreHole	179.93	

Water Level Observation			Remarks:	S.W.L. (m)	
Date	Time (Hrs.)	W.L.(m) B.G.L.		4.35 (BGL) 192.65 (RL)	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
				D.D. Supervisor	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**	**BH : 26**
Boring Diameter : 150 mm & NX		**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E810400.00, N2411400.00**	**R.L. : 197.230**
Boring Equipment : Mechanical Cable Tools/NX Drilling.	**Orientation : Vertical**	**Date : 13.02.2018**

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	182155						
1.00 - 1.45	U	182156	0.90					
1.50 - 1.50	D	182157	0.90					
2.00 - 2.45	P	182158	1.90	10				
2.50 - 2.50	D	182159	1.90					
3.00 - 3.45	U	182160	2.90				Stiff to very stiff greyish brown silty clay with occasionally with a few nodules.	IA
3.50 - 3.50	D	182161	2.90					
4.50 - 4.95	P	182162	4.40	27				
6.00 - 6.35	P	182163	5.90	>100				
6.50 - 6.55	P	-	6.50	>100				
						7.00		190.23
							Highly to moderately weathered yellowish grey rock.	IVB
						11.30	End of BoreHole	185.93

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
6.30 - 7.05	NIL	NIL	NO	Greyish yellow	-
7.05 - 7.80	22.67	NIL	NO	Greyish yellow	-
7.80 - 8.55	40.00	NIL	NO	Greyish yellow	-
8.55 - 9.30	34.67	24.00	NO	Greyish yellow	-
9.30 - 10.05	49.33	NIL	NO	Greyish yellow	-
10.05 - 10.80	60.00	20.00	NO	Greyish yellow	-
10.80 - 11.30	68.00	36.00	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
15.02.2018	17.00	1.90
16.02.2018	17.00	1.10
17.02.2018	17.00	1.10

Remarks:

S.W.L. (m)
1.10
(BGL)
196.13
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**
Boring Diameter : 150 mm & NX	
Casing Diameter : 150 mm & NX	**Co-Ordinate :E810500.00, N2409500.00**
Boring Equipment : Mechanical Cable Tools/NX Drilling.	**Orientation : Vertical**

BH : 27	**Sheet : 1 of 9**
R.L. : 202.405	**Date** : 20.02.2018

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	170660						
1.00 - 1.45	P	170661	0.90	10				
1.50 - 1.50	D	170662	0.90					
2.00 - 2.45	U	170663	1.90					
2.50 - 2.50	D	170664	1.90				Stiff brownish grey silty clay to clayey silt with a few silt concreation.	IA
3.00 - 3.45	P	170665	2.90	19				
3.50 - 3.50	D	170666	2.90					
4.50 - 4.95	U	170667	4.40					
						5.00		197.41
6.00 - 6.45	P	170668	5.90	30				
7.50 - 7.95	P	170669	7.40	37			Hard brownish grey silty clay to clayey silt with a few silt concreation.	IB
						8.50		193.91
8.50 - 8.59	P	170670	8.40	>100				
							Highly to moderately weathered yellowish grey rock.	IVB
						13.50	End of BoreHole	188.91

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.50 - 9.25	29.33	NIL	NO	Greyish Yellow	-
9.25 - 10.00	36.00	NIL	NO	Greyish Yellow	-
10.000 - 10.75	24.00	10.00	NO	Greyish Yellow	-
10.75 - 11.50	29.33	14.00	NO	Greyish Yellow	-
11.50 - 12.25	52.00	NIL	NO	Greyish Yellow	-
12.25 - 13.00	53.33	12.00	NO	Greyish Yellow	-
13.00 - 13.50	58.00	13.00	NO	Greyish Yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
22.02.2018	17.00	3.90
23.02.2018	17.00	4.70
24.02.2018	17.00	4.70

Remarks:

S.W.L. (m)
4.70
(BGL)
197.71
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**
Boring Diameter : 150 mm & NX	**BH** : 28
Casing Diameter : 150 mm & NX	**Sheet : 1 of 9**
Boring Equipment : Mechanical Cable Tools/NX Drilling.	**Co-Ordinate :E810850.00, N2409050.00**
	R.L. : 201.102
	Orientation : Vertical
	Date : 02.02.2018

Sample In-situ Tests Depth (m)	Type	No.	Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
0.50 - 0.50	D	160770					Stiff brownish grey silty clay to sandy silty clay with a few nodules at upper reaches only.	IA
1.00 - 1.45	U	160771	0.90					
1.50 - 1.50	D	160772	0.90					
2.00 - 2.45	P	160773	1.90	12				
2.50 - 2.50	D	160774	2.50					
3.00 - 3.45	U	160775	2.90					
3.50 - 3.50	D	160776	2.90					
4.50 - 4.95	P	160777	4.40	20				
						5.90		195.20
6.00 - 6.45	P	160778	5.90	33			MEdium dense to dense silty sand.	II
7.00 - 7.45	P	160779	6.90	41				
						8.00		193.10
8.00 - 8.10	P	160780	7.50	>100			Highly to moderately weathered yellowish grey rock.	IVB
						13.00	End of BoreHole	188.10

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.00 - 8.75	24.00	NIL	NO	Greyish yellow	-
8.75 - 9.50	36.00	NIL	NO	Greyish yellow	-
9.50 - 10.25	29.33	10.00	NO	Greyish yellow	-
10.25 - 11.00	52.00	15.00	NO	Greyish yellow	-
11.00 - 11.75	29.33	NIL	NO	Greyish yellow	-
11.75 - 12.50	52.00	16.00	NO	Greyish yellow	-
12.50 - 13.00	58.00	14.00	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
23.02.2018	17.00	3.50
24.02.2018	17.00	4.20
25.02.2018	17.00	4.20

Remarks:

S.W.L. (m)

4.20
(BGL)

196.90
(RL)

D.D.
Supervisor

D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

SKM Geosurvey

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH** : 29
Boring Diameter : 150 mm & NX			**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E810200.00, N2408750.00**		**R.L.** : 202.925
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date** : 22.02.2018

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)
Depth (m)	**Type**	**No.**			
0.50 - 0.50	D	130151			
1.00 - 1.45	P	130152	0.90	15	
1.50 - 1.50	D	130153	0.90		
2.00 - 2.45	U	130154	1.90		
2.50 - 2.50	D	130155	1.90		
3.00 - 3.45	P	130156	2.90	21	
3.50 - 3.50	D	130157	2.90		
4.50 - 4.95	U	130158	4.40		
6.00 - 6.45	P	130159	5.90	31	
7.50 - 7.95	P	130160	7.40	42	
8.50 - 8.60	P	130161	8.40	>100	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.50 - 9.25	29.33	NIL	NO	Greyish yellow	-
9.25 - 10.00	24.00	10.00	NO	Greyish yellow	-
10.00 - 10.75	38.67	NIL	NO	Greyish yellow	-
10.75 - 11.50	52.00	15.00	NO	Greyish yellow	-
11.50 - 12.25	36.00	NIL	NO	Greyish yellow	-
12.25 - 13.00	52.00	10.00	NO	Greyish yellow	-
13.00 - 13.50	60.00	12.00	NO	Greyish yellow	-

Depth (BGL) (m)	Description	R.L.(M)	Log
	Stiff brownish grey silty clay to clayey silt with a few silt concreation.	IA	
3.00		199.93	
	Very stiff brownish grey silty clay to clayey silt with a few silt concreation.	IB	
5.00		197.93	
	Dense brownish grey silty sand.	II	
8.50		194.43	
	Highly to moderately weathered yellowish grey rock.	IVB	
13.50	End of BoreHole	189.43	

Water Level Observation		
Date	**Time (Hrs.)**	**W.L.(m) B.G.L.**
23.02.2018	17.00	3.50
24.02.2018	17.00	4.70
25.02.2018	17.00	4.70

Remarks:

S.W.L. (m)	
4.70 **(BGL)** **198.23** **(RL)**	D- Disturbed Sample B- Bulk Sample W- Water Sample U- Undisturbed sample P- Standard Penetration Test V- Vane Test PC- Cone Penetration Test
D.D. **Supervisor**	

Job No: 30796

BORELOG DATA SHEET

Boring Method : Shell Auger & NX Drilling.	**Site : Sambalpur**		**BH : 30**
Boring Diameter : 150 mm & NX			**Sheet : 1 of 9**
Casing Diameter : 150 mm & NX	**Co-Ordinate :E810650.00, N2408400.00**		**R.L. : 201.427**
Boring Equipment : Mechanical Cable Tools/NX Drilling.			
	Orientation : Vertical		**Date : 23.02.2018**

Sample In-situ Tests			Casing Depth(M)	N - Value	Date and Depth (m)	Depth (BGL) (m)	Description	R.L.(M)
Depth (m)	**Type**	**No.**						
0.50 - 0.50	D	180110					Stiff to very stiff brownish grey silty clay to sandy clay with a few nodules at upper reaches only.	IA
1.00 - 1.45	U	180111	0.90					
1.50 - 1.50	D	180112	0.90					
2.00 - 2.45	P	180113	1.90	13				
2.50 - 2.50	D	180114	1.90					
						3.00		198.43
3.00 - 3.45	U	180115	2.90				Very stiff to very stiff brownish grey silty clay to sandy clay with a few nodules at upper reaches only.	IB
3.50 - 3.50	D	180116	2.90					
4.50 - 4.95	P	180117	4.40	33				
						5.00		196.43
6.00 - 6.45	P	180118	5.90	41			Dense to very dense yellowish brown silty sand.	III
7.50 - 7.95	P	180119	7.40	51				
						8.20		193.23
8.20 - 8.29	P	180120	8.00	>100			Highly to moderately weathered yellowish grey rock.	IVB
						13.20		188.23
							End of BoreHole	

DRILLING

From To (m)	TCR %	RQD %	Water Loss	Color of Ret. Water	N Value
8.20 - 8.95	29.33	NIL	NO	Greyish yellow	-
8.95 - 9.70	24.00	12.00	NO	Greyish yellow	-
9.70 - 10.45	36.00	10.00	NO	Greyish yellow	-
10.45 - 11.20	52.00	12.00	NO	Greyish yellow	-
11.20 - 11.95	52.00	14.00	NO	Greyish yellow	-
11.95 - 12.70	36.00	NIL	NO	Greyish yellow	-
12.70 - 13.20	50.00	18.00	NO	Greyish yellow	-

Water Level Observation

Date	Time (Hrs.)	W.L.(m) B.G.L.
25.02.2018	17.00	3.60
26.02.2018	17.00	4.70
27.02.2018	17.00	4.70

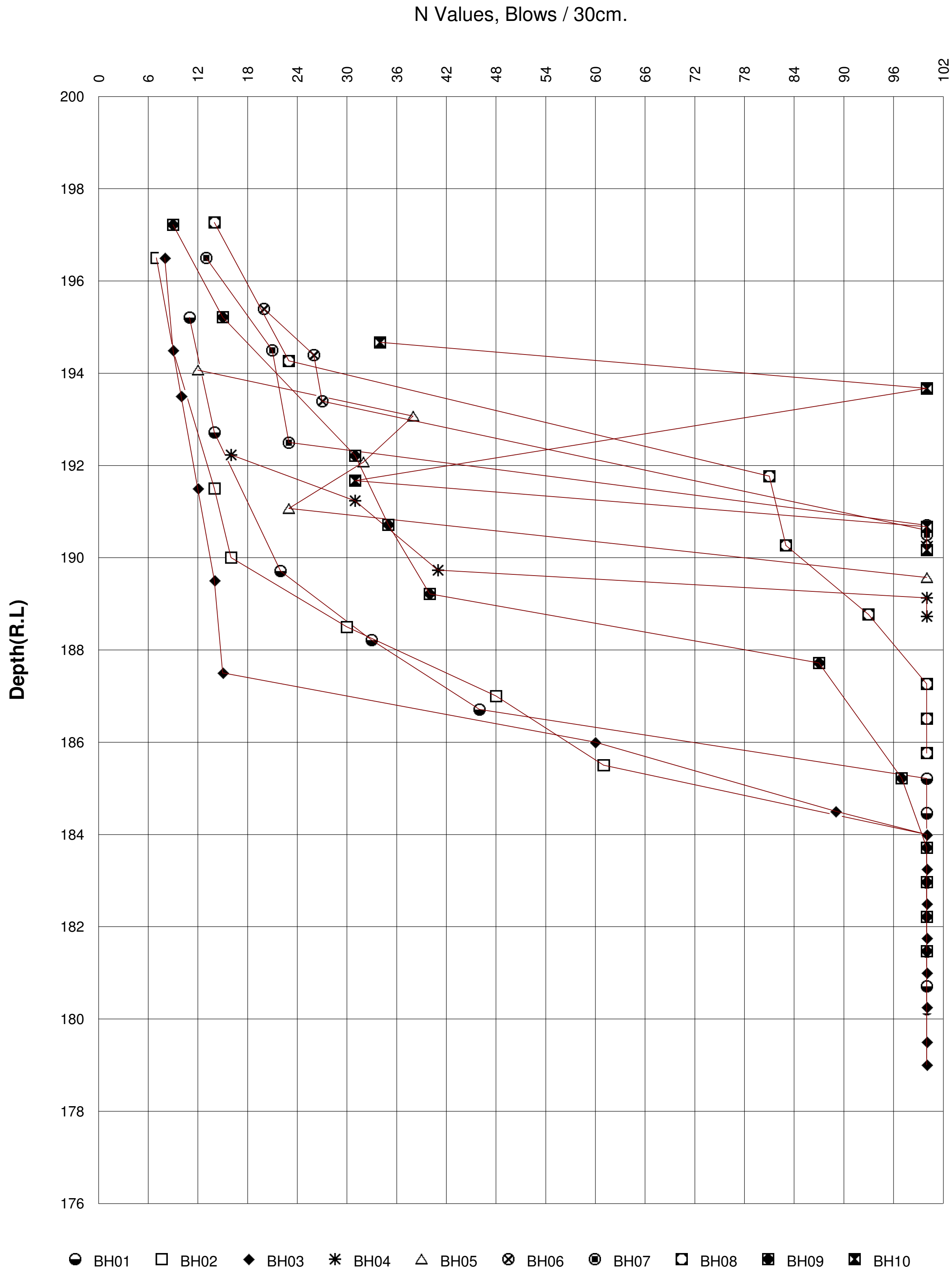
Remarks:

S.W.L. (m) **3.60 (BGL)** **197.83 (RL)**

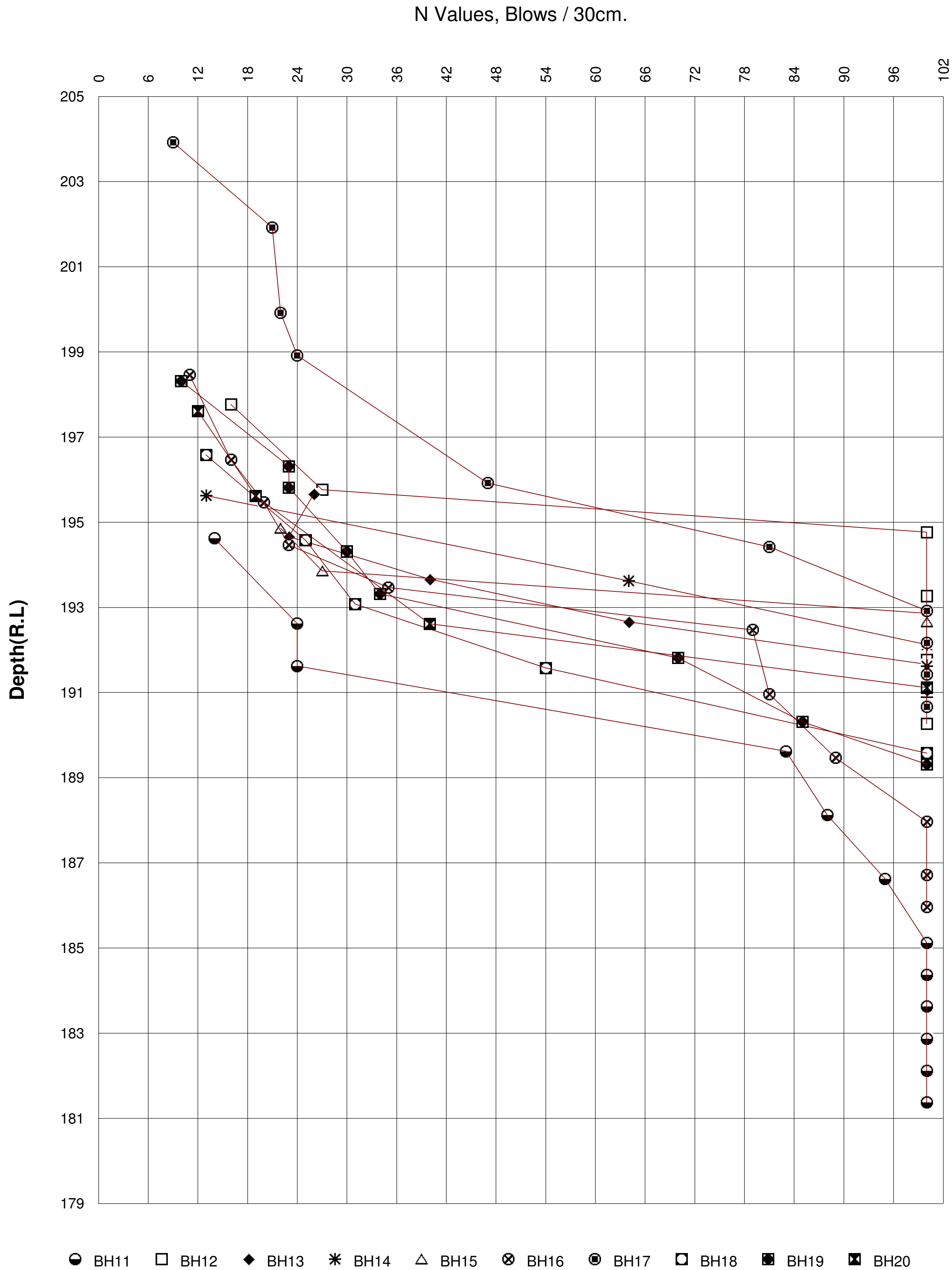
D- Disturbed Sample
B- Bulk Sample
W- Water Sample
U- Undisturbed sample
P- Standard Penetration Test
V- Vane Test
PC- Cone Penetration Test

Job No: 30796

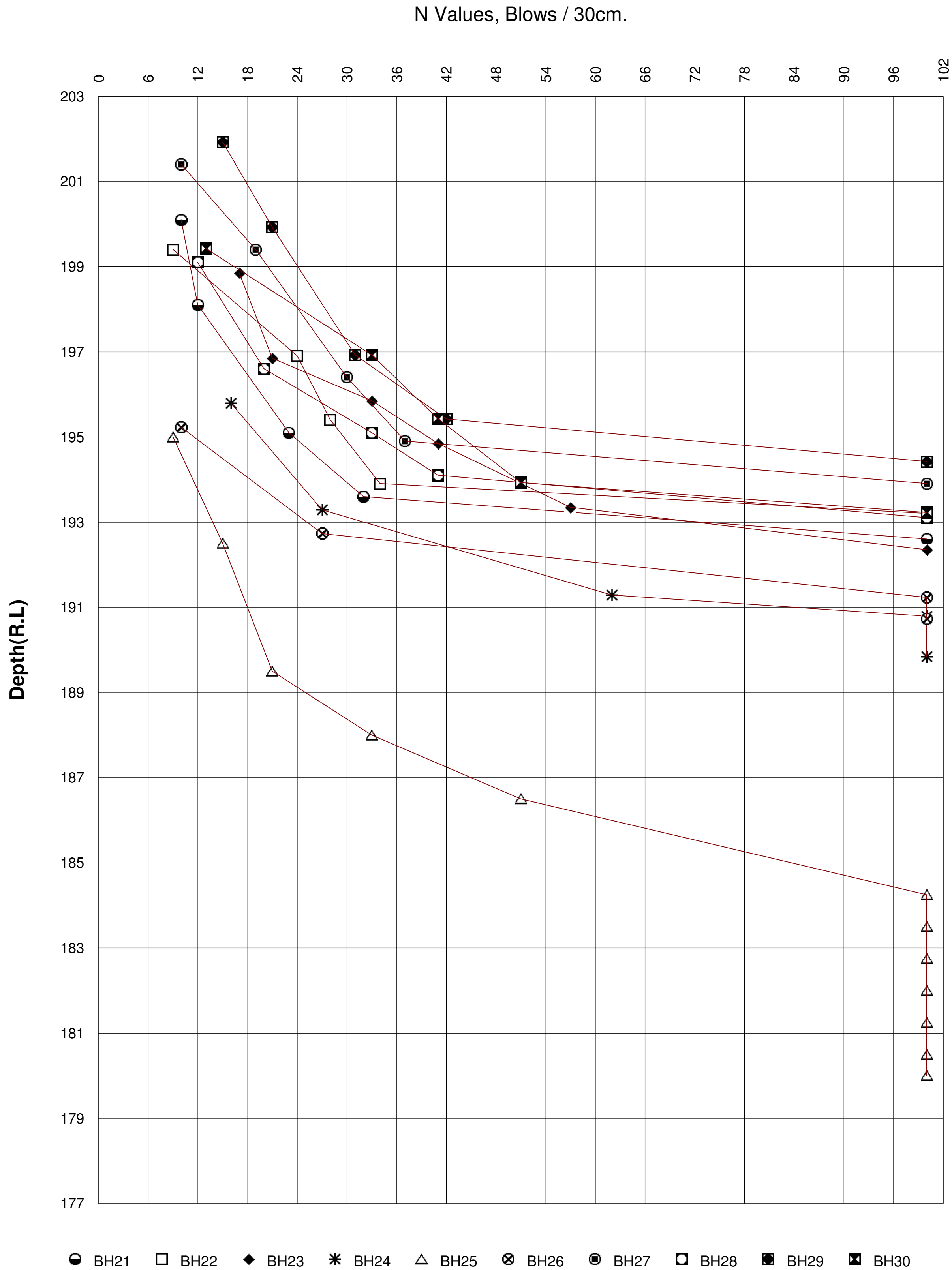
D.D. Supervisor



GRAPHICAL VIEW OF STANDARD PENETRATION TEST



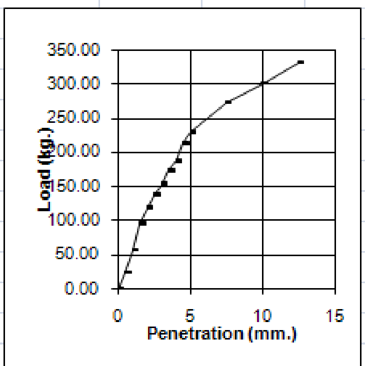
GRAPHICAL VIEW OF STANDARD PENETRATION TEST

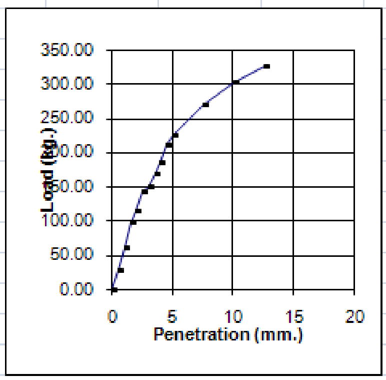


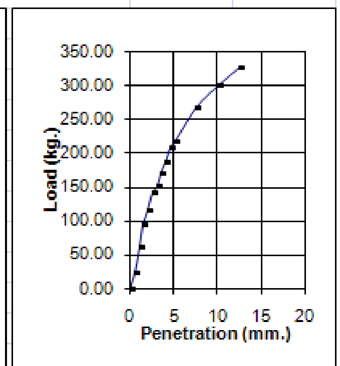
GRAPHICAL VIEW OF STANDARD PENETRATION TEST

Test Number	: **CBR.1**	Depth of Test	: 0.50m below G.L.
Location	: TP-4		
Surcharge Weight Used :			-
During Test :	5 kg.		:
Proving Ring Constant :	2.36 kg/div.	Date of Test	: 07.3.18

Penetration (mm)	Proving Ring Dial Gauge Reading (Division)			Load in (kg.)			Remarks
	1st	2nd	3rd	1st	2nd	3rd	
0	0	0	0	0.00	0.00	0.00	
0.5	10	11	10	23.60	25.96	23.60	
1	24	25	26	56.64	59.00	61.36	
1.5	40	41	40	94.40	96.76	94.40	
2	50	48	49	118.00	113.28	115.64	
2.5	58	60	60	136.88	141.60	141.60	
3	65	63	64	153.40	148.68	151.04	
3.5	73	71	72	172.28	167.56	169.92	
4	79	78	79	186.44	184.08	186.44	
4.5	90	89	88	212.40	210.04	207.68	
5	97	95	92	228.92	224.20	217.12	
7.5	115	114	113	271.40	269.04	266.68	
10	127	128	127	299.72	302.08	299.72	
12.5	140	138	138	330.40	325.68	325.68	





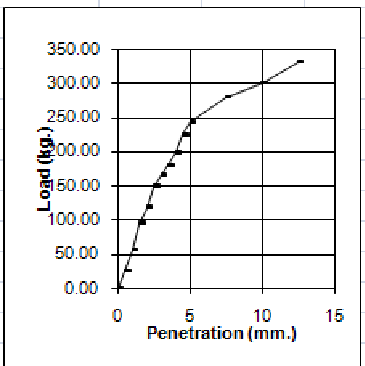


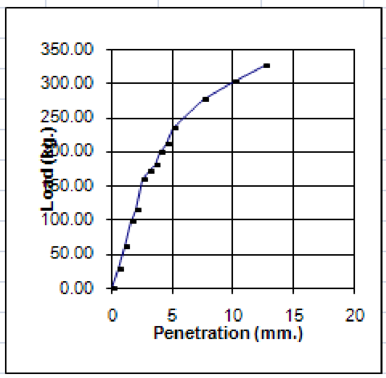
C.B.R. Test Results

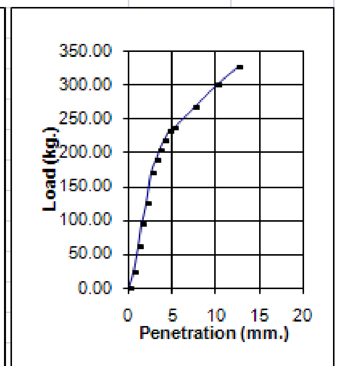
Penetration (mm)	Bearing Ratio (%)			Average (%)
2.5	9.99	10.34	10.34	10.34
5	11.14	10.91	10.57	10.74

Test Number	: **CBR.2**	Depth of Test	: 0.50m below G.L.
Location	: TP-9		
<u>Surcharge Weight Used :</u>			
During Test :	5 kg.		
Proving Ring Constant :	2.36 kg/div.	Date of Test	: 07.3.18

Penetration (mm)	Proving Ring Dial Gauge Reading (Division)			Load in (kg.)			Remarks
	1st	2nd	3rd	1st	2nd	3rd	
0	0	0	0	0.00	0.00	0.00	
0.5	11	11	10	25.96	25.96	23.60	
1	24	25	26	56.64	59.00	61.36	
1.5	40	41	40	94.40	96.76	94.40	
2	50	48	53	118.00	113.28	125.08	
2.5	63	67	72	148.68	158.12	169.92	
3	70	72	80	165.20	169.92	188.80	
3.5	76	76	86	179.36	179.36	202.96	
4	84	84	92	198.24	198.24	217.12	
4.5	95	89	98	224.20	210.04	231.28	
5	103	99	100	243.08	233.64	236.00	
7.5	118	117	113	278.48	276.12	266.68	
10	127	128	127	299.72	302.08	299.72	
12.5	140	138	138	330.40	325.68	325.68	





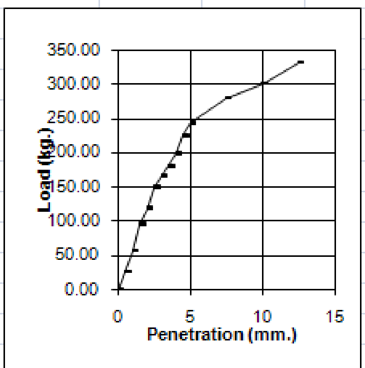


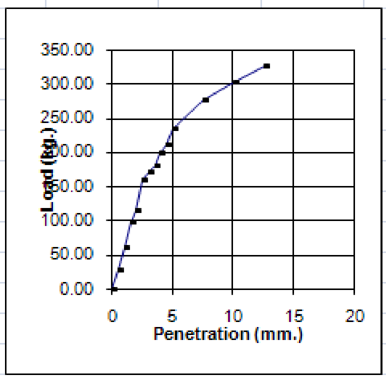
C.B.R. Test Results

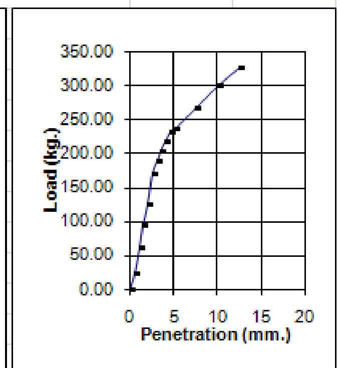
Penetration (mm)	Bearing Ratio (%)			Average (%)
2.5	10.85	11.54	12.40	11.97
5	11.83	11.37	11.48	11.43

Test Number	: **CBR.3**	Depth of Test	: 0.50m below G.L.
Location	: TP-11		
Surcharge Weight Used :			
During Test :	5 kg.		
Proving Ring Constant :	2.36 kg/div.	Date of Test	: 08.3.18

Penetration (mm)	Proving Ring Dial Gauge Reading (Division)			Load in (kg.)			Remarks
	1st	2nd	3rd	1st	2nd	3rd	
0	0	0	0	0.00	0.00	0.00	
0.5	11	11	10	25.96	25.96	23.60	
1	24	25	26	56.64	59.00	61.36	
1.5	40	41	40	94.40	96.76	94.40	
2	50	48	53	118.00	113.28	125.08	
2.5	63	67	72	148.68	158.12	169.92	
3	70	72	80	165.20	169.92	188.80	
3.5	76	76	86	179.36	179.36	202.96	
4	84	84	92	198.24	198.24	217.12	
4.5	95	89	98	224.20	210.04	231.28	
5	103	99	100	243.08	233.64	236.00	
7.5	118	117	113	278.48	276.12	266.68	
10	127	128	127	299.72	302.08	299.72	
12.5	140	138	138	330.40	325.68	325.68	





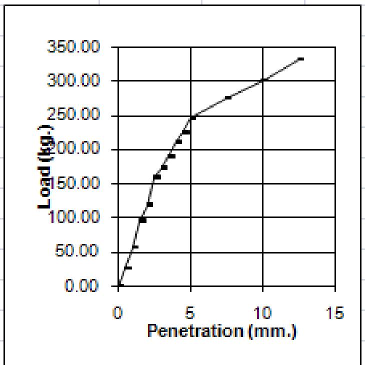


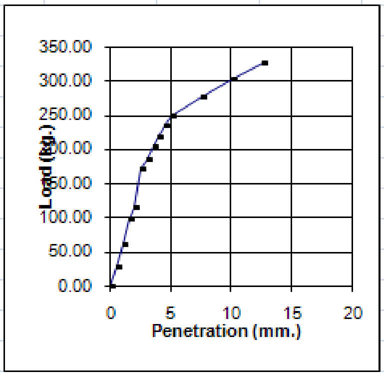
C.B.R. Test Results

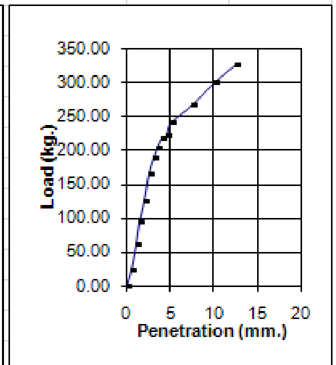
Penetration (mm)	Bearing Ratio (%)			Average (%)
2.5	10.85	11.54	12.40	11.97
5	11.83	11.37	11.48	11.43

Test Number	: **CBR.4**	Depth of Test	: 0.50m below G.L.
Location	: TP-15		
Surcharge Weight Used :			
During Test :	5 kg.		
Proving Ring Constant :	2.36 kg/div.	Date of Test	: 13.3.18

Penetration (mm)	Proving Ring Dial Gauge Reading (Division)			Load in (kg.)			Remarks
	1st	2nd	3rd	1st	2nd	3rd	
0	0	0	0	0.00	0.00	0.00	
0.5	11	11	10	25.96	25.96	23.60	
1	24	25	26	56.64	59.00	61.36	
1.5	40	41	40	94.40	96.76	94.40	
2	50	48	53	118.00	113.28	125.08	
2.5	67	72	70	158.12	169.92	165.20	
3	73	78	80	172.28	184.08	188.80	
3.5	80	86	86	188.80	202.96	202.96	
4	89	92	92	210.04	217.12	217.12	
4.5	95	99	94	224.20	233.64	221.84	
5	104	105	102	245.44	247.80	240.72	
7.5	116	117	113	273.76	276.12	266.68	
10	127	128	127	299.72	302.08	299.72	
12.5	140	138	138	330.40	325.68	325.68	





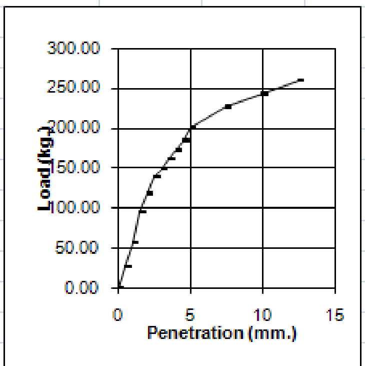


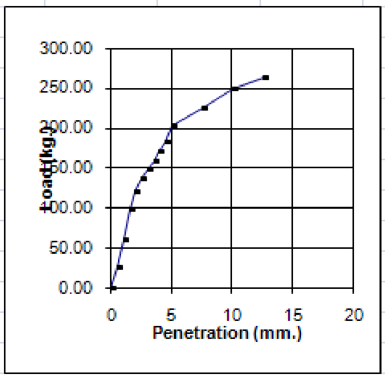
C.B.R. Test Results

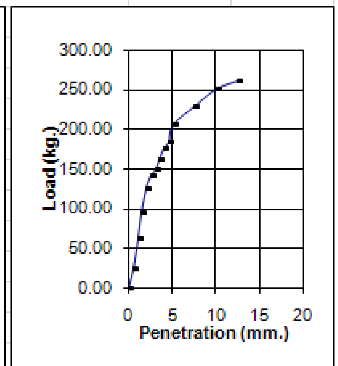
Penetration	Bearing Ratio (%)			Average (%)
2.5	11.54	12.40	12.06	12.23
5	11.94	12.06	11.71	11.89

Test Number	: **CBR.5**	Depth of Test	: 0.50m below G.L.
Location	: TP-2		
Surcharge Weight Used :			
During Test :	5 kg.		
Proving Ring Constant :	2.36 kg/div.	Date of Test	: 09.3.18

Penetration (mm)	Proving Ring Dial Gauge Reading (Division)			Load in (kg.)			Remarks
	1st	2nd	3rd	1st	2nd	3rd	
0	0	0	0	0.00	0.00	0.00	
0.5	11	11	10	25.96	25.96	23.60	
1	24	25	26	56.64	59.00	61.36	
1.5	40	41	40	94.40	96.76	94.40	
2	50	51	53	118.00	120.36	125.08	
2.5	59	58	60	139.24	136.88	141.60	
3	63	63	63	148.68	148.68	148.68	
3.5	68	67	68	160.48	158.12	160.48	
4	73	72	74	172.28	169.92	174.64	
4.5	78	77	78	184.08	181.72	184.08	
5	85	86	87	200.60	202.96	205.32	
7.5	96	95	97	226.56	224.20	228.92	
10	103	105	106	243.08	247.80	250.16	
12.5	110	111	110	259.60	261.96	259.60	

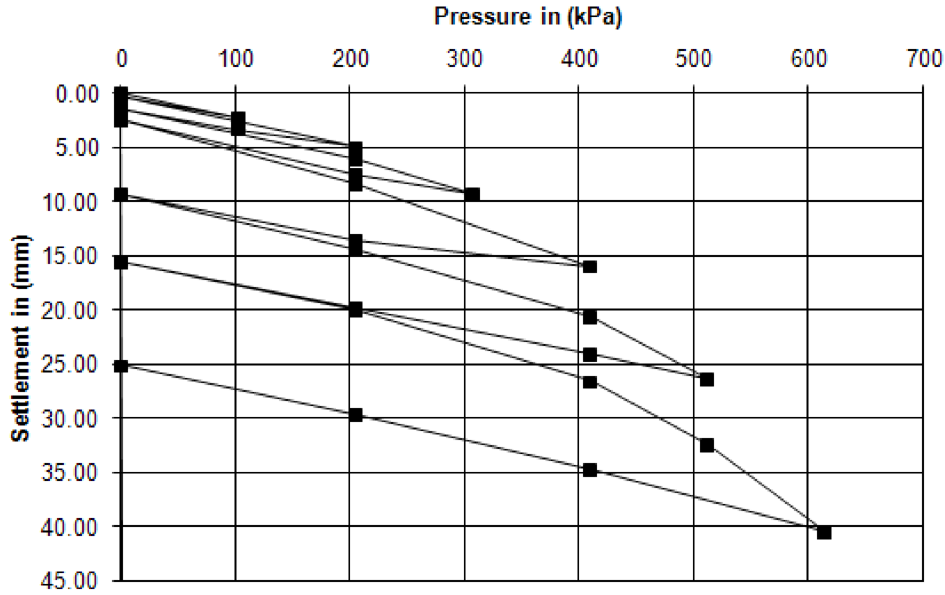






C.B.R. Test Results

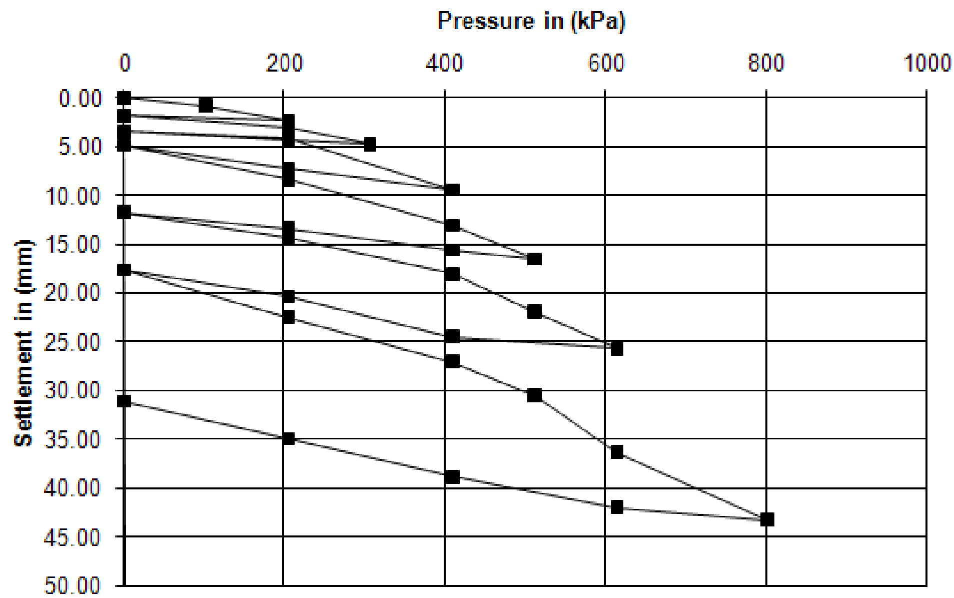
Penetration (mm)	Bearing Ratio (%)			Average (%)
2.5	10.16	9.99	10.34	10.16
5	9.76	9.88	9.99	9.93



Test No.	: CPLT.-01	R.L. of G.L.	198.5m
Plate Size	: 600mm x 600mm.	Dial Gauge Constant	: 0.01mm.
Pit Size	: 3 m x 3 m (Bottom)	L.C. of Pressure Gauge	: 5 kg/cm2
Depth of Test	: 2.50 m. b.g.l.	Ram Dia.	: 12.5cm.
Date of Test	: 12.02.2018	Site	: Sambalpur
Location of Test	N: 2410807.00, 808685.00		

CYCLIC PLATE LOAD TEST

TEST NO. : CPLT - 01

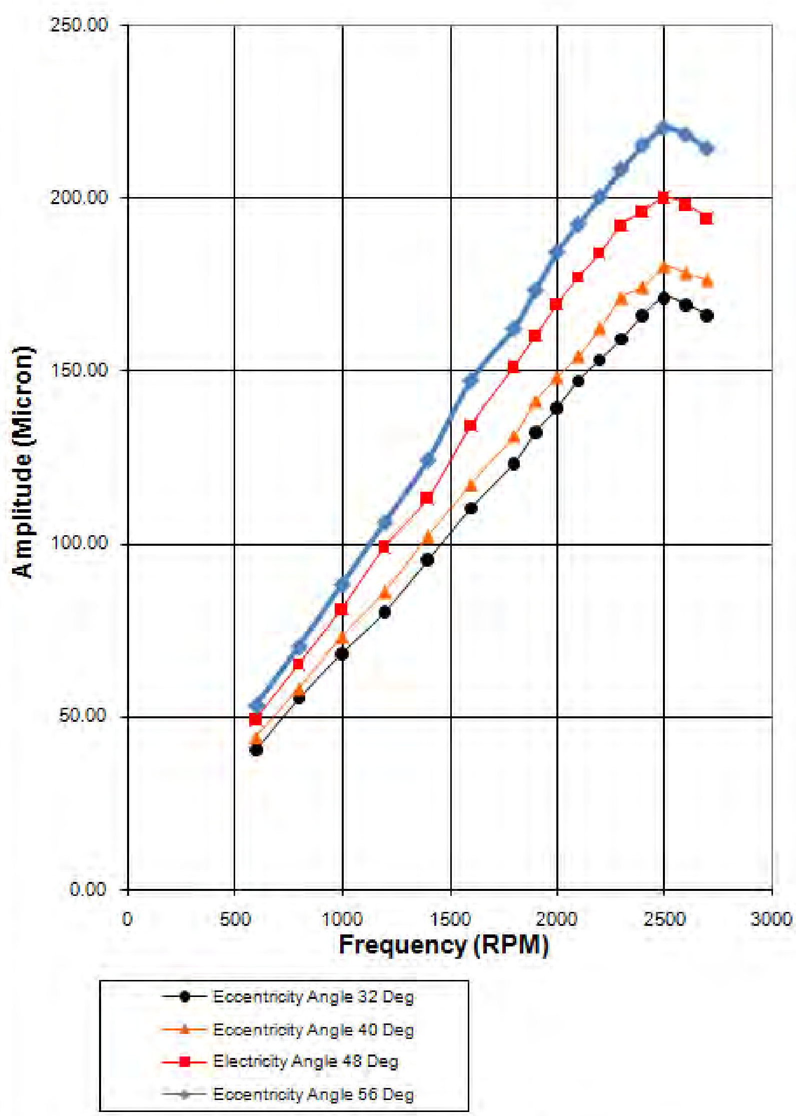


Test No.	: CPLT.-02	R.L. of G.L.	196.621m
Plate Size	: 600mm x 600mm.	Dial Gauge Constant	: 0.01mm.
Pit Size	: 3 m x 3 m (Bottom)	L.C. of Pressure Gauge	: 5 kg/cm2
Depth of Test	: 2.25 m. b.g.l.	Ram Dia.	: 12.5cm.
Date of Test	: 12.02.2018	Site	: Sambalpur
Location of Test	N: 2411120.00, 809085.00		

CYCLIC PLATE LOAD TEST

TEST NO. : CPLT - 02

Test No.	BVT-1 ,		
Site : NLC		Depth :	2.20m m below Egl
Date :	08.02.2018	Soil Type: :	Sandy silt
Block Size	1.50mx0.75mx1.00m	SWL: 0.15	
RL:	195.857m	Location:	N: 2411065, E: 809083



GRAPHICAL VIEW OF FREQUENCY Vs. AMPLITUDE

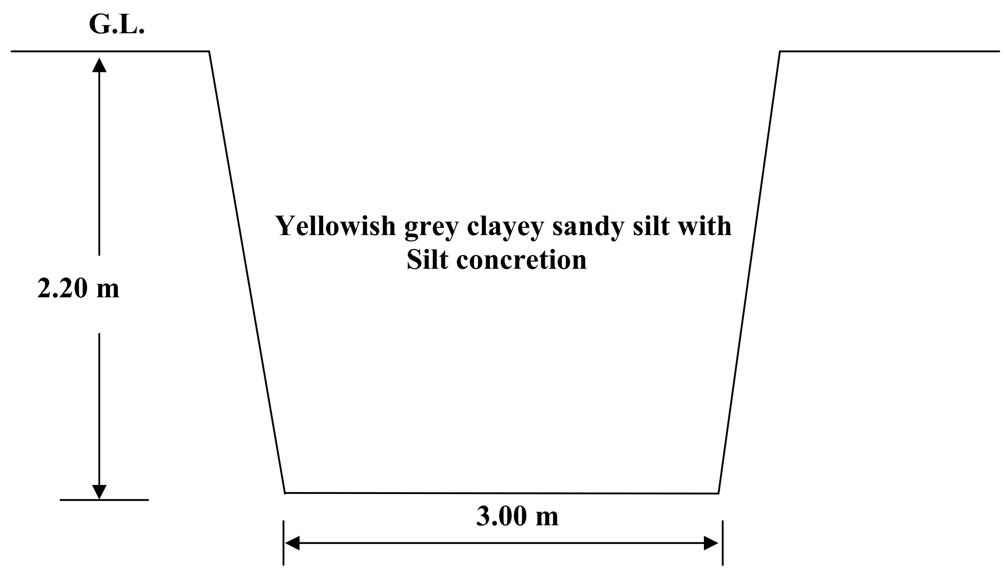
BLOCK VIBRATION TEST

BVT Pit Log

BVT Pit –1 (One)

Site : NLC, Sambalpur
Pit Volume: 5.0m x 3.0m x 2.2m
Date : 08.02.2018

RL : 195.857m
Depth : 2.20m
Co-Ordinate: N: 2411065, E: 809083



NOT TO SCALE

Dynamic Cone Penetration Test (DCPT)

DCPT : 1
Co-ordinate : N =2410807 / E= 808688
R.L. (m) : 198.50 **Near** : BH-03
Depth (m) : 12.60m **Date** : 04.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	1		4.30	4	
0.20	1	3	4.40	6	17
0.30	1		4.50	7	
0.40	1		4.60	5	
0.50	1	5	4.70	6	18
0.60	3		4.80	7	
0.70	2		4.90	5	
0.80	2	7	5.00	6	18
0.90	3		5.10	7	
1.00	2		5.20	5	
1.10	2	7	5.30	6	18
1.20	3		5.40	7	
1.30	3		5.50	5	
1.40	3	10	5.60	6	19
1.50	4		5.70	8	
1.60	3		5.80	6	
1.70	4	11	5.90	6	19
1.80	4		6.00	7	
1.90	4		6.10	6	
2.00	4	12	6.20	6	19
2.10	4		6.30	7	
2.20	4		6.40	6	
2.30	4	12	6.50	6	19
2.40	4		6.60	7	
2.50	4		6.70	6	
2.60	4	12	6.80	6	19
2.70	4		6.90	7	
2.80	4		7.00	6	
2.90	4	14	7.10	6	20
3.00	6		7.20	8	
3.10	4		7.30	6	
3.20	4	15	7.40	7	21
3.30	7		7.50	8	
3.40	4		7.60	6	
3.50	5	15	7.70	7	21
3.60	6		7.80	8	
3.70	4		7.90	7	
3.80	5	16	8.00	7	23
3.90	7		8.10	9	
4.00	4		8.20	7	
4.10	5	16	8.30	8	23
4.20	7		8.40	8	

Job No.30044

SKM Geosurvey

Dynamic Cone Penetration Test (DCPT)

DCPT : 1
Co-ordinate : N =2410807 / E= 808688
R.L. (m) : 198.50 **Near** : BH-03
Depth (m) : 12.60m **Date** : 04.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	8		11.80	25	
8.60	8	24	11.90	29	86
8.70	8		12.00	32	
8.80	8		12.10	39	
8.90	9	26	12.20	43	137
9.00	9		12.30	55	
9.10	8		12.40	59	
9.20	9	26	12.50	63	190
9.30	9		12.60	68	
9.40	8				
9.50	9	26			
9.60	9				
9.70	9				
9.80	9	27			
9.90	9				
10.00	9				
10.10	9	28			
10.20	10				
10.30	9				
10.40	9	28			
10.50	10				
10.60	9				
10.70	10	29			
10.80	10				
10.90	9				
11.00	10	29			
11.10	10				
11.20	10				
11.30	17	47			
11.40	20				
11.50	13				
11.60	22	59			
11.70	24				

Dynamic Cone Penetration Test (DCPT)

DCPT : 2
Co-ordinate : N =2411135 / E= 808965
R.L. (m) : 194.729 **Near** : BH-04
Depth (m) : 5.40m **Date** : 04.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	3		4.30	20	
0.20	3	9	4.40	21	65
0.30	3		4.50	24	
0.40	4		4.60	20	
0.50	7	18	4.70	23	68
0.60	7		4.80	25	
0.70	5		4.90	20	
0.80	8	22	5.00	23	68
0.90	9		5.10	25	
1.00	5		5.20	29	
1.10	8	22	5.30	61	161
1.20	9		5.40	71	
1.30	5		5.50		
1.40	9	23	5.60		
1.50	9		5.70		
1.60	6		5.80		
1.70	9	24	5.90		
1.80	9		6.00		
1.90	6		6.10		
2.00	9	24	6.20		
2.10	9		6.30		
2.20	8		6.40		
2.30	9	26	6.50		
2.40	9		6.60		
2.50	9		6.70		
2.60	9	28	6.80		
2.70	10		6.90		
2.80	11		7.00		
2.90	13	38	7.10		
3.00	14		7.20		
3.10	14		7.30		
3.20	14	42	7.40		
3.30	14		7.50		
3.40	14		7.60		
3.50	16	48	7.70		
3.60	18		7.80		
3.70	15		7.90		
3.80	17	53	8.00		
3.90	21		8.10		
4.00	16		8.20		
4.10	17	57	8.30		
4.20	24		8.40		

Dynamic Cone Penetration Test (DCPT)

DCPT : 3
Co-ordinate : N =2411085/ E= 809048
R.L. (m) : 195.568 **Near** : BH-05
Depth (m) : 6.00m **Date** : 04.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	1		4.30	14	
0.20	2	6	4.40	14	45
0.30	3		4.50	17	
0.40	3		4.60	15	
0.50	4	12	4.70	16	47
0.60	5		4.80	16	
0.70	4		4.90	22	
0.80	5	14	5.00	29	80
0.90	5		5.10	29	
1.00	4		5.20	39	
1.10	5	14	5.30	24	90
1.20	5		5.40	27	
1.30	6		5.50	39	
1.40	6	22	5.60	25	92
1.50	10		5.70	28	
1.60	11		5.80	39	
1.70	12	38	5.90	43	151
1.80	15		6.00	69	
1.90	13		6.10	72	
2.00	13	40	6.20		
2.10	14		6.30		
2.20	15		6.40		
2.30	19	56	6.50		
2.40	22		6.60		
2.50	16		6.70		
2.60	20	58	6.80		
2.70	22		6.90		
2.80	16		7.00		
2.90	20	58	7.10		
3.00	22		7.20		
3.10	16		7.30		
3.20	20	58	7.40		
3.30	22		7.50		
3.40	16		7.60		
3.50	20	58	7.70		
3.60	22		7.80		
3.70	14		7.90		
3.80	20	56	8.00		
3.90	22		8.10		
4.00	14		8.20		
4.10	16	50	8.30		
4.20	20		8.40		

Dynamic Cone Penetration Test (DCPT)

DCPT : 4
Co-ordinate : N =2410982/ E= 808979
R.L. (m) : 195.568 **Near** : BH-06
Depth (m) : 6.90m **Date** : 05.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	3		4.30	16	
0.20	3	11	4.40	17	50
0.30	5		4.50	17	
0.40	5		4.60	20	
0.50	5	16	4.70	24	77
0.60	6		4.80	33	
0.70	6		4.90	25	
0.80	7	24	5.00	26	78
0.90	11		5.10	27	
1.00	7		5.20	27	
1.10	10	27	5.30	27	82
1.20	10		5.40	28	
1.30	10		5.50	30	
1.40	10	30	5.60	32	96
1.50	10		5.70	34	
1.60	10		5.80	40	
1.70	10	30	5.90	42	124
1.80	10		6.00	42	
1.90	10		6.10	42	
2.00	10	32	6.20	42	136
2.10	12		6.30	52	
2.20	12		6.40	43	
2.30	12	37	6.50	47	142
2.40	13		6.60	52	
2.50	13		6.70	57	
2.60	14	42	6.80	68	193
2.70	15		6.90	68	
2.80	13		7.00		
2.90	14	42	7.10		
3.00	15		7.20		
3.10	14		7.30		
3.20	14	43	7.40		
3.30	15		7.50		
3.40	15		7.60		
3.50	15	45	7.70		
3.60	15		7.80		
3.70	15		7.90		
3.80	15	45	8.00		
3.90	15		8.10		
4.00	15		8.20		
4.10	15	46	8.30		
4.20	16		8.40		

Dynamic Cone Penetration Test (DCPT)

DCPT : 5
Co-ordinate : N =2410933/ E= 808954
R.L. (m) : 197.499 **Near** : BH-07
Depth (m) : 6.90m **Date** : 05.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	2		4.30	13	
0.20	3	8	4.40	13	40
0.30	3		4.50	14	
0.40	3		4.60	13	
0.50	4	12	4.70	13	40
0.60	5		4.80	14	
0.70	5		4.90	13	
0.80	5	17	5.00	14	41
0.90	7		5.10	14	
1.00	8		5.20	19	
1.10	8	24	5.30	37	101
1.20	8		5.40	45	
1.30	8		5.50	45	
1.40	8	25	5.60	45	136
1.50	9		5.70	46	
1.60	8		5.80	46	
1.70	8	25	5.90	39	124
1.80	9		6.00	39	
1.90	9		6.10	45	
2.00	9	27	6.20	45	139
2.10	9		6.30	49	
2.20	10		6.40	46	
2.30	10	31	6.50	46	142
2.40	11		6.60	50	
2.50	11		6.70	54	
2.60	11	34	6.80	66	187
2.70	12		6.90	67	
2.80	12		7.00		
2.90	12	36	7.10		
3.00	12		7.20		
3.10	12		7.30		
3.20	12	37	7.40		
3.30	13		7.50		
3.40	12		7.60		
3.50	12	37	7.70		
3.60	13		7.80		
3.70	12		7.90		
3.80	13	38	8.00		
3.90	13		8.10		
4.00	12		8.20		
4.10	13	38	8.30		
4.20	13		8.40		

SKM Geosurvey

Dynamic Cone Penetration Test (DCPT)

DCPT : 6
Co-ordinate : N =2410807/ E= 809049
R.L. (m) : 199.264 **Near** : BH-08
Depth (m) : 10.50m **Date** : 05.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	2		4.30	13	
0.20	2	6	4.40	14	41
0.30	2		4.50	14	
0.40	2		4.60	13	
0.50	3	11	4.70	14	41
0.60	6		4.80	14	
0.70	6		4.90	14	
0.80	6	18	5.00	14	42
0.90	6		5.10	14	
1.00	6		5.20	15	
1.10	6	18	5.30	21	59
1.20	6		5.40	23	
1.30	6		5.50	21	
1.40	6	20	5.60	23	67
1.50	8		5.70	23	
1.60	7		5.80	27	
1.70	7	22	5.90	33	100
1.80	8		6.00	40	
1.90	7		6.10	33	
2.00	7	22	6.20	33	100
2.10	8		6.30	34	
2.20	8		6.40	34	
2.30	8	26	6.50	34	102
2.40	10		6.60	34	
2.50	9		6.70	34	
2.60	10	29	6.80	36	111
2.70	10		6.90	41	
2.80	11		7.00	36	
2.90	12	35	7.10	37	111
3.00	12		7.20	38	
3.10	12		7.30	40	
3.20	12	36	7.40	42	128
3.30	12		7.50	46	
3.40	12		7.60	40	
3.50	13	38	7.70	42	128
3.60	13		7.80	46	
3.70	12		7.90	40	
3.80	13	38	8.00	43	129
3.90	13		8.10	46	
4.00	13		8.20	41	
4.10	13	40	8.30	43	130
4.20	14		8.40	46	

Dynamic Cone Penetration Test (DCPT)

DCPT : 6
Co-ordinate : N =2410807/ E= 809049
R.L. (m) : 199.264 **Near** : BH-08
Depth (m) : 10.50m **Date** : 05.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	41				
8.60	43	130			
8.70	46				
8.80	43				
8.90	45	136			
9.00	48				
9.10	44				
9.20	45	138			
9.30	49				
9.40	44				
9.50	45	138			
9.60	49				
9.70	45				
9.80	45	140			
9.90	50				
10.00	48				
10.10	48	149			
10.20	53				
10.30	57				
10.40	62	181			
10.50	62				
8.50	41				
8.60	43	130			
8.70	46				
8.80	43				
8.90	45	136			
9.00	48				
9.10	44				
9.20	45	138			
9.30	49				
9.40	44				
9.50	45	138			
9.60	49				
9.70	45				
9.80	45	140			
9.90	50				
10.00	48				
10.10	48	149			
10.20	53				
10.30	57				
10.40	62	181			
10.50	62				

Dynamic Cone Penetration Test (DCPT)

DCPT : 7
Co-ordinate : N =2410795/ E= 808950
R.L. (m) : 198.215 **Near** : BH-09
Depth (m) : 10.50m **Date** : 06.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	1		4.30	11	
0.20	1	4	4.40	12	35
0.30	2		4.50	12	
0.40	1		4.60	12	
0.50	2	5	4.70	12	37
0.60	2		4.80	13	
0.70	2		4.90	14	
0.80	3	10	5.00	10	37
0.90	5		5.10	13	
1.00	4		5.20	13	
1.10	5	14	5.30	13	39
1.20	5		5.40	13	
1.30	7		5.50	13	
1.40	10	28	5.60	13	40
1.50	11		5.70	14	
1.60	12		5.80	14	
1.70	13	37	5.90	16	48
1.80	12		6.00	18	
1.90	13		6.10	18	
2.00	17	51	6.20	18	49
2.10	21		6.30	13	
2.20	17		6.40	15	
2.30	19	57	6.50	15	48
2.40	21		6.60	18	
2.50	7		6.70	15	
2.60	11	33	6.80	16	50
2.70	15		6.90	19	
2.80	10		7.00	15	
2.90	10	30	7.10	16	52
3.00	10		7.20	21	
3.10	10		7.30	15	
3.20	10	30	7.40	17	53
3.30	10		7.50	21	
3.40	9		7.60	16	
3.50	10	30	7.70	17	54
3.60	11		7.80	21	
3.70	11		7.90	19	
3.80	11	31	8.00	20	60
3.90	9		8.10	21	
4.00	10		8.20	21	
4.10	10	32	8.30	21	63
4.20	12		8.40	21	

Dynamic Cone Penetration Test (DCPT)

DCPT : 7
Co-ordinate : N =2410795/ E= 808950
R.L. (m) : 198.215 **Near** : BH-09
Depth (m) : 10.50m **Date** : 06.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	21				
8.60	22	66			
8.70	23				
8.80	21				
8.90	22	68			
9.00	25				
9.10	28				
9.20	34	103			
9.30	41				
9.40	30				
9.50	36	111			
9.60	45				
9.70	43				
9.80	46	139			
9.90	50				
10.00	45				
10.10	48	146			
10.20	53				
10.30	59				
10.40	61	186			
10.50	66				
8.50	21				
8.60	22	66			
8.70	23				
8.80	21				
8.90	22	68			
9.00	25				
9.10	28				
9.20	34	103			
9.30	41				
9.40	30				
9.50	36	111			
9.60	45				
9.70	43				
9.80	46	139			
9.90	50				
10.00	45				
10.10	48	146			
10.20	53				
10.30	59				
10.40	61	186			
10.50	66				

Dynamic Cone Penetration Test (DCPT)

DCPT : 8
Co-ordinate : N =2411180/ E= 809059
R.L. (m) : 195.668
Near : BH-10
Depth (m) : 5.40m
Date : 06.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	4		4.30	20	
0.20	6	17	4.40	24	76
0.30	7		4.50	32	
0.40	8		4.60	33	
0.50	8	26	4.70	34	111
0.60	10		4.80	44	
0.70	10		4.90	45	
0.80	12	37	5.00	45	146
0.90	15		5.10	56	
1.00	18		5.20	61	
1.10	19	56	5.30	68	197
1.20	19		5.40	68	
1.30	20		5.50		
1.40	23	70	5.60		
1.50	27		5.70		
1.60	33		5.80		
1.70	42	128	5.90		
1.80	53		6.00		
1.90	41		6.10		
2.00	46	138	6.20		
2.10	51		6.30		
2.20	30		6.40		
2.30	36	111	6.50		
2.40	45		6.60		
2.50	23		6.70		
2.60	10	43	6.80		
2.70	10		6.90		
2.80	12		7.00		
2.90	12	45	7.10		
3.00	21		7.20		
3.10	13		7.30		
3.20	16	45	7.40		
3.30	16		7.50		
3.40	16		7.60		
3.50	14	43	7.70		
3.60	13		7.80		
3.70	13		7.90		
3.80	14	46	8.00		
3.90	19		8.10		
4.00	13		8.20		
4.10	14	46	8.30		
4.20	19		8.40		

Dynamic Cone Penetration Test (DCPT)

DCPT : 9
Co-ordinate : N =2410725/ E= 809060
R.L. (m) : 198.621 **Near** : BH-11
Depth (m) : 11.40m **Date** : 06.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	3		4.30	14	
0.20	3	9	4.40	14	47
0.30	3		4.50	19	
0.40	3		4.60	14	
0.50	4	11	4.70	15	47
0.60	4		4.80	18	
0.70	3		4.90	17	
0.80	4	11	5.00	17	51
0.90	4		5.10	17	
1.00	6		5.20	17	
1.10	6	18	5.30	19	64
1.20	6		5.40	28	
1.30	6		5.50	17	
1.40	6	20	5.60	24	71
1.50	8		5.70	30	
1.60	6		5.80	24	
1.70	6	20	5.90	25	80
1.80	8		6.00	31	
1.90	7		6.10	30	
2.00	8	23	6.20	30	91
2.10	8		6.30	31	
2.20	8		6.40	30	
2.30	9	26	6.50	30	91
2.40	9		6.60	31	
2.50	9		6.70	31	
2.60	9	28	6.80	31	93
2.70	10		6.90	31	
2.80	9		7.00	33	
2.90	9	28	7.10	37	109
3.00	10		7.20	39	
3.10	10		7.30	34	
3.20	10	32	7.40	37	110
3.30	12		7.50	39	
3.40	10		7.60	36	
3.50	11	34	7.70	39	116
3.60	13		7.80	41	
3.70	13		7.90	40	
3.80	13	39	8.00	40	120
3.90	13		8.10	40	
4.00	13		8.20	40	
4.10	14	44	8.30	40	120
4.20	17		8.40	40	

Dynamic Cone Penetration Test (DCPT)

DCPT : 9
Co-ordinate : N =2410725/ E= 809060
R.L. (m) : 198.621 **Near** : BH-11
Depth (m) : 11.40m **Date** : 06.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	42		9.50	44	131
8.60	43	128	9.60	44	
8.70	43		9.70	45	
8.80	43		9.80	45	137
8.90	43	130	9.90	47	
9.00	44		10.00	45	
9.10	43		10.10	46	140
9.20	44	131	10.20	49	
9.30	44		10.30	46	
9.40	43		10.40	47	143
9.50	44	131	10.50	50	
9.60	44		10.60	47	
9.70	45		10.70	47	144
9.80	45	137	10.80	50	
9.90	47		10.90	48	
10.00	45		11.00	49	148
10.10	46	140	11.10	51	
10.20	49		11.20	57	
10.30	46		11.30	57	180
10.40	47	143	11.40	66	
10.50	50		11.50	69	
10.60	47				
10.70	47	144			
10.80	50				
10.90	48				
11.00	49	148			
11.10	51				
11.20	57				
11.30	57	180			
11.40	66				
11.50	69				
8.50	42				
8.60	43	128			
8.70	43				
8.80	43				
8.90	43	130			
9.00	44				
9.10	43				
9.20	44	131			
9.30	44				
9.40	43				

Dynamic Cone Penetration Test (DCPT)

DCPT : 10
Co-ordinate : N =2410730/ E= 809099
R.L. (m) : 199.764 **Near** : BH-10
Depth (m) : 5.70m **Date** : 07.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	2		4.30	22	
0.20	2	6	4.40	47	129
0.30	2		4.50	60	
0.40	3		4.60	39	
0.50	4	12	4.70	44	129
0.60	5		4.80	46	
0.70	4		4.90	41	
0.80	5	16	5.00	47	136
0.90	7		5.10	48	
1.00	6		5.20	49	
1.10	7	20	5.30	49	148
1.20	7		5.40	50	
1.30	6		5.50	57	
1.40	7	20	5.60	61	191
1.50	7		5.70	73	
1.60	7				
1.70	7	22			
1.80	8				
1.90	8				
2.00	8	26			
2.10	10				
2.20	8				
2.30	9	27			
2.40	10				
2.50	8				
2.60	9	27			
2.70	10				
2.80	10				
2.90	10	32			
3.00	12				
3.10	12				
3.20	12	36			
3.30	12				
3.40	13				
3.50	13	40			
3.60	14				
3.70	13				
3.80	14	41			
3.90	14				
4.00	14				
4.10	14	44			
4.20	16				

Dynamic Cone Penetration Test (DCPT)

DCPT : 11
Co-ordinate : N =2411180/ E= 809098
R.L. (m) : 196.550 **Near** : BH-13
Depth (m) : 5.40m **Date** : 07.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	3		4.30	40	
0.20	3	11	4.40	42	126
0.30	5		4.50	44	
0.40	4		4.60	41	
0.50	4	14	4.70	43	130
0.60	6		4.80	46	
0.70	6		4.90	46	
0.80	12	34	5.00	47	141
0.90	16		5.10	48	
1.00	12		5.20	53	
1.10	14	42	5.30	59	181
1.20	16		5.40	69	
1.30	14		5.50		
1.40	14	42	5.60		
1.50	14		5.70		
1.60	14				
1.70	14	42			
1.80	14				
1.90	14				
2.00	14	42			
2.10	14				
2.20	14				
2.30	15	46			
2.40	17				
2.50	17				
2.60	17	51			
2.70	17				
2.80	18				
2.90	22	62			
3.00	22				
3.10	23				
3.20	23	70			
3.30	24				
3.40	24				
3.50	25	77			
3.60	28				
3.70	27				
3.80	28	86			
3.90	31				
4.00	28				
4.10	29	88			
4.20	31				

Dynamic Cone Penetration Test (DCPT)

DCPT : 12
Co-ordinate : N =2411120/ E= 809086
R.L. (m) : 196.621 **Near** : BH-14
Depth (m) : 4.80m **Date** : 07.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	4		4.30	44	
0.20	6	17	4.40	46	138
0.30	7		4.50	48	
0.40	7		4.60	53	
0.50	7	21	4.70	59	183
0.60	7		4.80	71	
0.70	7				
0.80	7	22			
0.90	8				
1.00	7				
1.10	8	26			
1.20	11				
1.30	10				
1.40	11	32			
1.50	11				
1.60	10				
1.70	11	32			
1.80	11				
1.90	12				
2.00	13	41			
2.10	16				
2.20	17				
2.30	17	53			
2.40	19				
2.50	23				
2.60	29	81			
2.70	29				
2.80	29				
2.90	29	89			
3.00	31				
3.10	32				
3.20	32	96			
3.30	32				
3.40	32				
3.50	32	96			
3.60	32				
3.70	33				
3.80	33	101			
3.90	35				
4.00	38				
4.10	41	122			
4.20	43				

Dynamic Cone Penetration Test (DCPT)

DCPT : 13
Co-ordinate : N =2411050/ E= 809080
R.L. (m) : 195.857 **Near** : BH-15
Depth (m) : 3.30m **Date** : 07.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	5				
0.20	7	20			
0.30	8				
0.40	8				
0.50	8	24			
0.60	8				
0.70	8				
0.80	9	27			
0.90	10				
1.00	11				
1.10	11	34			
1.20	12				
1.30	12				
1.40	12	36			
1.50	12				
1.60	12				
1.70	13	39			
1.80	14				
1.90	13				
2.00	14	41			
2.10	14				
2.20	15				
2.30	18	56			
2.40	23				
2.50	24				
2.60	24	72			
2.70	24				
2.80	36				
2.90	43	134			
3.00	55				
3.10	57				
3.20	60	180			
3.30	63				

Dynamic Cone Penetration Test (DCPT)

DCPT : 14
Co-ordinate : N =2410806/ E= 809080
R.L. (m) : 199.466 **Near** : BH-16
Depth (m) : 11.10m **Date** : 08.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	3		4.30	11	
0.20	3	9	4.40	12	35
0.30	3		4.50	12	
0.40	3		4.60	12	
0.50	5	14	4.70	12	36
0.60	6		4.80	12	
0.70	4		4.90	13	
0.80	5	16	5.00	14	42
0.90	7		5.10	15	
1.00	6		5.20	15	
1.10	6	19	5.30	17	49
1.20	7		5.40	17	
1.30	6		5.50	17	
1.40	6	19	5.60	18	56
1.50	7		5.70	21	
1.60	7		5.80	19	
1.70	7	22	5.90	19	58
1.80	8		6.00	20	
1.90	8		6.10	23	
2.00	8	24	6.20	27	79
2.10	8		6.30	29	
2.20	8		6.40	30	
2.30	8	24	6.50	32	96
2.40	8		6.60	34	
2.50	8		6.70	34	
2.60	8	25	6.80	34	102
2.70	9		6.90	34	
2.80	9		7.00	34	
2.90	9	28	7.10	35	106
3.00	10		7.20	37	
3.10	10		7.30	36	
3.20	10	31	7.40	36	108
3.30	11		7.50	36	
3.40	11		7.60	37	
3.50	11	33	7.70	40	118
3.60	11		7.80	41	
3.70	11		7.90	38	
3.80	11	34	8.00	40	120
3.90	12		8.10	42	
4.00	11		8.20	39	
4.10	11	34	8.30	41	124
4.20	12		8.40	44	

Dynamic Cone Penetration Test (DCPT)

DCPT : 14
Co-ordinate : N =2410806/ E= 809080
R.L. (m) : 199.466 **Near** : BH-16
Depth (m) : 11.10m **Date** : 08.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	40				
8.60	42	128			
8.70	46				
8.80	41				
8.90	44	130			
9.00	45				
9.10	41				
9.20	45	131			
9.30	45				
9.40	41				
9.50	45	131			
9.60	45				
9.70	45				
9.80	47	140			
9.90	48				
10.00	45				
10.10	48	141			
10.20	48				
10.30	48				
10.40	49	146			
10.50	49				
10.60	48				
10.70	48	148			
10.80	52				
10.90	52				
11.00	56	168			
11.10	60				

Dynamic Cone Penetration Test (DCPT)

DCPT : 15
Co-ordinate : N =2410255/ E= 809372
R.L. (m) : 204.919 **Near** : BH-17
Depth (m) : 12.00m **Date** : 08.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	2		4.30	13	
0.20	2	7	4.40	13	40
0.30	3		4.50	14	
0.40	3		4.60	13	
0.50	3	9	4.70	13	40
0.60	3		4.80	14	
0.70	3		4.90	13	
0.80	4	12	5.00	13	40
0.90	5		5.10	14	
1.00	5		5.20	13	
1.10	5	16	5.30	14	41
1.20	6		5.40	14	
1.30	6		5.50	14	
1.40	8	24	5.60	14	42
1.50	10		5.70	14	
1.60	7		5.80	14	
1.70	10	28	5.90	14	42
1.80	11		6.00	14	
1.90	7		6.10	14	
2.00	10	28	6.20	14	43
2.10	11		6.30	15	
2.20	9		6.40	14	
2.30	10	30	6.50	14	43
2.40	11		6.60	15	
2.50	9		6.70	15	
2.60	11	32	6.80	15	46
2.70	12		6.90	16	
2.80	12		7.00	16	
2.90	13	38	7.10	16	48
3.00	13		7.20	16	
3.10	13		7.30	16	
3.20	13	39	7.40	16	48
3.30	13		7.50	16	
3.40	12		7.60	16	
3.50	13	38	7.70	18	52
3.60	13		7.80	18	
3.70	13		7.90	18	
3.80	13	39	8.00	18	54
3.90	13		8.10	18	
4.00	13		8.20	18	
4.10	13	40	8.30	19	57
4.20	14		8.40	20	

Dynamic Cone Penetration Test (DCPT)

DCPT : 15
Co-ordinate : N =2410255/ E= 809372
R.L. (m) : 204.919 **Near** : BH-17
Depth (m) : 12.00m **Date** : 08.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	20				
8.60	21	62			
8.70	21				
8.80	21				
8.90	21	64			
9.00	22				
9.10	22				
9.20	22	66			
9.30	22				
9.40	22				
9.50	23	70			
9.60	25				
9.70	26				
9.80	28	83			
9.90	29				
10.00	30				
10.10	32	94			
10.20	32				
10.30	33				
10.40	36	107			
10.50	38				
10.60	33				
10.70	36	111			
10.80	42				
10.90	40				
11.00	41	123			
11.10	42				
11.20	43				
11.30	47	138			
11.40	48				
11.50	48				
11.60	49	146			
11.70	49				
11.80	49				
11.90	56	168			
12.00	63				

Dynamic Cone Penetration Test (DCPT)

DCPT : 16
Co-ordinate : N =2409980/ E= 808905
R.L. (m) : 198.576 **Near** : BH-18
Depth (m) : 10.20m **Date** : 09.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	8		4.30	13	
0.20	8	24	4.40	14	42
0.30	8		4.50	15	
0.40	8		4.60	1	
0.50	12	34	4.70	44	59
0.60	14		4.80	14	
0.70	15		4.90	15	
0.80	20	57	5.00	16	47
0.90	22		5.10	16	
1.00	22		5.20	16	
1.10	23	68	5.30	16	48
1.20	23		5.40	16	
1.30	23		5.50	16	
1.40	25	73	5.60	16	49
1.50	25		5.70	17	
1.60	7		5.80	16	
1.70	7	22	5.90	17	51
1.80	8		6.00	18	
1.90	8		6.10	17	
2.00	8	24	6.20	18	53
2.10	8		6.30	18	
2.20	8		6.40	18	
2.30	8	24	6.50	22	63
2.40	8		6.60	23	
2.50	8		6.70	23	
2.60	8	24	6.80	23	70
2.70	8		6.90	24	
2.80	8		7.00	25	
2.90	9	26	7.10	26	78
3.00	9		7.20	27	
3.10	9		7.30	27	
3.20	10	30	7.40	27	82
3.30	11		7.50	28	
3.40	10		7.60	28	
3.50	11	32	7.70	29	86
3.60	11		7.80	29	
3.70	11		7.90	29	
3.80	12	36	8.00	32	93
3.90	13		8.10	32	
4.00	12		8.20	34	
4.10	13	38	8.30	39	120
4.20	13		8.40	47	

Dynamic Cone Penetration Test (DCPT)

DCPT : 16
Co-ordinate : N =2409980/ E= 808905
R.L. (m) : 198.576 **Near** : BH-18
Depth (m) : 10.20m **Date** : 09.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	39				
8.60	39	120			
8.70	42				
8.80	41				
8.90	41	124			
9.00	42				
9.10	42				
9.20	46	135			
9.30	47				
9.40	48				
9.50	49	146			
9.60	49				
9.70	49				
9.80	49	148			
9.90	50				
10.00	53				
10.10	56	169			
10.20	60				

Dynamic Cone Penetration Test (DCPT)

DCPT : 17
Co-ordinate : N =2410376/ E= 809083
R.L. (m) : 199.313 **Near** : BH-19
Depth (m) : 10.20m **Date** : 09.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	2		4.30	14	
0.20	2	7	4.40	14	42
0.30	3		4.50	14	
0.40	3		4.60	14	
0.50	3	9	4.70	15	46
0.60	3		4.80	17	
0.70	3		4.90	15	
0.80	4	12	5.00	15	46
0.90	5		5.10	16	
1.00	5		5.20	16	
1.10	5	15	5.30	16	48
1.20	5		5.40	16	
1.30	5		5.50	16	
1.40	6	17	5.60	17	50
1.50	6		5.70	17	
1.60	6		5.80	17	
1.70	8	22	5.90	18	54
1.80	8		6.00	19	
1.90	8		6.10	19	
2.00	9	26	6.20	20	62
2.10	9		6.30	23	
2.20	10		6.40	21	
2.30	10	30	6.50	22	68
2.40	10		6.60	25	
2.50	11		6.70	24	
2.60	11	34	6.80	25	74
2.70	12		6.90	25	
2.80	11		7.00	26	
2.90	12	35	7.10	27	81
3.00	12		7.20	28	
3.10	12		7.30	28	
3.20	13	38	7.40	28	86
3.30	13		7.50	30	
3.40	13		7.60	31	
3.50	13	39	7.70	32	97
3.60	13		7.80	34	
3.70	13		7.90	31	
3.80	13	39	8.00	33	99
3.90	13		8.10	35	
4.00	13		8.20	32	
4.10	13	40	8.30	35	102
4.20	14		8.40	35	

Dynamic Cone Penetration Test (DCPT)

DCPT : 17
Co-ordinate : N =2410376/ E= 809083
R.L. (m) : 199.313 **Near** : BH-19
Depth (m) : 10.20m **Date** : 09.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	36				
8.60	36	110			
8.70	38				
8.80	36				
8.90	37	111			
9.00	38				
9.10	40				
9.20	42	124			
9.30	42				
9.40	42				
9.50	45	132			
9.60	45				
9.70	46				
9.80	48	142			
9.90	48				
10.00	47				
10.10	52	158			
10.20	59				

Dynamic Cone Penetration Test (DCPT)

DCPT : 18
Co-ordinate : N =2411025/ E= 808688
R.L. (m) : 197.50 **Near** : BH-2
Depth (m) : 11.70m **Date** : 19.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	1		4.30	4	
0.20	1	3	4.40	6	17
0.30	1		4.50	7	
0.40	1		4.60	6	
0.50	2	5	4.70	5	18
0.60	2		4.80	7	
0.70	2		4.90	5	
0.80	3	7	5.00	6	18
0.90	2		5.10	7	
1.00	2		5.20	6	
1.10	3	7	5.30	7	18
1.20	2		5.40	5	
1.30	2		5.50	6	
1.40	4	10	5.60	5	19
1.50	4		5.70	8	
1.60	3		5.80	6	
1.70	4	11	5.90	6	19
1.80	4		6.00	7	
1.90	4		6.10	6	
2.00	4	12	6.20	8	22
2.10	4		6.30	8	
2.20	4		6.40	6	
2.30	4	13	6.50	7	21
2.40	5		6.60	8	
2.50	5		6.70	7	
2.60	3	12	6.80	7	22
2.70	4		6.90	8	
2.80	4		7.00	7	
2.90	5	14	7.10	7	24
3.00	5		7.20	10	
3.10	4		7.30	8	
3.20	5	15	7.40	8	24
3.30	6		7.50	8	
3.40	4		7.60	7	
3.50	5	15	7.70	8	23
3.60	6		7.80	8	
3.70	5		7.90	9	
3.80	5	16	8.00	9	27
3.90	6		8.10	9	
4.00	5		8.20	8	
4.10	4	16	8.30	9	27
4.20	7		8.40	10	

Dynamic Cone Penetration Test (DCPT)

DCPT : 18
Co-ordinate : N =2411025/ E= 808688
R.L. (m) : 197.50 **Near** : BH-2
Depth (m) : 11.70m **Date** : 19.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	9				
8.60	9	29			
8.70	11				
8.80	9				
8.90	9	30			
9.00	12				
9.10	12				
9.20	13	39			
9.30	14				
9.40	11				
9.50	14	38			
9.60	13				
9.70	12				
9.80	17	47			
9.90	18				
10.00	15				
10.10	21	60			
10.20	24				
10.30	20				
10.40	25	72			
10.50	27				
10.60	25				
10.70	29	86			
10.80	32				
10.90	26				
11.00	31	91			
11.10	34				
11.20	39				
11.30	43	137			
11.40	55				
11.50	55				
11.60	63	186			
11.70	68				

Dynamic Cone Penetration Test (DCPT)

DCPT : 19
Co-ordinate : N =2411255/ E= 808577
R.L. (m) : 197.210 **Near** : BH-1
Depth (m) : 11.10m **Date** : 20.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	1		4.30	4	
0.20	1	4	4.40	6	17
0.30	2		4.50	7	
0.40	1		4.60	5	
0.50	1	4	4.70	6	18
0.60	2		4.80	7	
0.70	2		4.90	5	
0.80	2	6	5.00	6	19
0.90	2		5.10	8	
1.00	2		5.20	5	
1.10	2	7	5.30	6	18
1.20	3		5.40	7	
1.30	2		5.50	5	
1.40	4	10	5.60	6	19
1.50	4		5.70	8	
1.60	4		5.80	6	
1.70	3	11	5.90	6	19
1.80	4		6.00	7	
1.90	4		6.10	6	
2.00	4	13	6.20	8	22
2.10	5		6.30	8	
2.20	4		6.40	6	
2.30	4	12	6.50	7	21
2.40	4		6.60	8	
2.50	4		6.70	7	
2.60	5	14	6.80	8	22
2.70	5		6.90	7	
2.80	3		7.00	7	
2.90	4	13	7.10	8	25
3.00	6		7.20	10	
3.10	4		7.30	8	
3.20	5	15	7.40	9	28
3.30	6		7.50	11	
3.40	4		7.60	11	
3.50	4	15	7.70	12	37
3.60	7		7.80	14	
3.70	5		7.90	12	
3.80	5	16	8.00	13	40
3.90	6		8.10	15	
4.00	5		8.20	13	
4.10	4	16	8.30	16	47
4.20	7		8.40	18	

Dynamic Cone Penetration Test (DCPT)

DCPT : 19
Co-ordinate : N =2411255/ E= 808577
R.L. (m) : 197.210 **Near** : BH-1
Depth (m) : 11.10m **Date** : 20.02.2018

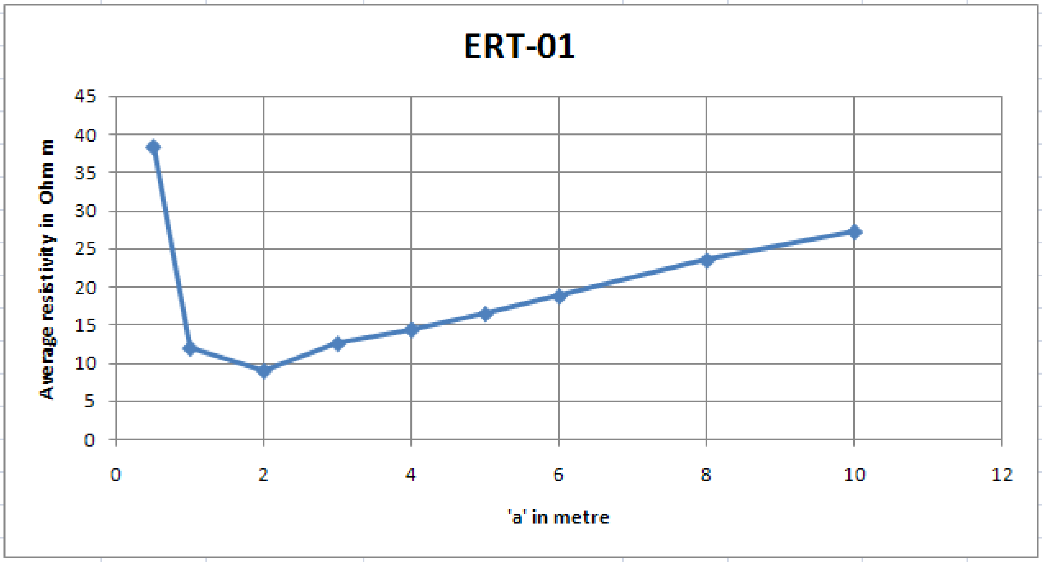
Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
8.50	15				
8.60	19	57			
8.70	23				
8.80	15				
8.90	21	60			
9.00	24				
9.10	20				
9.20	25	72			
9.30	27				
9.40	22				
9.50	26	78			
9.60	30				
9.70	23				
9.80	28	85			
9.90	34				
10.00	22				
10.10	29	88			
10.20	37				
10.30	26				
10.40	31	91			
10.50	34				
10.60	36				
10.70	40	122			
10.80	46				
10.90	52				
11.00	64	185			
11.10	69				

Dynamic Cone Penetration Test (DCPT)

DCPT : 20
Co-ordinate : N =2409655/ E= 878703
R.L. (m) : 198.614 **Near** : BH-20
Depth (m) : 8.10m **Date** : 21.02.2018

Depth (m)	No of blows	N-value	Depth (m)	No of blows	N-value
0.10	2		4.30	14	
0.20	2	7	4.40	14	42
0.30	3		4.50	14	
0.40	3		4.60	16	
0.50	3	9	4.70	17	50
0.60	3		4.80	17	
0.70	3		4.90	17	
0.80	4	12	5.00	18	54
0.90	5		5.10	19	
1.00	5		5.20	19	
1.10	5	15	5.30	20	62
1.20	5		5.40	23	
1.30	6		5.50	21	
1.40	6	18	5.60	22	68
1.50	6		5.70	25	
1.60	8		5.80	24	
1.70	8	24	5.90	25	74
1.80	8		6.00	25	
1.90	8		6.10	26	
2.00	9	26	6.20	27	81
2.10	9		6.30	28	
2.20	10		6.40	31	
2.30	10	30	6.50	33	99
2.40	10		6.60	35	
2.50	11		6.70	36	
2.60	11	34	6.80	36	110
2.70	12		6.90	38	
2.80	11		7.00	40	
2.90	12	35	7.10	42	124
3.00	12		7.20	42	
3.10	12		7.30	42	
3.20	13	38	7.40	45	132
3.30	13		7.50	45	
3.40	13		7.60	47	
3.50	13	39	7.70	48	143
3.60	13		7.80	48	
3.70	13		7.90	47	
3.80	13	39	8.00	52	158
3.90	13		8.10	59	
4.00	13				
4.10	13	40			
4.20	14				

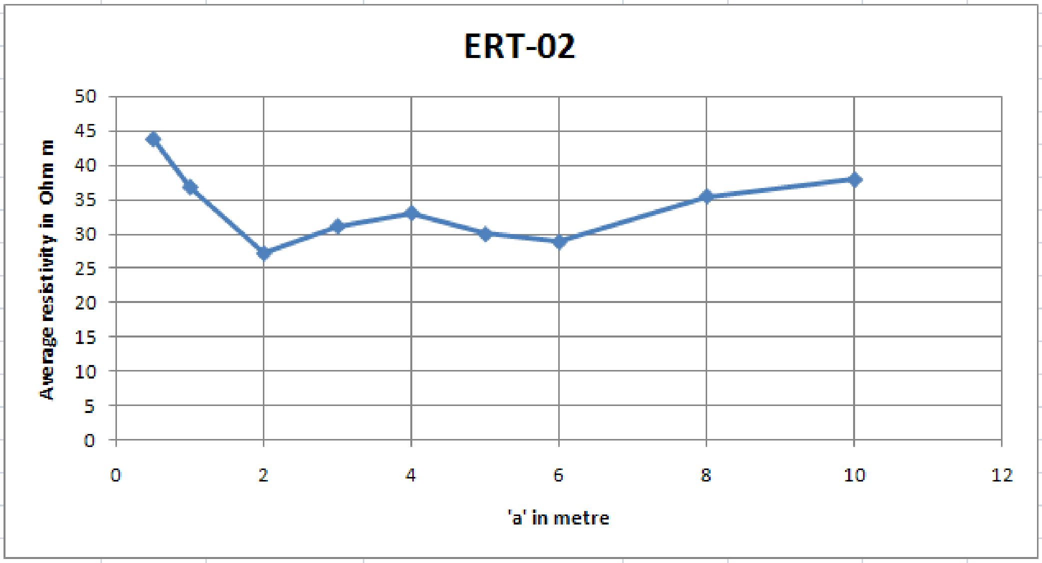
ERT TEST CURVE



ERT-01	Location:	N: 2411023		E: 808690		RL. 197.50m
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	38.32	38.48	38.16	38.48	
2	1	12.00	12.00	12.09	12.00	
3	2	8.86	9.11	9.11	9.05	
4	3	12.35	12.72	12.53	12.82	
5	4	14.07	14.33	14.45	14.95	
6	5	15.86	16.49	16.65	16.96	
7	6	18.10	18.47	19.04	19.60	
8	8	22.87	23.88	23.37	23.88	
9	10	26.07	27.33	27.33	28.27	

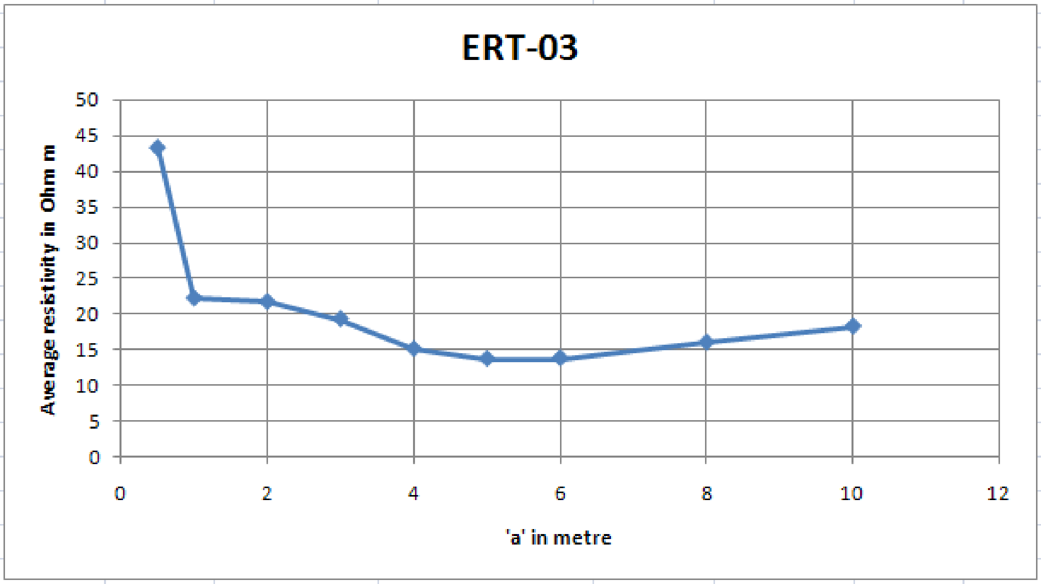
Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 0.50m	38.35
2	0.50-8.00	13.9
3	8.00-10.00	25.37

ERT TEST CURVE



ERT-02	Location:	N: 2411135	E: 808965			RL. 194.729
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	43.66	43.66	43.66	43.82	
2	1	36.72	36.76	36.76	36.85	
3	2	27.14	27.14	27.14	27.33	
4	3	31.01	31.19	31.194.	31.10	
5	4	33.17	32.92	32.92	33.05	
6	5	29.37	29.84	30.32	30.32	
7	6	28.46	28.46	28.65	29.78	
8	8	34.93	35.19	35.94	35.69	
9	10	37.38	38.64	37.70	37.70	
					Mean Resitivity:	33.76292 Ohm m

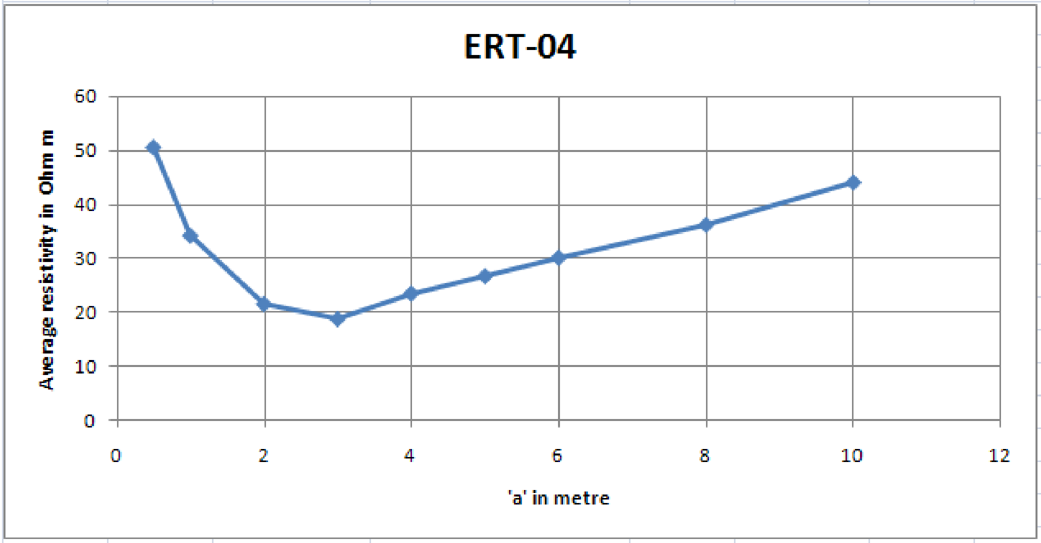
ERT TEST CURVE



ERT-03	Location:	N: 2410805		E: 809050		RL. 199.264
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	43.19	43.03	43.66	42.87	
2	1	22.18	22.18	22.08	22.15	
3	2	21.49	21.93	21.68	21.49	
4	3	19.13	19.23	19.23	19.41	
5	4	15.08	15.33	15.08	14.70	
6	5	13.51	13.82	13.51	13.82	
7	6	13.38	13.76	14.14	13.76	
8	8	15.58	15.58	16.08	16.59	
9	10	17.59	17.59	18.53	19.16	
					Mean Resitivity:	20.31969 Ohm m

Sl No.	Spacing(m)	Mean Resistivity (ohm.m)
1	Upto 0.50m	43.18
2	0.50-10.00	17.46

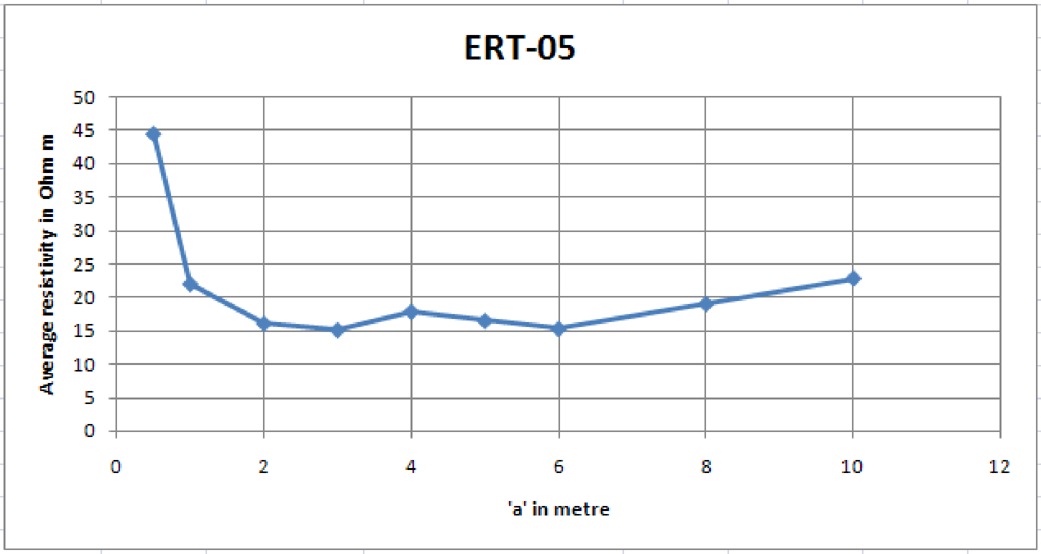
ERT TEST CURVE



ERT-04	Location:	N: 2410805		E: 809050		RL. 197.394
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	50.57	50.57	50.41	50.26	
2	1	34.31	34.15	34.12	34.02	
3	2	21.36	21.49	21.61	21.55	
4	3	18.47	18.75	18.85	18.85	
5	4	23.25	23.50	23.50	23.50	
6	5	26.39	26.86	26.70	26.70	
7	6	29.78	30.35	30.16	29.97	
8	8	35.69	36.69	36.44	35.69	
9	10	43.35	44.61	44.30	43.67	

Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 1.00m	42.29
2	1.00-5.00	22.58
3	5.00-10.00	36.72

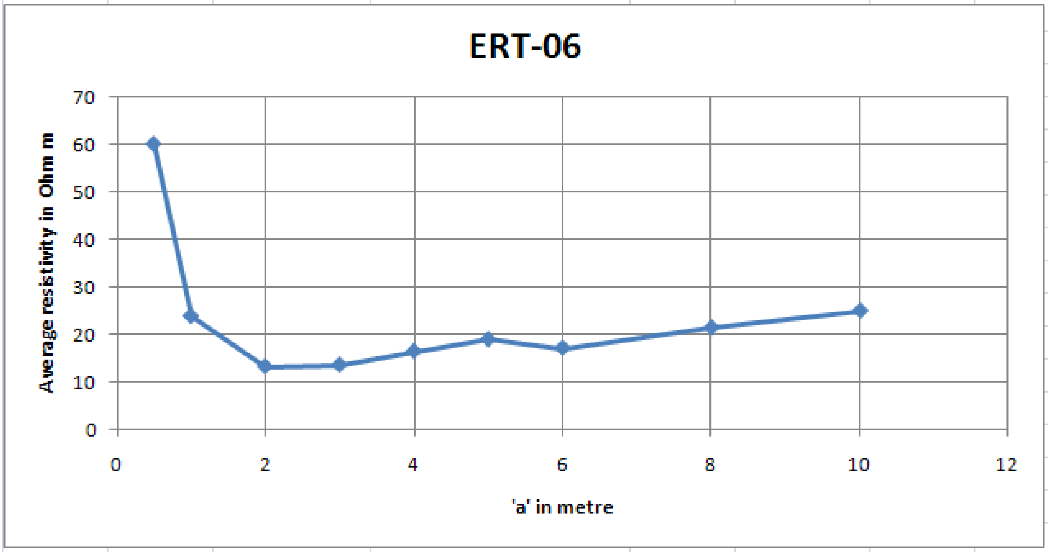
ERT TEST CURVE



ERT-05	Location:	N: 2410727		E: 809065	RL. 196.621m
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW
1	0.5	44.60	44.45	44.29	44.13
2	1	22.02	21.96	21.96	22.08
3	2	15.96	16.15	16.08	16.27
4	3	15.17	15.08	15.17	15.08
5	4	17.47	17.97	18.10	17.97
6	5	16.34	16.65	16.34	16.65
7	6	15.64	14.89	15.64	15.08
8	8	19.85	19.10	18.35	18.85
9	10	22.62	22.62	23.25	22.93

Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 0.50m	44.36
2	0.50-10.00	18.1

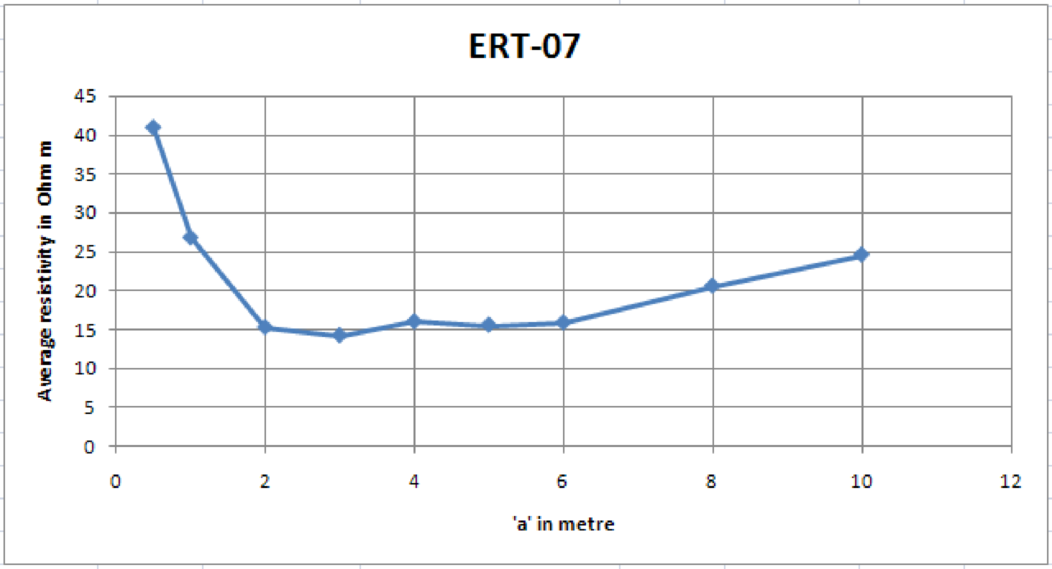
ERT TEST CURVE



ERT-06	Location:	N: 2410732		E: 809099		RL. 199.764m
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	60.31	60.15	60.15	60.31	
2	1	23.94	23.94	23.94	23.91	
3	2	13.19	13.38	13.32	13.32	
4	3	13.57	13.38	13.85	13.76	
5	4	16.59	16.59	16.59	16.34	
6	5	18.69	19.01	19.32	19.01	
7	6	16.96	16.40	17.53	17.91	
8	8	21.36	21.11	21.36	22.12	
9	10	24.82	25.13	25.13	25.13	

Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 0.50m	60.23
2	0.50-10.00	18.77

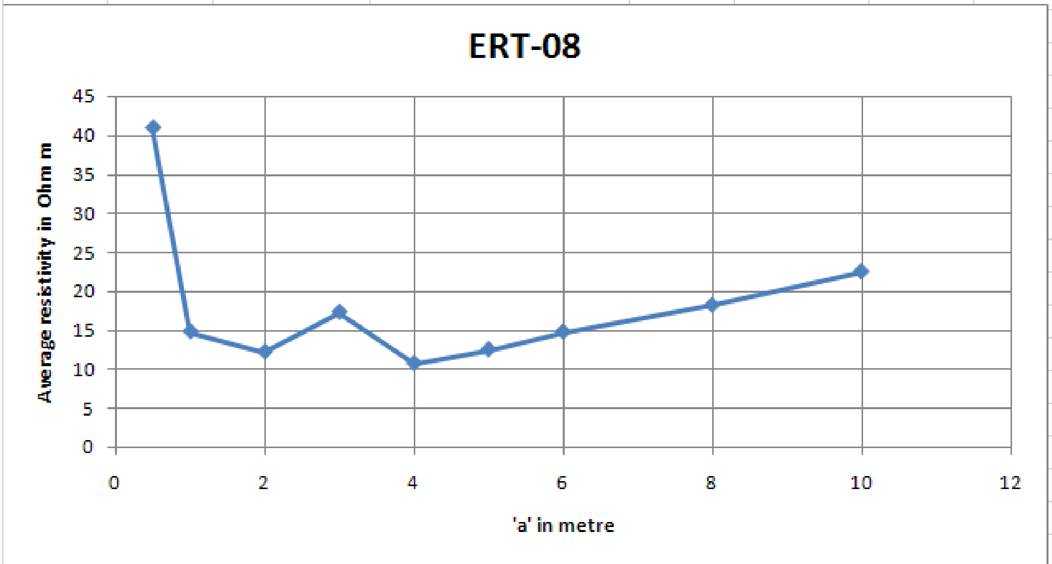
ERT TEST CURVE



ERT-07	Location:	N: 2411060		E: 809080		RL. 195.857m
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	40.99	41.15	40.99	40.68	
2	1	26.77	26.83	26.77	26.86	
3	2	15.08	15.33	15.27	15.46	
4	3	13.76	14.32	14.23	14.61	
5	4	15.83	16.21	15.83	16.21	
6	5	15.39	15.55	15.71	15.71	
7	6	15.64	15.83	16.21	15.83	
8	8	20.11	19.85	20.86	21.61	
9	10	24.50	24.50	24.00	25.45	

Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 1.00m	33.87
2	1.00-10.00	17.46

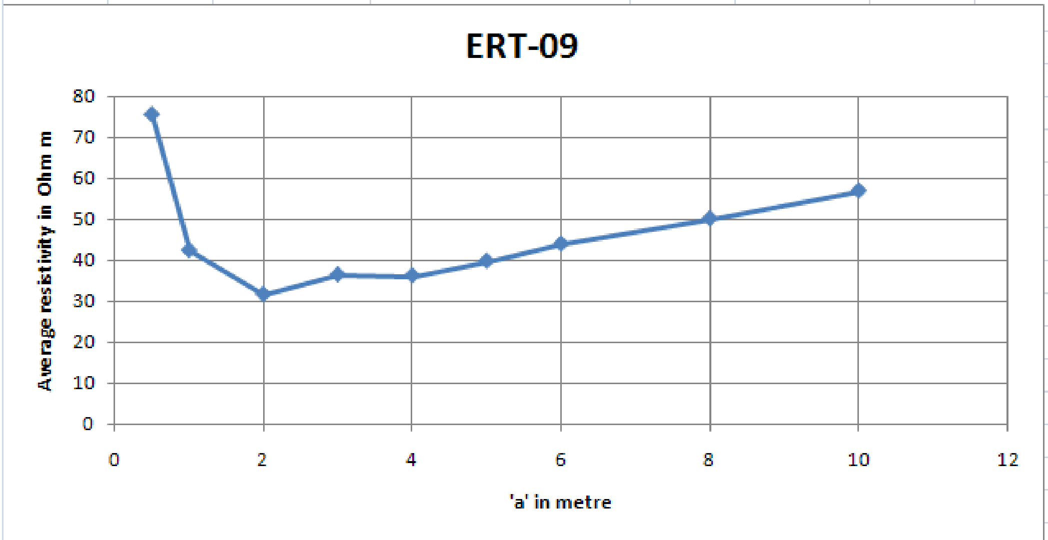
ERT TEST CURVE



ERT-08	Location:	N: 2411060		E: 809080	RL. 198.576
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW
1	0.5	40.83	40.99	41.15	41.15
2	1	14.83	14.83	14.83	14.86
3	2	12.00	12.13	12.25	12.50
4	3	16.96	17.25	17.53	17.62
5	4	10.81	10.81	10.43	10.93
6	5	12.25	12.57	12.41	12.88
7	6	14.70	14.70	15.46	14.33
8	8	17.59	18.35	19.10	17.84
9	10	21.68	22.62	23.88	21.99

Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 0.50m	41.03
2	0.50-10.00	15.4

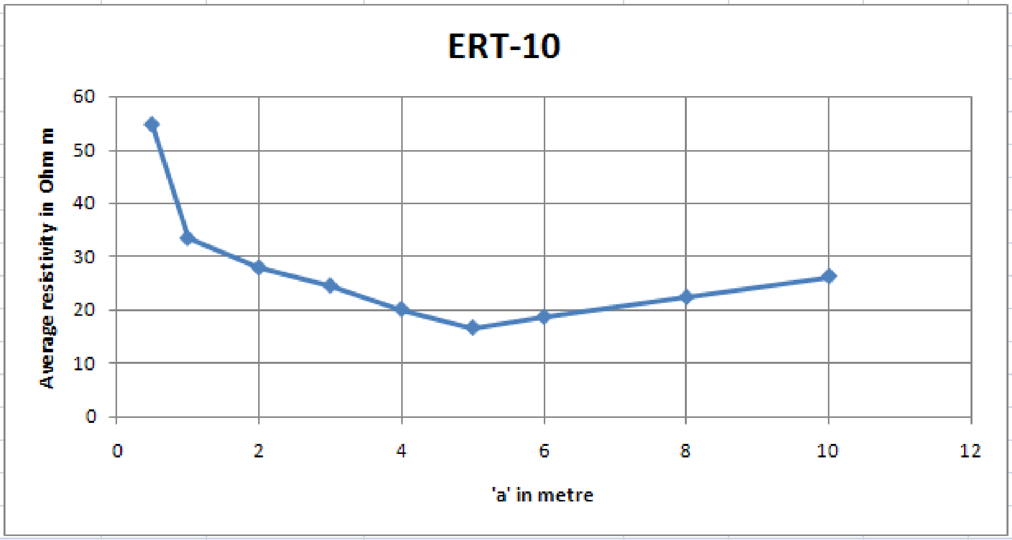
ERT TEST CURVE



ERT-09	Location:	N: 2411455		E: 809100		RL. 200.85
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	75.54	75.23	75.38	75.70	
2	1	42.35	42.28	42.35	42.32	
3	2	31.54	31.48	31.60	31.54	
4	3	36.38	36.28	36.19	36.66	
5	4	35.69	36.32	36.06	36.44	
6	5	39.11	39.90	39.74	40.05	
7	6	43.35	43.92	43.73	44.48	
8	8	49.76	49.76	50.01	50.77	
9	10	55.92	56.86	56.86	57.80	

Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 1.00m	58.89
2	1.00-8.00	37.52
3	8.00-10.00	53.47

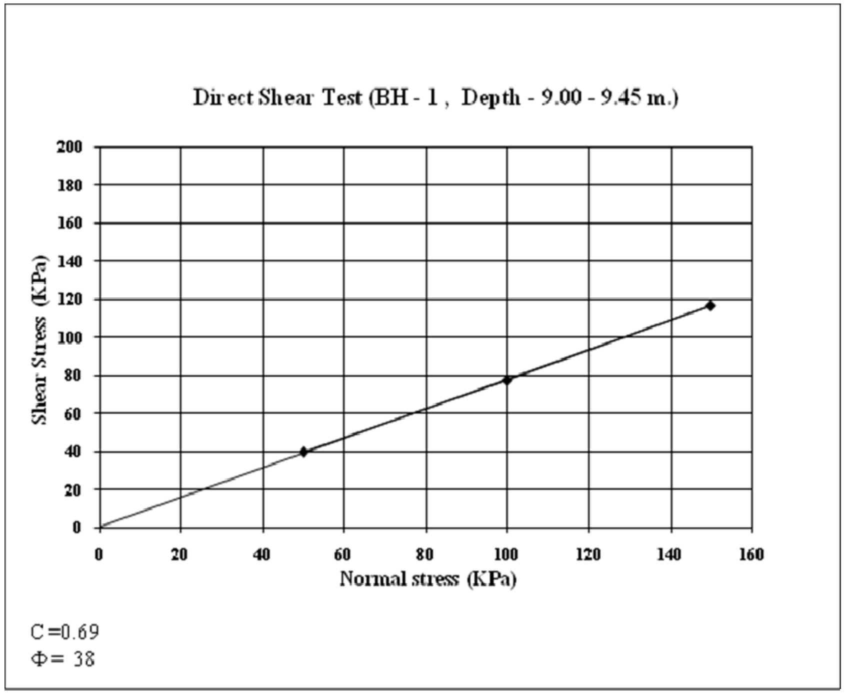
ERT TEST CURVE



ERT-10	Location:	N: 2411405		E: 810400		RL. 197.23m
Sl No.	S(m)	N-S	E-W	NE-SW	SE-NW	
1	0.5	54.03	54.97	54.65	54.81	
2	1	33.27	33.33	33.39	33.43	
3	2	27.58	27.77	27.90	28.08	
4	3	24.50	24.31	24.60	24.41	
5	4	19.85	20.23	19.85	20.23	
6	5	16.34	16.65	16.81	16.65	
7	6	17.91	18.47	19.41	18.66	
8	8	22.12	22.87	22.12	22.12	
9	10	26.70	27.02	25.45	25.76	

Sl No.	Spacing(m)	Mean Resistivity(ohm.m)
1	Upto 0.50m	54.613
2	0.50-4.00	28.55
3	4.00-10.00	20.76

DIRECT SHEAR TEST RESULTS

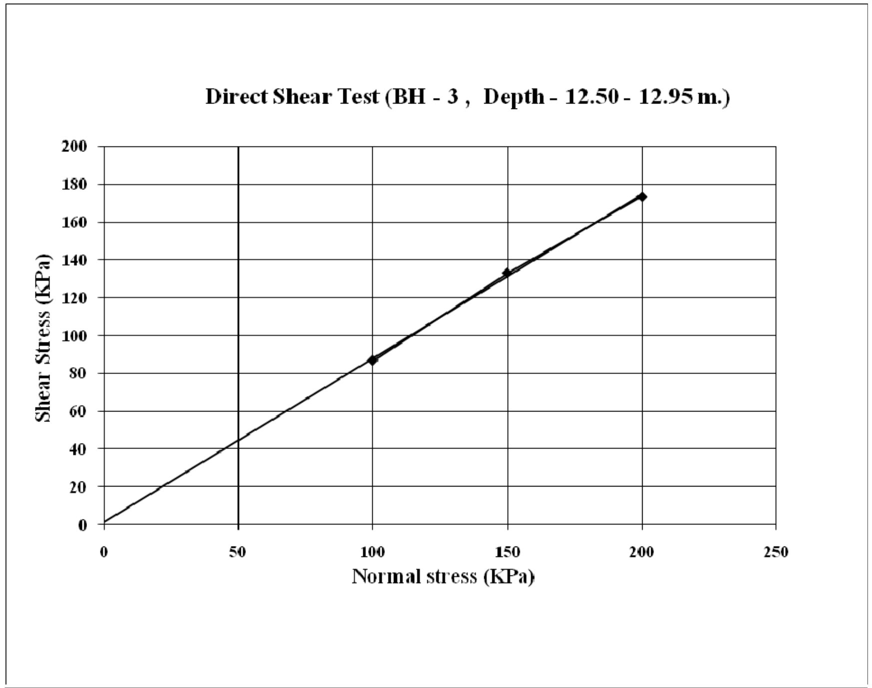


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
01	9.00-9.45	DS	20.10	16.60	21	0.69	38

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

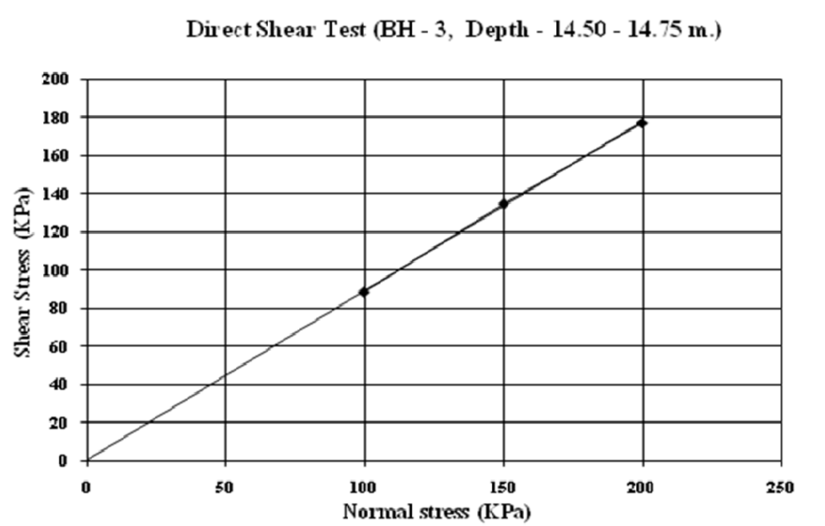


BH No.	Depth (m)	Type of Test	Bulk Density (KN / m^3)	Dry Density (KN / m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
03	12.50-12.95	DS	20.40	17.00	20	0.98	41

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS



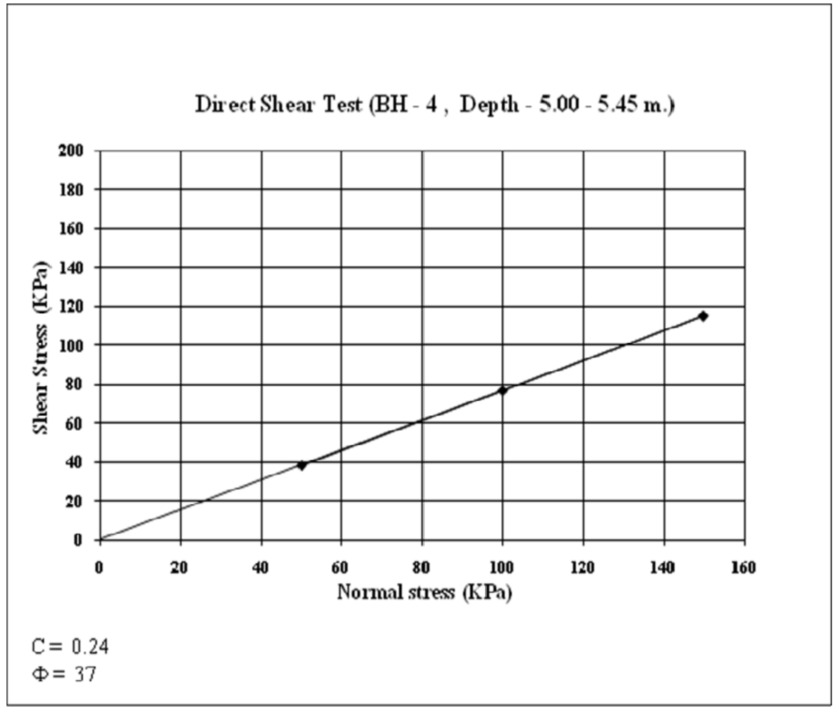
C= 0.15
Φ= 42

BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
03	14.50-14.75	DS	20.50	17.20	19	0.15	42

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

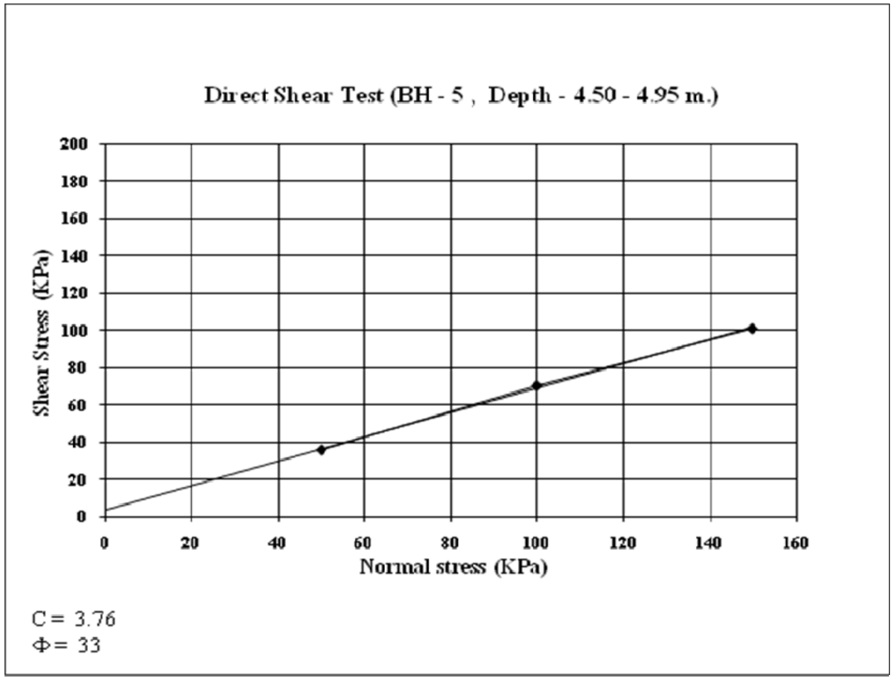


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
04	5.00-5.45	DS	19.70	15.90	24	0.24	37

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

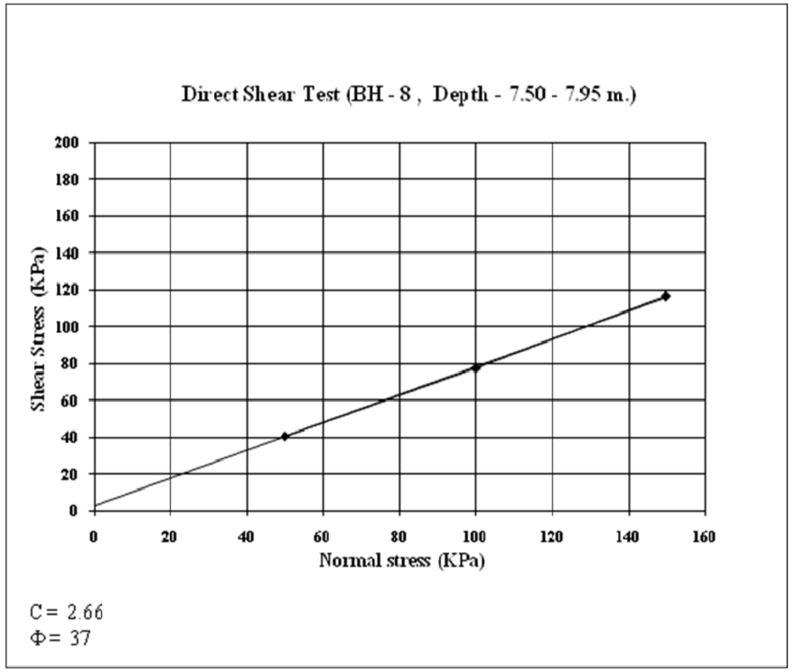


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
05	4.50-4.95	DS	19.60	15.70	25	3.76	33

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

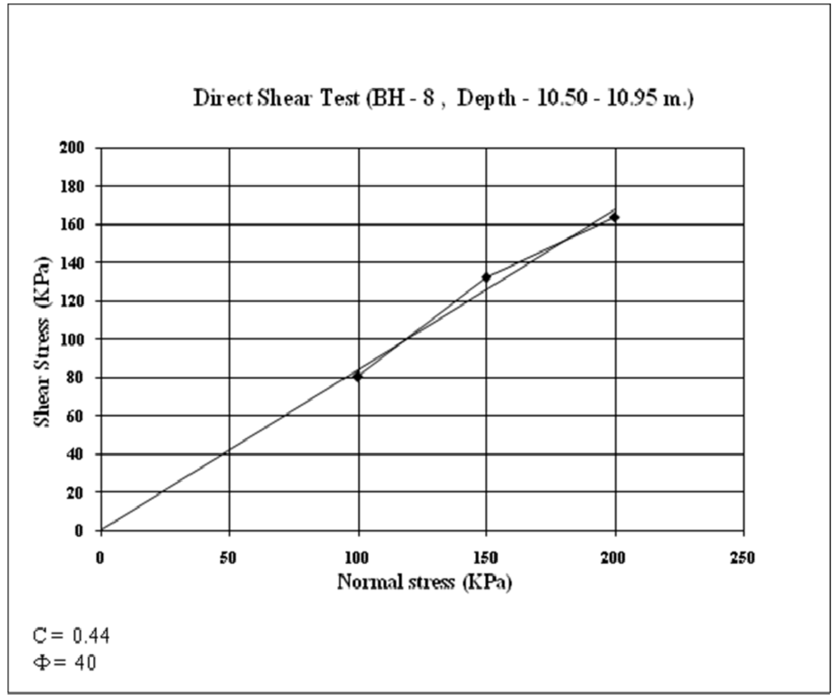


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
08	7.50-7.95	DS	20.20	16.60	22	2.66	37

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

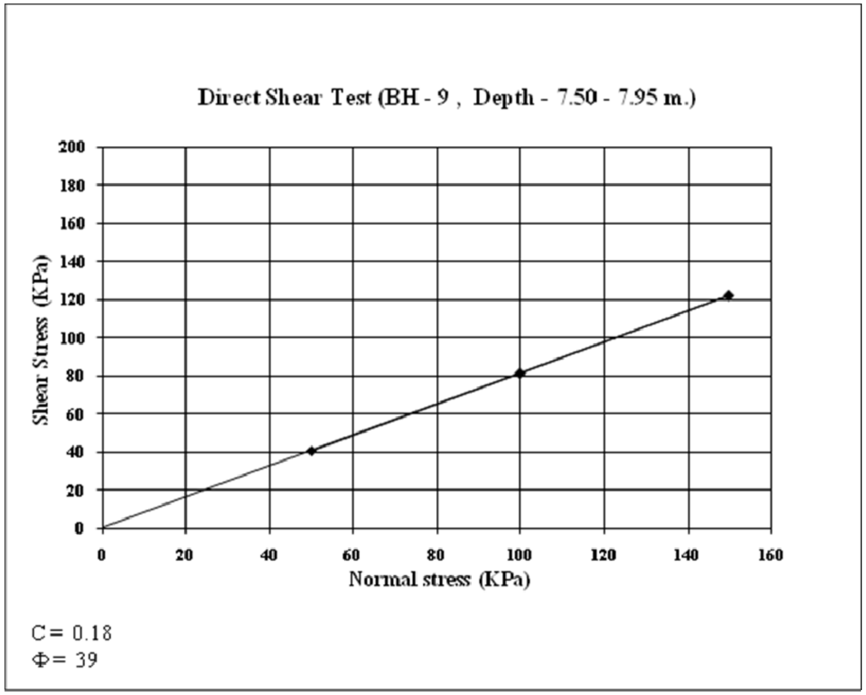


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
08	10.50-10.95	DS	20.30	16.90	20	0.44	40

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

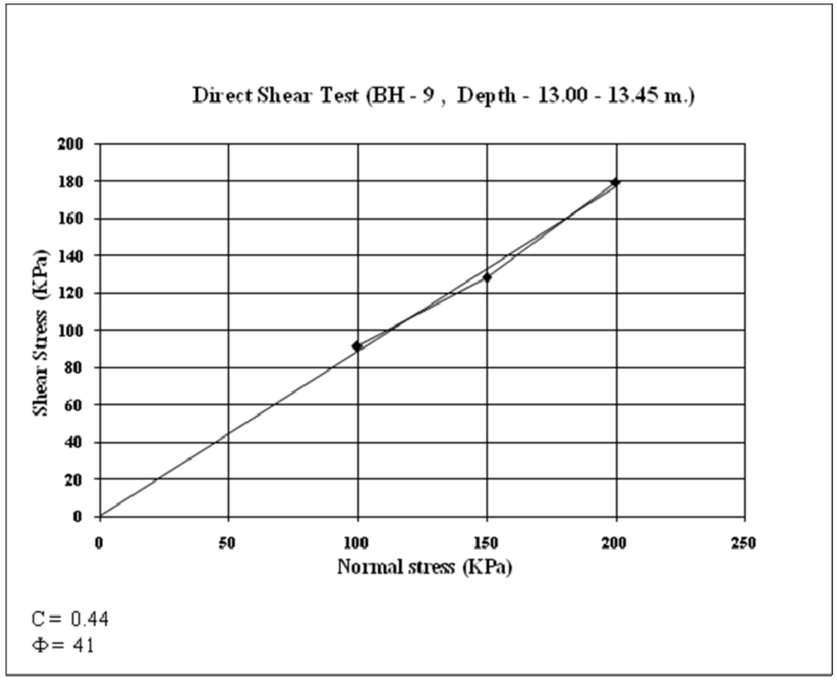


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
09	7.50-7.95	DS	20.10	16.30	23	0.18	39

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

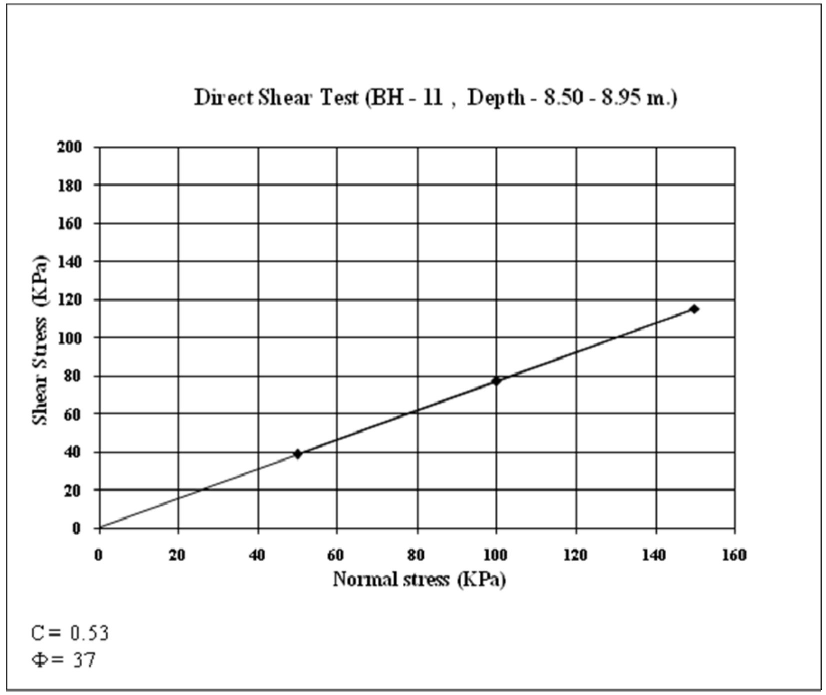


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
09	13.00-13.45	DS	20.40	17.10	19	0.44	41

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

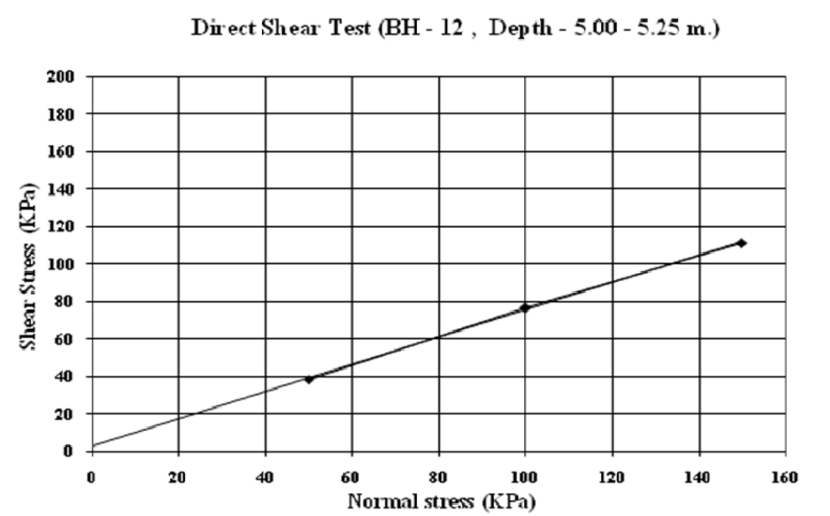


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
11	8.50-8.95	DS	20.20	16.40	23	0.53	37

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

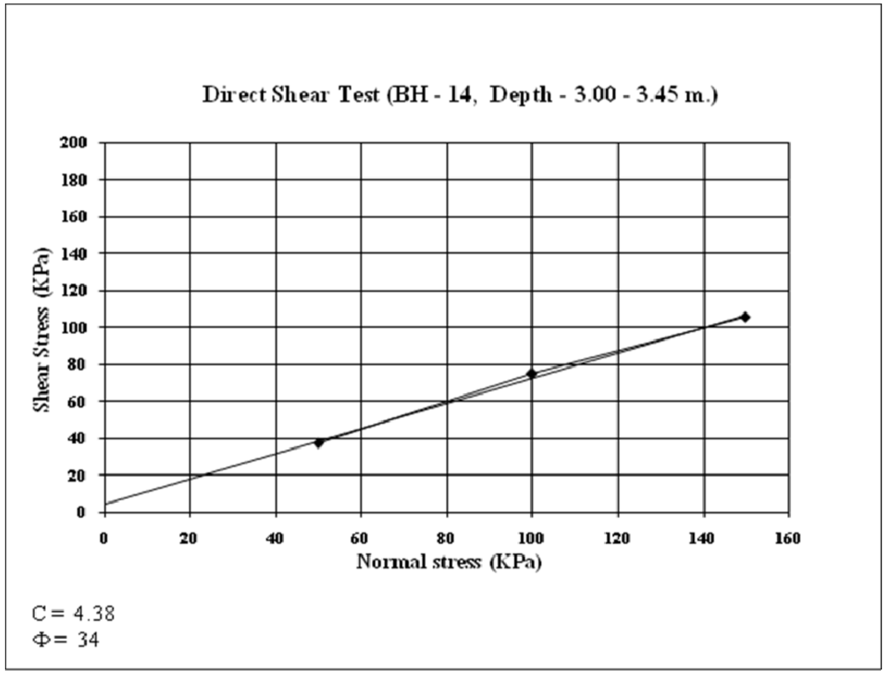


C = 2.57
Φ = 36

BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
12	5.00-5.25	DS	19.80	16.10	23	2.57	36

Note: DS: DIRECT SHEAR TEST

DIRECT SHEAR TEST RESULTS

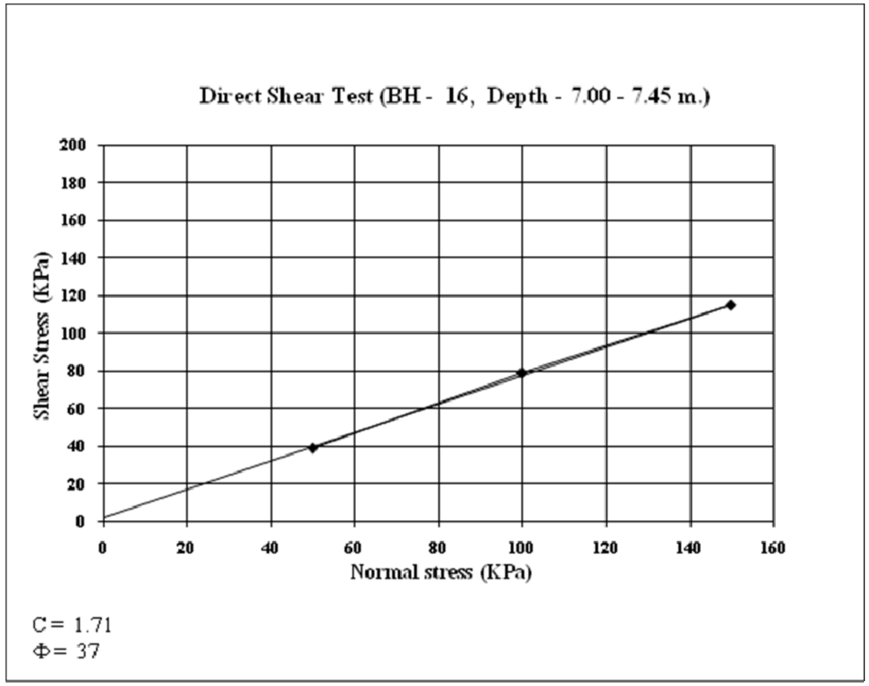


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
14	3.00-3.45	DS	19.70	15.80	25	4.38	34

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

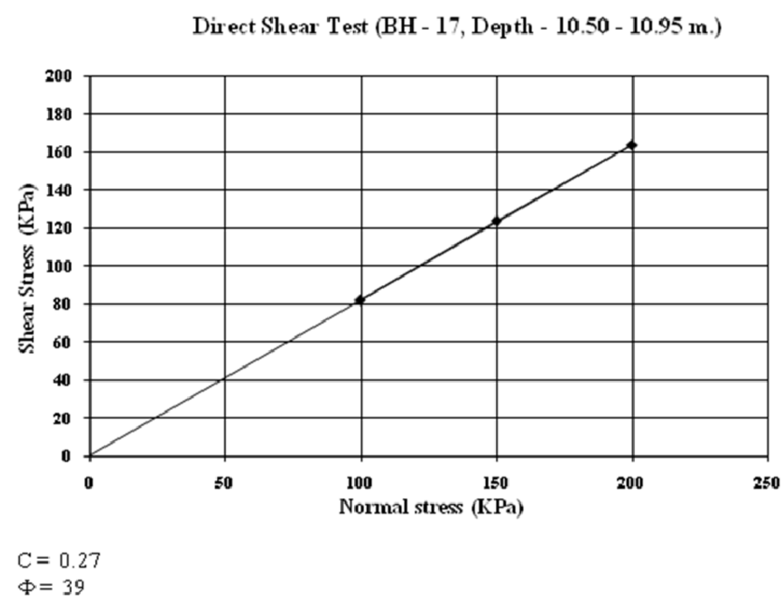


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
16	7.00-7.45	DS	20.00	16.40	22	1.71	37

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

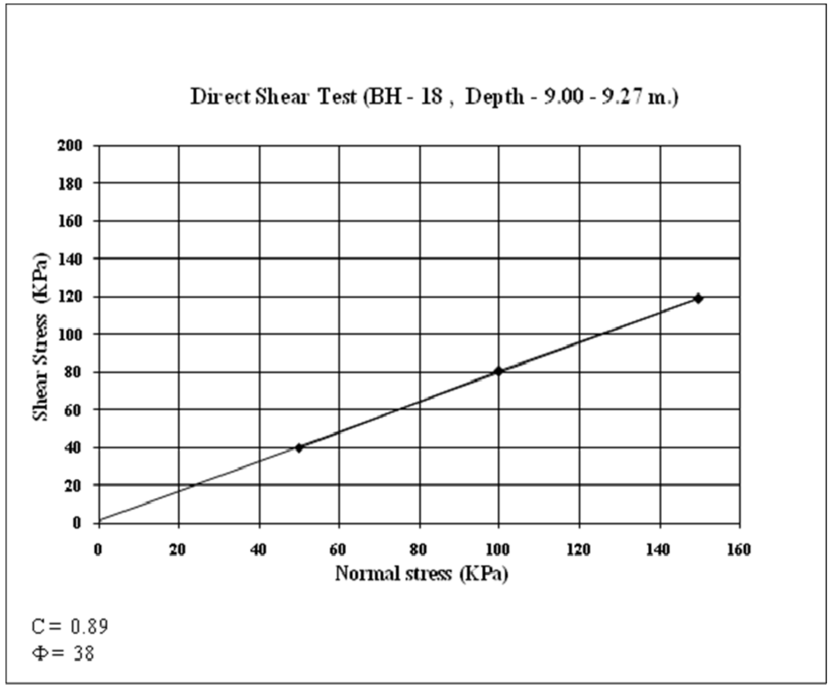


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
17	10.50-10.95	DS	20.30	16.80	21	0.27	39

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

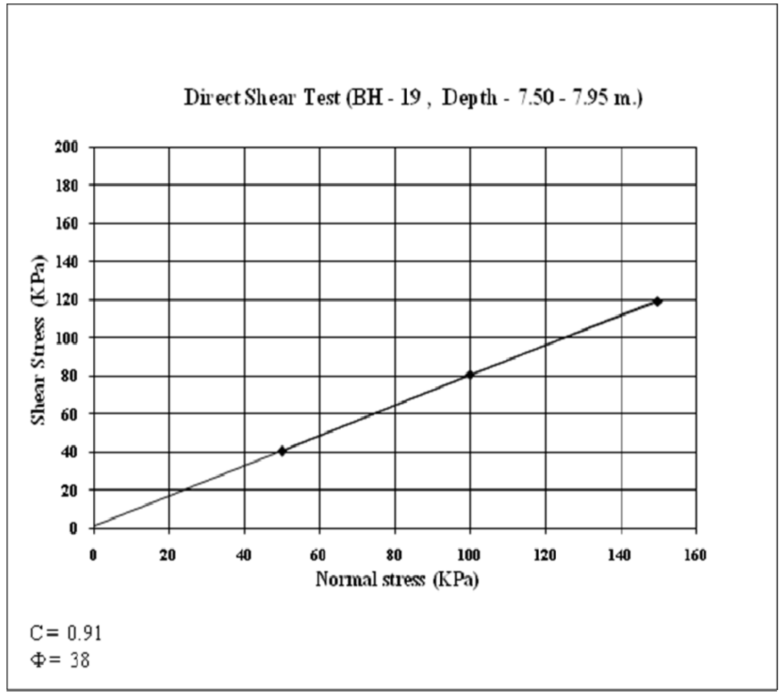


BH No.	Depth (m)	Type of Test	Bulk Density (KN / m^3)	Dry Density (KN / m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
18	9.00-9.27	DS	20.20	16.70	21	0.89	38

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

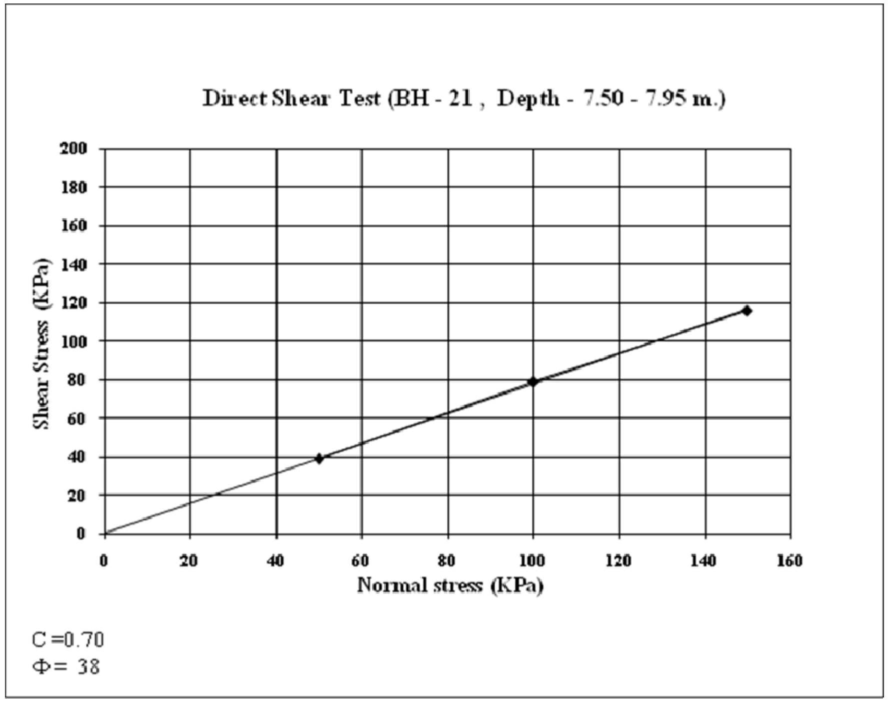


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
19	7.50-7.95	DS	20.00	16.30	23	0.91	38

Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

DIRECT SHEAR TEST RESULTS

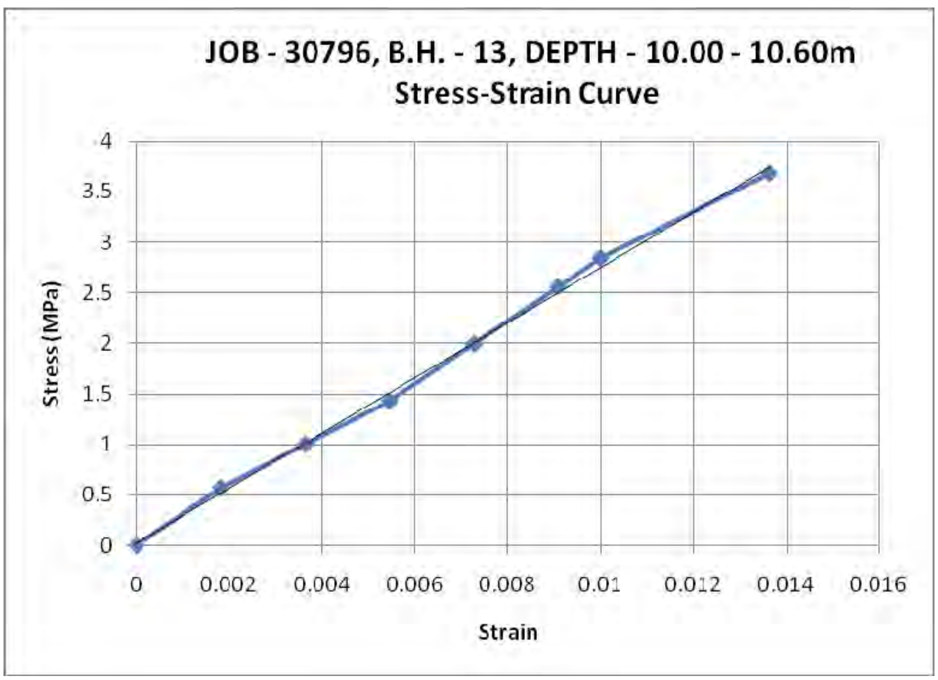


BH No.	Depth (m)	Type of Test	Bulk Density (KN/m^3)	Dry Density (KN/m^3)	Water Content (%)	Cohesion (kPa)	Angle of Internal Friction (Degrees)
21	7.50-7.95	DS	20.10	16.50	22	0.70	38

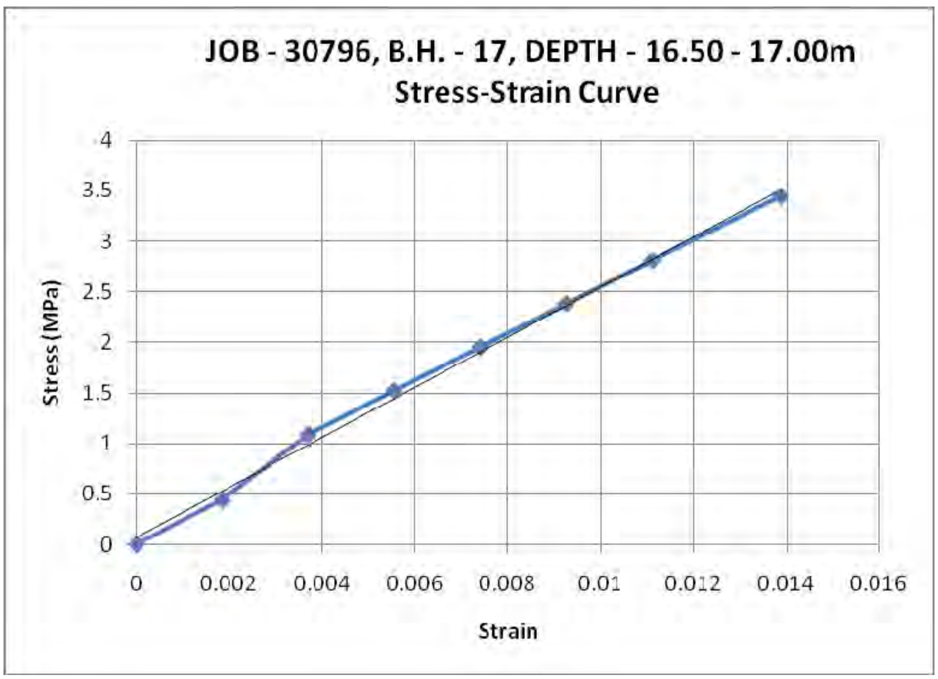
Note: DS: DIRECT SHEAR TEST

JOB NO. 30796

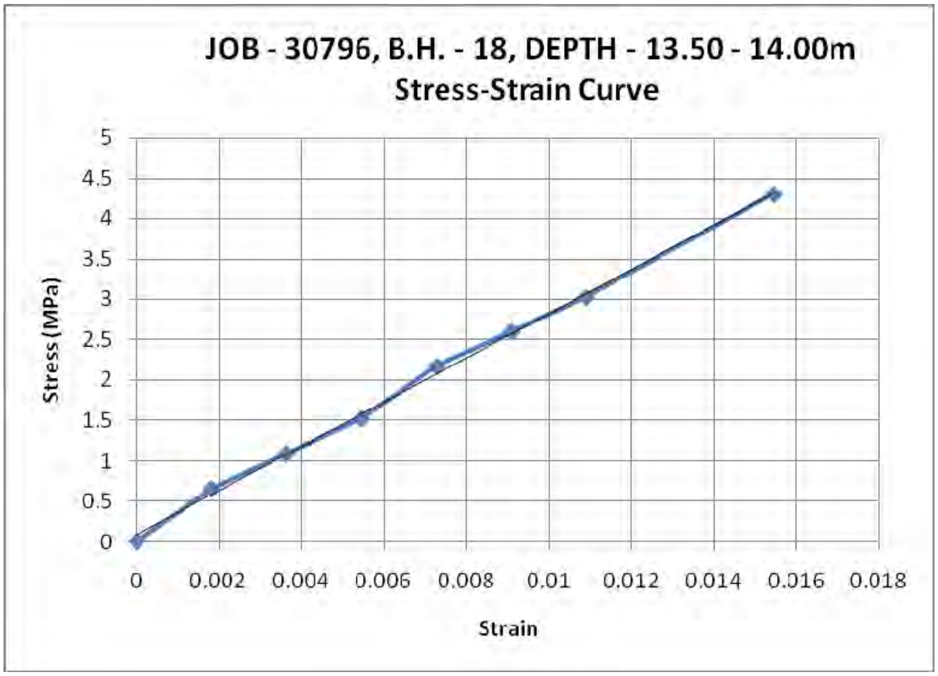
Stress-Strain Curve of Rock

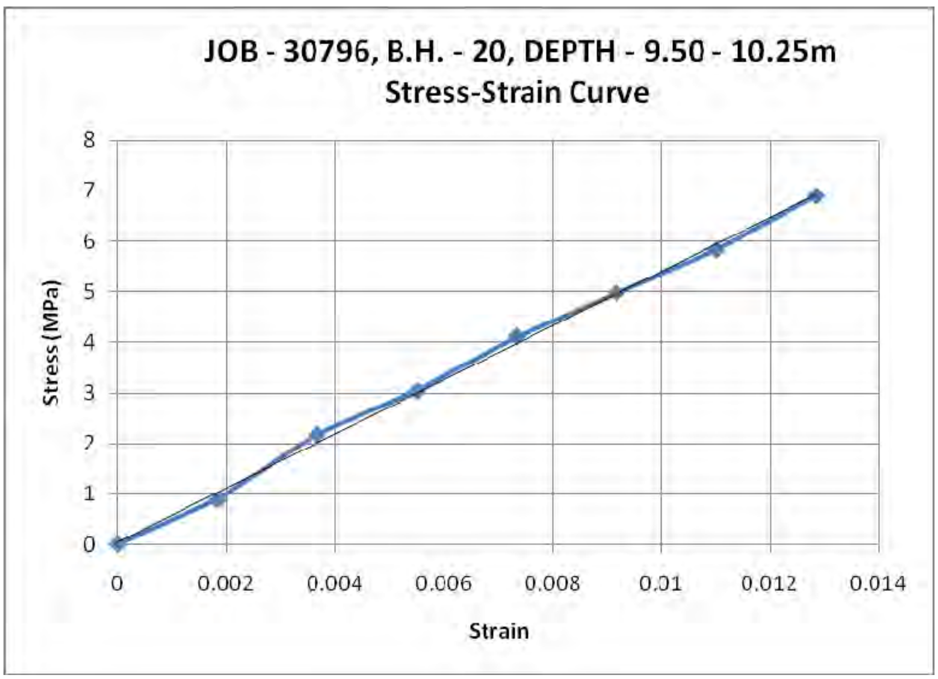


Stress-Strain Curve of Rock

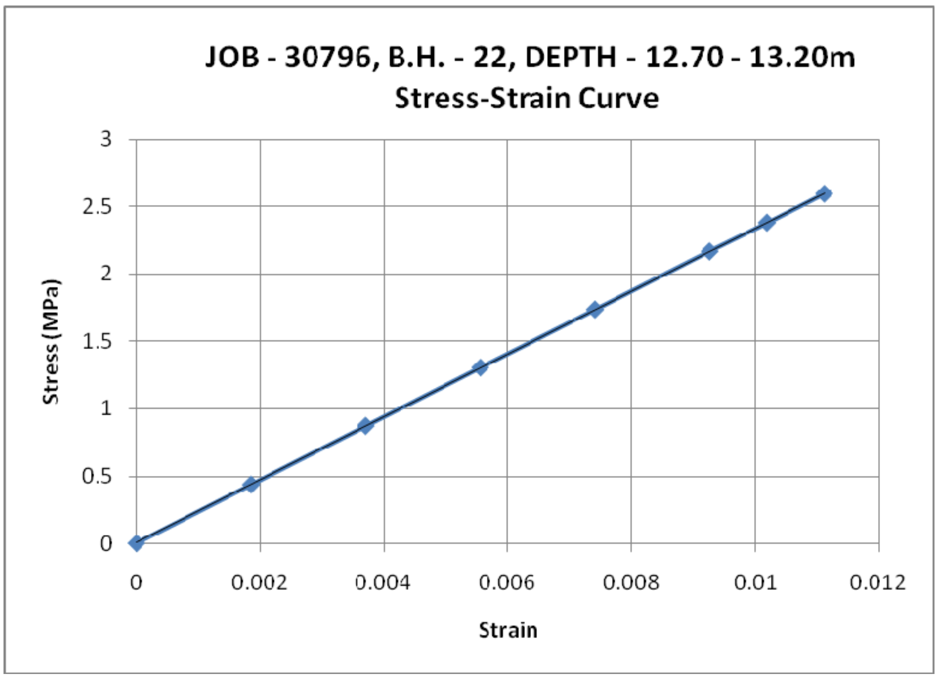


Stress-Strain Curve of Rock

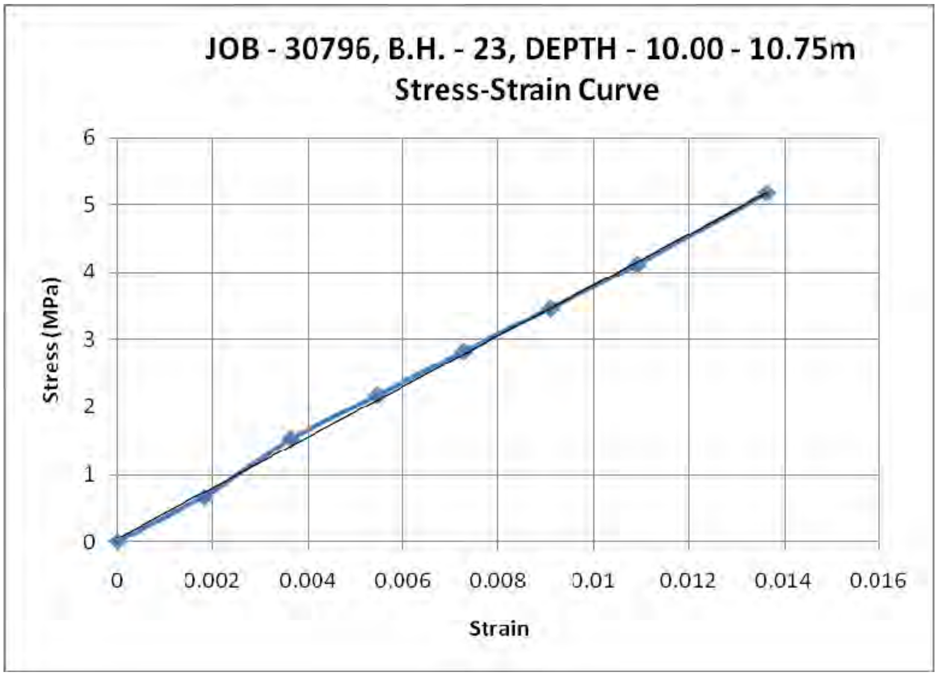


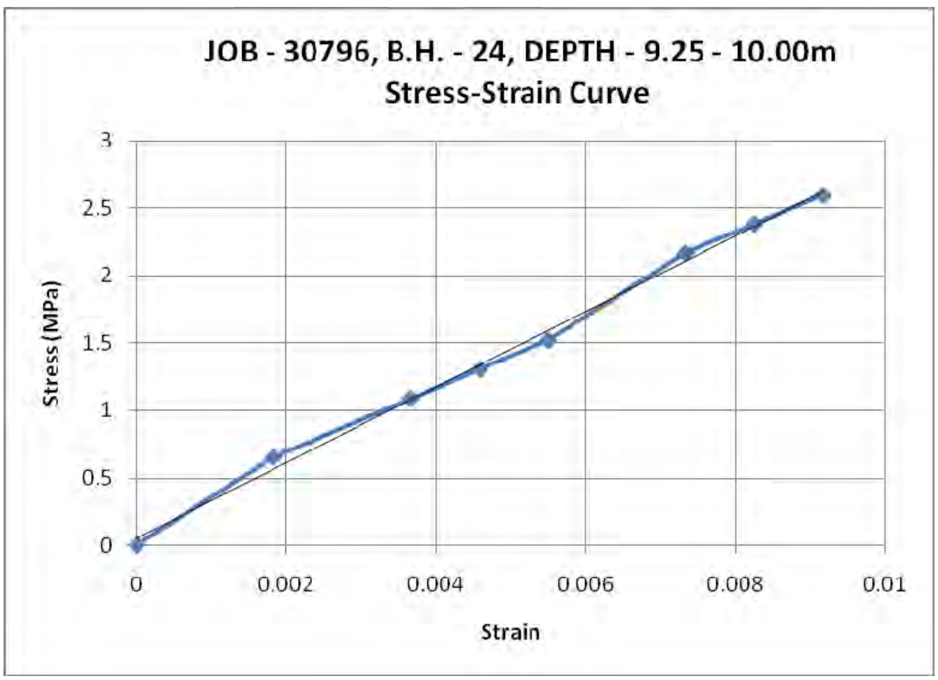


Stress-Strain Curve of Rock

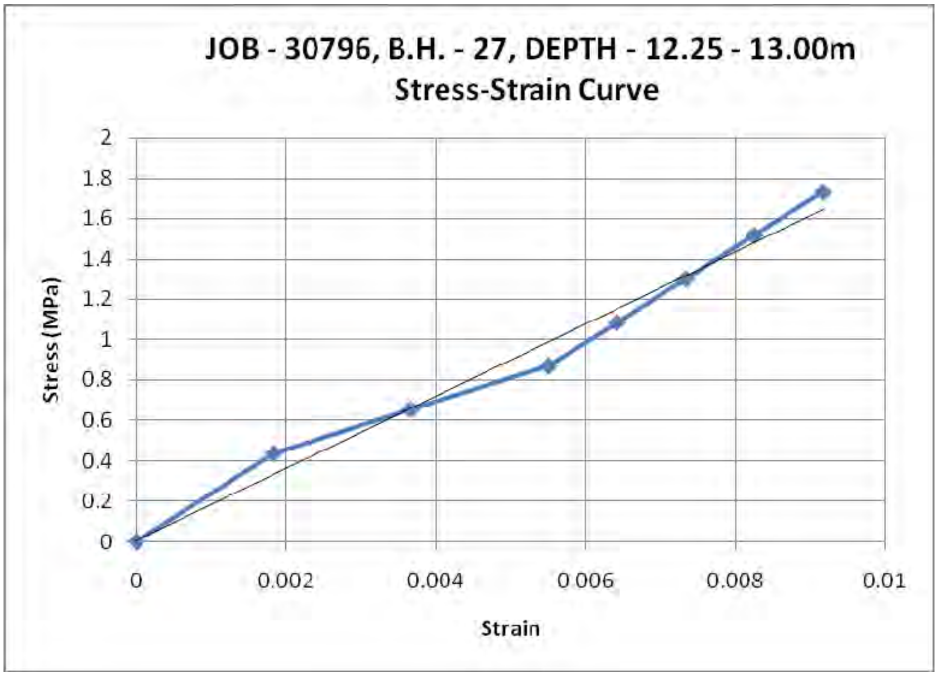


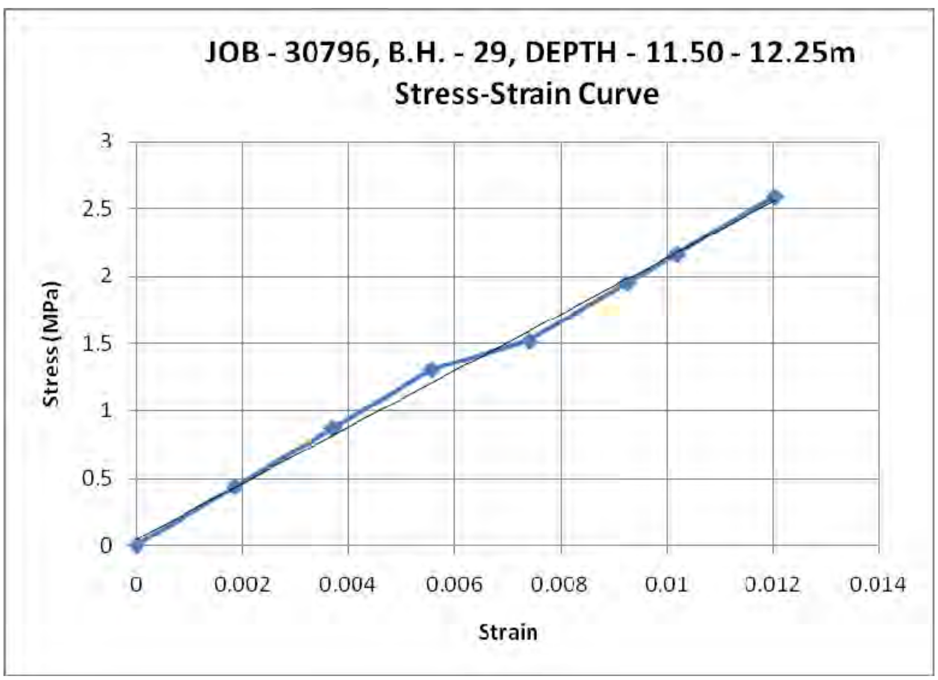
Stress-Strain Curve of Rock

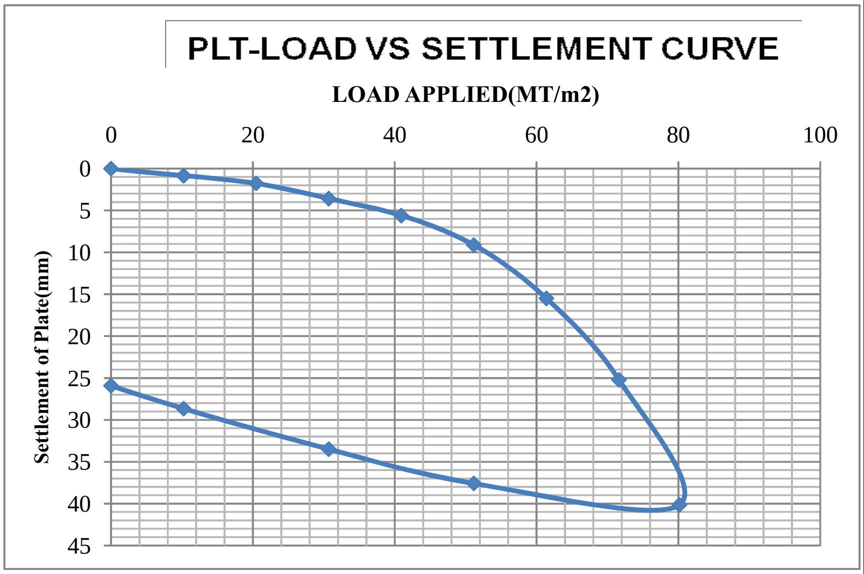


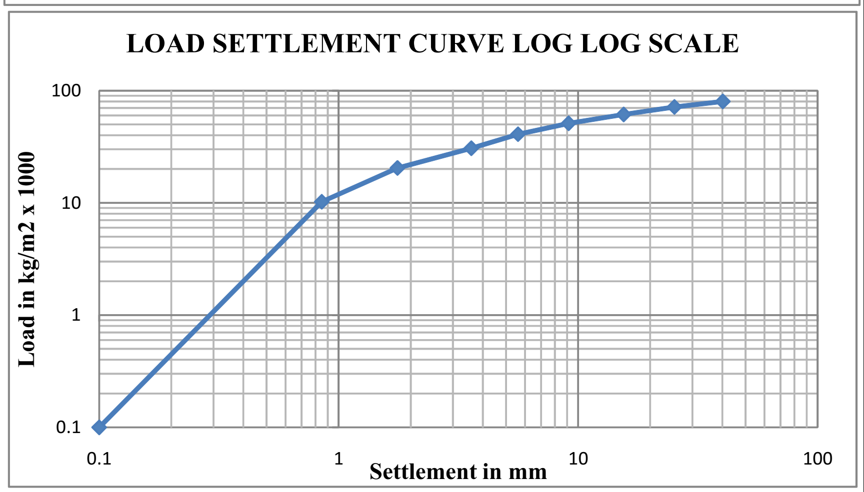


Stress-Strain Curve of Rock





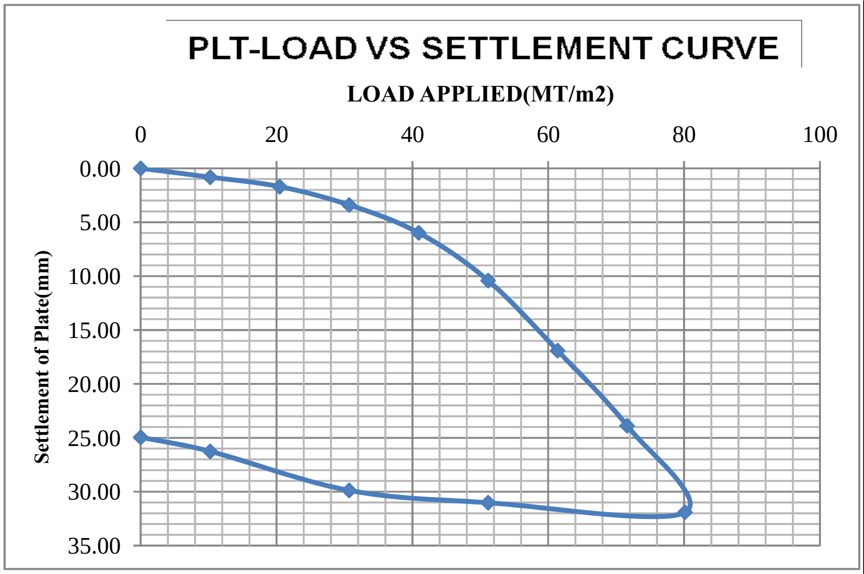


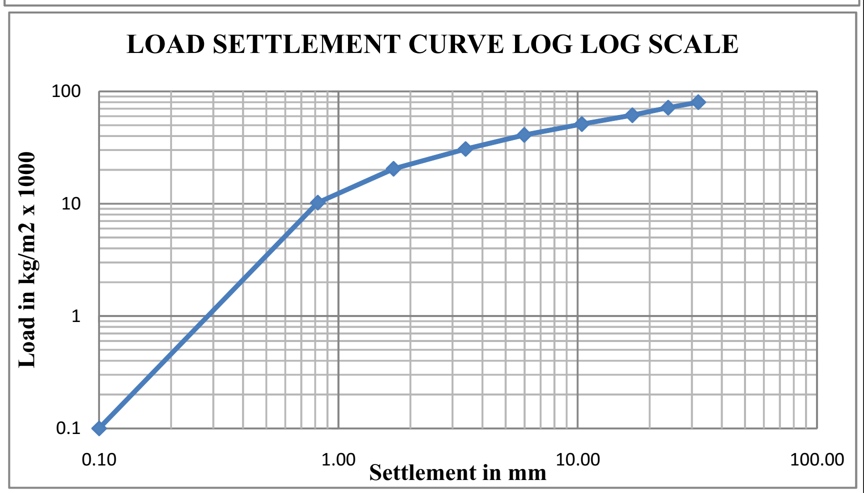


Test No.	: PLT.01	R.L. of G.L.	: 197.50m
Plate Size	: 60cm x 60cm.	Dial Gauge Constant	: 0.01mm.
Pit Size	: 3 m x 3 m	L.C. of Pressure Gauge	: 5 kg/cm2
Depth of Test	: 2.50m. b.g.l.	Ram Dia.	: 12.5cm.
Date of Test	: 05.02.2018	Site	: Sambalpur
Location of Test	: N: 2411027.00, E:	Client	: NLC India Ltd.
Soil Type: Silty clay			

PLATE LOAD TEST

TEST NO. : PLT - 01



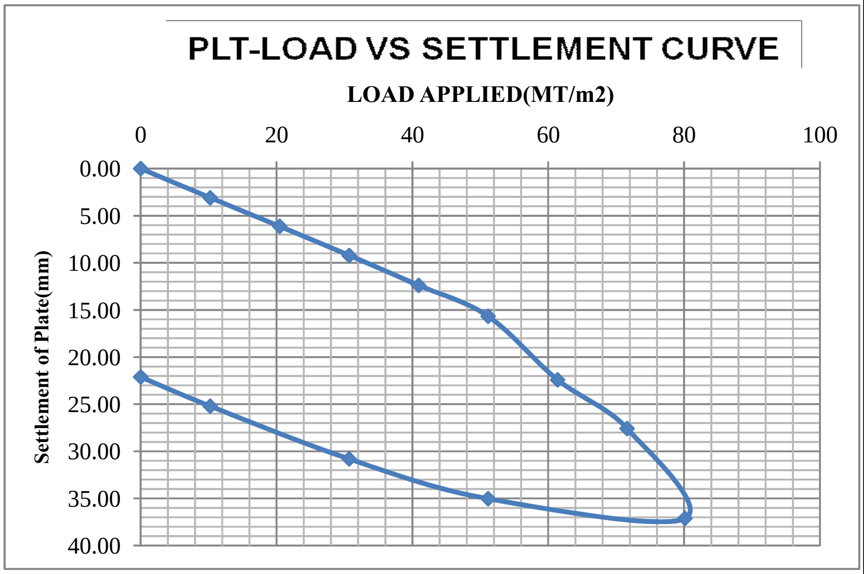


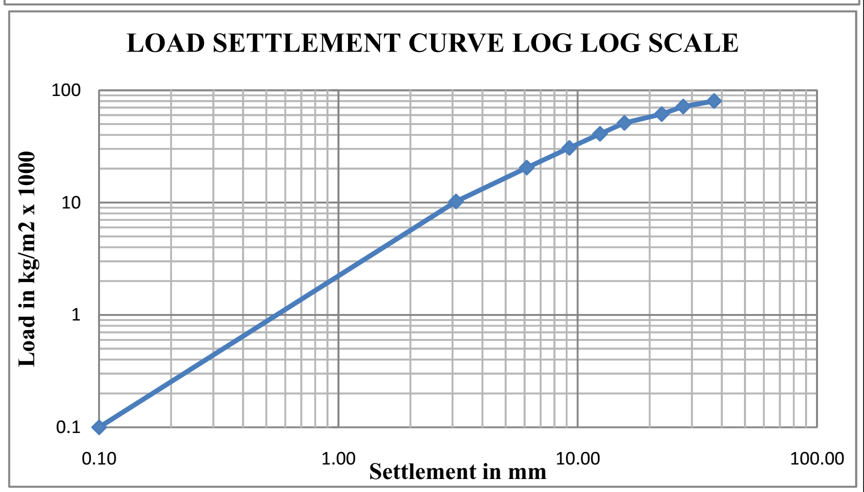
Test No.	: PLT.02	R.L. of G.L.	: 199.466m
Plate Size	: 60cm x 60cm.	Dial Gauge Constant	: 0.01mm.
Pit Size	: 3 m x 3 m	L.C. of Pressure Gauge	: 5 kg/cm2
Depth of Test	: 2.00m. b.g.l.	Ram Dia.	: 12.5cm.
Date of Test	: 08.02.2018	Site	: Sambalpur
Location of Test	: N: 241087.00, E: 8(	Client	: NLC India Ltd.

Soil Type: Silty clay

PLATE LOAD TEST

TEST NO. : PLT - 02

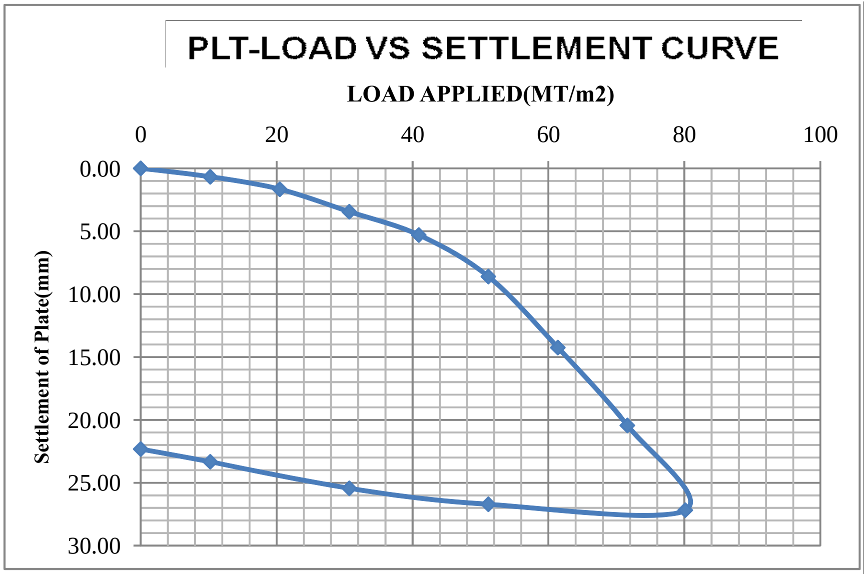


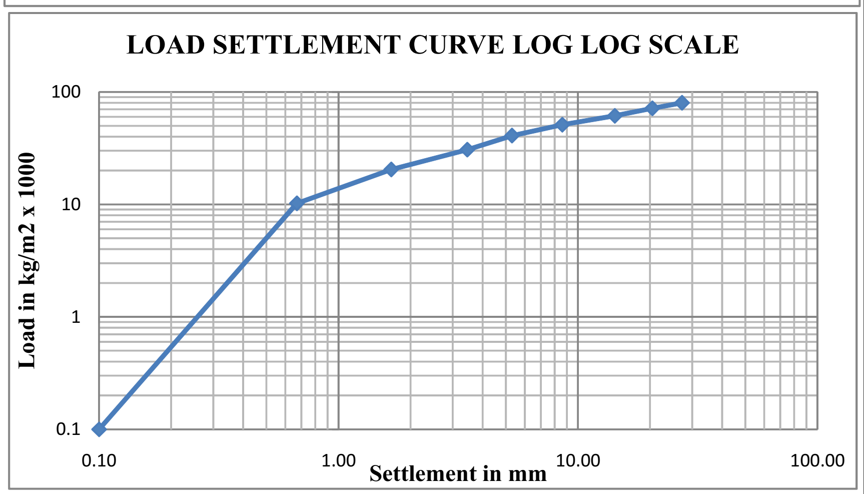


Test No.	**: PLT.03**	**R.L. of G.L.**	**: 197.394m**
Plate Size	**: 60cm x 60cm.**	**Dial Gauge Constant**	**: 0.01mm.**
Pit Size	**: 3 m x 3 m**	**L.C. of Pressure Gauge**	**: 5 kg/cm2**
Depth of Test	**: 2.50m. b.g.l.**	**Ram Dia.**	**: 12.5cm.**
Date of Test	**: 08.02.2018**	**Site**	**: Sambalpur**
Location of Test	**: N: 2410983.00, E:**	**Client**	**: NLC India Ltd.**
Soil Type: Silty clay			

PLATE LOAD TEST

TEST NO. : PLT - 03

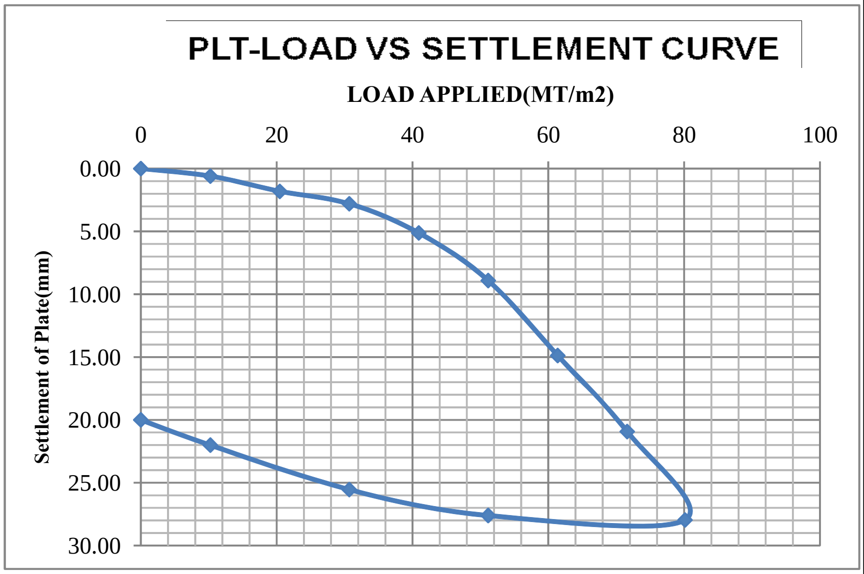


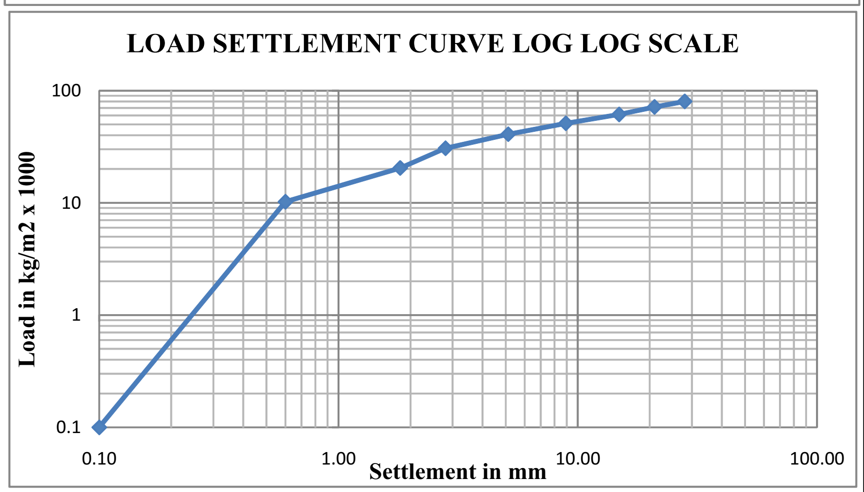


Test No.	: PLT.04	R.L. of G.L.	: 198.215m
Plate Size	: 60cm x 60cm.	Dial Gauge Constant	: 0.01mm.
Pit Size	: 3 m x 3 m	L.C. of Pressure Gauge	: 5 kg/cm2
Depth of Test	: 2.50m. b.g.l.	Ram Dia.	: 12.5cm.
Date of Test	: 16.02.2018	Site	: Sambalpur
Location of Test	: N: 2410785.00, E: ‹	Client	: NLC India Ltd.
Soil Type: Silty clay			

PLATE LOAD TEST

TEST NO. : PLT - 04





Test No.	: PLT.05	R.L. of G.L.	: 200.850m
Plate Size	: 60cm x 60cm.	Dial Gauge Constant	: 0.01mm.
Pit Size	: 3 m x 3 m	L.C. of Pressure Gauge	: 5 kg/cm2
Depth of Test	: 2.50m. b.g.l.	Ram Dia.	: 12.5cm.
Date of Test	: 16.02.2018	Site	: Sambalpur
Location of Test	: N: 2411452.00, E: !	Client	: NLC India Ltd.
Soil Type: Silty clay			

PLATE LOAD TEST

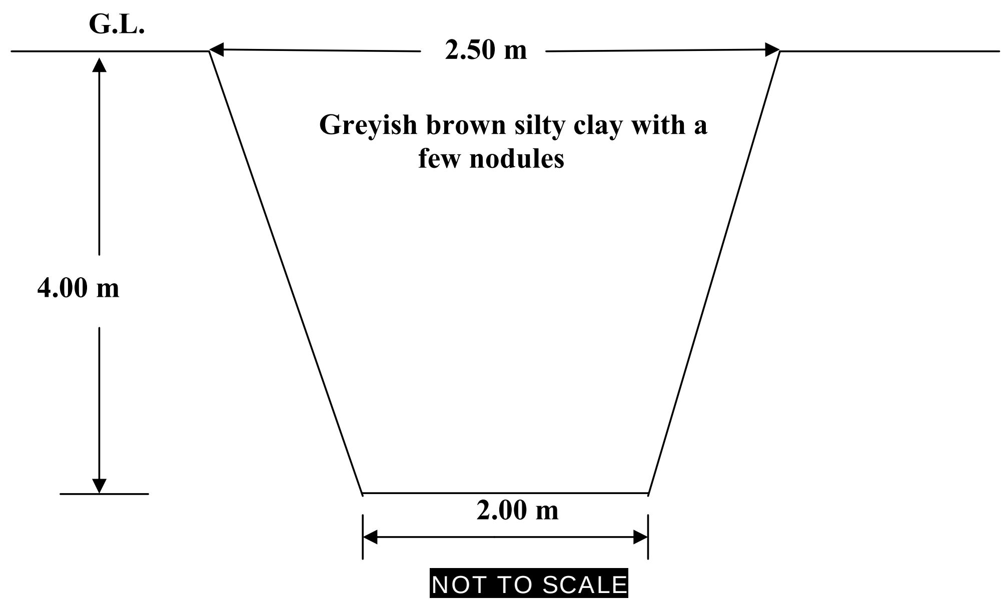
TEST NO. : PLT - 05

Trial Pit Log

Trial Pit –1 (One)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 19.02.2018

RL : 197.210m
Depth : 4.00m
Co-Ordinate: N: 2411240, E: 808580



Sample Collected

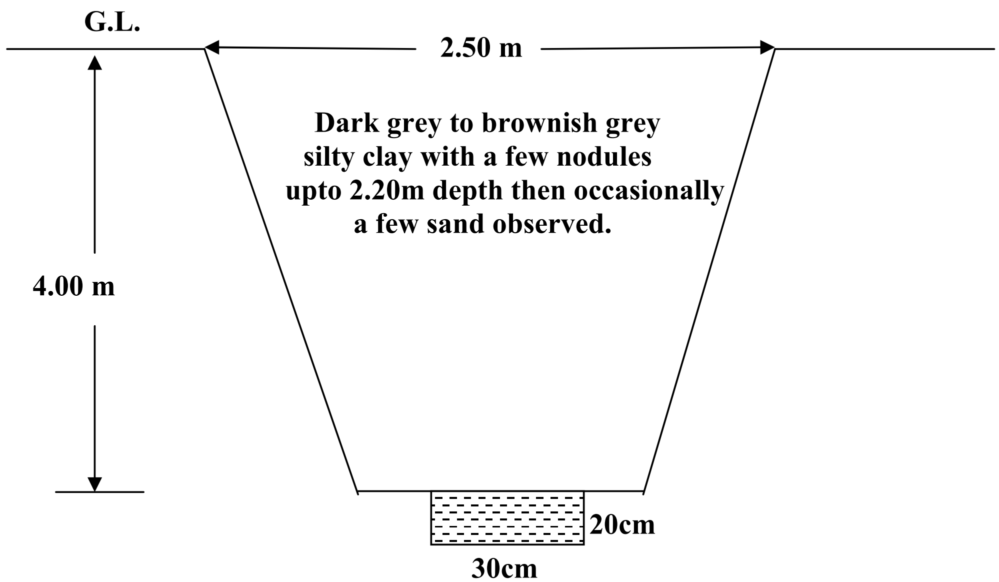
Date	Type of sample	Ref No.	Depth (m)	Remarks
19.02.2018	DS	162191	1.00	Silty clay
19.02.2018	UDS	162192	2.00	Silty clay
19.02.2018	DS	162193	3.00	Silty clay
19.02.2018	UDS	169194	4.00	Silty clay

Trial Pit Log

Trial Pit –2 (Two)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 03.02.2018

RL : 197.50m
epth : 4.00m
Co-Ordinate: N: 2411020, E: 808690



Time (Sec)	10	20	30	40	60	180	300	600	900	3600	7200
Water Level (cm)	0	0	0	1	1	2	2	3	4	4	4

Percolation rate = 0.787 inch/hr.

Sample Collected

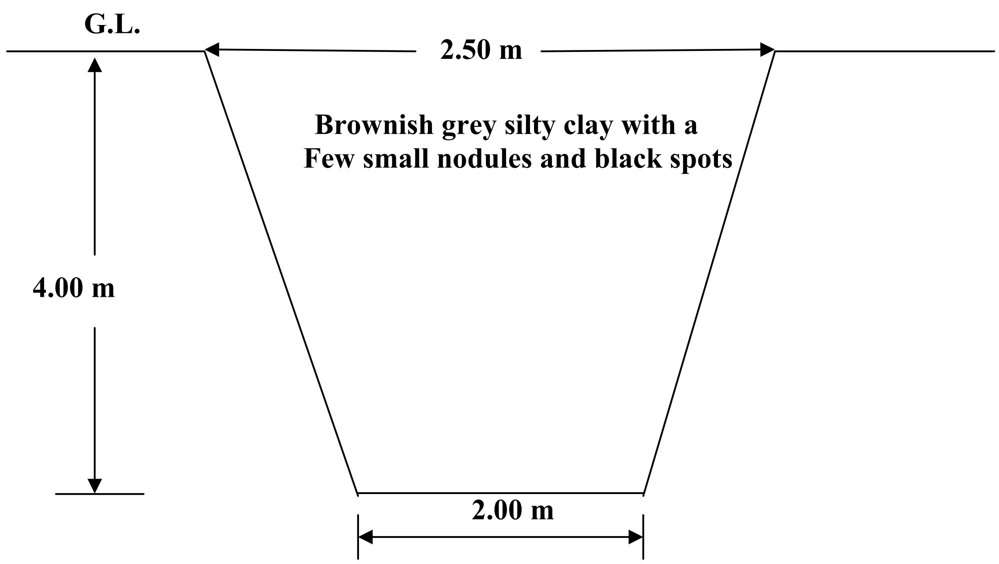
Date	Type of sample	Ref No.	Depth (m)	Remarks
03.02.2018	DS	100675	1.00	Silty clay
03.02.2018	UDS	100676	2.00	Silty clay
03.02.2018	DS	100677	3.00	Silty clay
03.02.2018	UDS	100678	4.00	Silty clay

Trial Pit Log

Trial Pit –3 (Three)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 01.02.2018

RL : 198.50m
Depth : 4.00m
Co-Ordinate: N: 2410815, E: 808692



NOT TO SCALE

Sample Collected

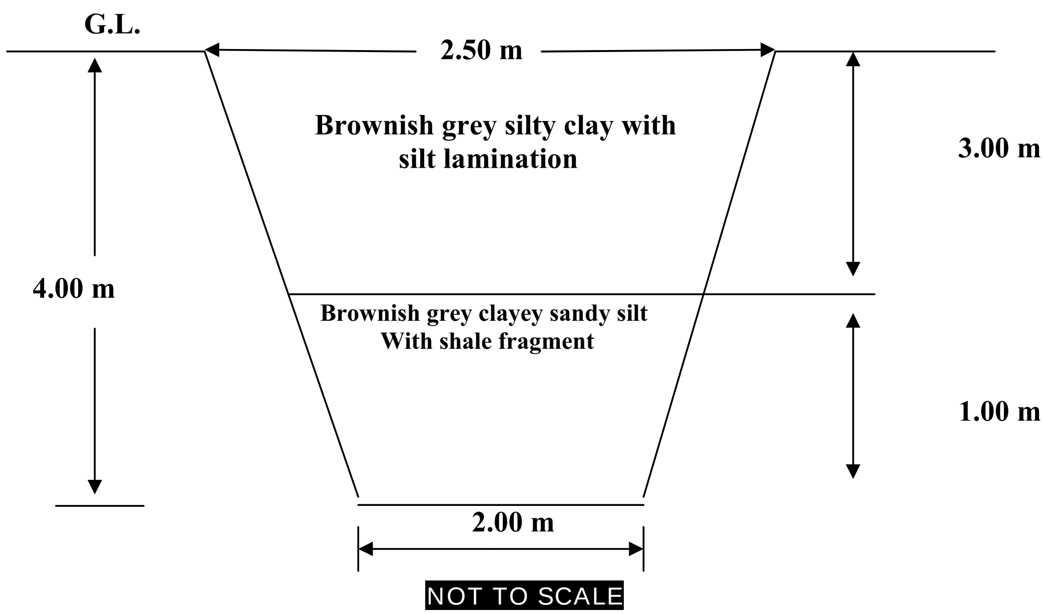
Date	Type of sample	Ref No.	Depth (m)	Remarks
01.02.2018	DS	106100	1.00	Silty clay
01.02.2018	UDS	106101	2.00	Silty clay
01.02.2018	DS	106102	3.00	Silty clay
01.02.2018	UDS	106103	4.00	Silty clay

Trial Pit Log

Trial Pit – 4 (Four)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 01.02.2018

RL : 194.729m
Depth : 4.00m
Co-Ordinate: N: 2411140, E: 808965



Sample Collected

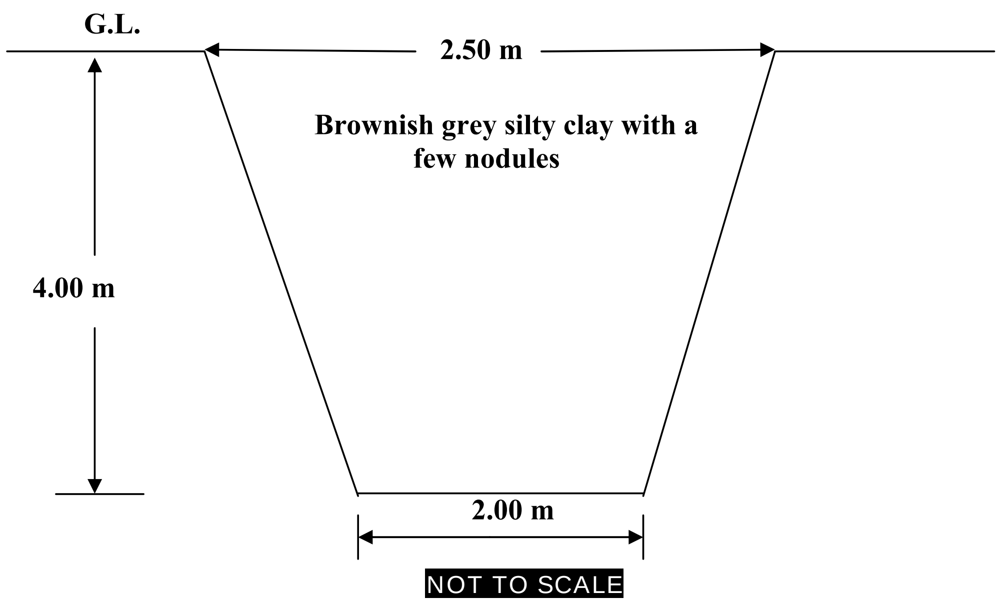
Date	Type of sample	Ref No.	Depth (m)	Remarks
01.02.2018	DS	106104	1.00	Silty clay
01.02.2018	UDS	106105	2.00	Silty clay
01.02.2018	DS	106106	3.00	Sandy clayey silt
01.02.2018	UDS	106107	4.00	Sandy clayey silt

Trial Pit Log

Trial Pit –5 (Five)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 19.02.2018

RL : 202.405m
Depth : 4.00m
Co-Ordinate: N: 2409510, E: 810500



Sample Collected

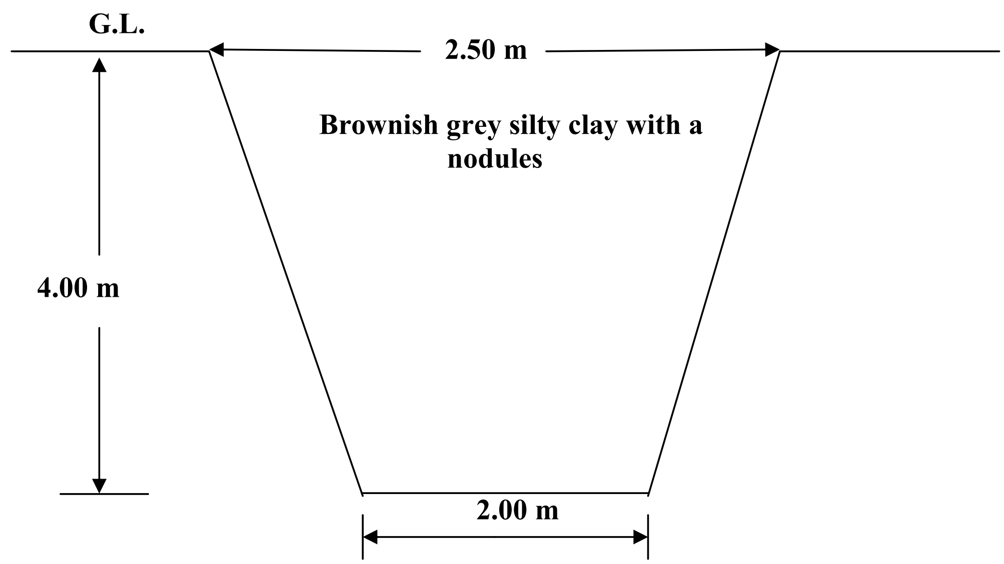
Date	Type of sample	Ref No.	Depth (m)	Remarks
19.02.2018	UDS	151251	1.00	Silty clay
19.02.2018	DS	151252	2.00	Silty clay
19.02.2018	UDS	151253	3.00	Silty clay
19.02.2018	DS	151254	4.00	Silty clay

Trial Pit Log

Trial Pit –6 (Six)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 19.02.2018

RL : 202.925m
Depth : 4.00m
Co-Ordinate: N: 2408758, E: 810205



NOT TO SCALE

Sample Collected

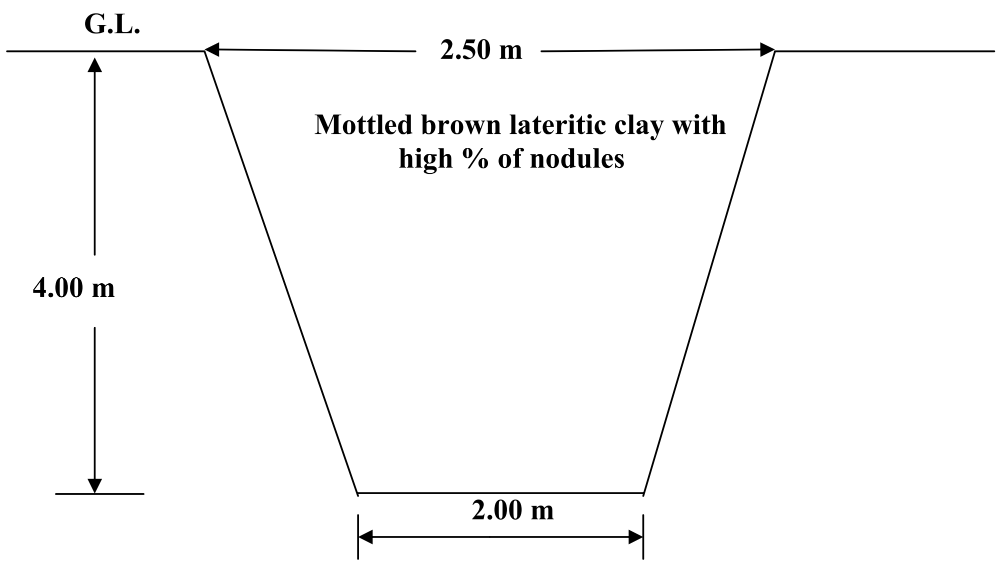
Date	Type of sample	Ref No.	Depth (m)	Remarks
19.02.2018	UDS	171620	1.00	Silty clay
19.02.2018	DS	171621	2.00	Silty clay
19.02.2018	UDS	171622	3.00	Silty clay
19.02.2018	DS	171623	4.00	Silty clay

Trial Pit Log

Trial Pit –7 (Seven)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 03.02.2018

RL : 200.850m
Depth : 4.00m
Co-Ordinate: N: 2411457, E: 809105



NOT TO SCALE

Sample Collected

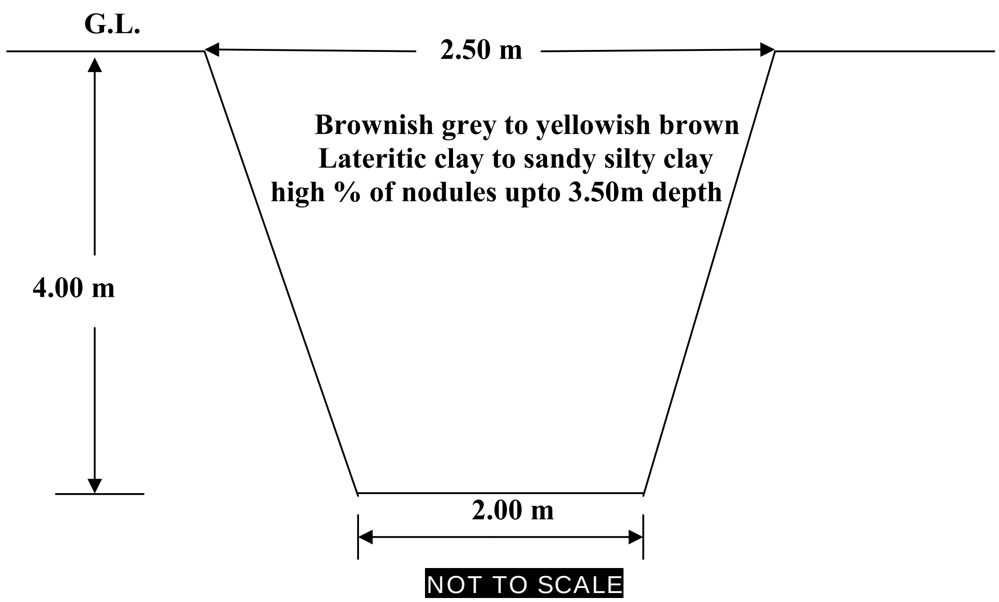
Date	Type of sample	Ref No.	Depth (m)	Remarks
03.02.2018	DS	100710	1.00	Lateritic clay
03.02.2018	UDS	100711	2.00	Lateritic clay
03.02.2018	DS	100712	3.00	Lateritic clay
03.02.2018	DS	100713	4.00	Lateritic clay

Trial Pit Log

Trial Pit –8 (Eight)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 31.02.2018

RL : 199.264m
Depth : 4.00m
Co-Ordinate: N: 2410810, E: 809050



Sample Collected

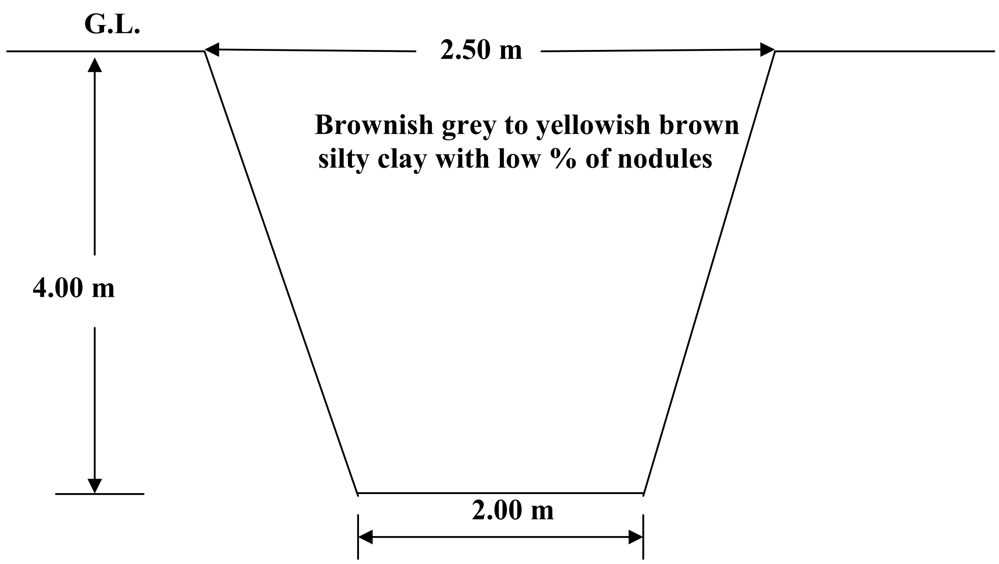
Date	Type of sample	Ref No.	Depth (m)	Remarks
31.02.2018	DS	105129	1.00	Lateritic clay
31.02.2018	UDS	105130	2.00	Lateritic clay
31.02.2018	UDS	105131	3.00	Lateritic clay
31.02.2018	DS	105132	4.00	Lateritic clay

Trial Pit Log

Trial Pit –9 (Nine)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 04.02.2018

RL : 198.614m
Depth : 4.00m
Co-Ordinate: N: 2409655, E: 808710



NOT TO SCALE

Sample Collected

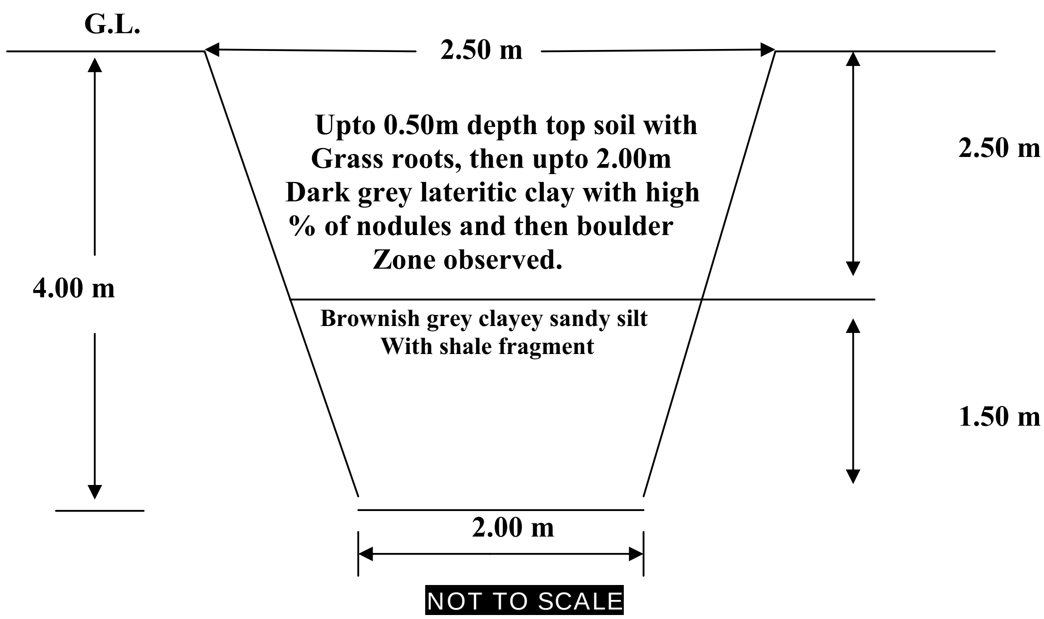
Date	Type of sample	Ref No.	Depth (m)	Remarks
04.02.2018	UDS	120150	1.00	Silty clay
04.02.2018	DS	120151	2.00	Silty clay
04.02.2018	UDS	120152	3.00	Clayey silt
04.02.2018	DS	120153	4.00	Clayey silt

Trial Pit Log

Trial Pit – 10 (Ten)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 31.01.2018

RL : 195.668m
Depth : 4.00m
Co-Ordinate: N: 2411180, E: 809065



Sample Collected

Date	Type of sample	Ref No.	Depth (m)	Remarks
31.01.2018	DS	105133	1.00	Lateritic soil
31.01.2018	DS	105134	2.00	Boulders
31.01.2018	UDS	105135	3.00	Silty clay
31.01.2018	DS	105136	4.00	Sandy clayey silt

Trial Pit Log

Trial Pit –11 (Eleven)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 04.02.2018

RL : 201.101m
Depth : 4.00m
Co-Ordinate: N: 2409560, E: 809200

Sample Collected

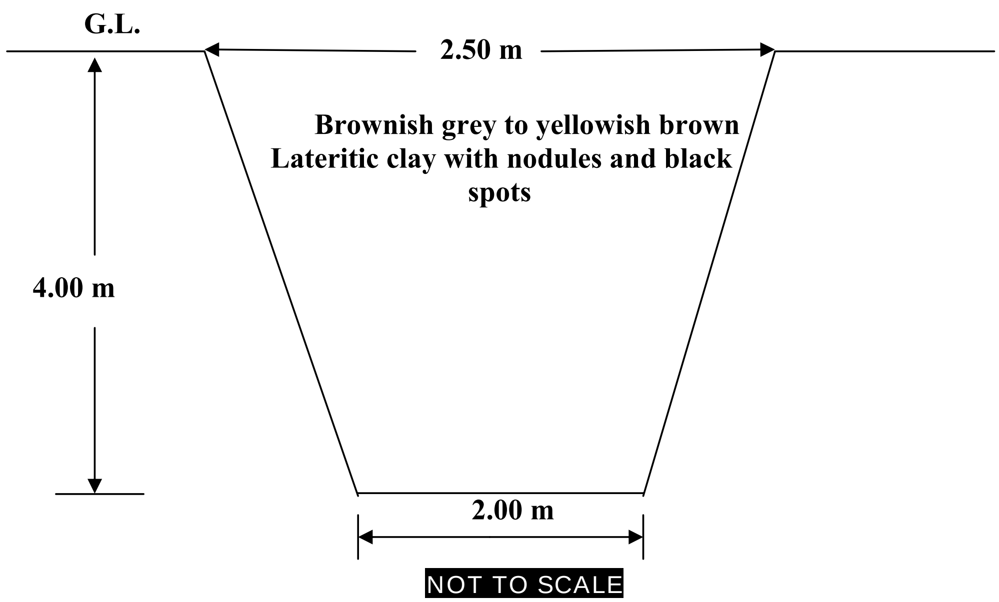
Date	Type of sample	Ref No.	Depth (m)	Remarks
04.02.2018	UDS	150122	1.00	Silty clay
04.02.2018	DS	150123	2.00	Silty clay
04.02.2018	UDS	150124	3.00	Clayey silt
04.02.2018	DS	150125	4.00	Clayey silt

Trial Pit Log

Trial Pit –12 (Twelve)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 02.02.2018

RL : m
Depth : 4.00m
Co-Ordinate: N:, E:



Sample Collected

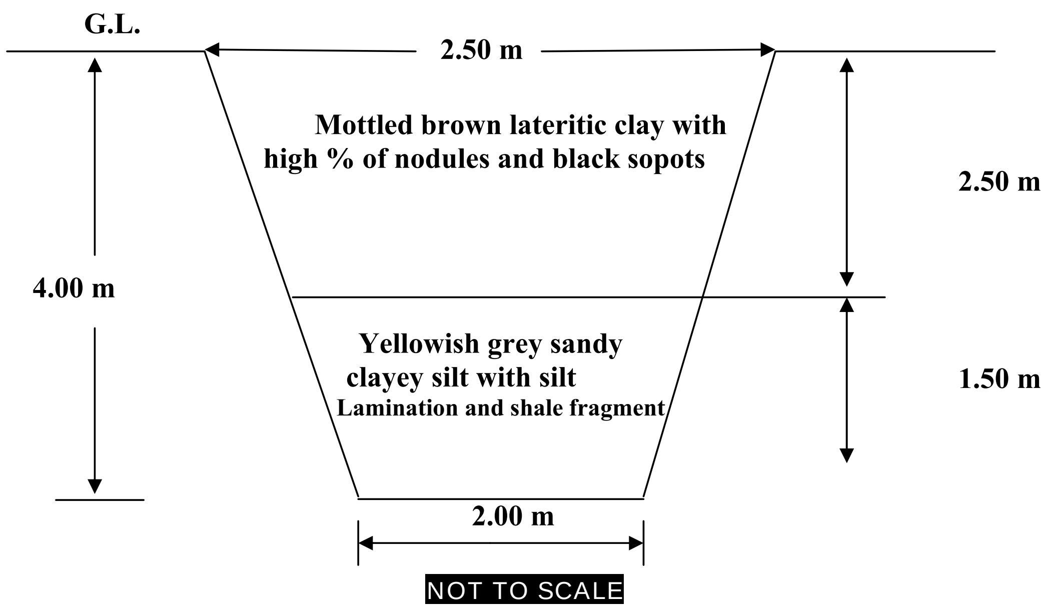
Date	Type of sample	Ref No.	Depth (m)	Remarks
02.02.2018	UDS	106112	1.00	Lateritic clay
02.02.2018	DS	106113	2.00	Lateritic clay
02.02.2018	UDS	106114	3.00	Lateritic clay
02.02.2018	DS	106115	4.00	Lateritic clay

Trial Pit Log

Trial Pit –13 (Thirteen)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 31.01.2018

RL : 196.660m
Depth : 4.00m
Co-Ordinate: N:2411180, E: 8090105



Sample Collected

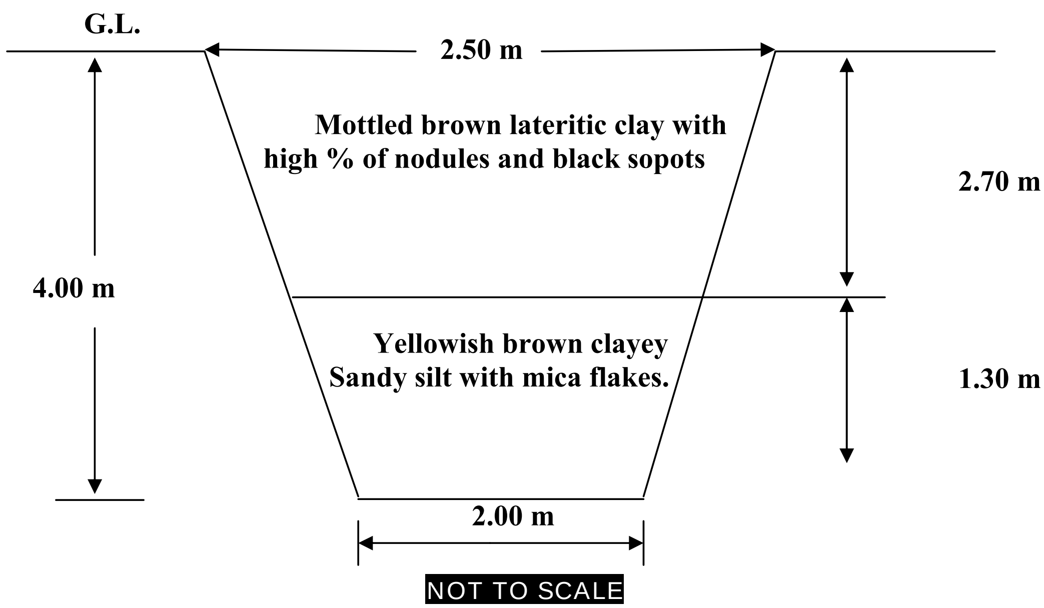
Date	Type of sample	Ref No.	Depth (m)	Remarks
31.01.2018	DS	105121	1.00	Lateritic clay
31.01.2018	DS	105122	2.00	Lateritic clay
31.01.2018	DS	105123	3.00	Sandy clayey silt
31.01.2018	DS	105124	4.00	Sandy clayey silt

Trial Pit Log

Trial Pit –14 (fourteen)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 31.01.2018

RL : 196.621m
Depth : 4.00m
Co-Ordinate: N:2411125, E: 809070



Sample Collected

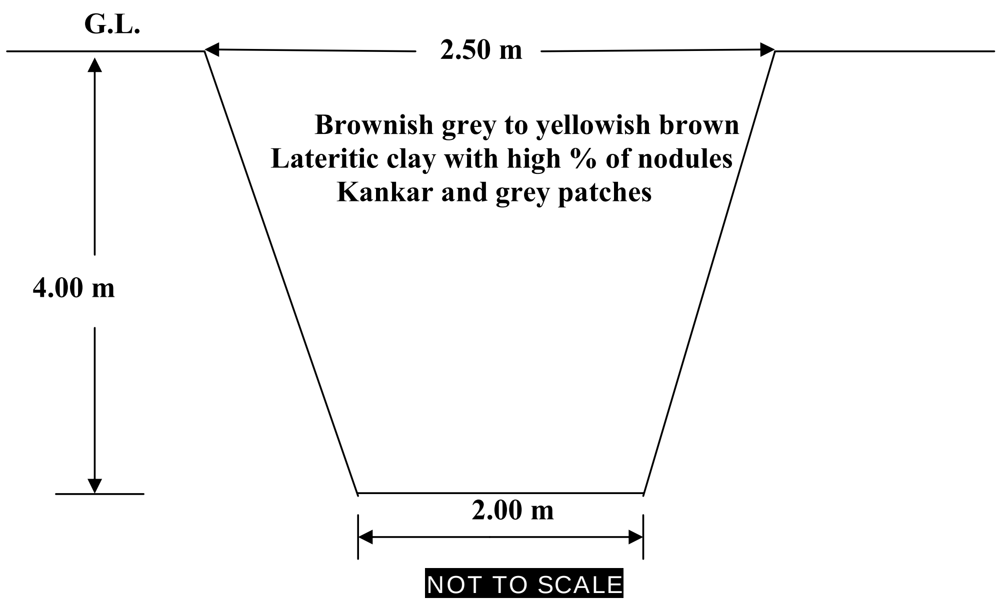
Date	Type of sample	Ref No.	Depth (m)	Remarks
31.01.2018	DS	105125	1.00	Sandy silty clay
31.01.2018	UDS	105126	2.00	Sandy silty clay
31.01.2018	DS	105127	3.00	Clayey sandy silt
31.01.2018	DS	105128	4.00	Clayey sandy silt

Trial Pit Log

Trial Pit –15 (Fifteen)

Site : NLC, Sambalpur
Pit Volume: 2.0m x 2.0m x 4m
Date : 02.02.2018

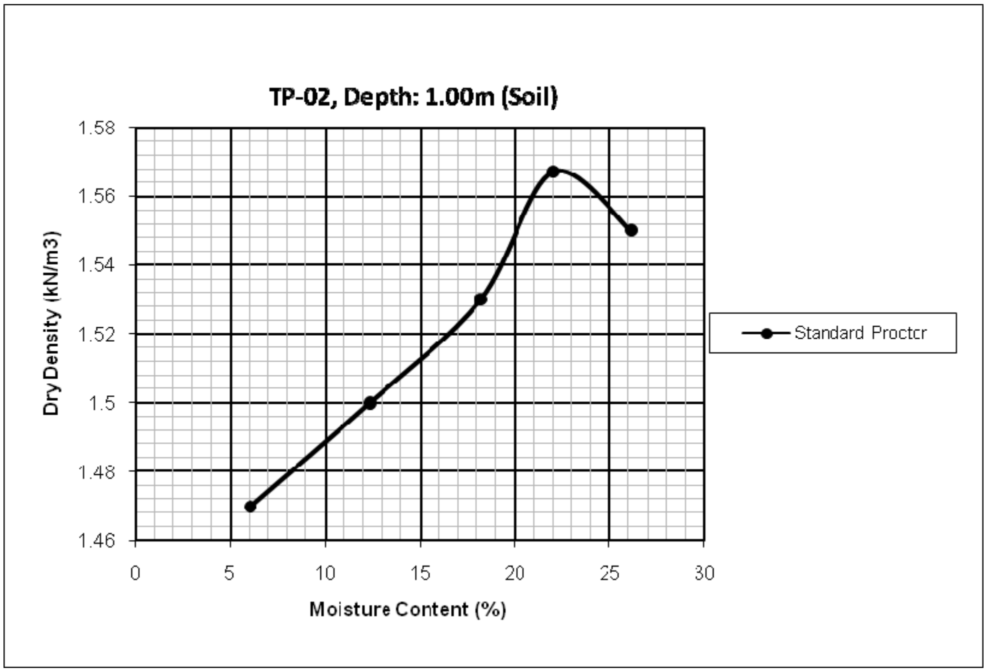
RL : 199.466m
Depth : 4.00m
Co-Ordinate: N:2410812, E: 809090



Sample Collected

Date	Type of sample	Ref No.	Depth (m)	Remarks
02.02.2018	UDS	106108	1.00	Lateritic clay
02.02.2018	DS	106109	2.00	Lateritic clay
02.02.2018	UDS	106110	3.00	Lateritic clay
02.02.2018	DS	106111	4.00	Lateritic clay

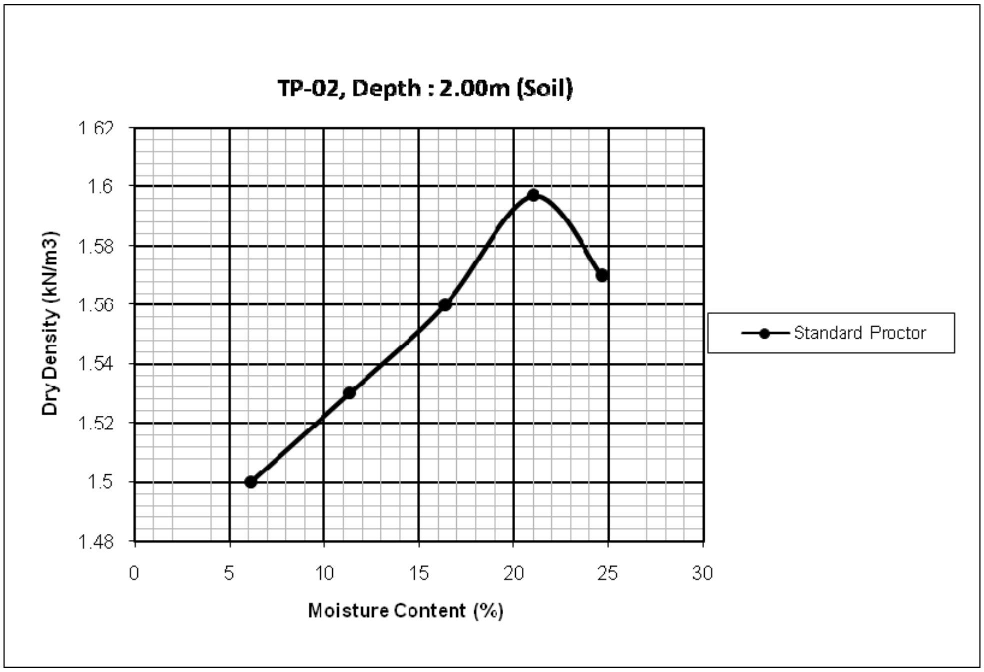
PROCTOR CURVE



OMC(%)	MDD (KN/m^3)
22	1.567

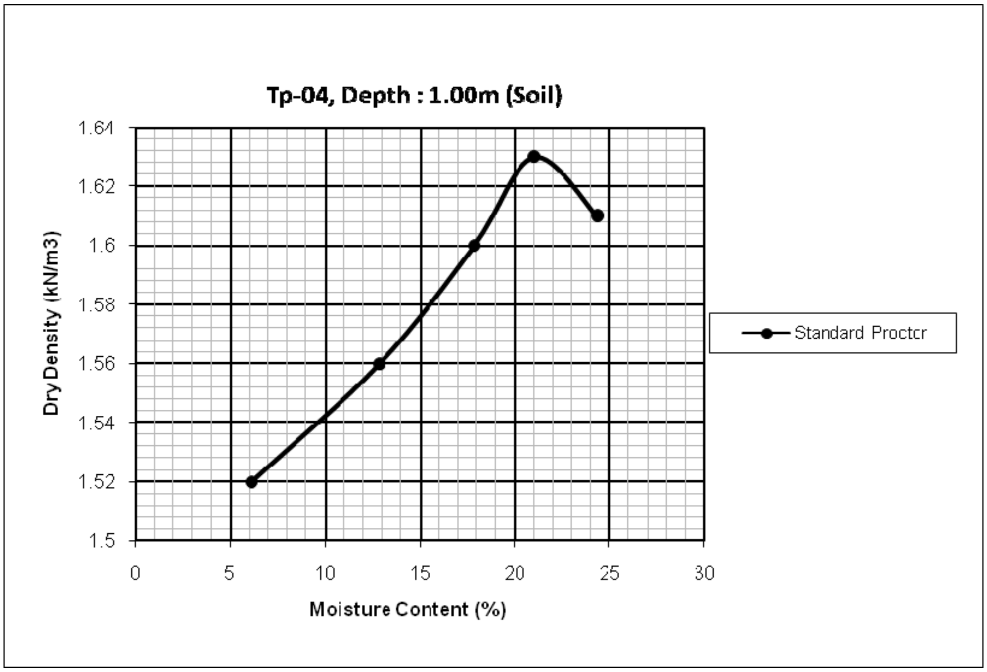
`

PROCTOR CURVE



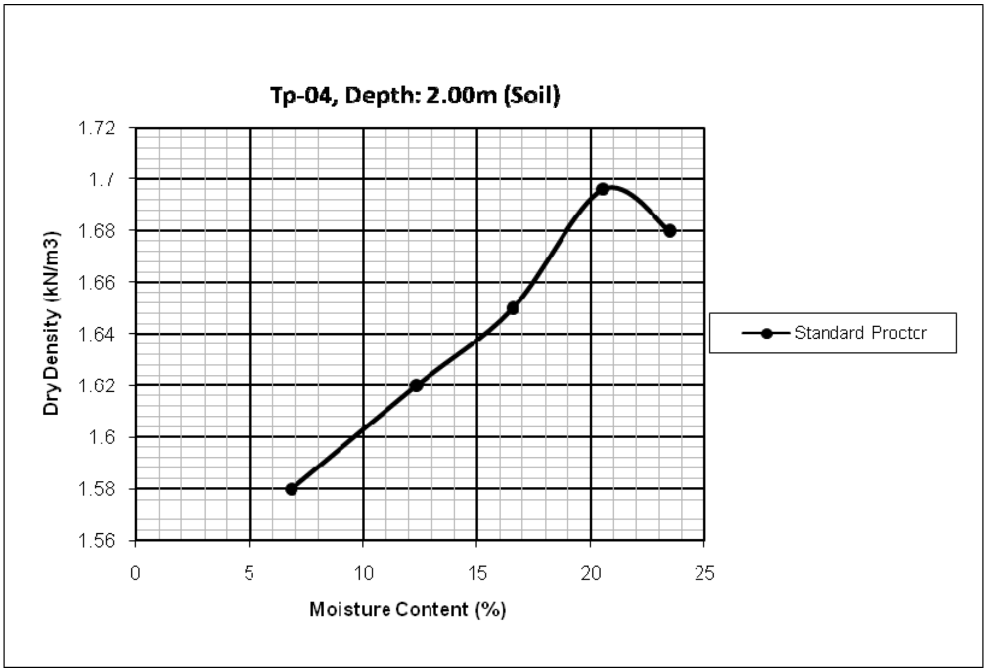
OMC(%)	MDD (KN/m^3)
21	1.597

PROCTOR CURVE



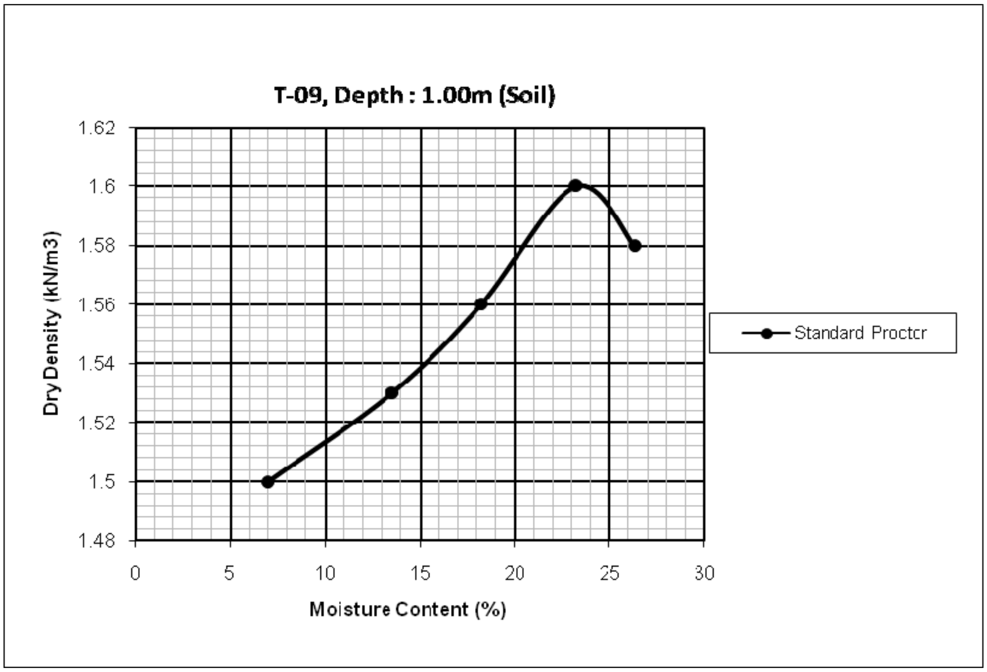
OMC(%)	MDD (KN/m^3)
21	1.63

PROCTOR CURVE



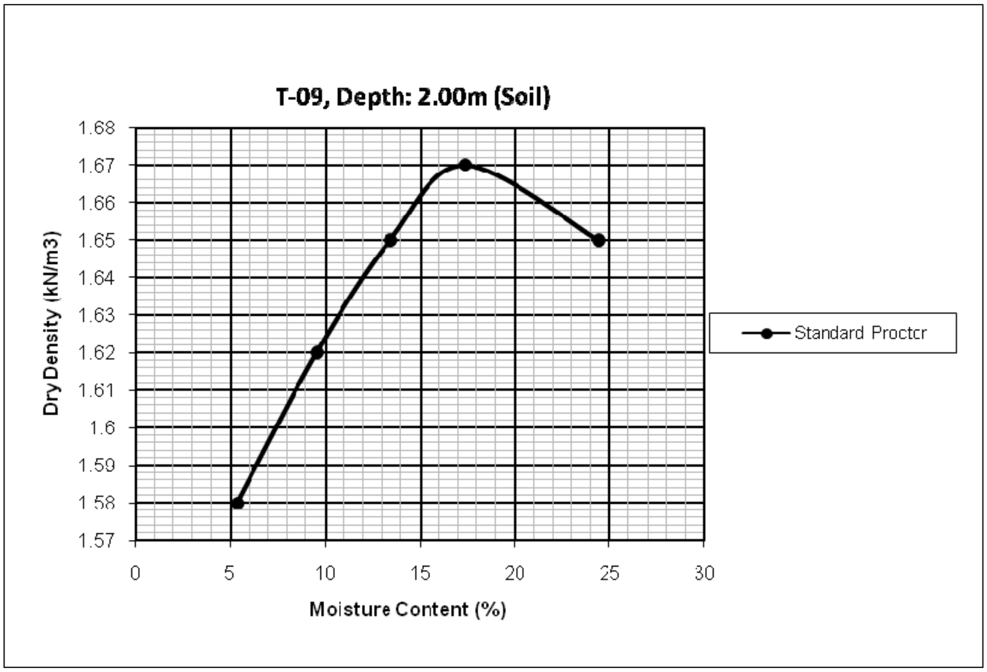
OMC(%)	MDD (KN/m^3)
20.5	1.696

PROCTOR CURVE



OMC(%)	MDD (KN/m^3)
23.2	1.6

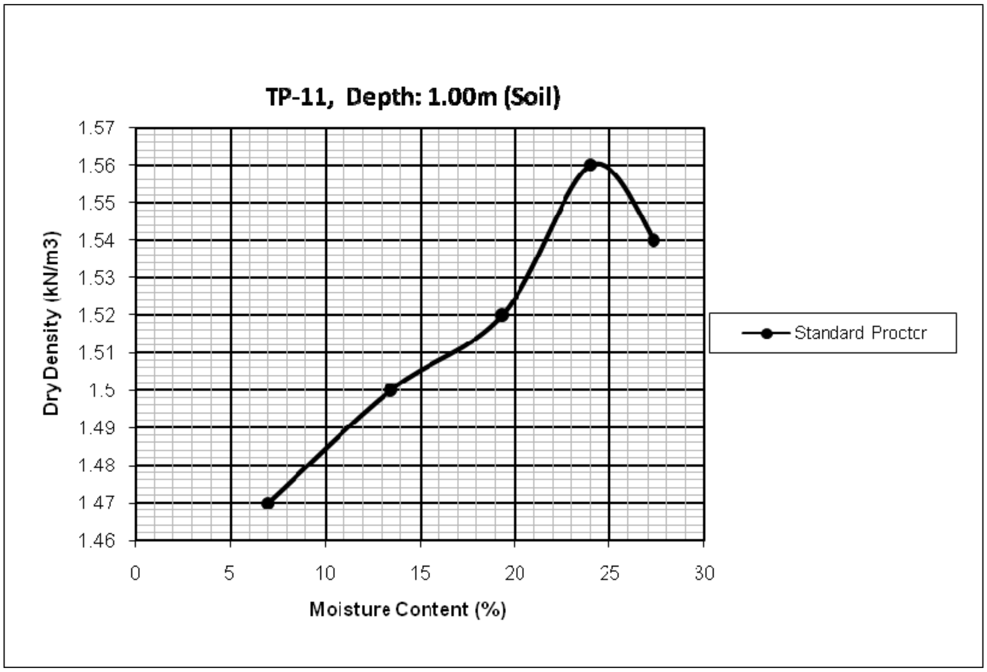
PROCTOR CURVE



OMC(%)	MDD (KN/m^3)
17.36	1.67

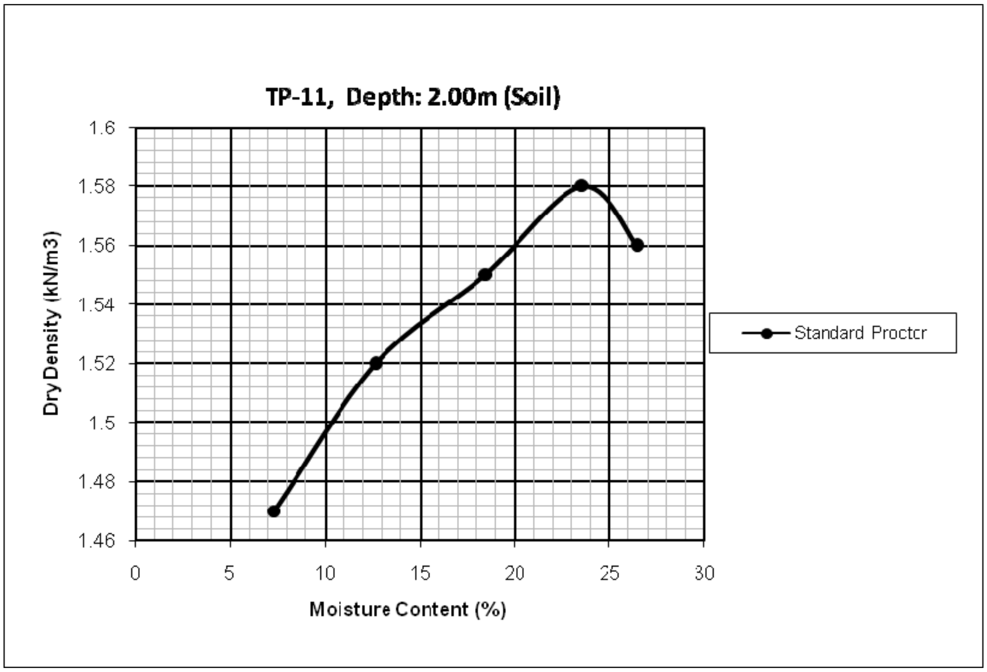
`

PROCTOR CURVE



OMC(%)	MDD (KN/m^3)
24	1.56

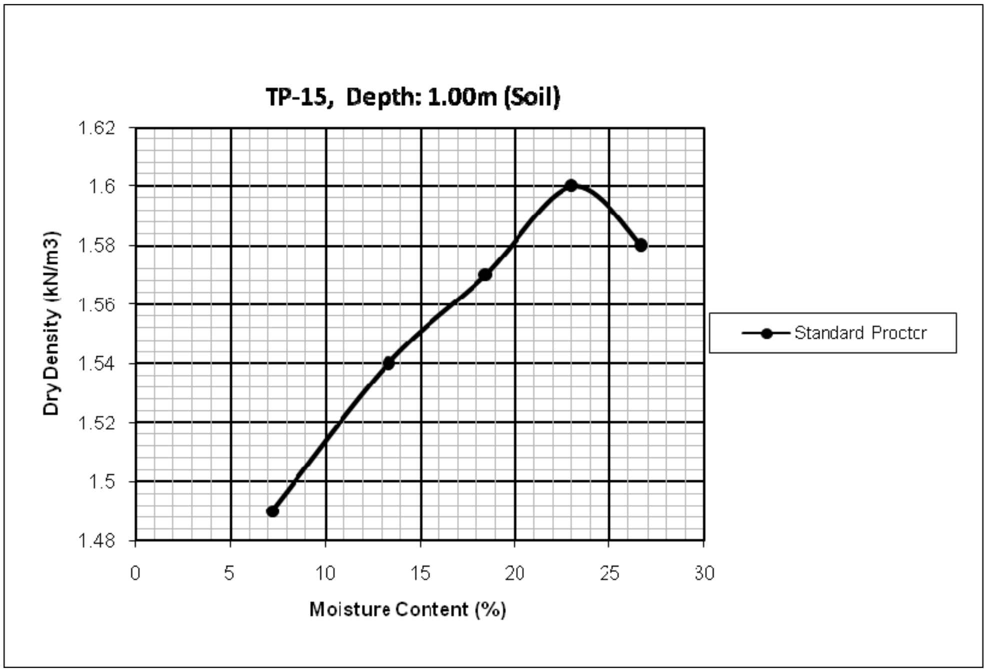
PROCTOR CURVE



OMC(%)	MDD (KN/m^3)
23.5	1.58

`

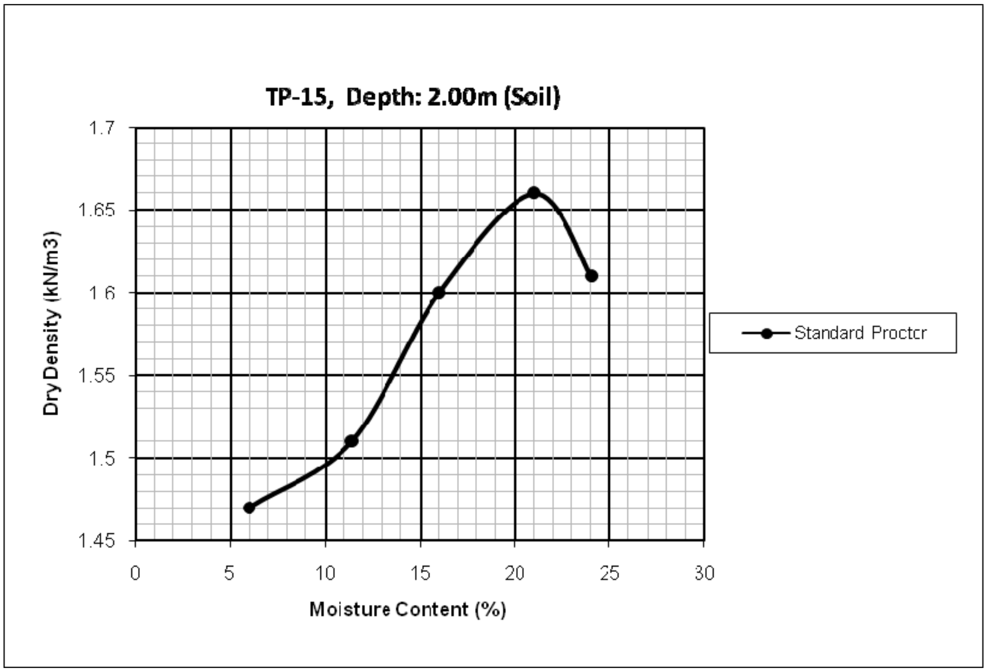
PROCTOR CURVE



OMC(%)	MDD (KN/m^3)
23	1.6

`

PROCTOR CURVE



OMC(%)	MDD (KN/m^3)
21	1.66

`

BH No.	Depth (m)	Sample Number	Type	Description	NMC (%)	LL (%)	PL (%)	SL (%)	Grain Size Analysis (%)				Shear Test (kPa)				Density (KN/m³)		SC	SW. Pr.	FR. SW.	Stratum
									Gravel	Sand	Silt	Clay	UC	UU	CU	φ°	Bulk	Dry				
01	1.00 - 1.45	177121	U	Stiff to very stiff brownish grey sandy silty clay.	14	58	20							45		1	18.90	16.60	CH			I
01	3.00 - 3.45	177125	U		23	43	17	13	2	6	70	22	63				19.20	15.60	CI			I
01	6.00 - 6.45	177128	U		19	30	16							83		9	19.70	16.60	CL			I
01	9.00 - 9.45	177131	P	Medium dense brownish yellow silty sand.		NP	NP			80	20								SM			II
02	1.00 - 1.45	160122	P	Stiff to very stiff brownish grey sandy silty clay.	24	51	20						38				19.00	15.30	CH			I
02	4.50 - 4.95	160128	U		21	36	17			5	76	19			4	32	19.40	16.00	CI			I
02	7.50 - 7.95	160131	P			NP	NP															I
02	9.00 - 9.45	160132	P	Medium dense brownish yellow silty sand.		NP	NP												SM			II
02	12.00 - 12.45	160134	P							78	22											II
03	1.00 - 1.45	100869	U	Stiff to very stiff brownish grey sandy silty clay.	13	63	17	15		11	53	36		40		0	18.60	16.50	CH	NIL	40	I
03	3.00 - 3.45	100873	U		15	66	18	16		10	54	36	36				18.80	16.30	CH			I
03	6.00 - 6.45	100877	U		20	55	18	14		12	56	32	40				18.80	15.70	CH	NIL	30	I
03	8.00 - 8.45	100879	U		19	58	17			14	52	34			CD=3	25	19.20	16.10	CH			I
03	11.00 - 11.45	100881	P			64	20			5	61	34							CH			I

NMC : Natural Moisture Content. LL : Liquid Limit. PL : Plastic Limit. UC : Unconfined Compression Test. UU : Unconsolidated Undrained Tri-axial Shear Test. CU : Consolidated Undrained Tri-axial Shear Test. Sp. Gr. : Specific Gravity. Sw. Pr. : Swelling Pressure. Fr.Sw. : Free Swell. O : Disturbed sample. P : Disturbed sample. U : Undisturbed sample. NP : Non-Plastic.
CD : Consolidation Drained, SC : Soil Classification

LABORATORY TEST RESULTS

Job No.: 30796

SKM Geosurvey

BH No.	Depth (m)	Sample Number	Type	Description	NMC (%)	LL (%)	PL (%)	SL (%)	Grain Size Analysis (%)				Shear Test (kPa)				Density (KN/m³)		SC	SW. Pr.	FR. SW.	Stratum
									Gravel	Sand	Silt	Clay	UC	UU	CU	$\phi°$	Bulk	Dry				
03	12.50 - 12.95	100882	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP		3	77	20								SM			III
03	14.50 - 14.75	100884	P	Completely weathered decomposed product of rock.		NP	NP															IVA
04	1.50 - 1.95	100902	U	Stiff to very stiff brownish grey sandy silty clay.	18	48	16	12		1	75	24		47		0	18.90	16.00	CI	NIL	20	I
04	3.50 - 3.95	100906	P			NP	NP			49	47	4							SM			I
04	5.00 - 5.45	100908	P	Medium dense brownish yellow silty sand.		NP	NP			81	19								SM			II
05	1.50 - 1.95	100453	P	Stiff to very stiff brownish grey sandy silty clay.		59	20	13		1	65	34							CH			I
05	3.50 - 3.95	100457	P			61	21			5	61	34							CH			I
05	4.50 - 4.95	100459	P	Medium dense brownish yellow silty sand.		32	17			37	48	15							CL			II
06	1.00 - 1.45	105112	U	Stiff to very stiff brownish grey sandy silty clay.	16	44	15	12	5	5	68	22			46	11	19.10	16.50	CI	NIL	30	I
06	3.00 - 3.45	105116	P			30	16			34	53	13							CL			I
06	4.00 - 4.45	105118	P			NP	NP			78	22								SM			II
07	1.00 - 1.45	105102	P	Stiff to very stiff brownish grey sandy silty clay.		58	19		1	27	37	35							CH			I
07	2.00 - 2.45	105104	U		20	40	17	12	1	31	46	22	52				19.00	15.80	CI	NIL	20	I
07	5.00 - 5.45	105108	P			29	18			55	32	13							CL			I

NMC : Natural Moisture Content. LL : Liquid Limit. PL : Plastic Limit. UC : Unconfined Compression Test. UU : Unconsolidated Undrained Tri-axial Shear Test. CU : Consolidated Undrained Tri-axial Shear Test. Sp. Gr. : Specific Gravity. Sw. Pr. : Swelling Pressure. Fr.Sw. : Free Swell. O : Disturbed sample. P : Disturbed sample. U : Undisturbed sample. NP : Non-Plastic.

CD : Consolidation Drained, SC : Soil Classification

LABORATORY TEST RESULTS

Job No.: 30796

SKM Geosurvey

BH No.	Depth (m)	Sample Number	Type	Description	NMC (%)	LL (%)	PL (%)	SL (%)	Grain Size Analysis (%)				Shear Test (kPa)				Density (KN/m³)		SC	SW. Pr.	FR. SW.	Stratum
									Gravel	Sand	Silt	Clay	UC	UU	CU	$\phi°$	Bulk	Dry				
08	1.00 - 1.45	100968	U	Stiff to very stiff brownish grey sandy silty clay.	14	58	19	15		32	34	34			5	27	18.90	16.60	CH			I
08	3.00 - 3.45	100972	U		17	46	15	12		35	43	22			7	32	19.40	16.60	CI			I
08	7.50 - 7.95	100976	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			67	30	3							SM			III
08	10.50 - 10.95	100978	P			NP	NP															III
09	2.00 - 2.45	100878	U	Stiff to very stiff brownish grey sandy silty clay.	25	62	21	16	3	14	48	35		52		0	18.90	15.10	CH	NIL	40	I
09	4.50 - 4.95	100882	U		20	40	17								42	12	19.60	16.30	CI			I
09	7.50 - 7.95	100884	P	Medium dense brownish yellow silty sand.		NP	NP			77	23											II
09	13.00 - 13.45	100889	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			77	23								SM			III
10	1.00 - 1.45	100472	P	Stiff to very stiff brownish grey sandy silty clay.		30	17		8	61	17	14							CL			I
10	3.00 - 3.45	100476	U		24	44	18	12		12	67	21	91				19.50	15.70	CI	NIL	20	I
11	1.00 - 1.45	100852	U	Stiff to very stiff brownish grey sandy silty clay.	15	42	14	11		9	73	18			51	10	19.00	16.50	CI			I
11	3.00 - 3.45	100856	U		24	NP	NP							80		9	19.30	15.60				II
11	5.00 - 5.45	100860	P			NP	NP			74	25	1							SM			II
11	8.50 - 8.95	100862	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			77	23								SM			III

NMC : Natural Moisture Content. LL : Liquid Limit. PL : Plastic Limit. UC : Unconfined Compression Test. UU : Unconsolidated Undrained Tri-axial Shear Test. CU : Consolidated Undrained Tri-axial Shear Test. Sp. Gr. : Specific Gravity. Sw. Pr. : Swelling Pressure. Fr.Sw. : Free Swell. O : Disturbed sample. P : Disturbed sample. U : Undisturbed sample. NP : Non-Plastic.

CD : Consolidation Drained, SC : Soil Classification

LABORATORY TEST RESULTS

BH No.	Depth (m)	Sample Number	Type	Description	NMC (%)	LL (%)	PL (%)	SL (%)	Grain Size Analysis (%)				Shear Test (kPa)				Density (KN/m³)		SC	SW. Pr.	FR. SW.	Stratum
									Gravel	Sand	Silt	Clay	UC	UU	CU	$\phi°$	Bulk	Dry				
12	1.00 - 1.45	100978	U	Stiff to very stiff brownish grey sandy silty clay.	18	64	19	15							7	26	19.00	16.10	CH			I
12	3.00 - 3.45	100982	U		23	39	17	16	10	44	28	17	79				19.60	15.90	CI			I
12	5.00 - 5.25	100985	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			67	30	3							SM			III
13	2.00 - 2.45	100485	P	Stiff to very stiff brownish grey sandy silty clay.	50	19			9	30	32	29							CI			I
13	4.00 - 4.45	100489	P	Medium dense brownish yellow silty sand.		44	18			2	78	20							CI			III
14	2.00 - 2.45	100554	U	Stiff to very stiff brownish grey sandy silty clay.	14	46	17	13	1	13	64	22	74				18.90	16.60	CI	NIL	30	I
14	3.00 - 3.45	100556	P	Medium dense brownish yellow silty sand.		48	17			12	63	25							CI			III
15	1.00 - 1.45	100465	P	Medium dense brownish yellow silty sand.		50	19			2	73	25							CI			II
15	2.00 - 2.45	100467	P			47	18												CI			II
16	2.00 - 2.45	100954	U	Stiff to very stiff brownish grey sandy silty clay.	20	63	18	16		33	32	35		50		1	18.90	15.80	CH	NIL	40	I
16	5.00 - 5.45	100958	P	Medium dense brownish yellow silty sand.		33	16			59	26	15							CL			II
16	7.00 - 7.45	100962	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			66	31	3							SM			III
16	10.00 - 10.45	100964	P			NP	NP															III

NMC : Natural Moisture Content. LL : Liquid Limit. PL : Plastic Limit. UC : Unconfined Compression Test. UU : Unconsolidated Undrained Tri-axial Shear Test. CU : Consolidated Undrained Tri-axial Shear Test. Sp. Gr. : Specific Gravity. Sw. Pr. : Swelling Pressure. Fr.Sw. : Free Swell. O : Disturbed sample. P : Disturbed sample. U : Undisturbed sample. NP : Non-Plastic.

CD : Consolidation Drained, SC : Soil Classification

LABORATORY TEST RESULTS

Job No.: 30796

SKM Geosurvey

BH No.	Depth (m)	Sample Number	Type	Description	NMC (%)	LL (%)	PL (%)	SL (%)	Grain Size Analysis (%)				Shear Test (kPa)				Density (KN/m³)		SC	SW. Pr.	FR. SW.	Stratum
									Gravel	Sand	Silt	Clay	UC	UU	CU	φ°	Bulk	Dry				
17	1.00 - 1.45	100515	P	Stiff to very stiff brownish grey sandy silty clay.		60	20	15		1	65	34							CH			I
17	2.00 - 2.45	100517	U		24	56	20							47		1	18.70	15.10	CH	NIL	30	I
17	4.00 - 4.45	100521	U		21	43	17			2	78	20	102				19.30	16.00	CI			I
17	7.50 - 7.95	100524	U		18	NP	NP			78	22				2	33	19.70	16.70	SM			III
17	10.50 - 10.95	100527	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			79	21								SM			III
18	1.00 - 1.45	100531	U	Stiff to very stiff brownish grey sandy silty clay.	15	60	20	15		21	46	33	48				18.90	16.40	CH			I
18	3.00 - 3.45	100535	U		23	36	18								CD= 3	23	19.10	15.50	CI	NIL	20	I
18	5.50 - 5.95	100539	P			NP	NP			62	36	2							SM			III
18	9.00 - 9.27	100541	P	Highly weathered rock		NP	NP															IVB
19	2.00 - 2.45	100503	U	Stiff to very stiff brownish grey sandy silty clay.	23	50	19	13	1	9	61	29	53				19.00	15.40	CI-CH			I
19	4.00 - 4.45	100507	U		20	NP	NP			76	24			113		9	19.50	16.30	SM			III
19	7.50 - 7.95	100511	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			78	22								SM			III
20	2.00 - 2.45	120103	U	Stiff to very stiff brownish grey sandy silty clay.	23	43	17	12		2	78	20					19.20	15.60	CI	NIL	20	I
20	4.50 - 4.95	120106	U		19	29	16			5	80	15	108				19.60	16.50	CL			I

NMC : Natural Moisture Content. LL : Liquid Limit. PL : Plastic Limit. UC : Unconfined Compression Test. UU : Unconsolidated Undrained Tri-axial Shear Test. CU : Consolidated Undrained Tri-axial Shear Test. Sp. Gr. : Specific Gravity. Sw. Pr. : Swelling Pressure. Fr.Sw. : Free Swell. O : Disturbed sample. P : Disturbed sample. U : Undisturbed sample. NP : Non-Plastic.
CD : Consolidation Drained, SC : Soil Classification

LABORATORY TEST RESULTS

Job No.: 30796

SKM Geosurvey

BH No.	Depth (m)	Sample Number	Type	Description	NMC (%)	LL (%)	PL (%)	SL (%)	Grain Size Analysis (%)				Shear Test (kPa)				Density (KN/m³)		SC	SW. Pr.	FR. SW.	Stratum
									Gravel	Sand	Silt	Clay	UC	UU	CU	φ°	Bulk	Dry				
21	1.00 - 1.45	120111	P	Stiff to very stiff brownish grey sandy silty clay.		58	20	11		11	55	34							CH			I
21	2.00 - 2.45	120113	U		22	40	17						52				19.00	15.60	CH			I
21	4.50 - 4.95	120117	U		19	29	16			6	79	15	93				19.70	16.60	CL	NIL	NIL	I
21	7.50 - 7.95	120119	P			NP	NP			77	23								SM			II
22	1.00 - 1.45	165101	U	Stiff to very stiff brownish grey sandy silty clay.	15	60	19			5	59	36	46				18.80	16.30	CH			I
22	3.00 - 3.45	165105	U		22	44	18							56		2	19.30	15.80	CI			I
22	7.50 - 7.95	165109	P			NP	NP			80	20								SM			II
23	1.00 - 1.45	100251	U	Stiff to very stiff brownish grey sandy silty clay.	16	57	19	15	1	6	60	33		66		1	19.00	16.40	CH	NIL	40	I
23	3.00 - 3.45	100254	U		24	39	17								54	9	19.2	15.5	CI			I
23	5.00 - 5.45	100257	P			NP	NP															I
23	6.00 - 6.45	100258	P							78	22								SM			I
23	7.50 - 7.95	100259	P			NP	NP															III
23	8.50 - 8.75	100260	P	Highly weathered rock						78	22								SM			IVB
24	1.00 - 1.45	100102	U	Stiff to very stiff brownish grey sandy silty clay.	14	45	18	13	2	13	61	24			CD= 4	33	18.80	16.50	CI			I
24	3.00 - 3.45	100106	U		24	30	17							104		7	19.10	15.40	CL	NIL	10	I

NMC : Natural Moisture Content. LL : Liquid Limit. PL : Plastic Limit. UC : Unconfined Compression Test. UU : Unconsolidated Undrained Tri-axial Shear Test. CU : Consolidated Undrained Tri-axial Shear Test. Sp. Gr. : Specific Gravity. Sw. Pr. : Swelling Pressure. Fr.Sw. : Free Swell. O : Disturbed sample. P : Disturbed sample. U : Undisturbed sample. NP : Non-Plastic.

CD : Consolidation Drained, SC : Soil Classification

LABORATORY TEST RESULTS

Job No.: 30796

BH No.	Depth (m)	Sample Number	Type	Description	NMC (%)	LL (%)	PL (%)	SL (%)	Grain Size Analysis (%)				Shear Test (kPa)				Density (KN/m³)		SC	SW. Pr.	FR. SW.	Stratum
									Gravel	Sand	Silt	Clay	UC	UU	CU	φ°	Bulk	Dry				
24	5.00 - 5.00	100109	D	Stiff to very stiff brownish grey sandy silty clay.		30	16			51	35	14							CL			I
25	1.00 - 1.45	170020	U	Stiff to very stiff brownish grey sandy silty clay.	15	59	20	14	1	6	60	33		39		1	18.60	16.20	CH			I
25	3.00 - 3.45	170024	U		24	50	18						56				19.20	15.50	CI			I
25	6.00 - 6.45	170027	U		20	31	17			44	41	15			54	9	19.60	16.30	CL			I
26	1.00 - 1.45	182156	U	Stiff to very stiff brownish grey sandy silty clay.	16	58	20			4	63	33	49				18.90	16.30	CH			I
26	3.00 - 3.45	182160	U		23	47	18							62		2	19.10	15.50	CI			I
27	4.50 - 4.95	170667	U	Stiff to very stiff brownish grey sandy silty clay.	19	36	17			23	59	18			2	32	19.5	16.4	CI	NIL	10	I
28	1.00 - 1.45	160771	U	Stiff to very stiff brownish grey sandy silty clay.	16	51	19			26	44	30	51				19.90	16.30	CH			I
28	3.00 - 3.45	160775	U		24	37	17	14							47	10	19.30	15.60	CL			I
28	6.00 - 6.45	160778	P	Very dense brownish yellow silty sand with mica flakes.		NP	NP			59	38	3							SM			II
29	2.00 - 2.45	130154	U	Stiff to very stiff brownish grey sandy silty clay.	20	50	19		2	25	44	29		58		0	19.10	15.70	CI			I
29	4.50 - 4.95	130158	U		20	32	17	15					107				19.50	16.30	CL			I
29	7.50 - 7.95	130160	P			NP	NP			60	37	3							SM			II
30	1.00 - 1.45	180111	U	Stiff to very stiff brownish grey sandy silty clay.	15	55	19	13		14	55	31		50		1	19.00	16.50	CH			I
30	3.00 - 3.45	180115	U		24	38	17						73				19.30	15.60	CI	NIL	20	I

NMC : Natural Moisture Content. LL : Liquid Limit. PL : Plastic Limit. UC : Unconfined Compression Test. UU : Unconsolidated Undrained Tri-axial Shear Test. CU : Consolidated Undrained Tri-axial Shear Test. Sp. Gr. : Specific Gravity. Sw. Pr. : Swelling Pressure. Fr.Sw. : Free Swell. O : Disturbed sample. P : Disturbed sample. U : Undisturbed sample. NP : Non-Plastic.

CD : Consolidation Drained, SC : Soil Classification

LABORATORY TEST RESULTS

Job No.: 30796

TRIAL PIT LAB TEST RESULTS

BH-No.	Depth	Sample Number	Type	NMC	L.L. %	P.L. %	Grain Size Analysis %				Shear Test (kPa_		Density (KN/m3)	
							Gravel %	Sand %	Silt %	Clay %	UU	Φ	Bulk	Dry
TP1	2.00	162192	U	22	50	19		6	68	26	45	1	19.20	15.70
TP1	4.00	162194	U	19	35	16		5	78	17	72	5	20.00	16.80
TP-2	2.00	100676	U	21	52	18		7	67	26	37	1	19.30	16.00
TP-2	4.00	100678	U	20	42	17		4	77	19	64	2	20.00	16.70
TP-3	2.00	106101	U	22	64	20		4	60	36	33	1	19.10	15.70
TP-3	4.00	106103	U	18	61	19		3	62	35	36	0	19.30	16.40
TP-4	2.00	106105	U	20	38	17		1	81	18	58	4	20.30	16.90
TP-5	1.00	151251	U	13	53	19		6	64	30	50	1	19.20	15.60
TP-5	3.00	151253	U	19	44	17		9	69	22	74	3	20.00	16.80
TP-6	1.00	171620	U	23	54	20		6	64	30	47	1	19.40	15.80
TP-6	3.00	171622	U	20	43	18		7	73	20	84	2	20.50	17.10
TP-7	2.00	100711	U	20	44	17	1	4	74	21	63	3	20.60	17.20
TP-8	2.00	105130	U	21	54	19	1	18	50	31	59	1	20.00	16.50
TP-8	3.00	105131	U	20	46	17		25	54	21	72	2	20.60	17.20
TP-9	1.00	120150	U	23	48	18		3	76	21	50	1	19.60	15.90
TP-9	3.00	120152	U	19	34	16		19	66	15	75	8	20.80	17.50
TP-10	3.00	105135	U	18	44	16		10	70	20	93	4	21.60	18.30
TP-11	1.00	150122	U	24	58	20		11	55	34	44	1	19.30	15.60
TP-11	3.00	150124	U	21	34	16		7	78	15	88	9	19.60	16.20
TP-12	1.00	106112	U	19	60	18	1	10	55	34	44	0	20.30	17.10
TP-12	3.00	106114	U	19	55	17		6	62	32	59	3	21.20	17.90
TP-14	2.00	105126	U	21	46	17		18	61	21	54	2	20.60	17.00
TP-15	1.00	106108	U	23	64	20	2	34	31	33	45	0	19.60	15.90
TP-15	3.00	106110	U	20	43	18	2	10	67	21	79	2	20.30	16.90

LABORATORY TEST RESULTS ON ROCK SAMPLES

BH NO.	DEPTH (m)	Stratum	NMC (%)	BULK DENSITY (KN/m3)	Porosity (%)	Absorption (%)	Rock Strength (MPa)					Specific Gravity	Soundness(%)	Slake Durability Index	Impact Value(%)
							Point Load Index (Mpa)		Unconfined Compressive Strength		Modulus of Elasticity (E)				
							Soaked	Un Soaked	Soaked	Un Soaked					
04	6.75-7.50	IVB		22.60				2.26					63		
04	9.75-10.50	IVB	1.65	22.80	D	D		3.52				2.68			
05	7.25-8.00	IVB	10.03	21.80	D	D		1.17						Very poor	
05	8.00-8.75	IVB		22.80				1.13				2.69	56		
05	9.50-10.25	IVB		23.70				2.26							
05	11.00-11.50	IVB	6.16	23.10	15.91	7.38				4.39	287.90				49
06	7.75-8.50	IVC	0.69	22.50	9.52	4.40				15.48					
06	10.75-11.50	IVC		22.00						18.38		2.71	46		
07	7.75-8.50	IVC		22.60						20.09					
07	11.50-12.00	IVC		22.00	9.67	4.42				11.61				Poor	
08	14.25-15.00	IVB		23.30				2.64					53		
08	15.75-16.50	IVB		21.10				1.49						very poor	
08	16.50-17.00	IVB	1.66	21.90	D	D		1.70				2.68			
09	16.75-17.50	IVB		21.90	D	D		2.26							
09	19.00-19.50	IVB		22.30				3.39				2.70	51		
10	5.50-6.25	IVB	9.38	21.00	D	D		1.17							54
10	7.00-7.75	IVB		23.50				2.26				2.69		Very poor	
10	9.25-10.00	IVB		22.10				3.39							
10	10.00-10.50	IVB		23.70						7.74					
11	16.00-16.50	IVB		22.10	D	D		2.34					61		
12	9.50-10.25	IVB	3.31	21.90	D	D				6.02					
12	11.00-11.75	IVB	22.00					2.64				2.67			
12	12.50-13.00	IVB	1.51	21.10	D	D		1.43						Very poor	
13	5.60-6.35	IVB		22.50				1.13							
13	7.85-8.60	IVB	6.97	21.70	D	D		1.13				2.68	65		
13	8.60-9.35	IVB		22.40				2.26							56
13	10.10-10.60	IVB		23.10						3.67	272.60		39		
14	5.32-6.07	IVB	7.41	20.70	D	D		2.34							
14	7.57-8.32	IVB		22.10				2.26				2.68			
14	9.07-9.82	IVB		22.20				6.79						Poor to very poor	

JOB NO. 30796

SKM Geosurvey

LABORATORY TEST RESULTS ON ROCK SAMPLES

BH NO.	DEPTH (m)	Stratum	NMC (%)	BULK DENSITY (KN/m3)	Porosity (%)	Absorption (%)	Rock Strength (MPa)					Specific Gravity	Soundness(%)	Slake Durability Index	Impact Value(%)
							Point Load Index (Mpa)		Unconfined Compressive Strength		Modulus of Elasticity (E)				
							Soaked	Un Soaked	Soaked	Un Soaked					
15	3.95-4.70	IVB	10.39	20.60	D	D		1.22							
15	7.70-8.20	IVB		22.40						4.83			41		
16	13.50-14.25	IVB	2.56	21.60	D	D		2.74							
16	15.00-15.75	IVB		21.70						3.52	247.80				
16	16.50-17.00	IVB		20.80						6.77		2.68		Poor to very poor	
17	14.25-15.00	IVB		23.40	13.26	5.88		4.52							
17	15.75-16.50	IVB		21.40						5.02					
17	16.50-17.00	IVB	2.05	22.50	D	D				3.44	248.20	2.68	46		
18	9.75-11.50	IVB	1.95	22.10	D	D		2.34						Very poor	
18	12.25-13.00	IVB		21.50						6.02					
18	13.75-14.50	IVB	7.75	21.80	D	D				4.30	274.00	2.69			42
19	10.75-11.50	IVB		23.20	11.76	5.19				9.67					
19	12.25-13.00	IVB		22.50				2.34				2.68			
19	13.75-14.50	IVB		21.80	D	D				5.80				Poor to Very poor	
20	8.00-8.75	IVB		22.90				3.39							
20	9.50-10.25	IVB		23.80	15.91	7.38				6.89	535.80			Poor	
20	12.50-13.00	IVB		21.90						7.74			38		
21	8.50-9.25	IVB		22.50				2.34							
21	10.00-10.75	IVB	4.40	23.50						8.70				Poor	
21	12.25-13.00	IVB		21.40						4.32	391.60				
21	13.00-13.50	IVB		21.90	D	D				6.02		2.70			
22	8.20-8.95	IVB		22.30	D	D		2.26							
22	10.45-11.20	IVB		23.10						7.74		2.70	48		
22	12.70-13.20	IVB		22.50						2.58	233.20				
23	9.25-10.00	IVB		22.30				2.26				2.69			58
23	10.00-10.75	IVB		23.20						5.17	376.50			Very poor	
23	11.50-12.25	IVB	1.50	22.30	D	D		3.39							
23	13.00-13.50	IVB		22.60						4.01		2.70			
24	7.75-8.50	IVB		21.90	D	D		2.26				2.68	57		
24	9.25-10.00	IVB		22.20						2.59	280.70				
24	11.50-12.00	IVB		22.40						4.83					

JOB NO. 30796

SKM Geosurvey

LABORATORY TEST RESULTS ON ROCK SAMPLES

BH NO.	DEPTH (m)	Stratum	NMC (%)	BULK DENSITY (KN/m3)	Porosity (%)	Absorption (%)	Rock Strength (MPa) Point Load Index (Mpa)		Unconfined Compressive Strength		Modulus of Elasticity (E)	Specific Gravity	Soundness(%)	Slake Durability Index	Impact Value(%)
							Soaked	Un Soaked	Soaked	Un Soaked					
26	7.80-8.55	IVB	9.20	21.70	D	D				5.80				Very poor to poor	
26	10.05-10.80	IVB		22.60				2.26							
27	9.25-10.00	IVB	0.95	22.30	D	D		1.13					66		
27	12.25-13.00	IVB		21.50						1.73	178.60				
28	9.50-10.25	IVB		22.70						6.77			53		
28	12.50-13.00	IVB	0.65	22.90	D	D		2.26				2.69		Very poor	
29	8.50-9.25	IVB	1.01	22.00	D	D		2.34							
29	11.50-12.25	IVB		22.70						2.58	209.00		56		
30	8.95-9.70	IVB		22.40						3.87				Very poor	
30	11.95-12.70	IVB	2.05	22.80	D	D				5.80		2.69			

JOB NO. 30796

SKM Geosurvey

PERMEABILITY TEST RESULTS

Test No.	BH No.	Depth of Test (m)	Coefficient of Permeability,k (cm/sec)
1	01	1.00	1.00×10^{-8}
2	01	2.00	5.00×10^{-8}
3	02	3.00	4.00×10^{-8}
4	02	5.00	2.00×10^{-7}
5	11	1.00	1.00×10^{-6}
6	11	3.00	3.00×10^{-6}
7	04	2.50	2.00×10^{-8}
8	06	4.00	3.00×10^{-6}
9	07	3.00	2.00×10^{-7}
10	08	1.00	4.00×10^{-5}
11	09	3.00	4.00×10^{-6}
12	10	4.00	5.00×10^{-4}
13	12	6.50	1.00×10^{-4}
14	13	3.00	6.00×10^{-5}
15	14	2.00	4.00×10^{-6}
16	15	2.00	6.00×10^{-5}
17	16	4.00	2.00×10^{-3}
18	17	3.00	4.00×10^{-6}
19	18	4.00	3.00×10^{-5}
20	19	2.50	2.00×10^{-6}

CHEMICAL TEST RESULTS

Borehole Number	Sample Number	Depth (m)	Type of Sample	PH at °C	Value	Chloride		Sulphate	
						%	(ppm)	SO_3 (%)	SO_3 (ppm)
03	-	-	Water	30.4	6.5	ND	ND	ND	ND
05	100455	2.50-2.95	Soil	31.0	6.5	ND	ND	ND	ND
05	150901	0.10	Water	31.9	6.5	0.0010	9.894	0.0007	6.859
07	150902	2.40	Water	31.9	6.5	ND	ND	ND	ND
08	100970	2.00-2.45	Soil	31.0	6.5	ND	ND	ND	ND
08	150903	3.30	Water	31.9	6.5	0.0010	9.894	ND	ND
09	150904	2.85	Water	31.9	6.5	ND	ND	0.0007	6.859
13	100487	3.00-3.45	Soil	31.0	6.5	ND	ND	ND	ND
13	-	-	Water	30.4	6.5	ND	ND	ND	ND
17	150906	4.78	Water	31.9	6.5	0.0010	9.894	0.0007	6.859
20	150907	4.20	Water	31.6	6.5	ND	ND	ND	ND
21	-	-	Water	30.4	6.5	ND	ND	ND	ND
23	150909	3.50	Water	31.6	6.5	0.0010	9.894	ND	ND

ND: NOT DETECTED

JOB NO. 30796

CHEMICAL TEST RESULTS

Borehole Number	Sample Number	Depth (m)	Type of Sample	ORGANIC MATTER MATTER		CARBONATE		NITRATE		TURBIDITY
				(%)	(ppm)	(%)	(ppm)	(%)	(ppm)	(NUT)
03	-	-	Water	0.016	160.0	ND	ND	0.00003	0.17795	26.8
05	150901	0.10	Water	0.018	180.0	ND	ND	0.00002	0.1853	26.6
07	150902	2.40	Water	0.017	170.0	ND	ND	0.00003	0.17795	26.5
08	150903	3.30	Water	0.016	160.0	ND	ND	0.00002	0.1853	25.9
09	150904	2.85	Water	0.016	160.0	ND	ND	0.00004	0.3706	26.1
13	-	-	Water	0.018	180.0	ND	ND	0.00002	0.1853	26.8
17	150906	4.78	Water	0.019	190.0	ND	ND	0.00003	0.17795	25.9
20	150907	4.20	Water	0.016	160.0	ND	ND	0.00003	0.17795	26.6
21	-	-	Water	0.018	180.0	ND	ND	0.00002	0.1853	26.1
23	150909	3.50	Water	0.017	170.0	ND	ND	0.00004	0.3706	25.5

ND: NOT DETECTED

JOB NO. 30796

SKM Geosurvey

m_v Value(m^2/KN x 10^{-4})

BH No.	Depth (m)	00-10	10-25	25-50	50-100	100-200	200-400	400-800	800-1600	Sp.Gr.
		Range (kPa)								
1	6.00	0.55	0.73	1.10	1.21	1.32	1.37	1.22		2.64
2	2.00	1.11	1.11	1.11	1.56	1.67	1.72	1.52		2.64
3	1.00	0.55	0.74	1.11	1.11	1.28	1.25	1.11		2.68
3	6.00	0.55	1.09	1.31	1.20	1.09	1.15	1.04		2.64
4	1.50	0.54	0.72	0.86	0.97	0.91	0.97	0.95		2.64
6	1.00	0.54	1.08	1.29	1.18	1.24	1.21	1.05		2.67
7	2.00	0.54	1.08	1.30	1.51	1.57	1.46	1.15		2.65
8	3.00	1.08	1.44	1.51	1.51	1.40	1.35	1.01		2.64
9	2.00	0.01	0.36	0.86	1.07	1.12	1.07	0.88		2.68
9	4.50	0.52	0.69	0.62	0.73	0.83	0.93	0.88		2.67
10	3.00	0.55	1.09	1.31	1.31	1.48	1.37	1.20		2.67
11	1.00	0.55	1.10	1.54	1.43	1.32	1.32	1.26		2.65
11	3.00	0.54	0.36	0.65	0.65	0.86	1.00	0.95		2.65
12	1.00	0.01	0.35	0.63	0.74	0.89	1.05	1.04		2.68
14	2.00	1.11	1.48	1.78	1.67	1.61	1.56	1.31		2.67
16	2.00	1.07	1.07	1.28	1.39	1.34	1.28	1.02		2.68
17	2.00	1.11	1.48	1.78	1.67	1.67	1.58	1.22		2.64
17	7.50	0.53	0.71	0.64	0.85	0.96	1.04	0.96		2.65
18	3.00	0.53	0.71	0.64	0.85	0.96	1.04	0.96		2.66
19	4.00	0.53	0.70	1.05	1.05	1.05	1.05	0.90		2.65
20	2.00	0.56	0.75	1.12	1.24	1.24	1.29	1.18		2.67
21	4.50	1.10	1.47	1.76	1.65	1.65	1.51	1.16		2.65

JOB NO. 30796

SKM Geosurvey

m_v Value(m^2/KN x 10^{-4})

BH No.	Depth (m)	00-10	10-25	25-50	50-100	100-200	200-400	400-800	800-1600	Sp.Gr.
		Range (kPa)								
22	1.00	0.53	1.06	1.28	1.17	1.28	1.22	1.04		2.68
23	1.00	0.54	0.72	0.86	0.97	1.08	1.29	1.08		2.68
24	3.00	0.54	0.72	1.09	1.20	1.14	1.17	1.06		2.66
25	6.00	0.54	0.72	0.87	0.87	1.03	1.05	1.04		2.65
26	3.00	0.54	1.09	1.30	1.20	1.36	1.41	1.13		2.64
27	2.00	0.54	0.72	0.86	0.97	1.08	1.13	0.98		2.64
28	3.00	0.52	1.04	1.46	1.35	1.35	1.41	1.03		2.67
29	2.00	0.56	1.11	1.11	1.33	1.45	1.39	1.14		2.64
30	1.00	0.54	0.71	1.07	1.18	1.23	1.20	1.02		2.68
TP-3	2.00	0.55	1.10	1.32	1.43	1.54	1.59	1.35		2.68
TP-6	1.00	0.54	0.72	1.08	1.08	1.03	1.11	1.05		2.64
TP-9	3.00	0.53	0.70	1.26	1.37	1.32	1.24	0.95		2.65
TP-12	3.00	0.53	0.70	0.63	0.74	0.84	0.90	0.79		2.67
TP-15	1.00	1.06	1.06	1.27	1.38	1.32	1.27	1.01		2.68

DEPTH: 6.00-6.45m

BOREHOLE NO. 01

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	$mv \times 10^{-4}$ (m^2/KN)
0 - 10	10.000	-0.00100	-0.00088	0.59282	0.0000876	0.5497526
10 - 25	15.000	-0.00200	-0.00175	0.59107	0.0001168	0.7330035
25 - 50	25.000	-0.00500	-0.00438	0.58669	0.0001751	1.0995052
50 - 100	50.000	-0.01100	-0.00963	0.57706	0.0001926	1.2094557
100 - 200	100.000	-0.02400	-0.02102	0.55604	0.0002102	1.3194063
200 - 400	200.000	-0.05000	-0.04378	0.51226	0.0002189	1.3743815
400 - 800	400.000	-0.08900	-0.07793	0.43433	0.0001948	1.2231996
800-200	-600.000	0.01500	0.01313	0.44746	-0.0000219	-0.1374382
200-0	-200.000	0.06000	0.05254	0.50000		

DEPTH: 1.00-1.45m

BOREHOLE NO. 03

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	$mv \times 10^{-4}$ (m^2/KN)
0 - 10	10.000	-0.00100	-0.00090	0.61942	0.0000900	0.5558644
10 - 25	15.000	-0.00200	-0.00180	0.61762	0.0001200	0.7411525
25 - 50	25.000	-0.00500	-0.00450	0.61312	0.0001800	1.1117287
50 - 100	50.000	-0.01000	-0.00900	0.60412	0.0001800	1.1117287
100 - 200	100.000	-0.02300	-0.02070	0.58341	0.0002070	1.2784880
200 - 400	200.000	-0.04500	-0.04051	0.54291	0.0002025	1.2506948
400 - 800	400.000	-0.08000	-0.07201	0.47089	0.0001800	1.1117287
800-200	-600.000	0.01000	0.00900	0.47989	-0.0000150	-0.0926441
200-0	-200.000	0.03900	0.03511	0.51500		

DEPTH: 1.00-1.45m

BOREHOLE NO. 06

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	mv×10^{-4} (m^2/KN)
0 - 10	10.000	-0.00100	-0.00087	0.61906	0.0000871	0.5379236
10 - 25	15.000	-0.00300	-0.00261	0.61645	0.0001742	1.0758472
25 - 50	25.000	-0.00600	-0.00523	0.61122	0.0002090	1.2910167
50 - 100	50.000	-0.01100	-0.00958	0.60164	0.0001916	1.1834320
100 - 200	100.000	-0.02300	-0.02003	0.58161	0.0002003	1.2372243
200 - 400	200.000	-0.04500	-0.03919	0.54242	0.0001960	1.2103281
400 - 800	400.000	-0.07800	-0.06793	0.47449	0.0001698	1.0489510
800-200	-600.000	0.01200	0.01045	0.48494	-0.0000174	-0.1075847
200-0	-200.000	0.04600	0.04006	0.52500		

DEPTH: 3.00-3.45m

BOREHOLE NO. 10

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	mv×10^{-4} (m^2/KN)
0 - 10	10.000	-0.00100	-0.00093	0.69767	0.0000928	0.5467469
10 - 25	15.000	-0.00300	-0.00278	0.69489	0.0001856	1.0934937
25 - 50	25.000	-0.00600	-0.00557	0.68932	0.0002228	1.3121925
50 - 100	50.000	-0.01200	-0.01114	0.67818	0.0002228	1.3121925
100 - 200	100.000	-0.02700	-0.02506	0.65312	0.0002506	1.4762165
200 - 400	200.000	-0.05000	-0.04641	0.60671	0.0002320	1.3668671
400 - 800	400.000	-0.08800	-0.08168	0.52503	0.0002042	1.2028431
800-200	-600.000	0.01400	0.01299	0.53802	-0.0000217	-0.1275743
200-0	-200.000	0.05600	0.05198	0.59000		

Job No.: 30796

DEPTH: 2.00-2.45m

BOREHOLE NO. 14

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	mv×10^{-4} (m^2/KN)
0 - 10	10.000	-0.00200	-0.00179	0.60633	0.0001787	1.1123471
10 - 25	15.000	-0.00400	-0.00357	0.60276	0.0002382	1.4831294
25 - 50	25.000	-0.00800	-0.00715	0.59561	0.0002859	1.7797553
50 - 100	50.000	-0.01500	-0.01340	0.58221	0.0002680	1.6685206
100 - 200	100.000	-0.02900	-0.02591	0.55630	0.0002591	1.6129032
200 - 400	200.000	-0.05600	-0.05003	0.50627	0.0002502	1.5572859
400 - 800	400.000	-0.09400	-0.08398	0.42229	0.0002099	1.3070078
800-200	-600.000	0.01300	0.01161	0.43390	-0.0000194	-0.1205043
200-0	-200.000	0.04600	0.04110	0.47500		

DEPTH: 2.00-2.45m

BOREHOLE NO. 17

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	mv×10^{-4} (m^2/KN)
0 - 10	10.000	-0.00200	-0.00194	0.74836	0.0001945	1.1123471
10 - 25	15.000	-0.00400	-0.00389	0.74447	0.0002593	1.4831294
25 - 50	25.000	-0.00800	-0.00778	0.73669	0.0003112	1.7797553
50 - 100	50.000	-0.01500	-0.01459	0.72210	0.0002917	1.6685206
100 - 200	100.000	-0.03000	-0.02917	0.69293	0.0002917	1.6685206
200 - 400	200.000	-0.05700	-0.05543	0.63750	0.0002771	1.5850945
400 - 800	400.000	-0.08800	-0.08557	0.55193	0.0002139	1.2235818
800-200	-600.000	0.01500	0.01459	0.56652	-0.0000243	-0.1390434
200-0	-200.000	0.05500	0.05348	0.62000		

DEPTH: 2.00-2.45m

BOREHOLE NO. 20

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	mv×10^{-4} (m^2/KN)
0 - 10	10.000	-0.00100	-0.00096	0.71037	0.0000961	0.5621135
10 - 25	15.000	-0.00200	-0.00192	0.70845	0.0001282	0.7494847
25 - 50	25.000	-0.00500	-0.00481	0.70364	0.0001923	1.1242271
50 - 100	50.000	-0.01100	-0.01058	0.69307	0.0002115	1.2366498
100 - 200	100.000	-0.02200	-0.02115	0.67192	0.0002115	1.2366498
200 - 400	200.000	-0.04600	-0.04423	0.62769	0.0002211	1.2928612
400 - 800	400.000	-0.08400	-0.08076	0.54693	0.0002019	1.1804384
800-200	-600.000	0.01600	0.01538	0.56231	-0.0000256	-0.1498969
200-0	-200.000	0.06000	0.05769	0.62000		

DEPTH: 3.00-3.45m

BOREHOLE NO. 24

Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	$mv \times 10^{-4}$ (m^2/KN)
0 - 10	10.000	-0.00100	-0.00094	0.73095	0.0000941	0.5437738
10 - 25	15.000	-0.00200	-0.00188	0.72906	0.0001255	0.7250317
25 - 50	25.000	-0.00500	-0.00471	0.72436	0.0001882	1.0875476
50 - 100	50.000	-0.01100	-0.01035	0.71400	0.0002071	1.1963023
100 - 200	100.000	-0.02100	-0.01977	0.69424	0.0001977	1.1419250
200 - 400	200.000	-0.04300	-0.04047	0.65376	0.0002024	1.1691136
400 - 800	400.000	-0.07800	-0.07342	0.58035	0.0001835	1.0603589
800-200	-600.000	0.01600	0.01506	0.59541	-0.0000251	-0.1450063
200-0	-200.000	0.05800	0.05459	0.65000		

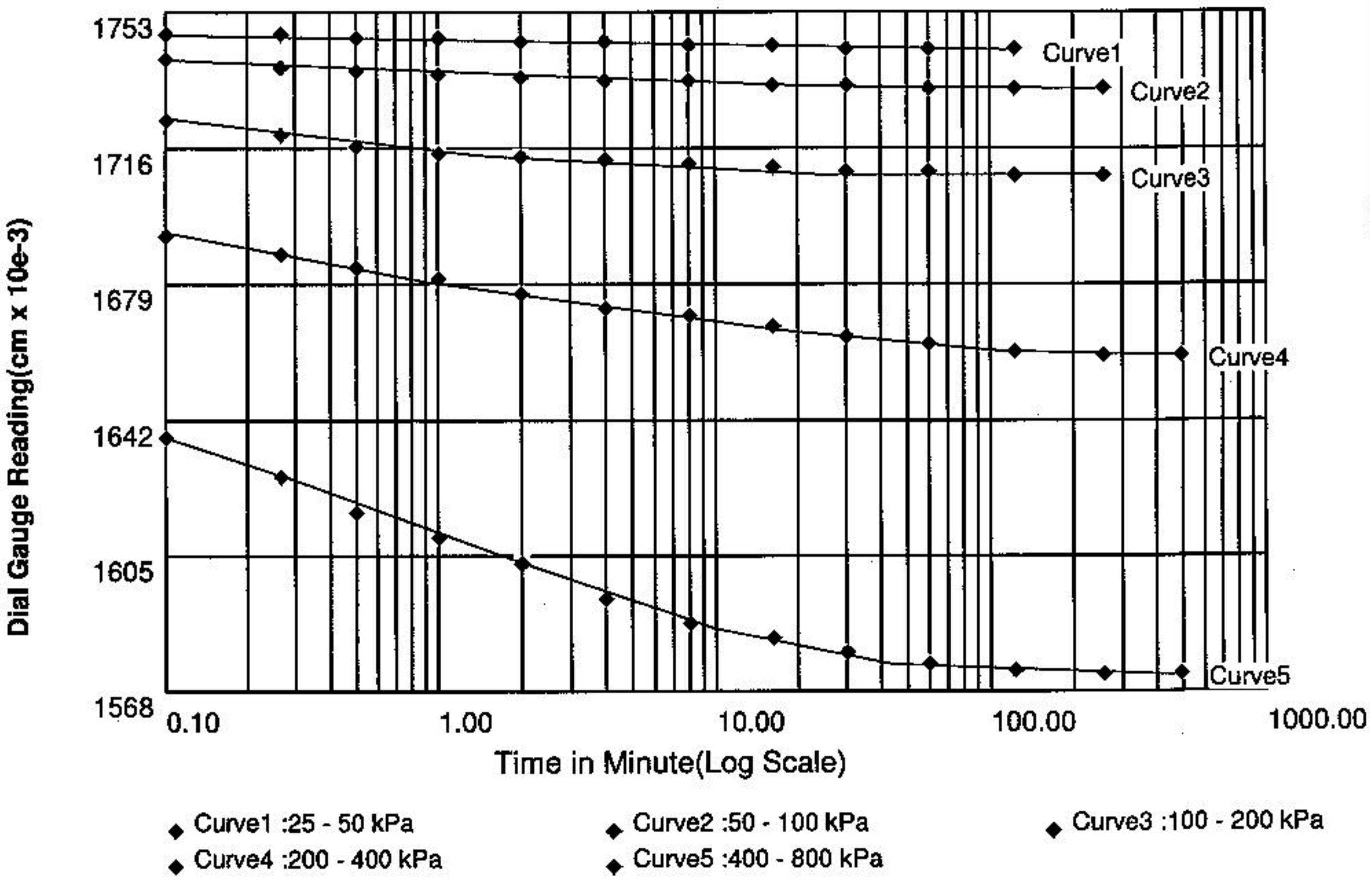
DEPTH: 1.00-1.45m

BOREHOLE NO. 30

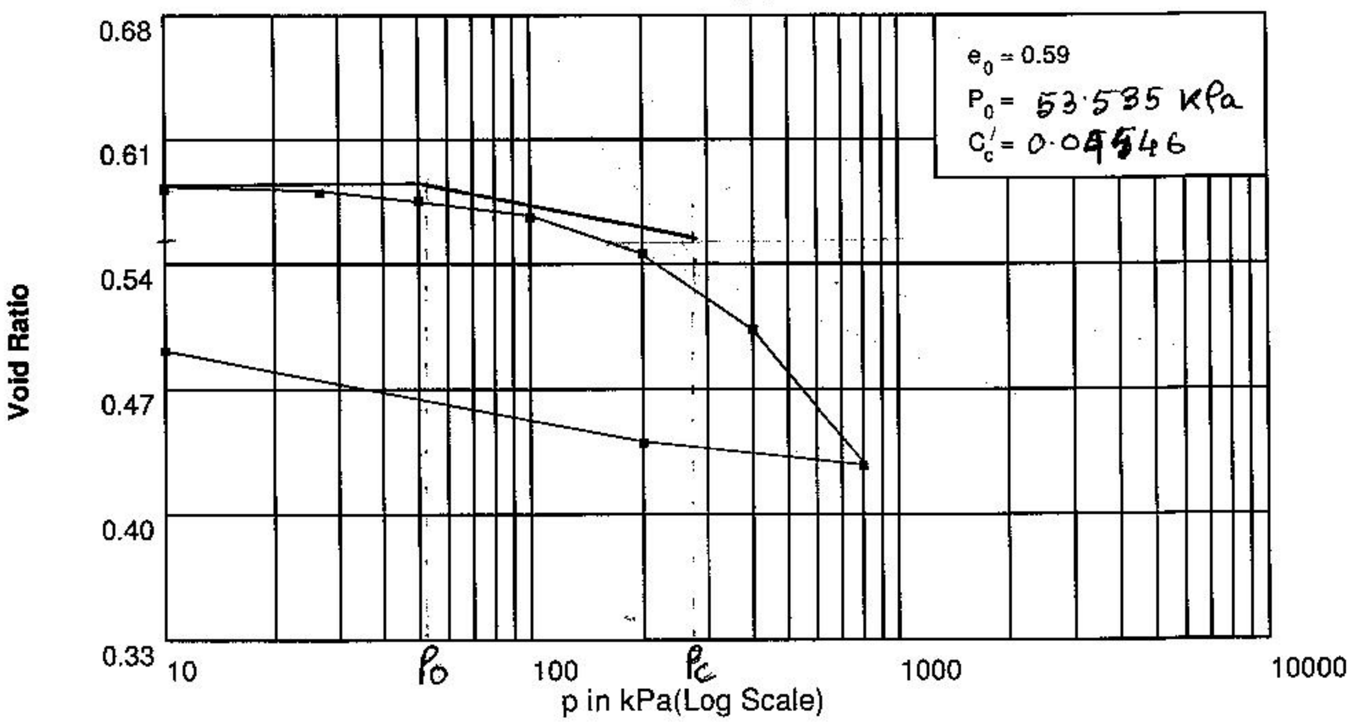
Pressure Range kPa	Pressure Increment kPa	Increase in thickness cm.	Change in Void Ratio Δe	Equilibrium Void Ratio e	av (m^2/KN)	mv×10^{-4} (m^2/KN)
0 - 10	10.000	-0.00100	-0.00087	0.61781	0.0000866	0.5350455
10 - 25	15.000	-0.00200	-0.00173	0.61608	0.0001154	0.7133940
25 - 50	25.000	-0.00500	-0.00433	0.61175	0.0001731	1.0700910
50 - 100	50.000	-0.01100	-0.00952	0.60223	0.0001904	1.1771001
100 - 200	100.000	-0.02300	-0.01991	0.58232	0.0001991	1.2306046
200 - 400	200.000	-0.04500	-0.03895	0.54337	0.0001948	1.2038523
400 - 800	400.000	-0.07600	-0.06579	0.47759	0.0001645	1.0165864
800-200	-600.000	0.01100	0.00952	0.48711	-0.0000159	-0.0980917
200-0	-200.000	0.03800	0.03289	0.52000		

Borehole No :01 Depth(m) :6.00-6.45 Sample No. :177128

LOG TIME VS SETTLEMENT CURVE



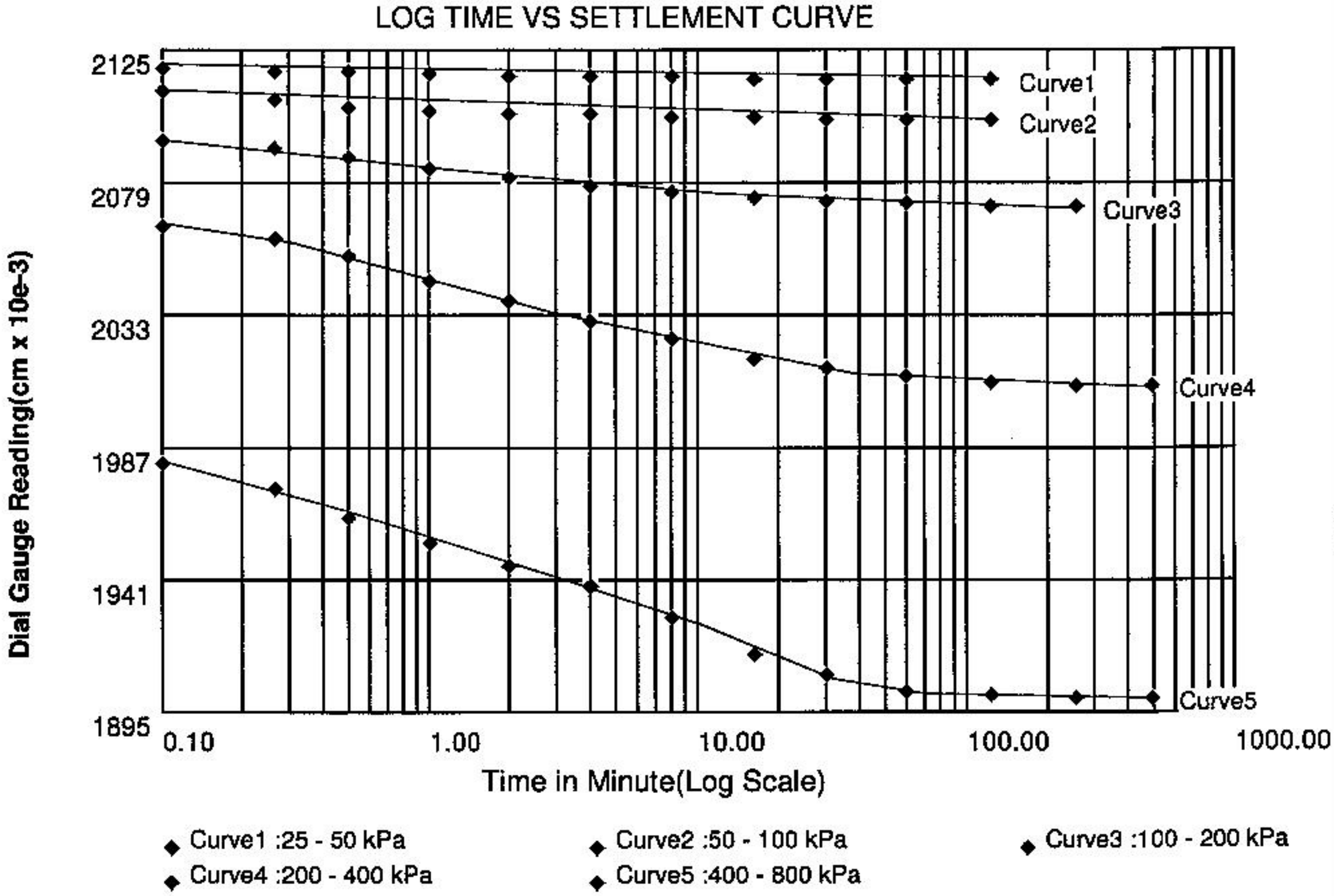
e Vs LOG(P)

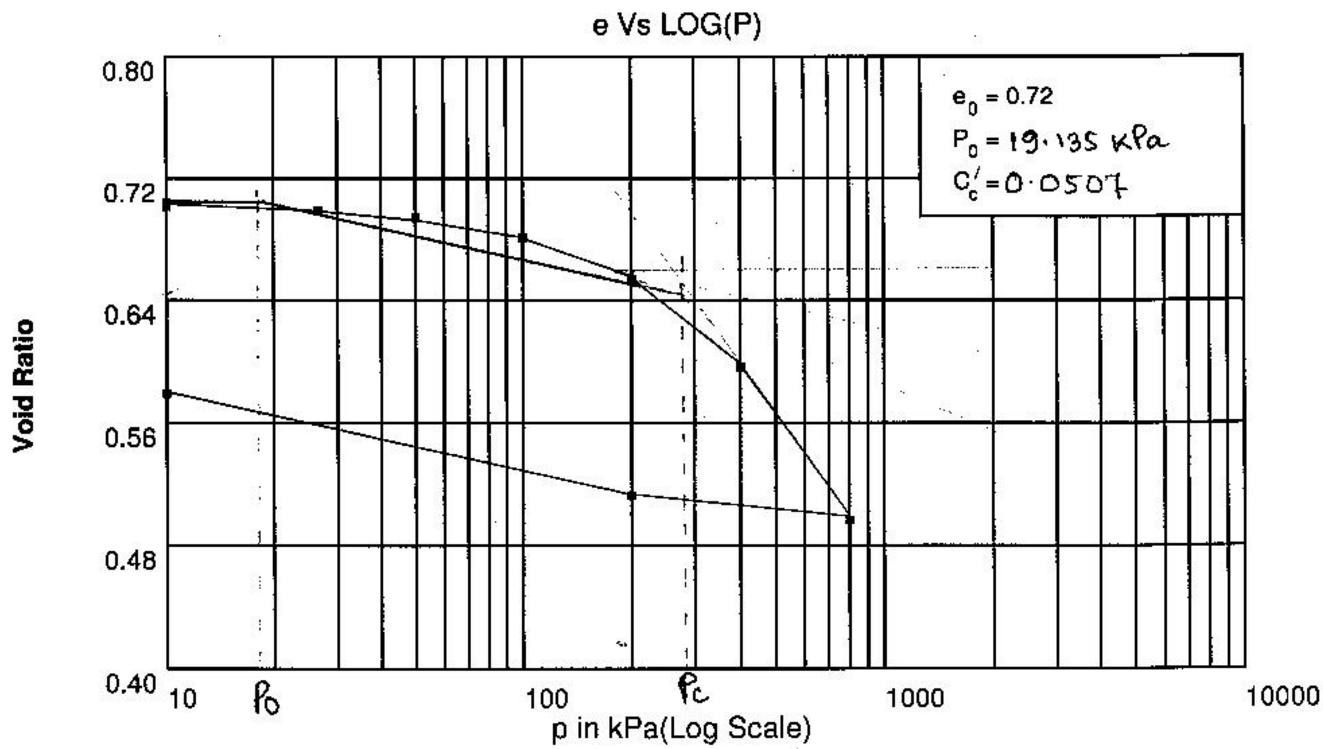


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :02 | Depth(m) :2.00-2.45 | Sample No. :160124





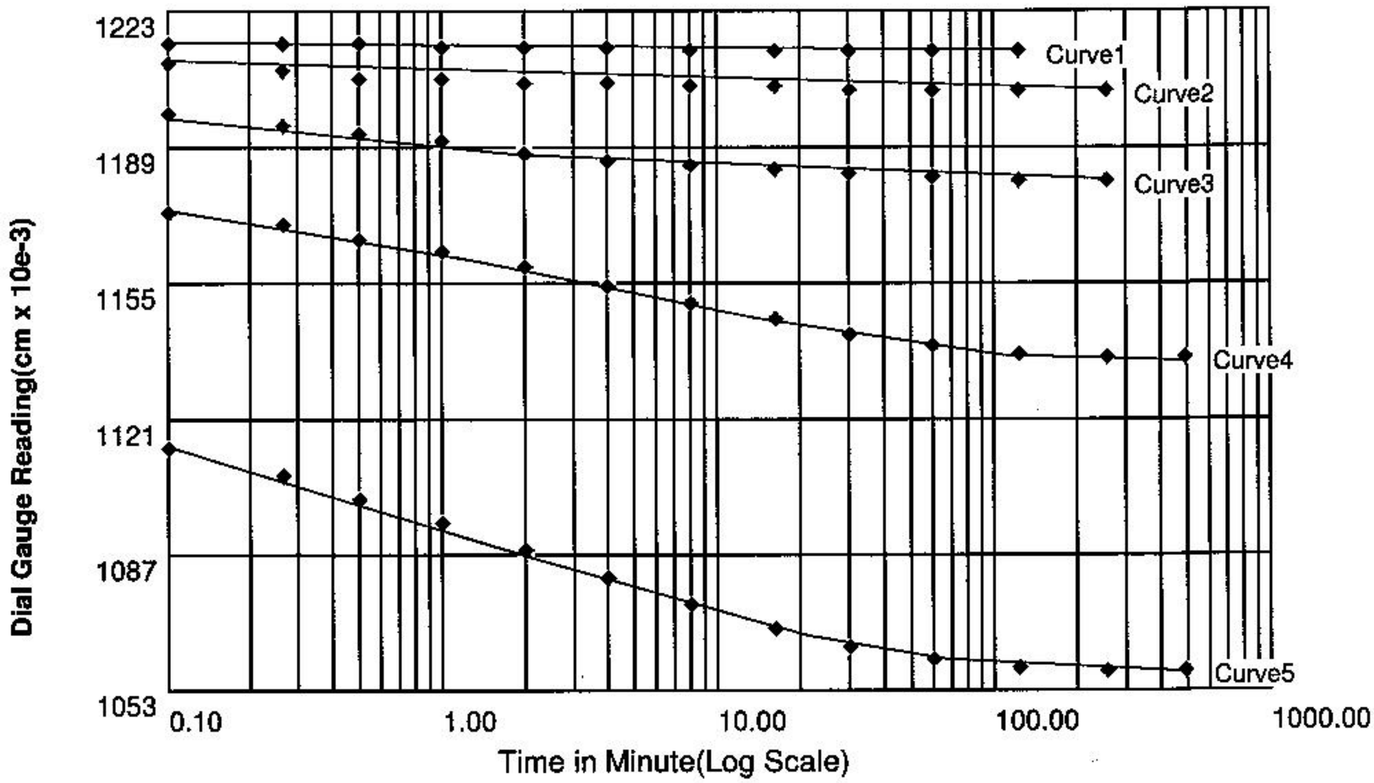
CONSOLIDATION TEST CURVES

Job No. :30796

SKM Geosurvey

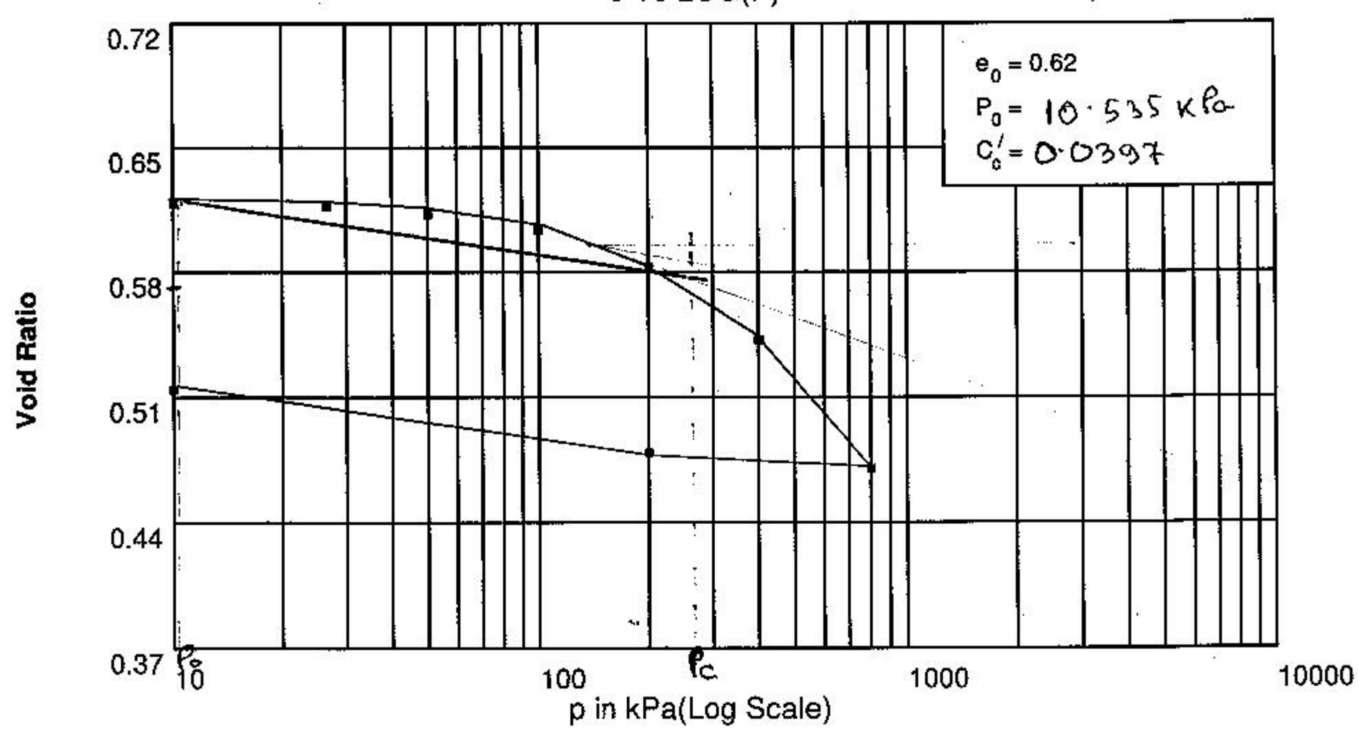
Borehole No :03 | Depth(m) :1.00-1.45 | Sample No. :100869

LOG TIME VS SETTLEMENT CURVE



Curve1 :25 - 50 kPa
Curve2 :50 - 100 kPa
Curve3 :100 - 200 kPa
Curve4 :200 - 400 kPa
Curve5 :400 - 800 kPa

e Vs LOG(P)

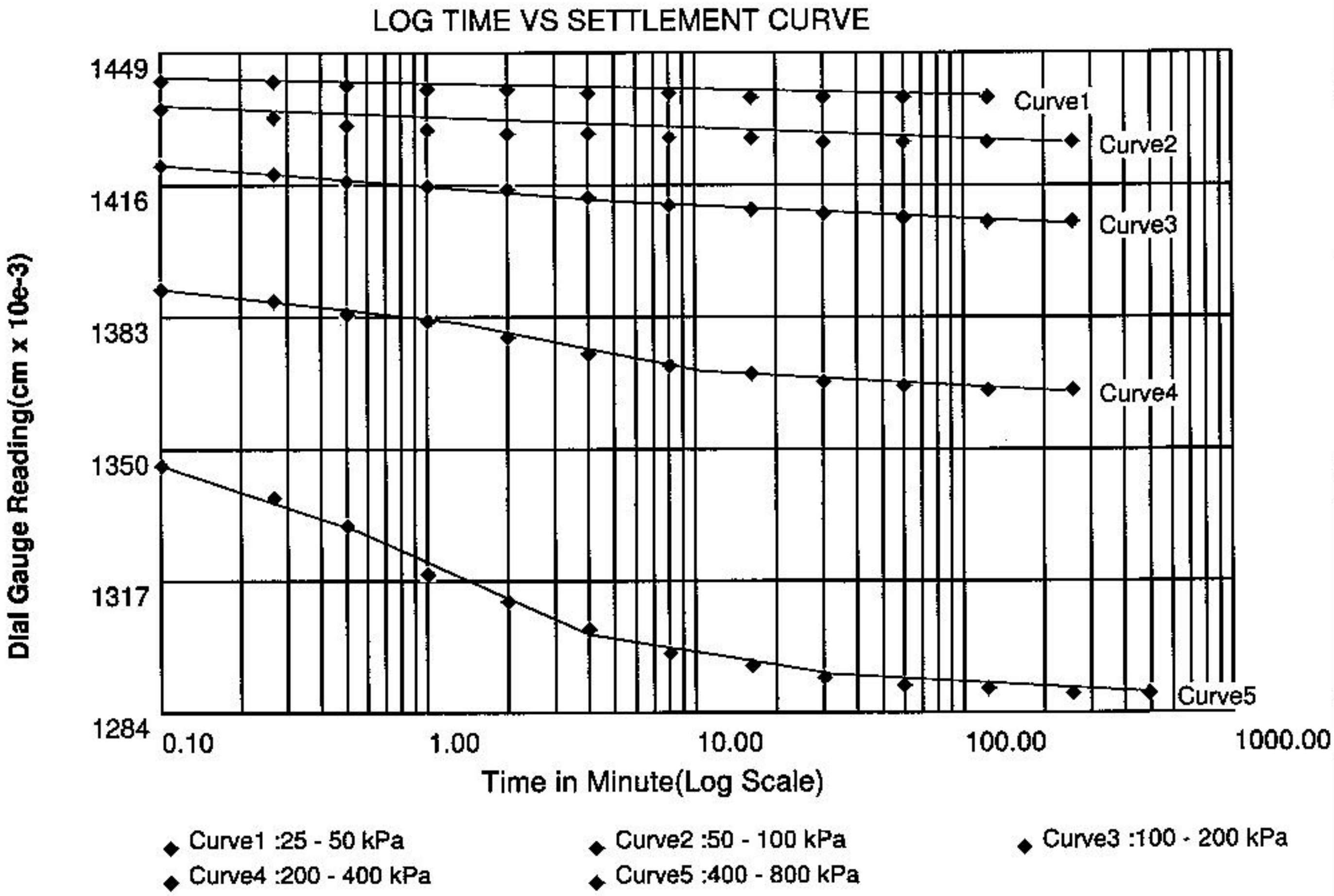


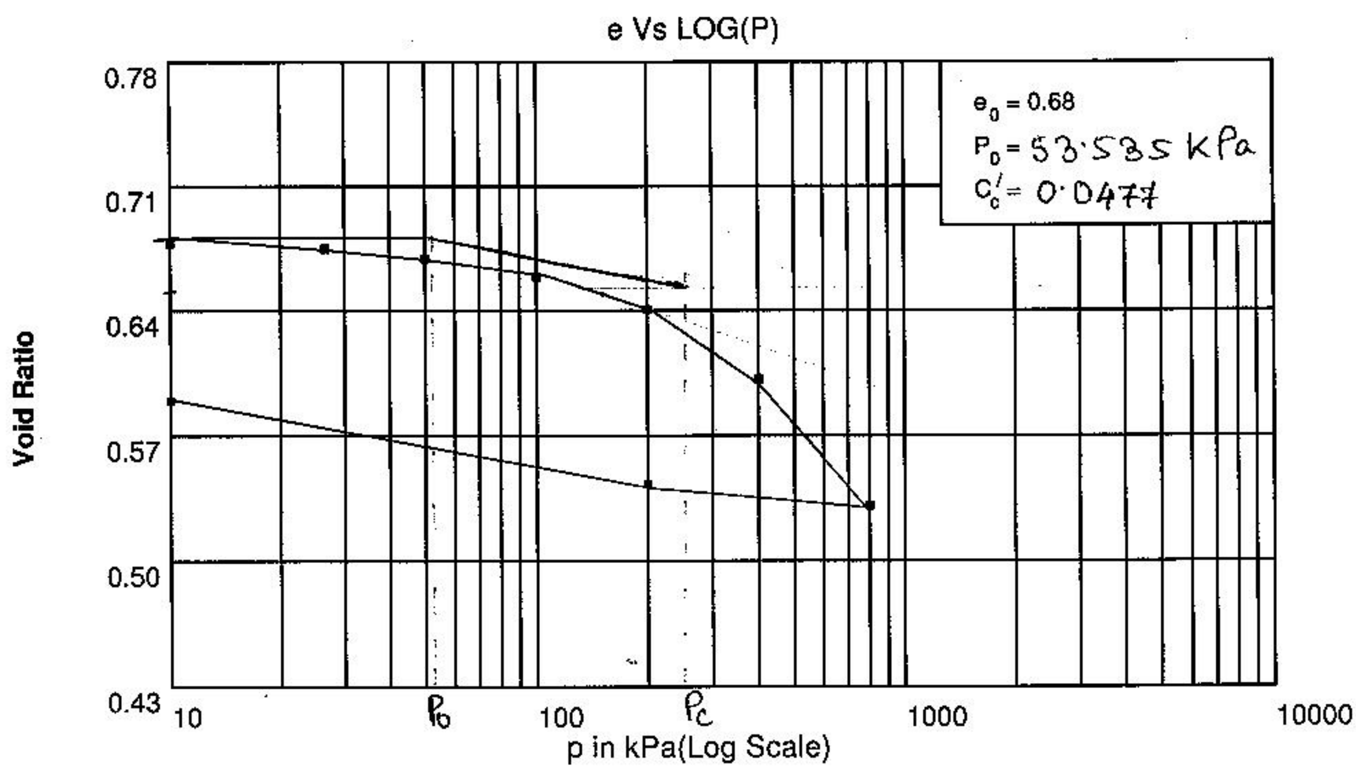
CONSOLIDATION TEST CURVES

Job No. :30796

SKM Geosurvey

Borehole No :03 Depth(m) :6.00-6.45 Sample No. :100877



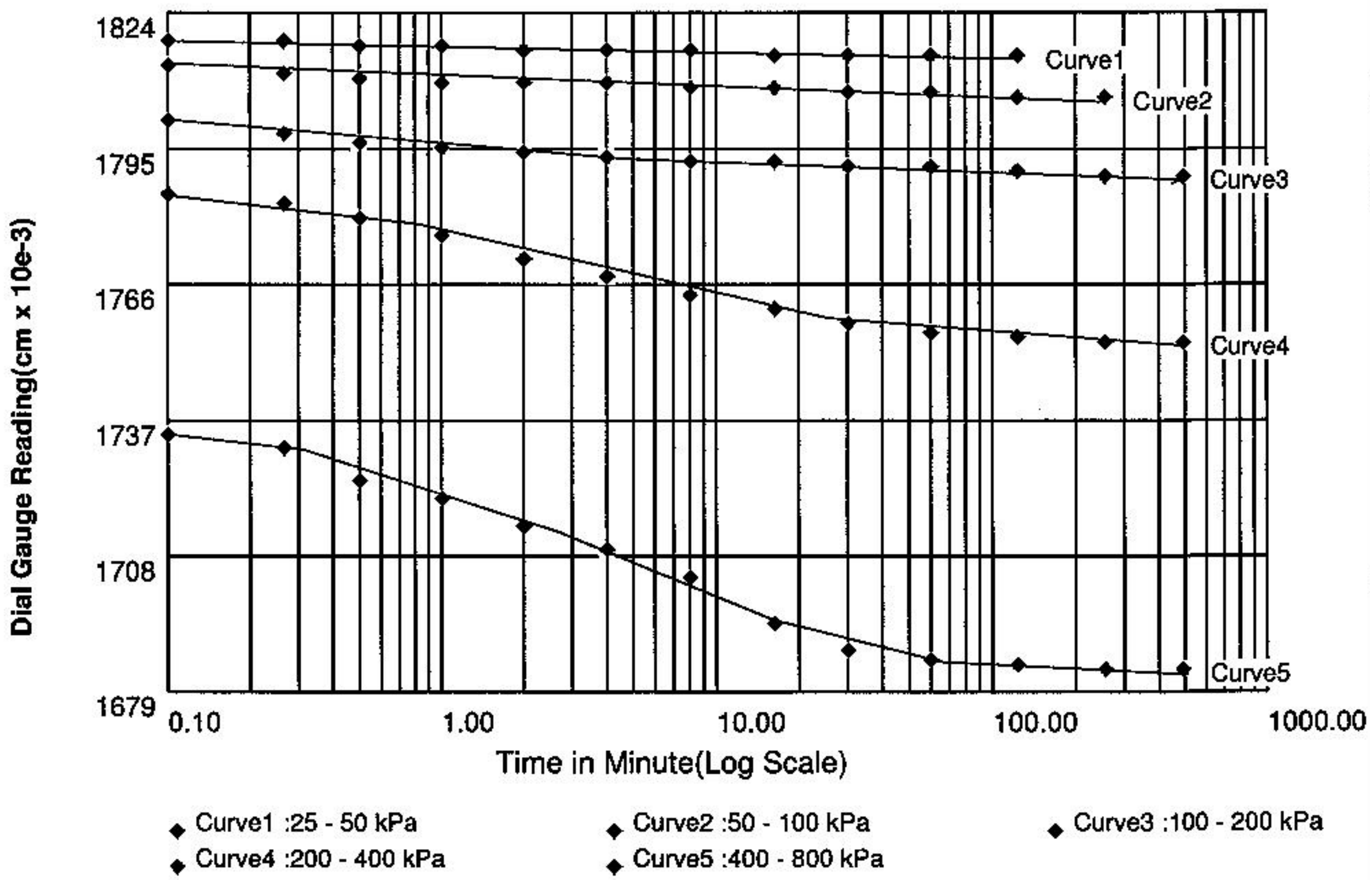


CONSOLIDATION TEST CURVES

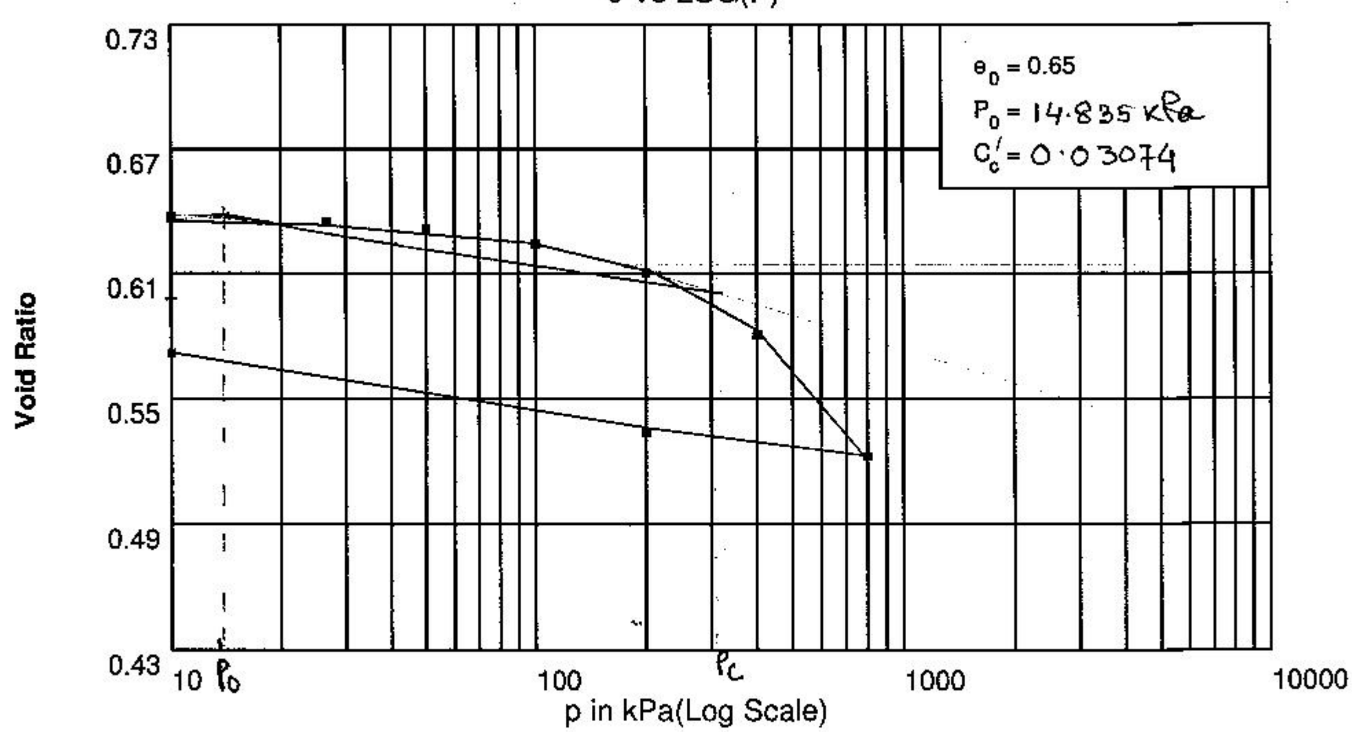
Job No. :30796

Borehole No :04 Depth(m) :1.50-1.95 Sample No. :100902

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)



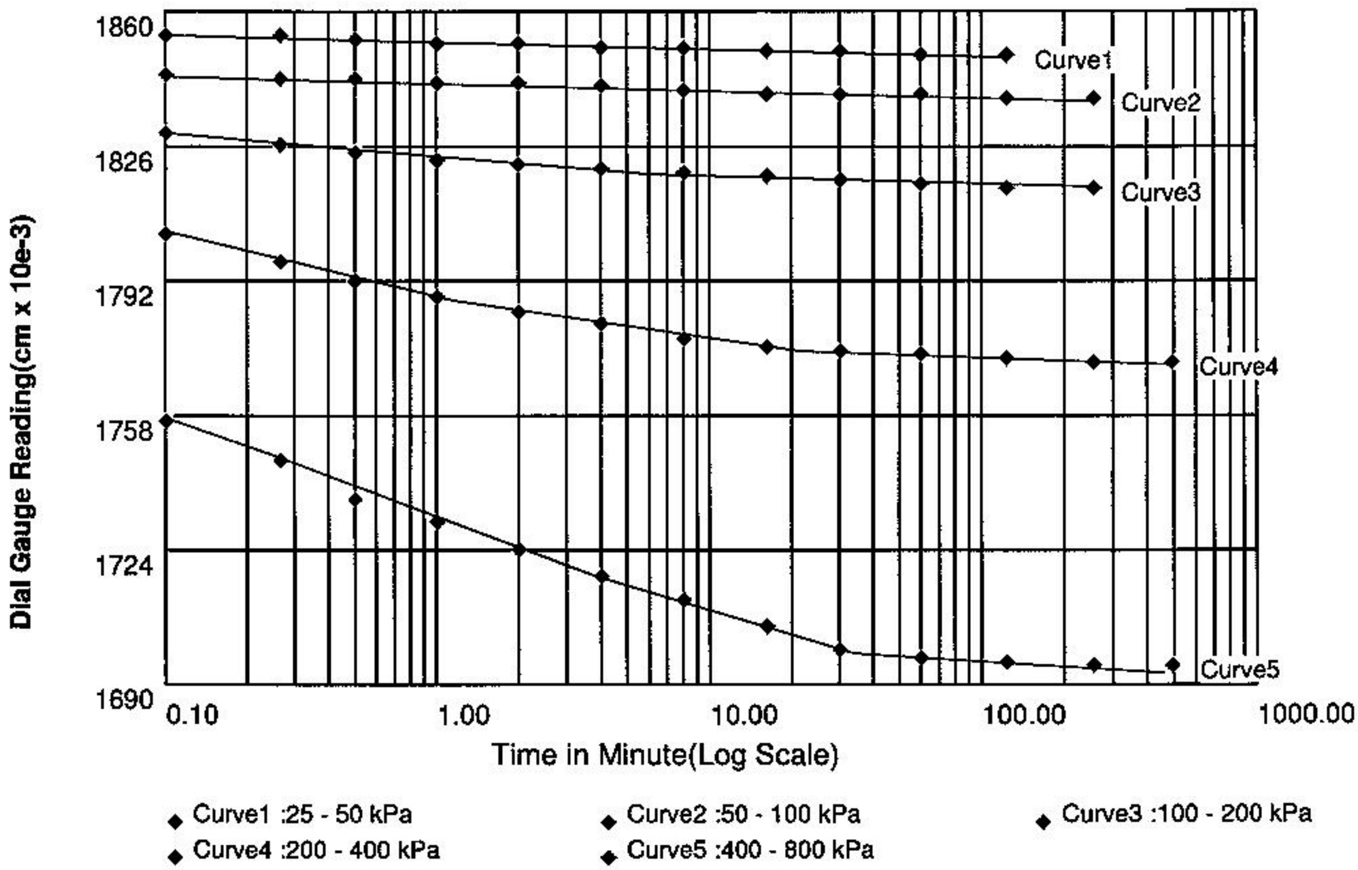
CONSOLIDATION TEST CURVES

Job No. :30796

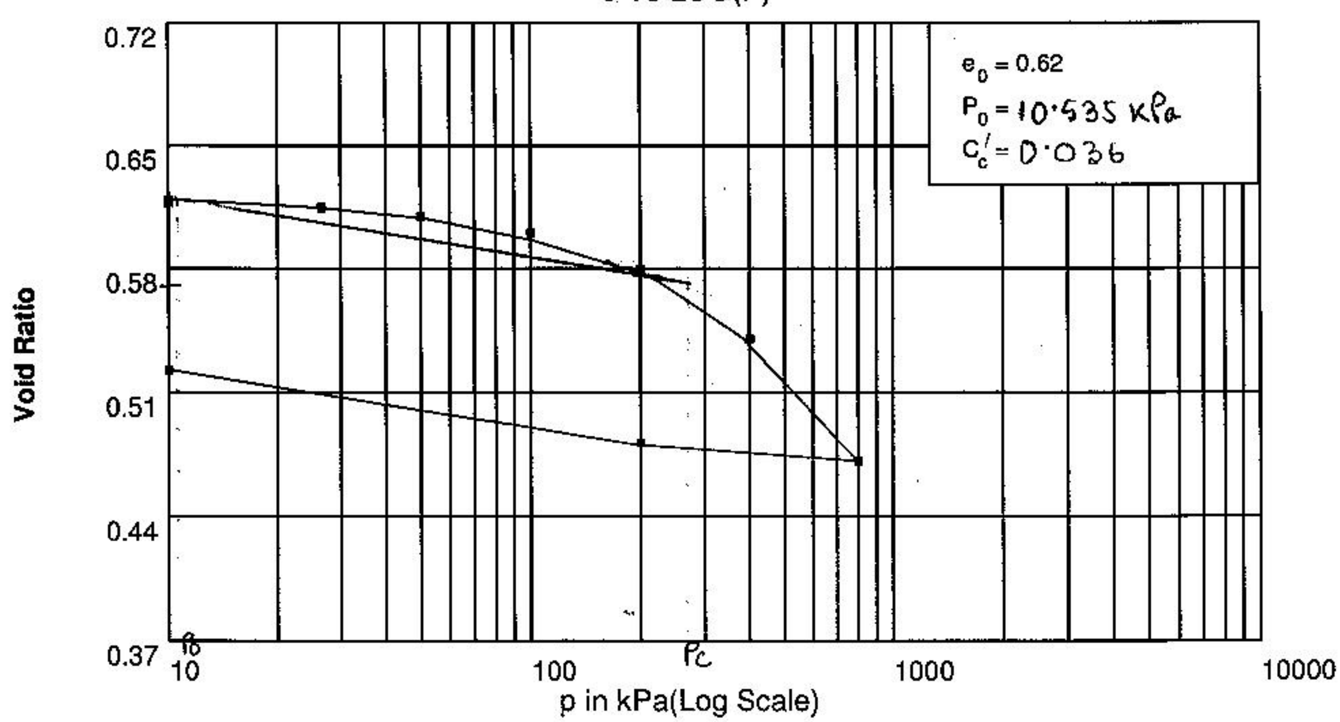
SKM Geosurvey

Borehole No :06 Depth(m) :1.00-1.45 Sample No. :105112

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)

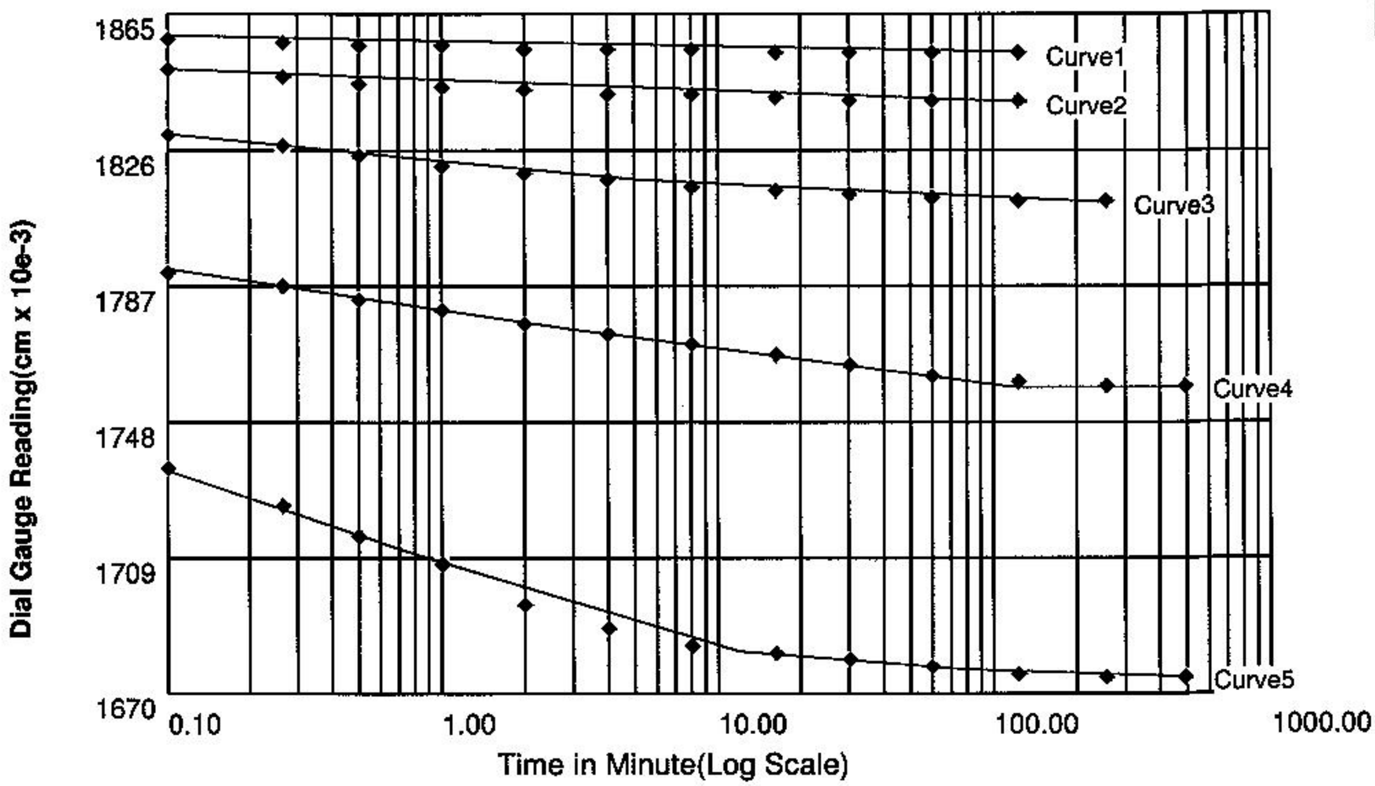


CONSOLIDATION TEST CURVES

Job No. :30796

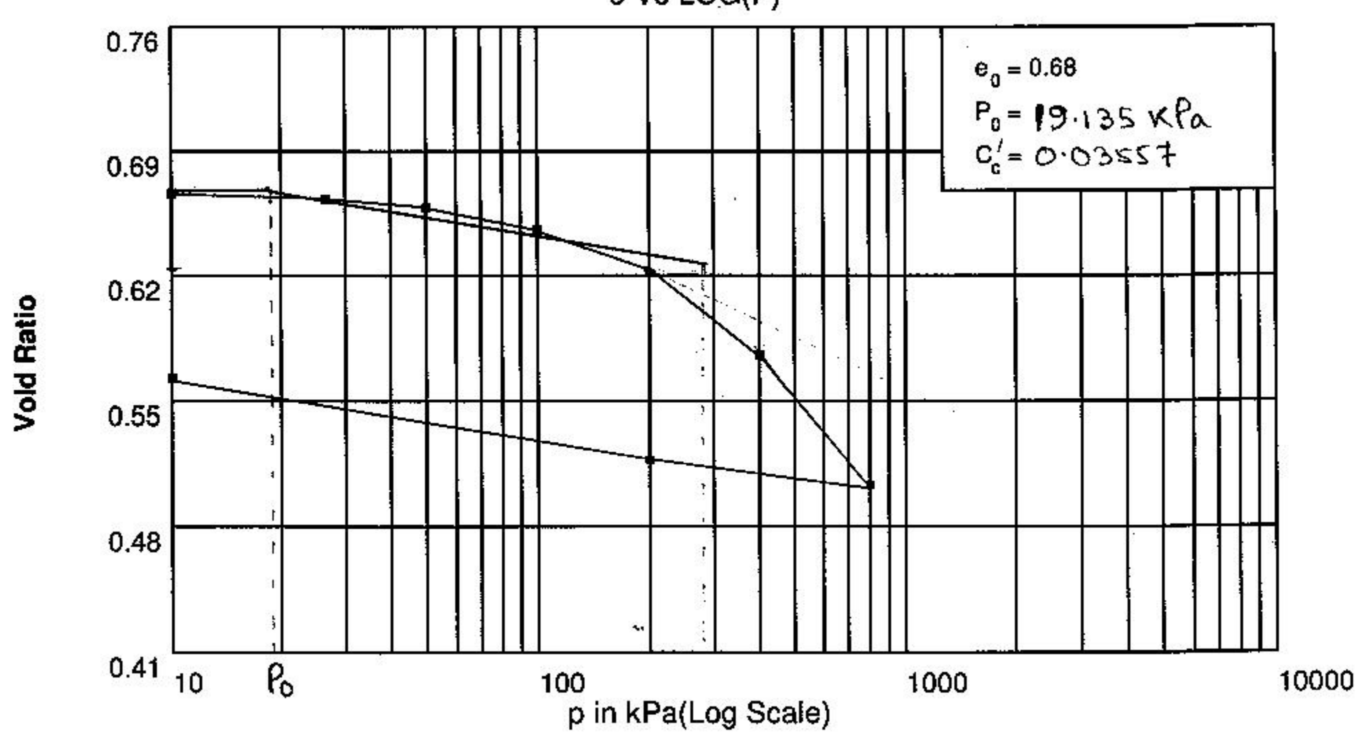
Borehole No :07 | Depth(m) :2.00-2.45 | Sample No. :105104

LOG TIME VS SETTLEMENT CURVE



- Curve1 :25 - 50 kPa
- Curve2 :50 - 100 kPa
- Curve3 :100 - 200 kPa
- Curve4 :200 - 400 kPa
- Curve5 :400 - 800 kPa

e Vs LOG(P)

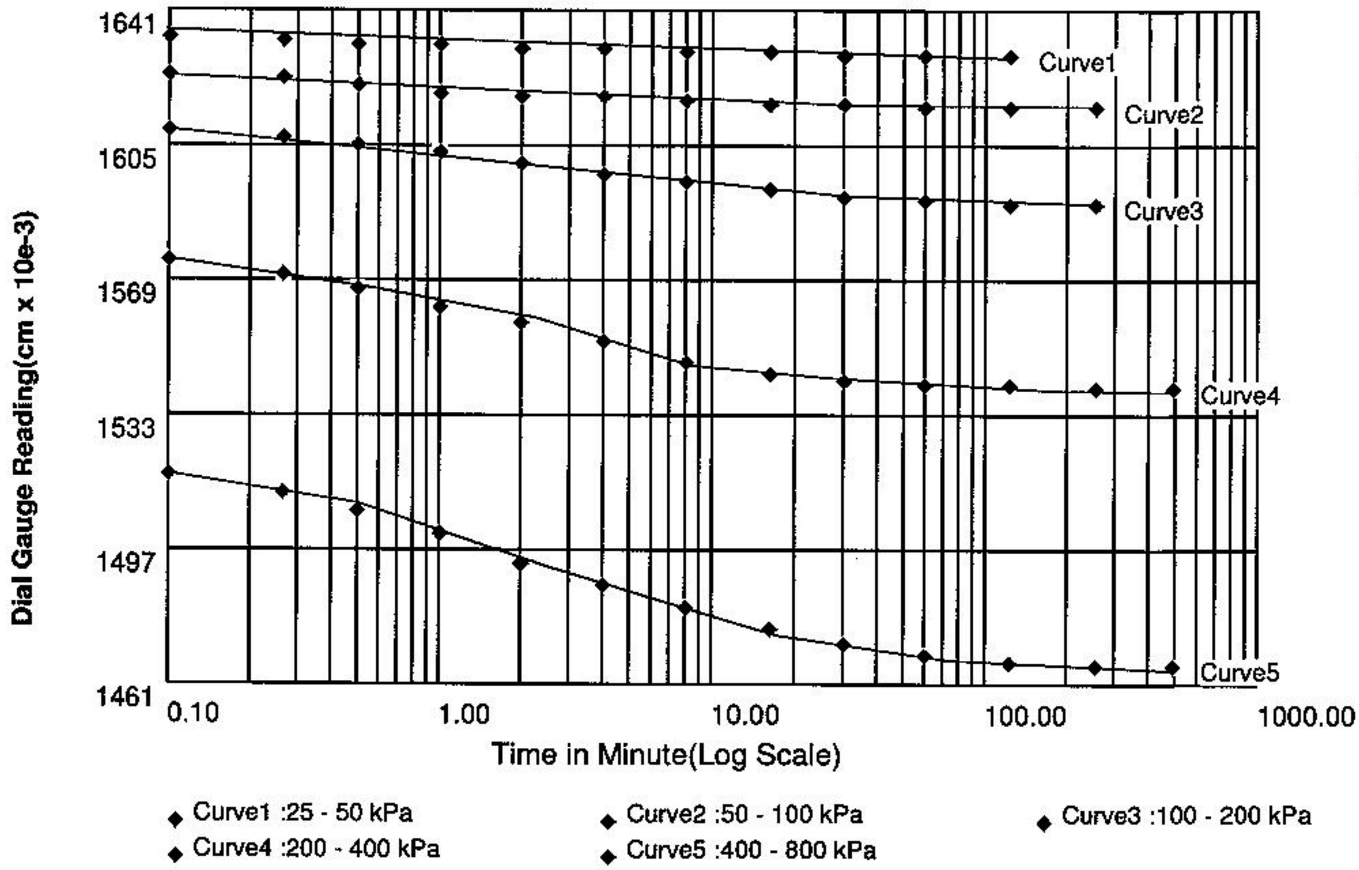


CONSOLIDATION TEST CURVES

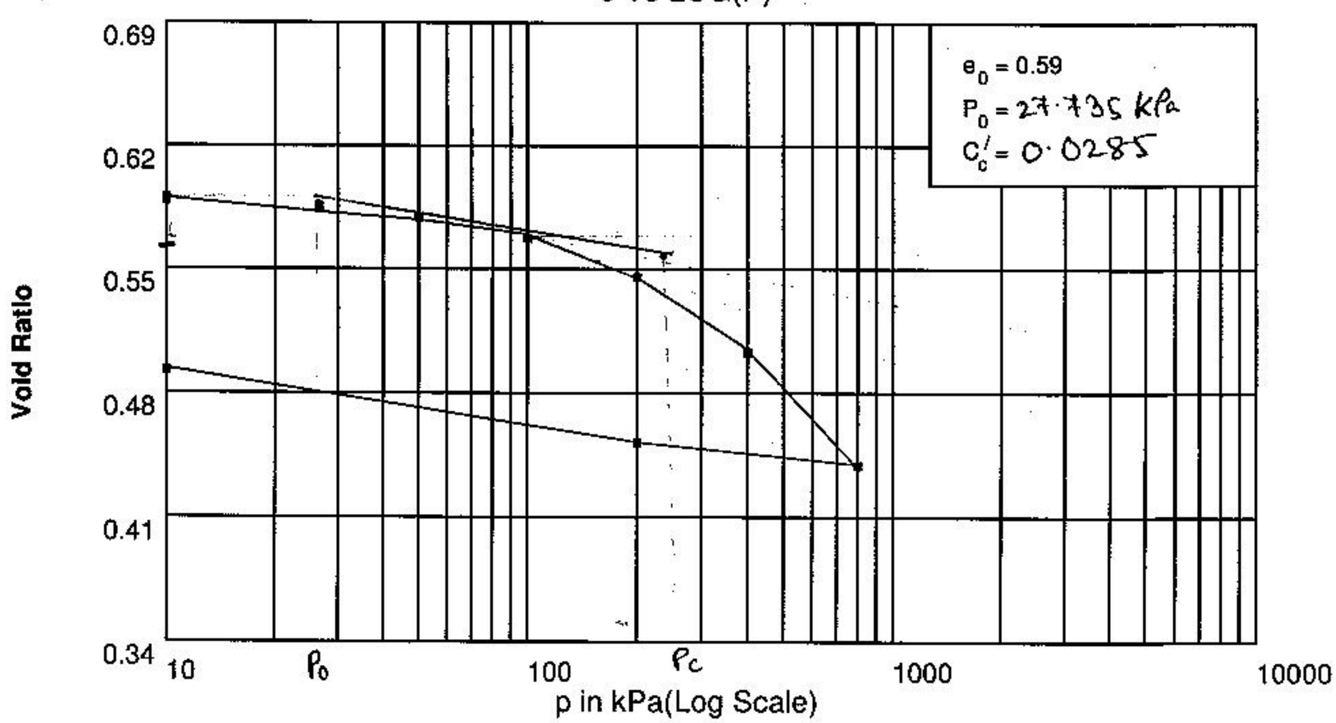
Job No. :30796

Borehole No :08 Depth(m) :3.00-3.45 Sample No. :100972

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)



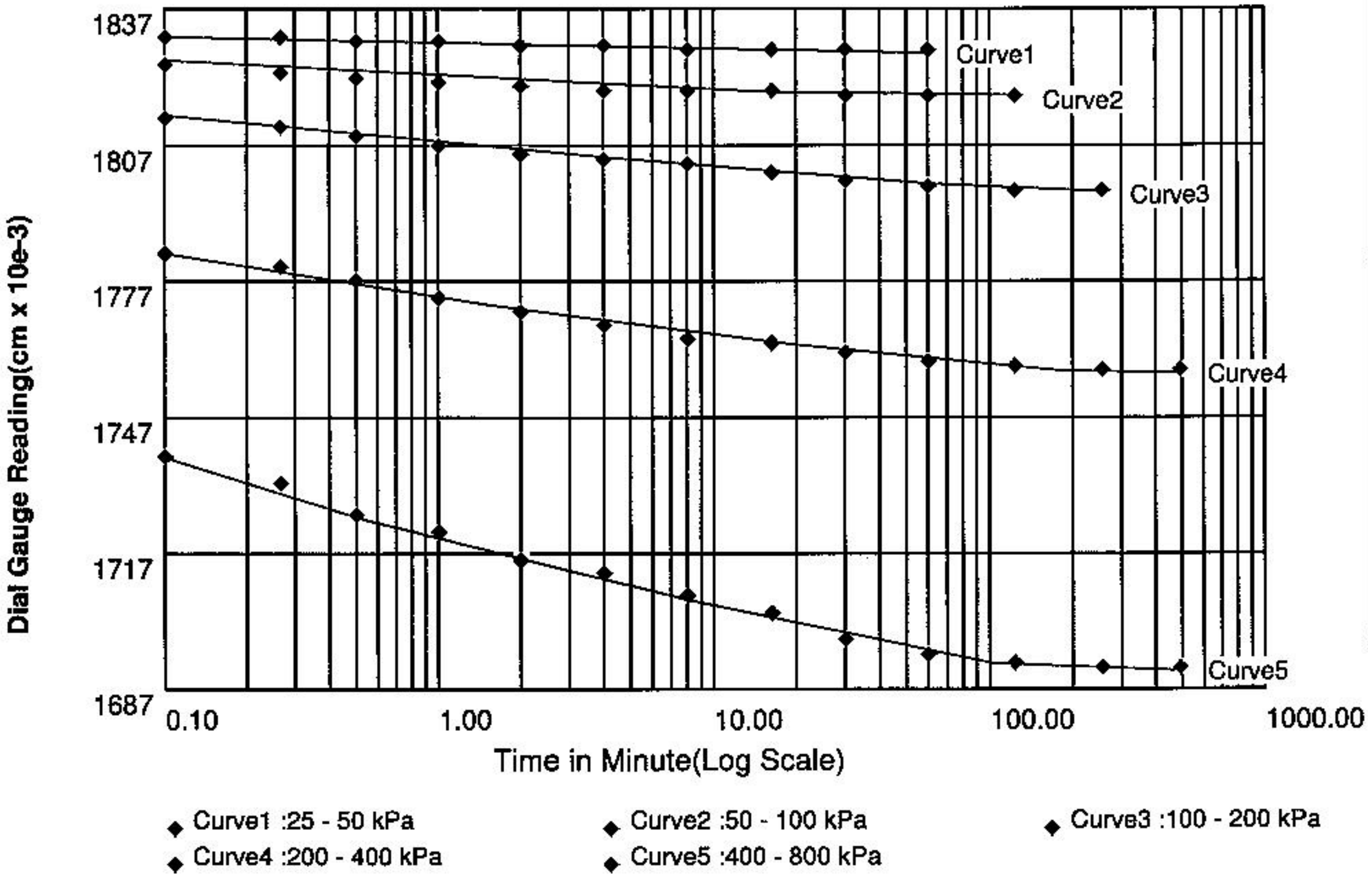
CONSOLIDATION TEST CURVES

Job No. :30796

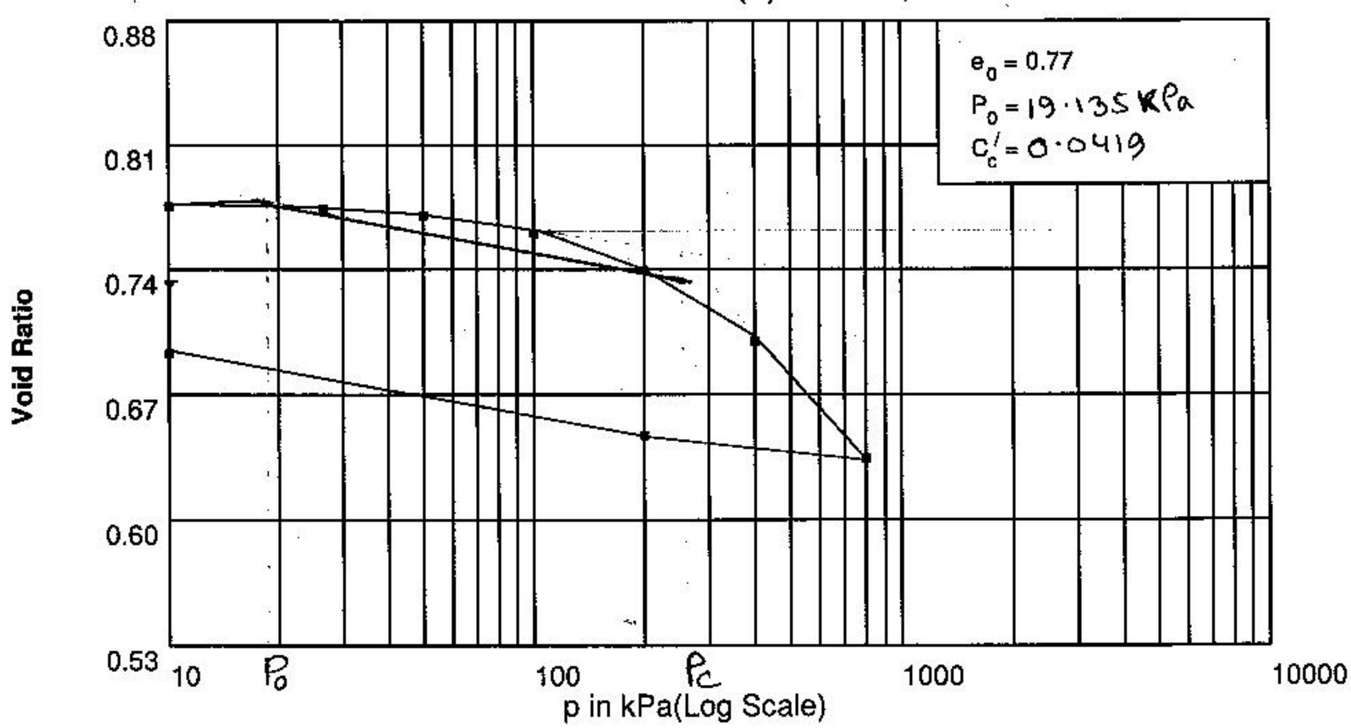
SKM Geosurvey

Borehole No :09 Depth(m) :2.00-2.45 Sample No. :100878

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)



CONSOLIDATION TEST CURVES

Job No. :30796

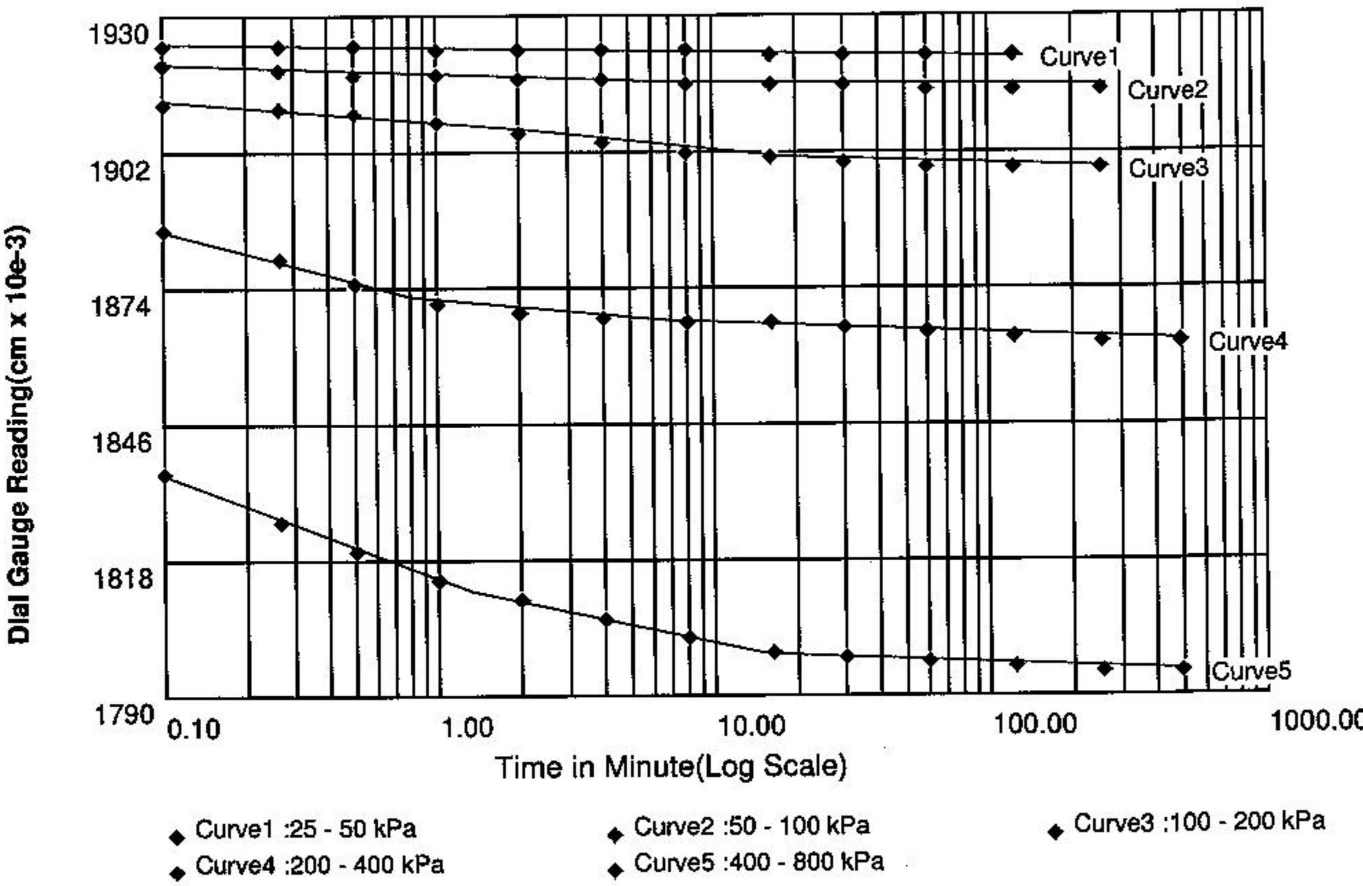
SKM Geosurvey

Sample No. :100882

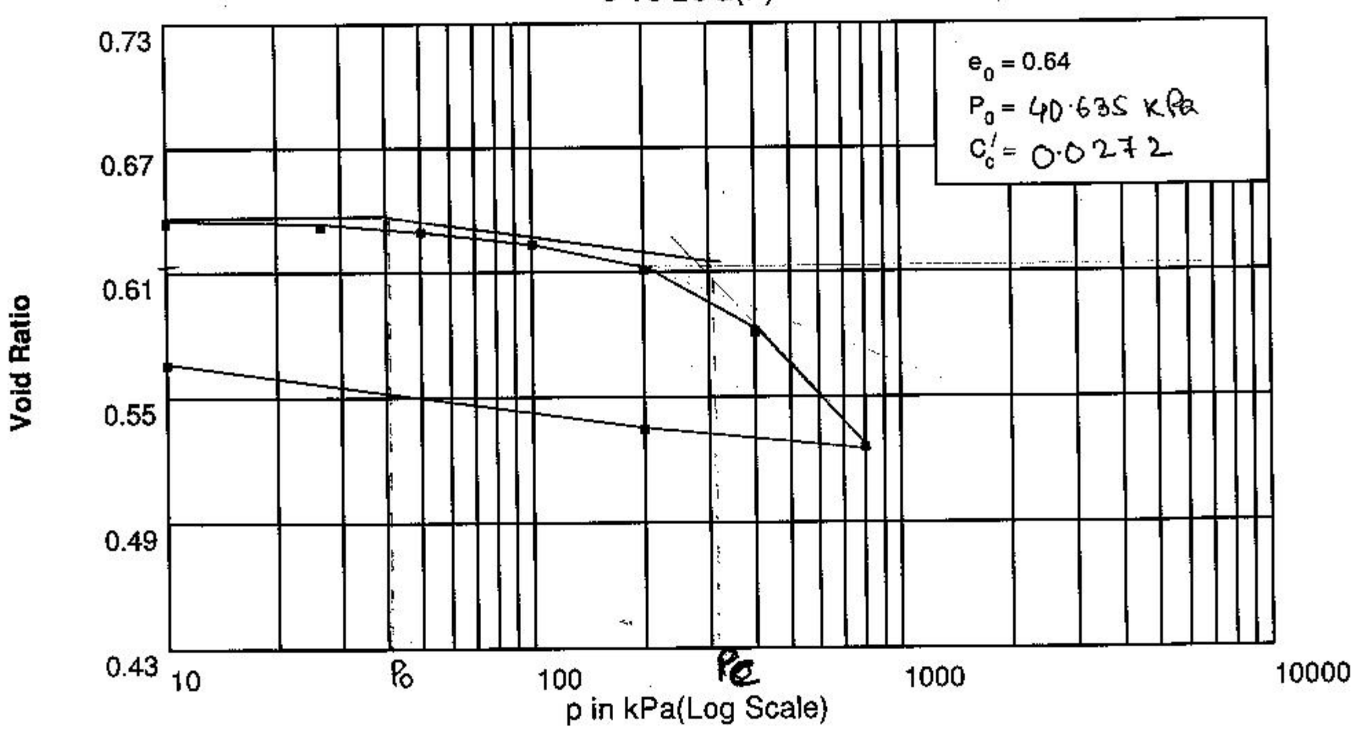
Borehole No :09

Depth(m) :4.50-4.95

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)



CONSOLIDATION TEST CURVES

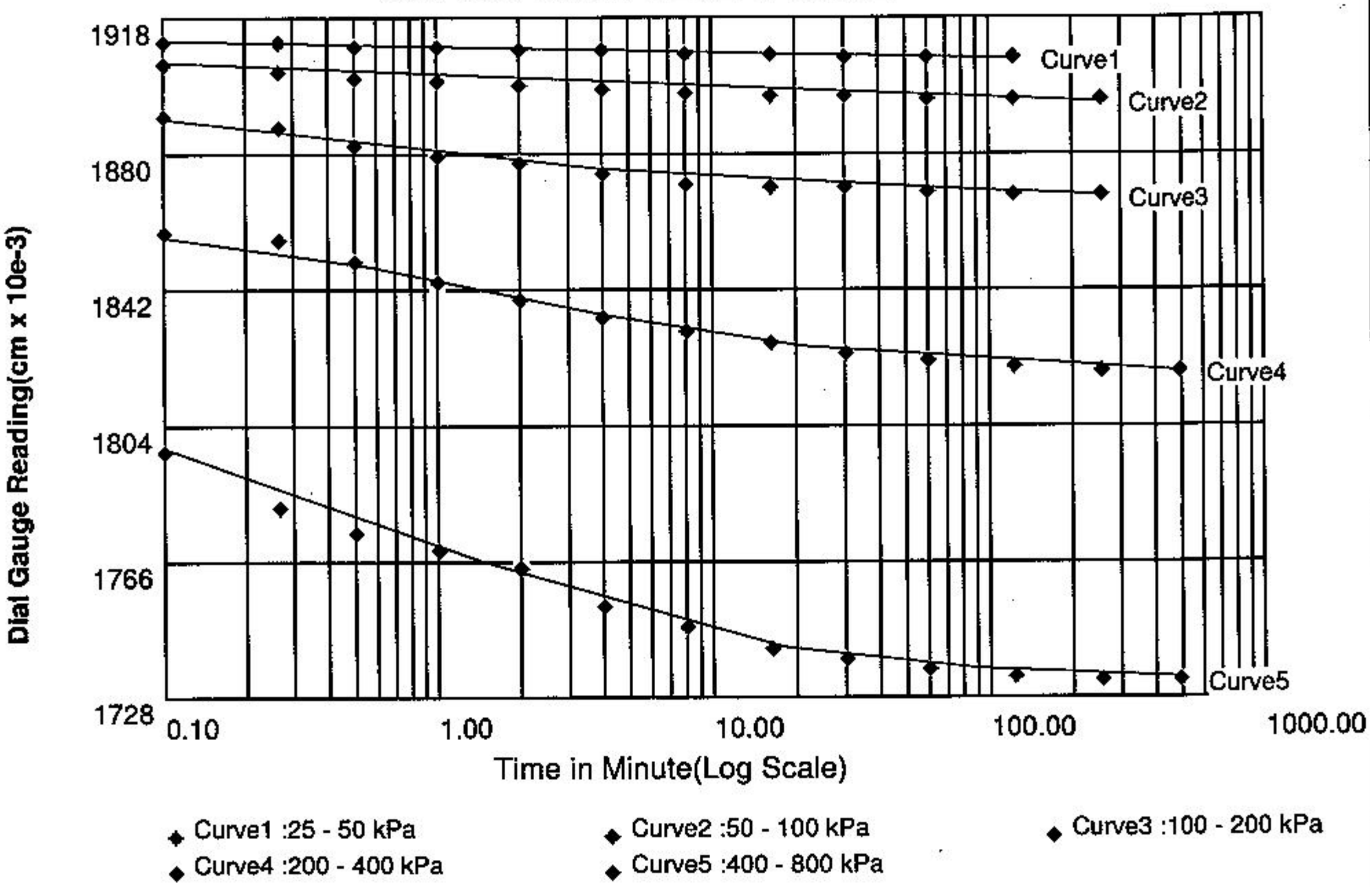
Job No. :30796

Borehole No :10

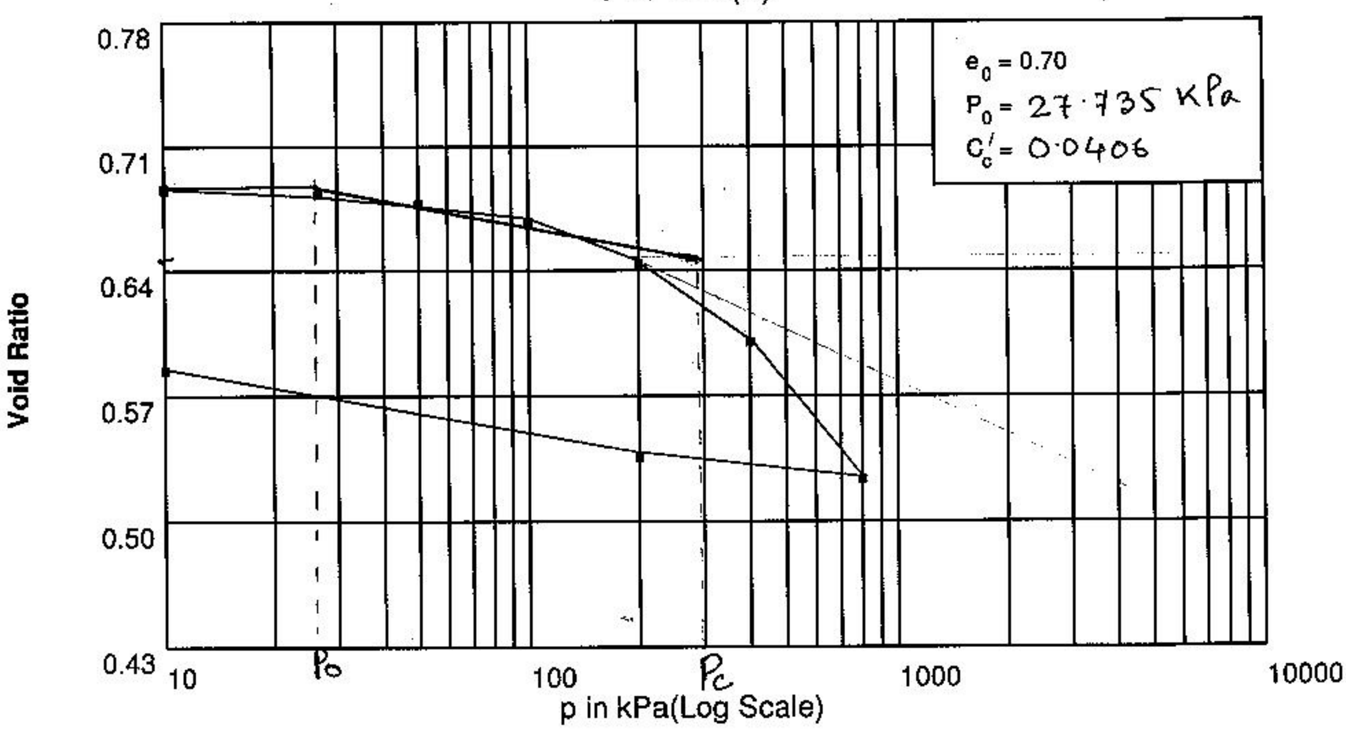
Depth(m) :3.00-3.45

Sample No. :100476

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)

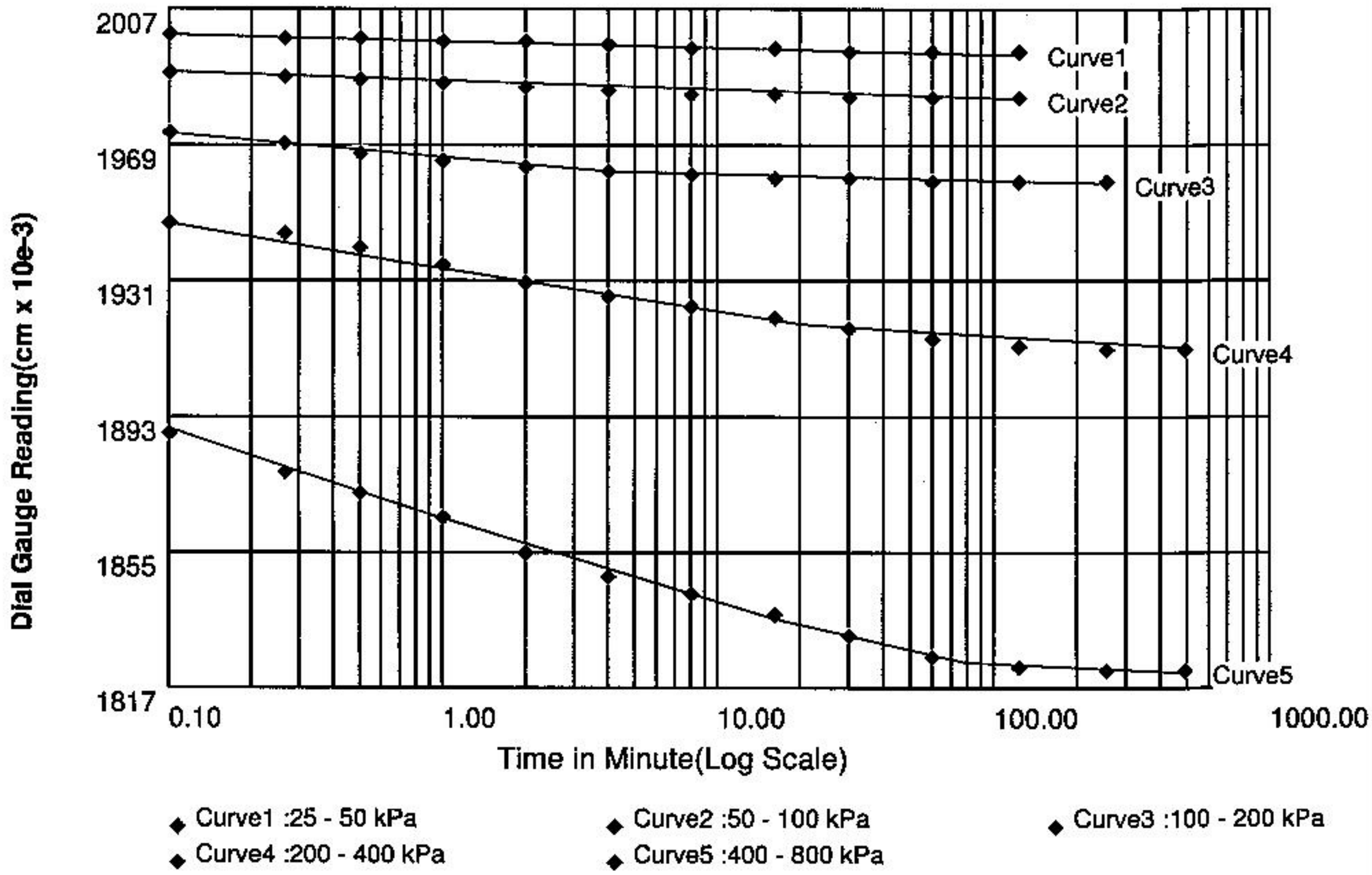


CONSOLIDATION TEST CURVES

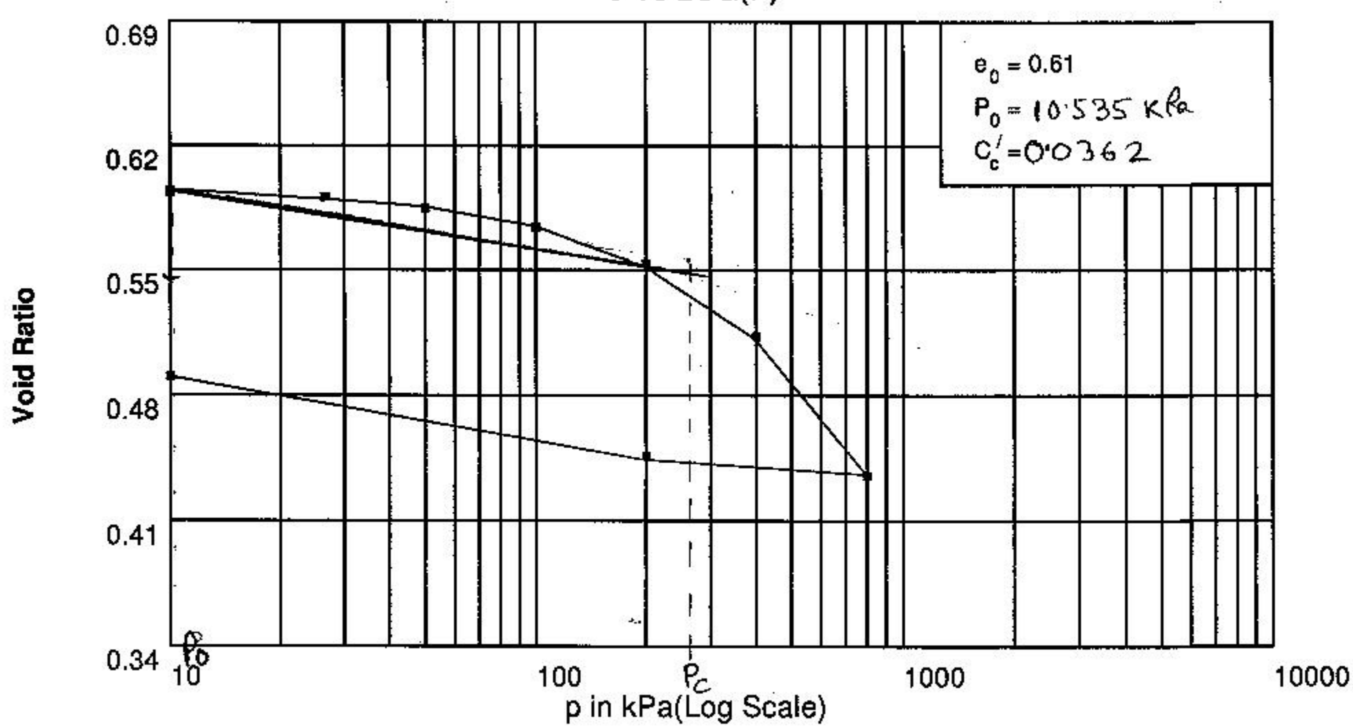
Job No. :30796

Borehole No :11 | Depth(m) :1.00-1.45 | Sample No. :100852

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)



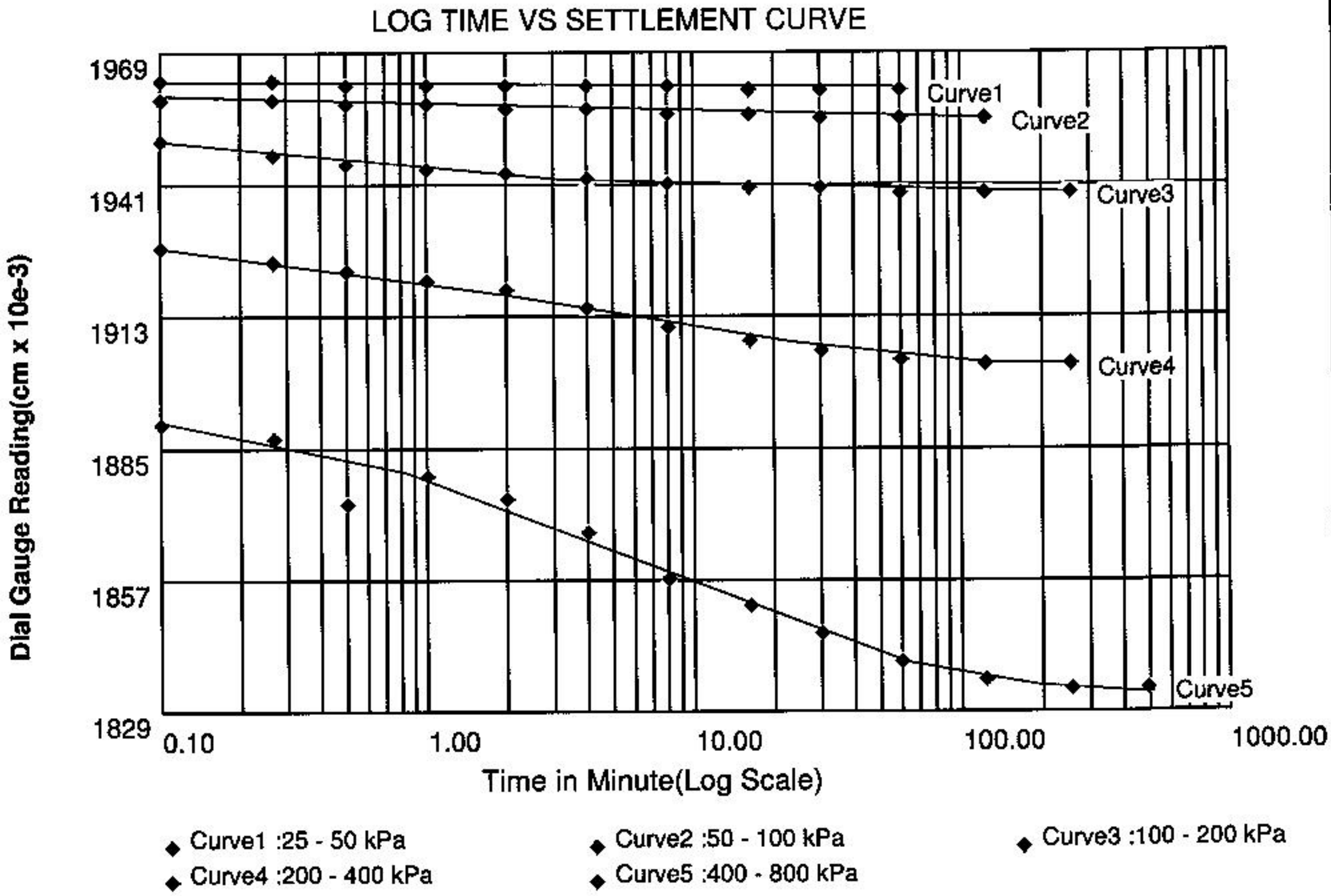
CONSOLIDATION TEST CURVES

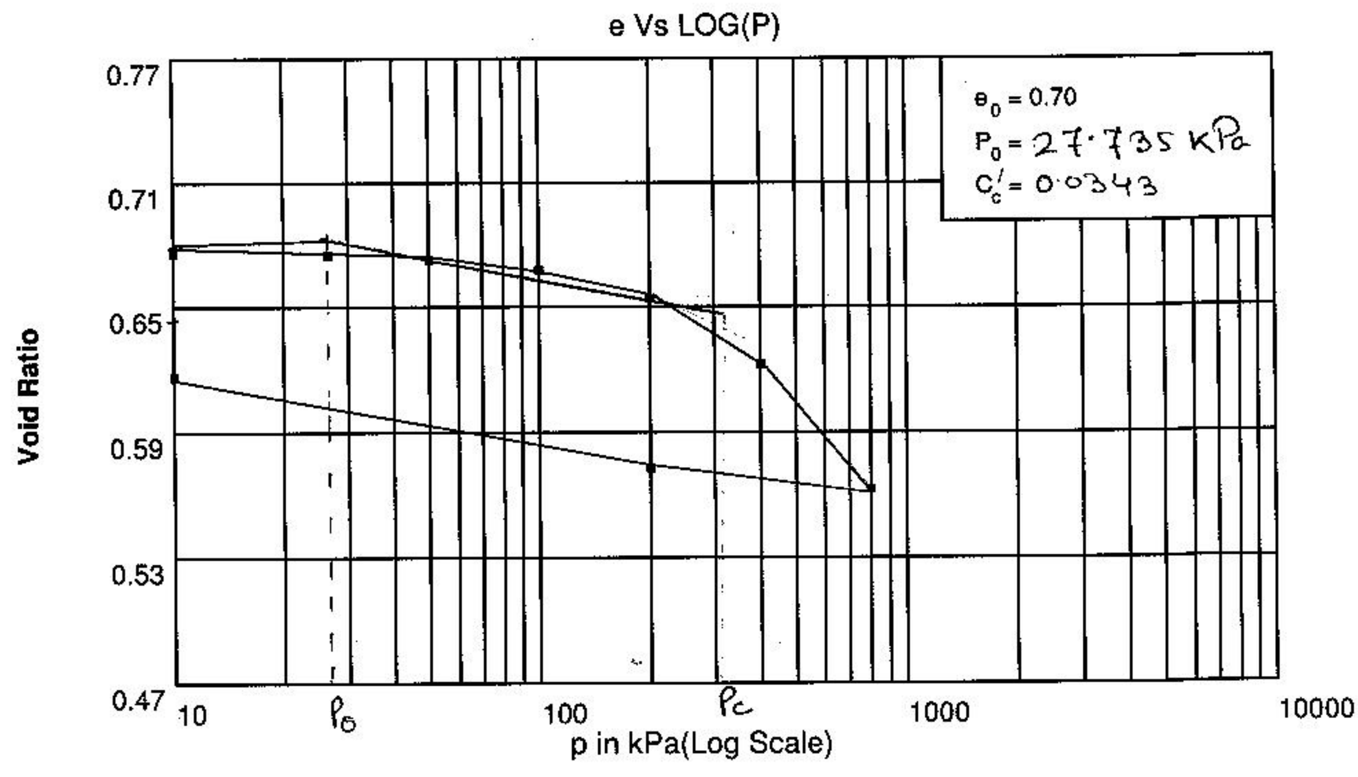
Job No. :30796

Borehole No :11

Depth(m) :3.00-3.45

Sample No. :100856





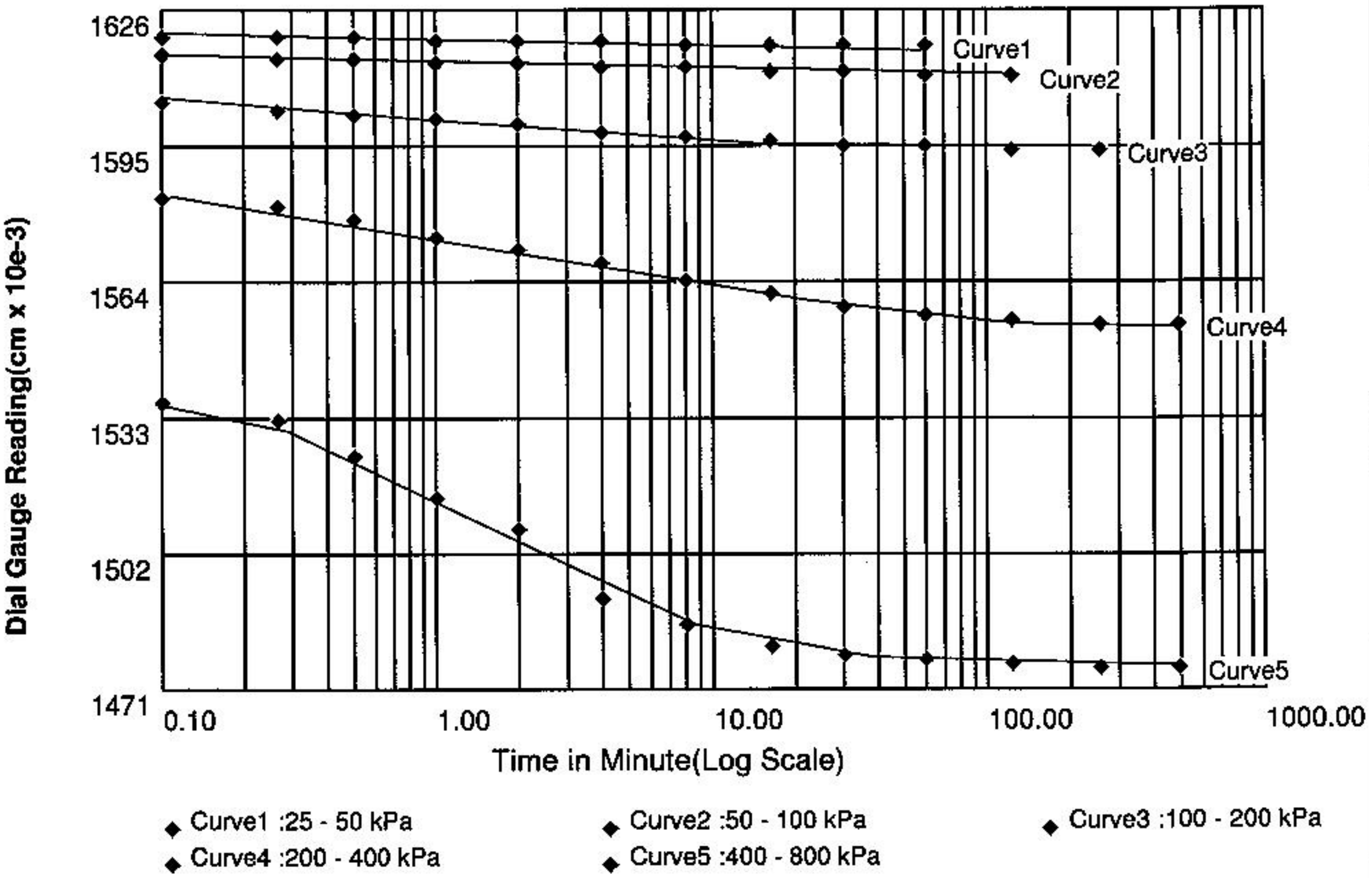
CONSOLIDATION TEST CURVES

Job No. :30796

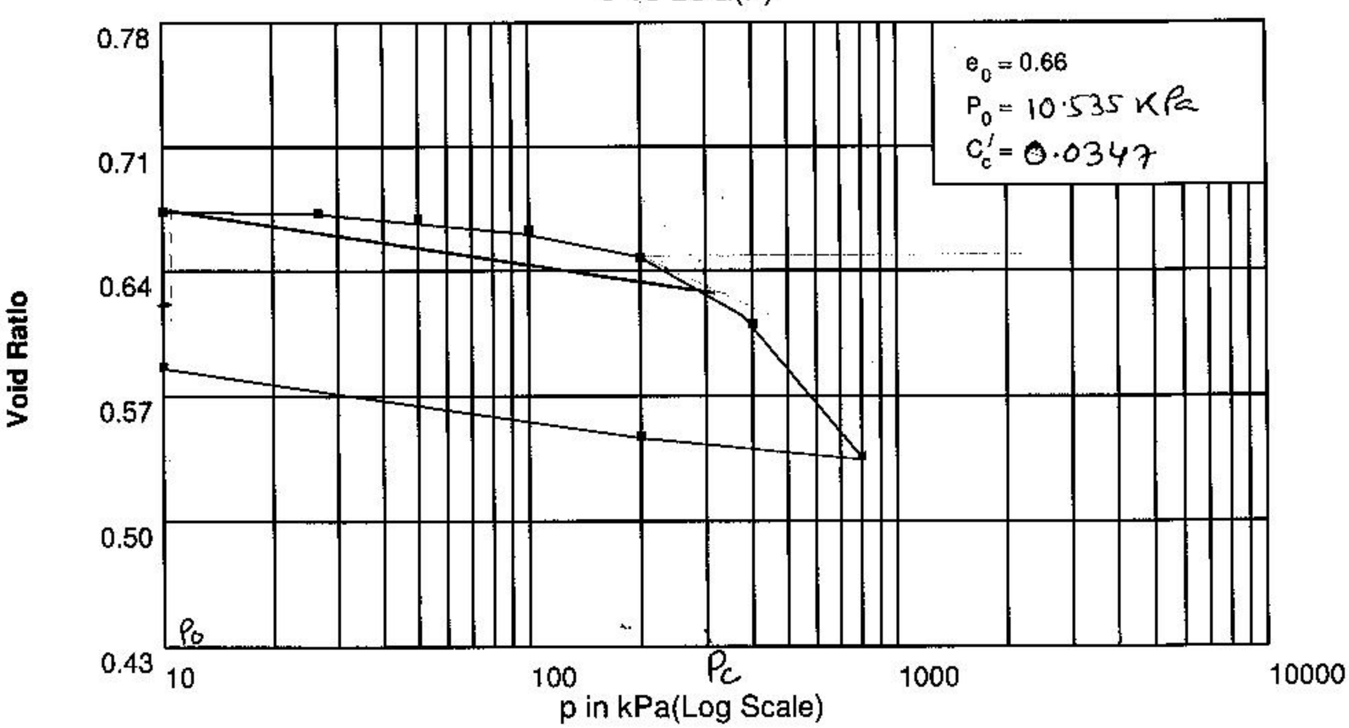
SKM Geosurvey

Borehole No :12 | Depth(m) :1.00-1.45 | Sample No. :100978

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)

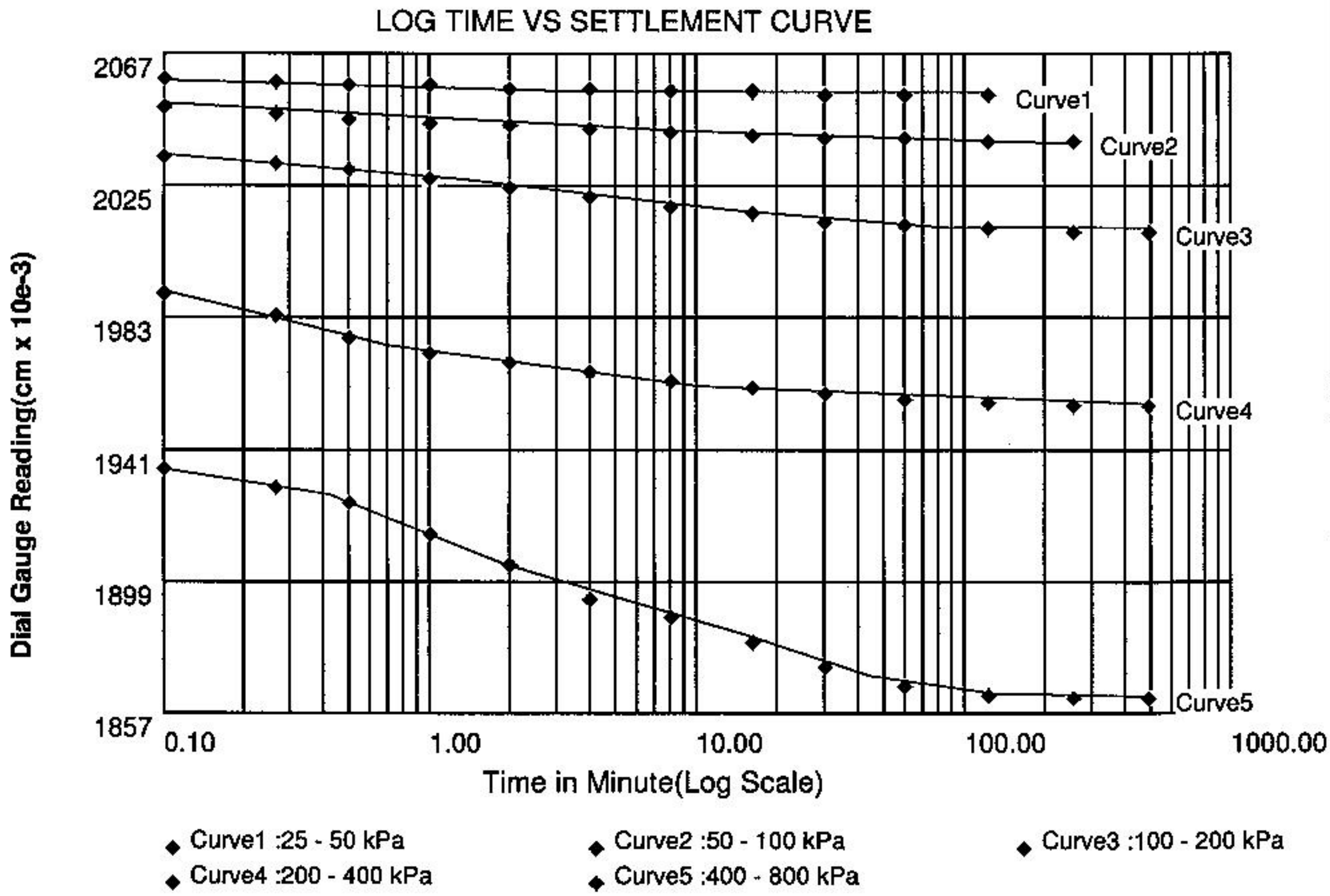


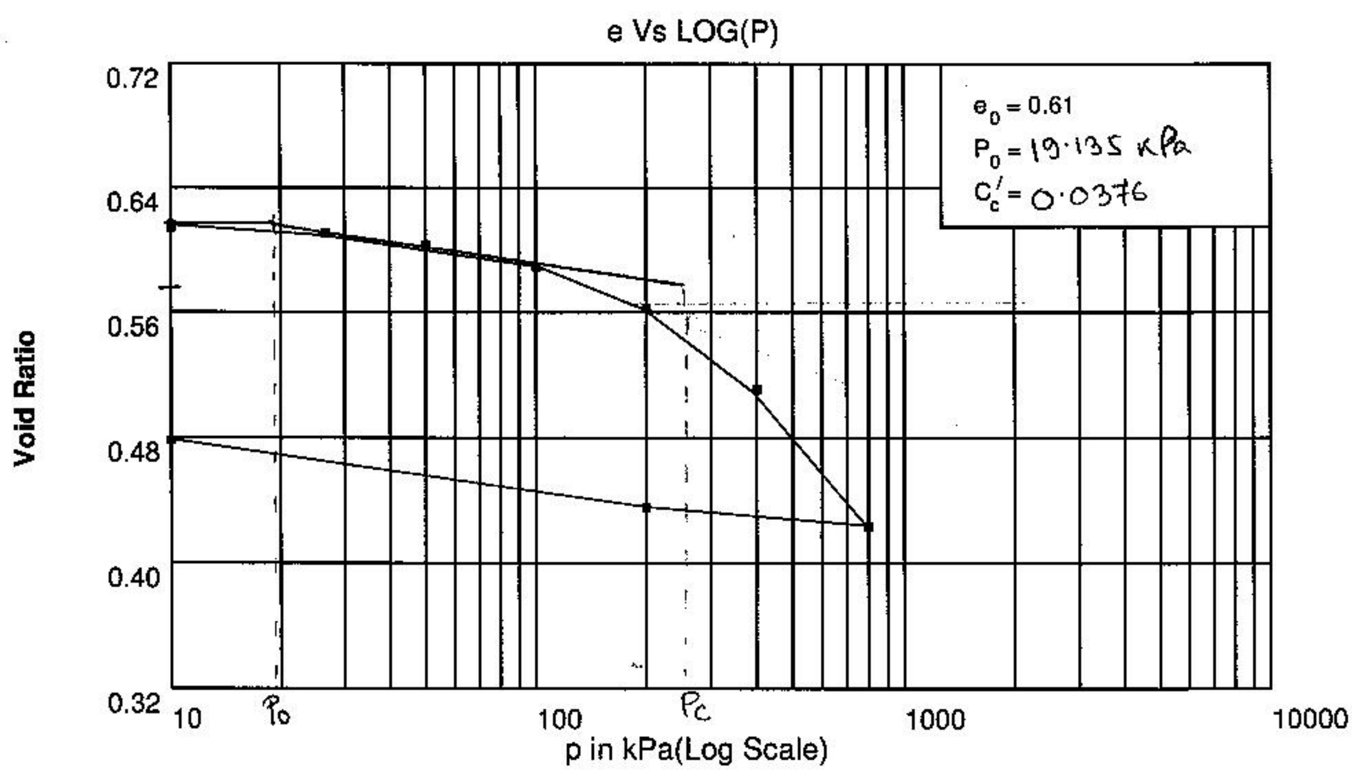
CONSOLIDATION TEST CURVES

Job No. :30796

SKM Geosurvey

Borehole No :14 Depth(m) :2.00-2.45 Sample No. :100554



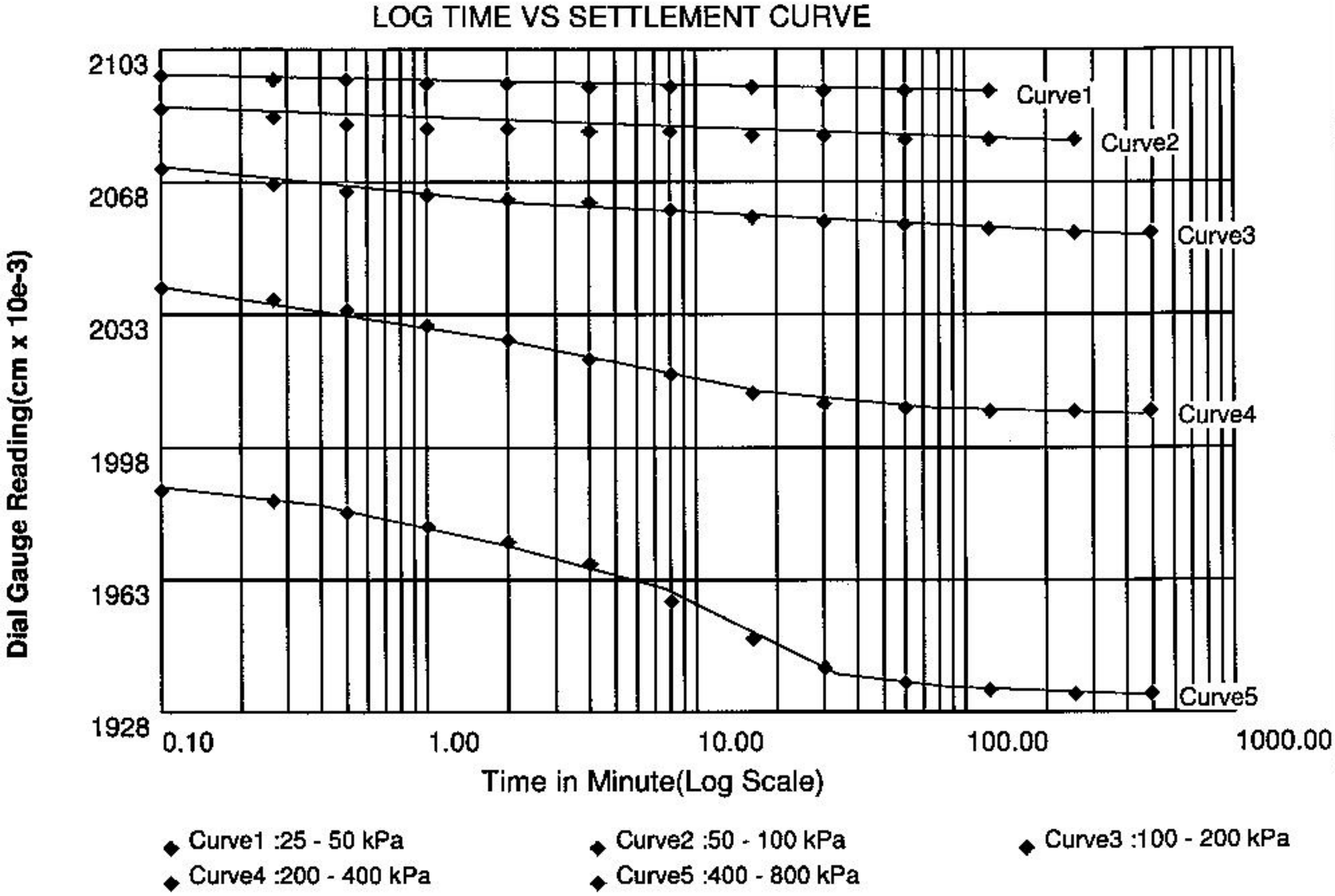


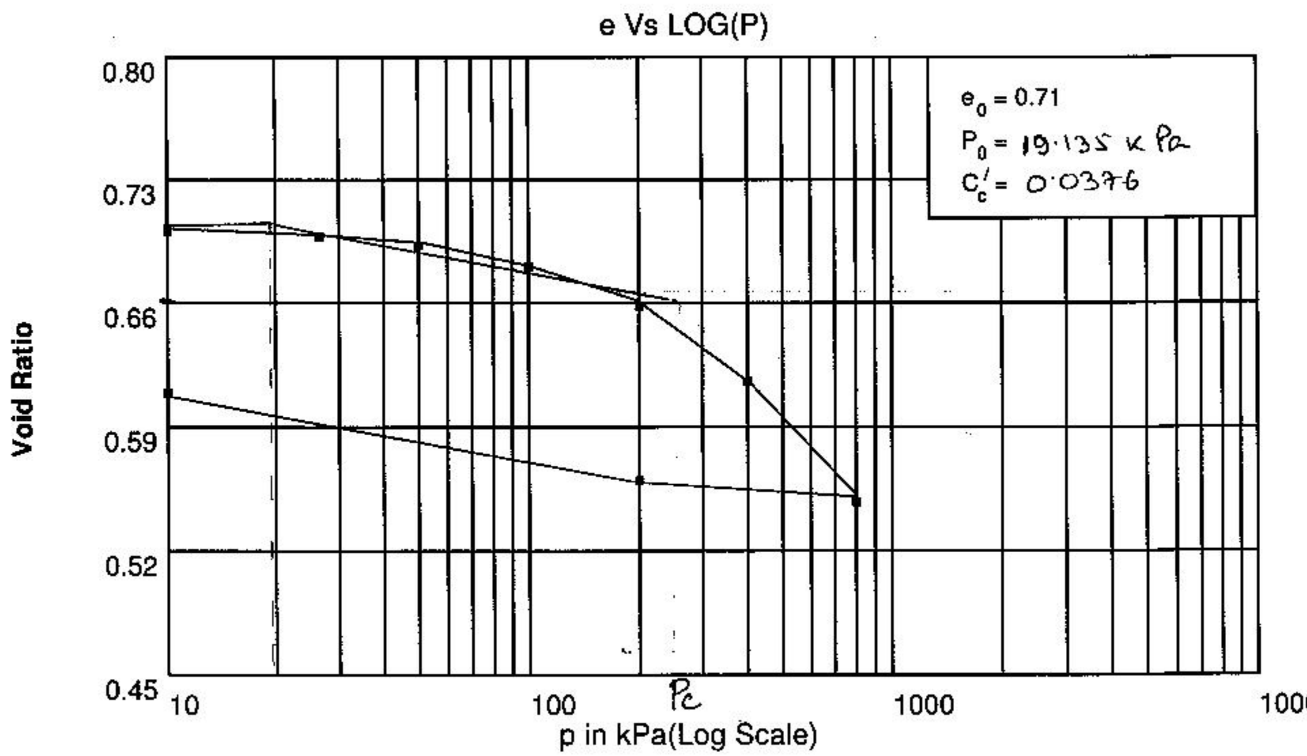
CONSOLIDATION TEST CURVES

Job No. :30796

SKM Geosurvey

Borehole No :16 Depth(m) :2.00-2.45 Sample No. :100954



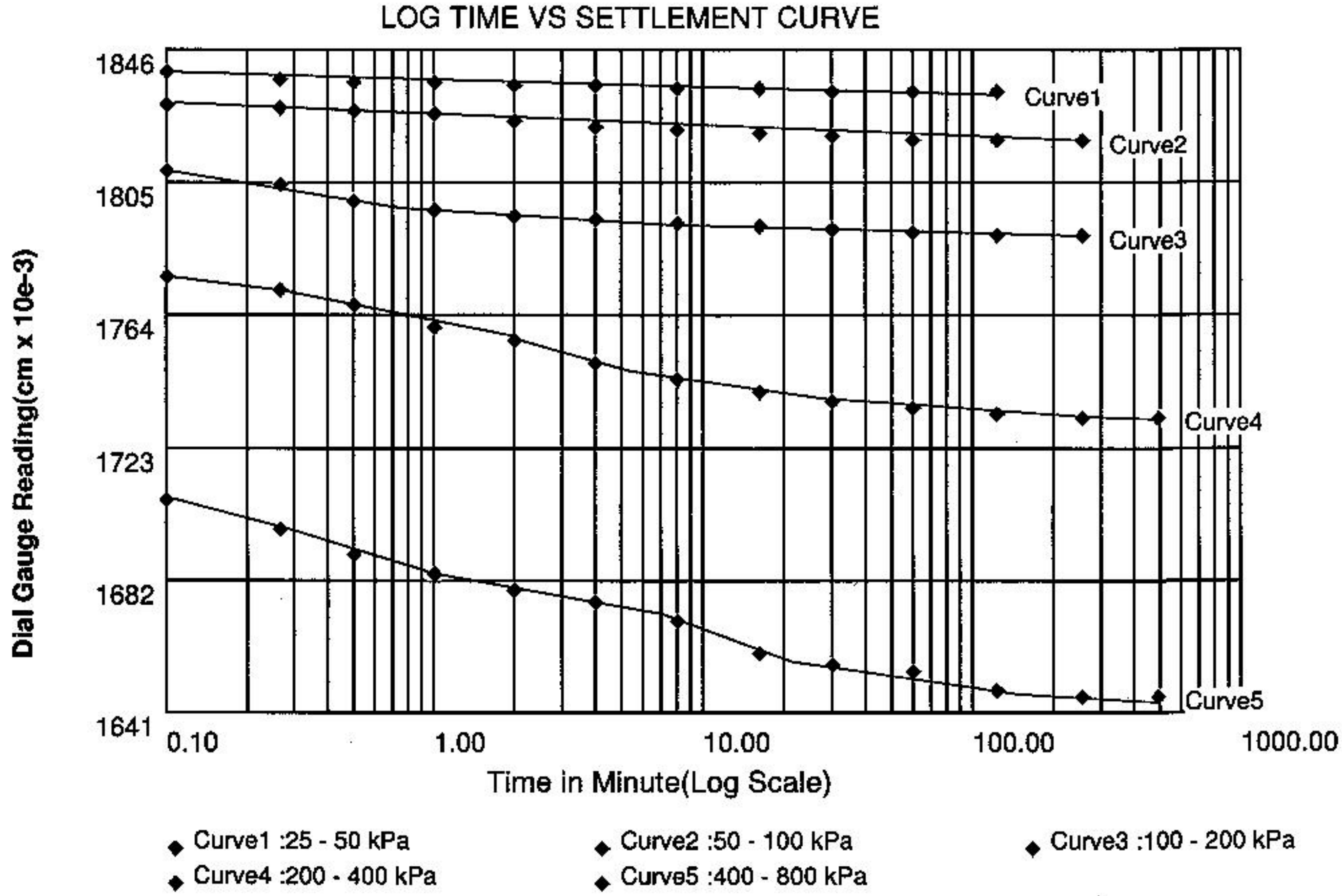


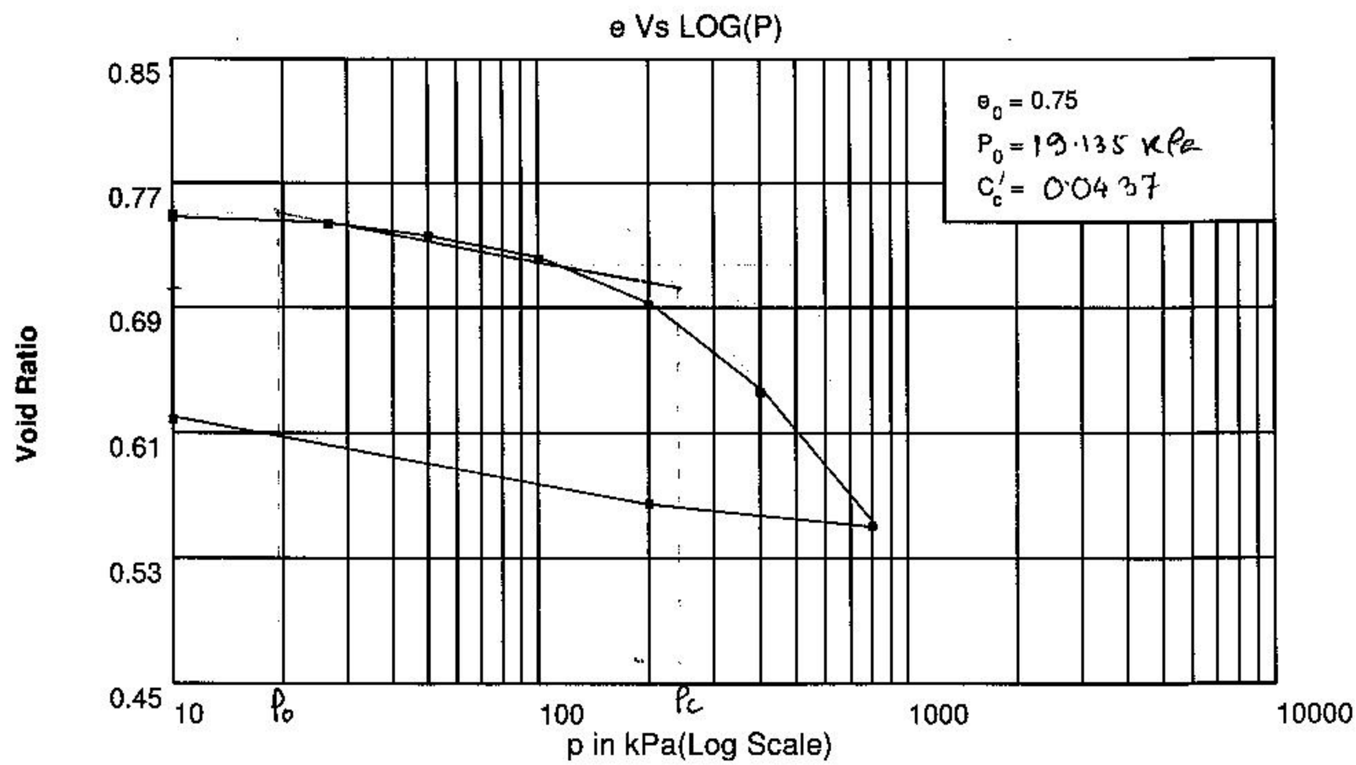
CONSOLIDATION TEST CURVES

Job No. :30796

SKM Geosurvey

Borehole No :17 Depth(m) :2.00-2.45 Sample No. :100517





CONSOLIDATION TEST CURVES

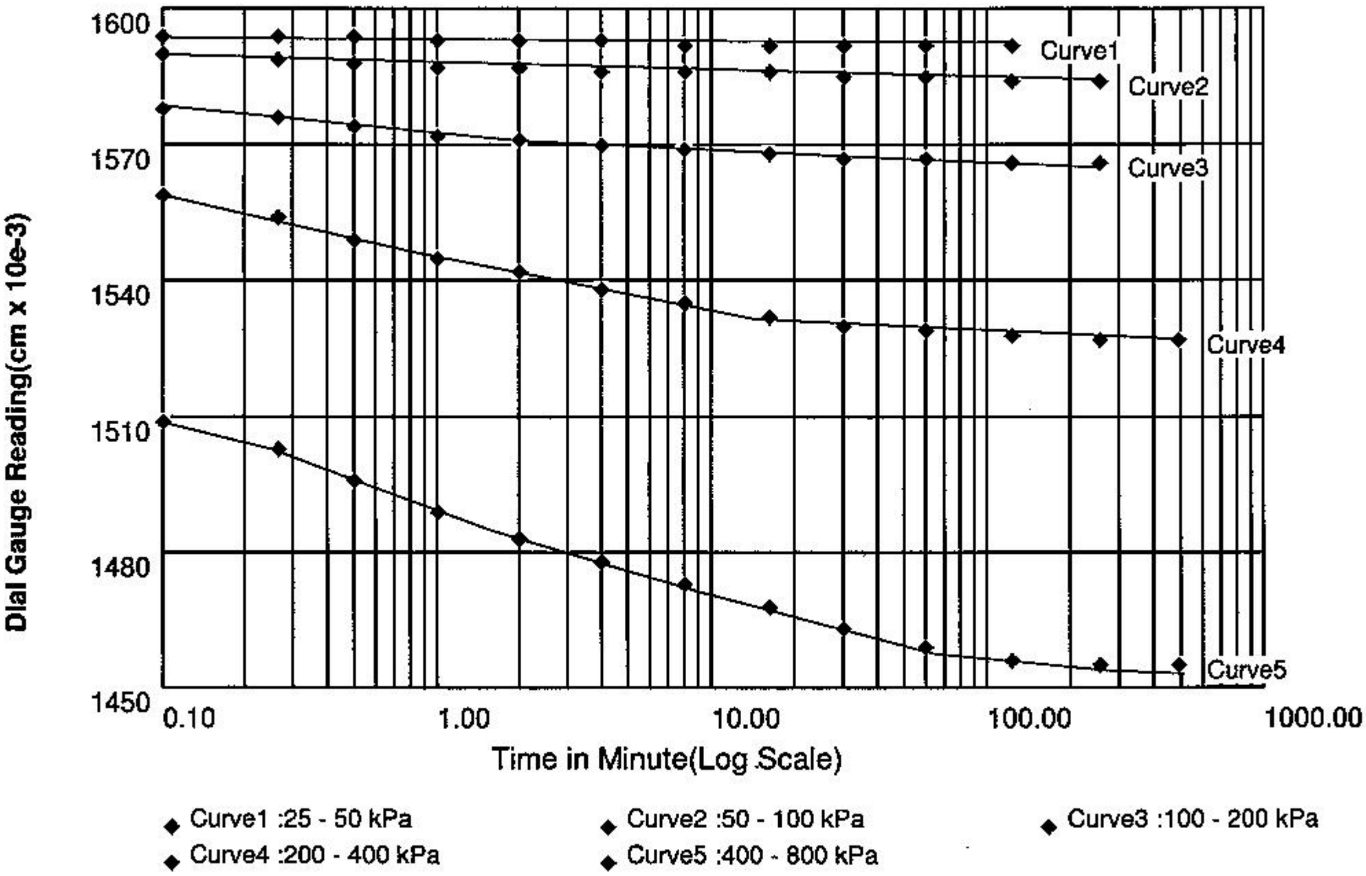
Job No. :30796

Borehole No :17

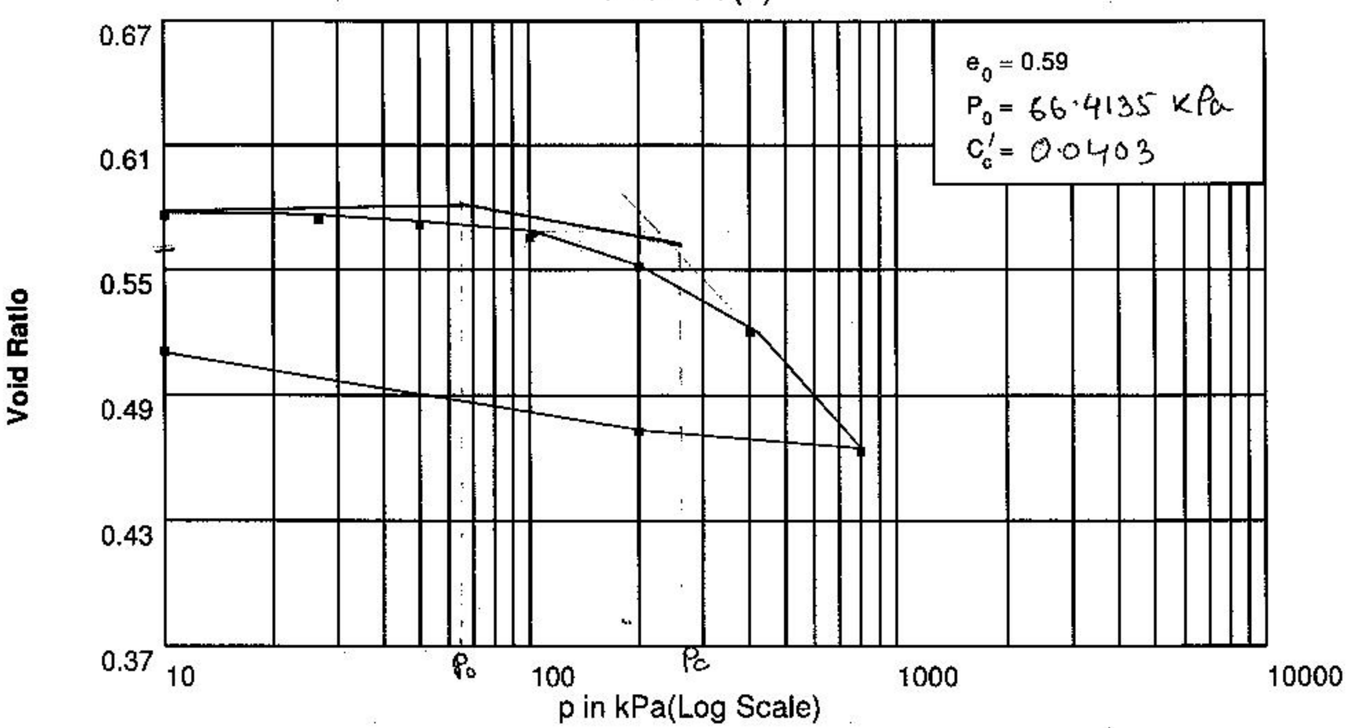
Depth(m) :7.50-7.95

Sample No. :100524

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)

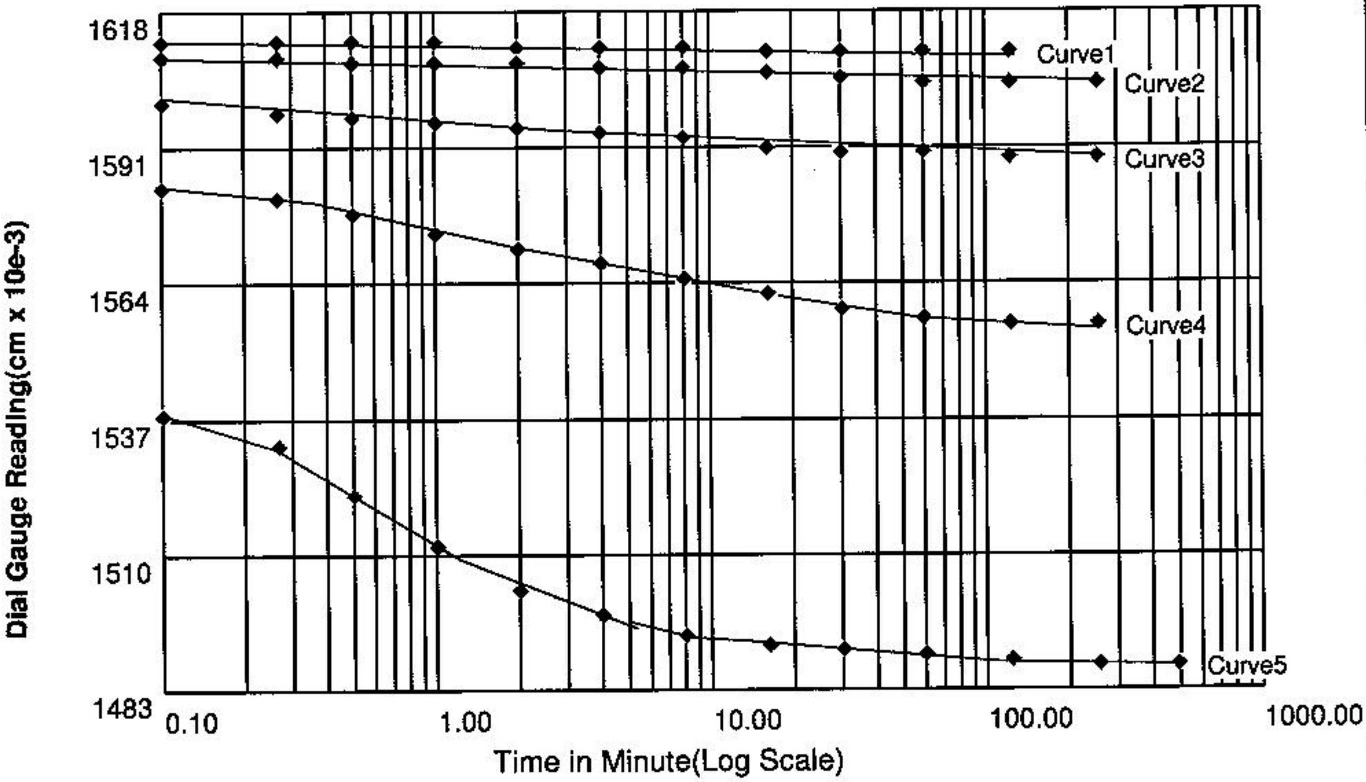


CONSOLIDATION TEST CURVES

Job No. :30796

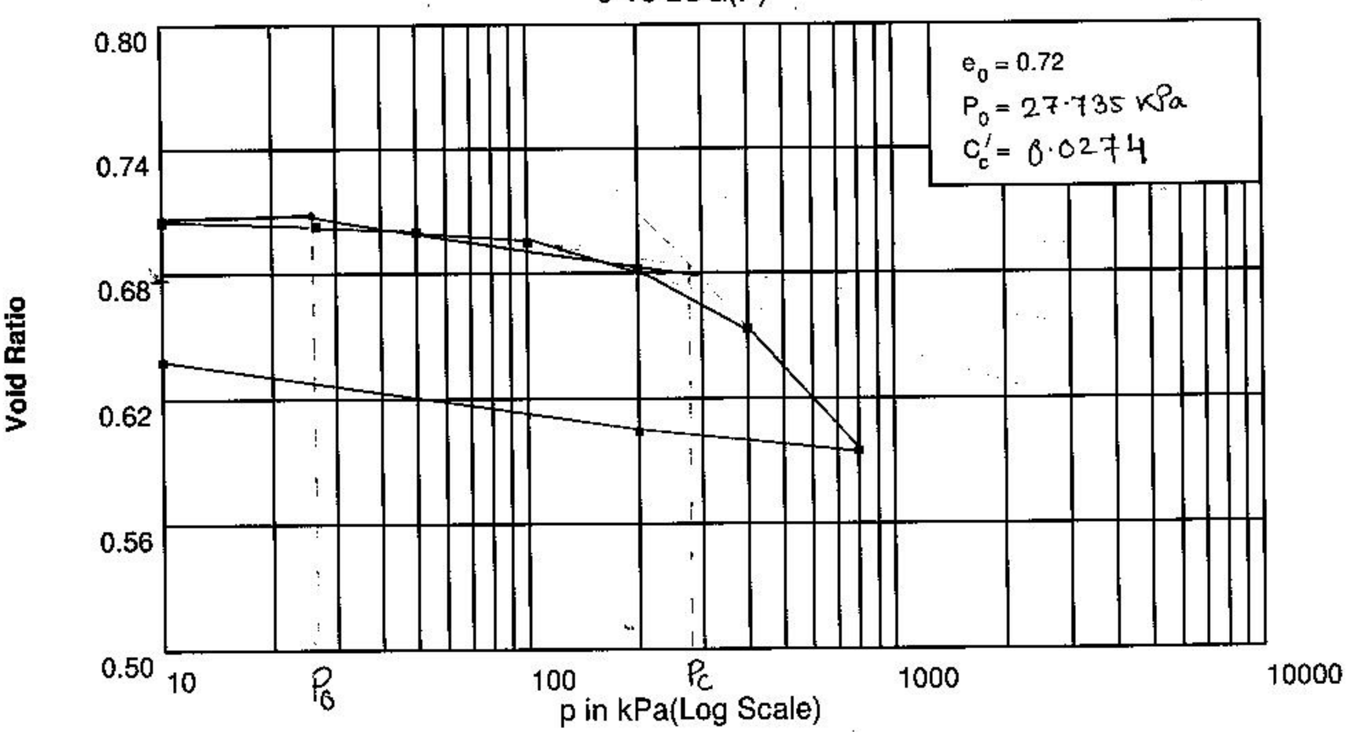
Borehole No :18 Depth(m) :3.00-3.45 Sample No. :100535

LOG TIME VS SETTLEMENT CURVE



Curve1 :25 - 50 kPa
Curve2 :50 - 100 kPa
Curve3 :100 - 200 kPa
Curve4 :200 - 400 kPa
Curve5 :400 - 800 kPa

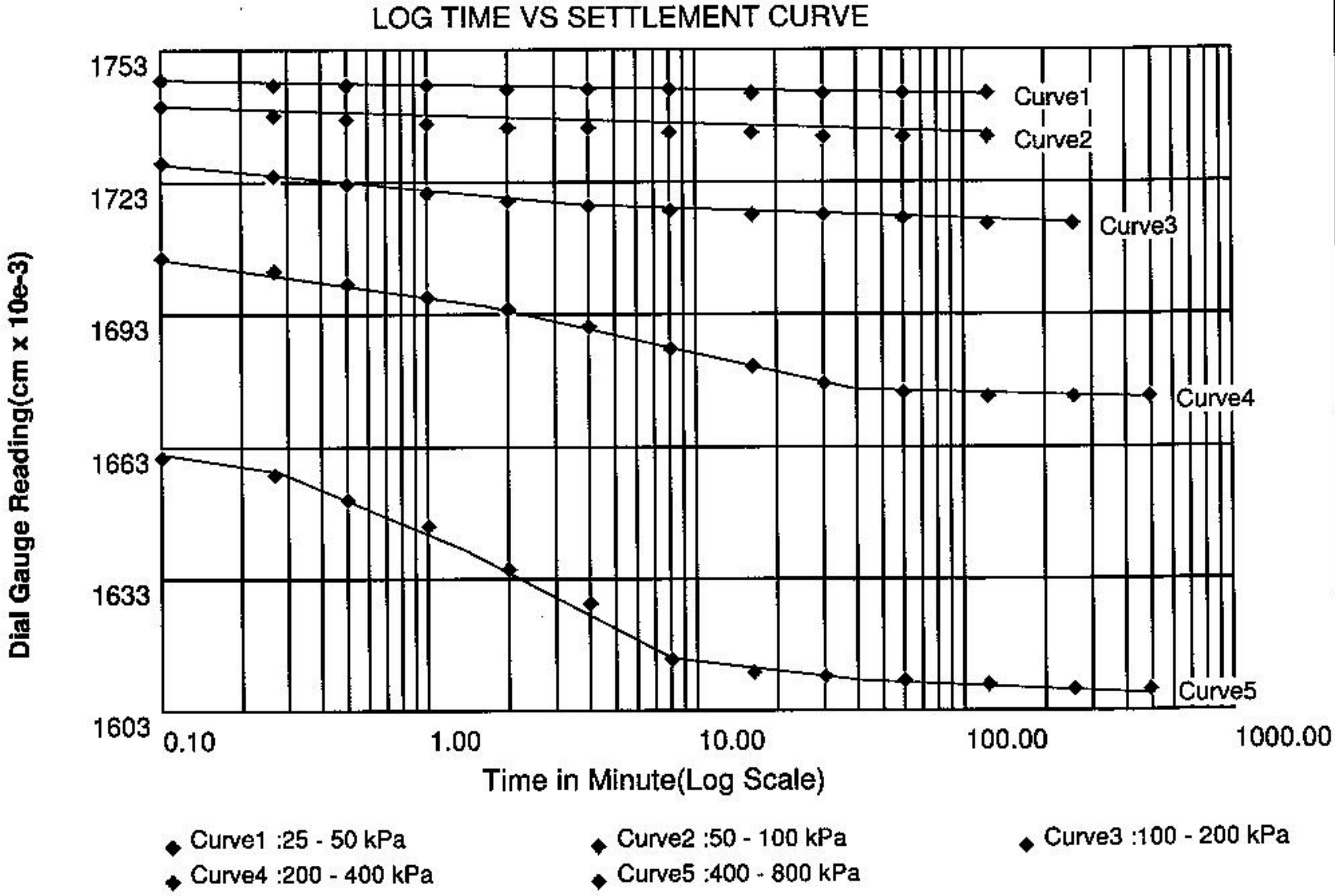
e Vs LOG(P)

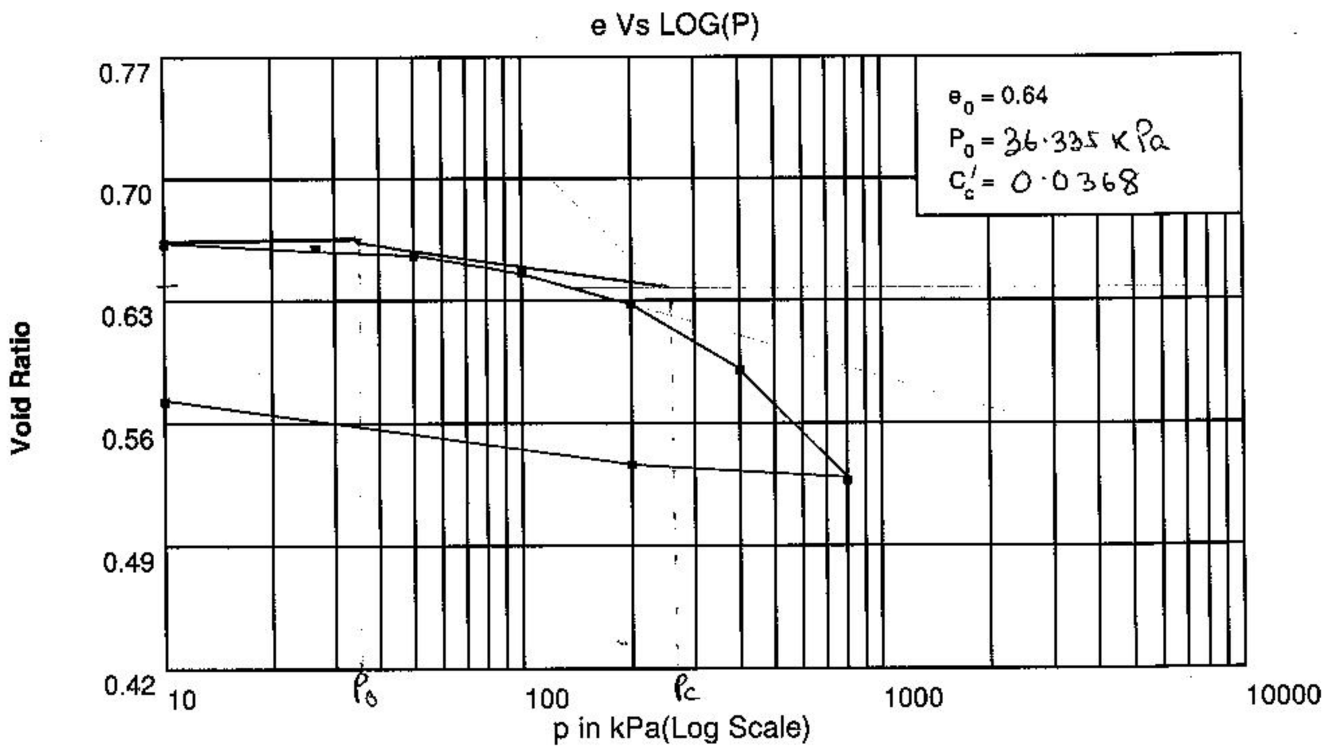


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :19 Depth(m) :4.00-4.45 Sample No. :100507

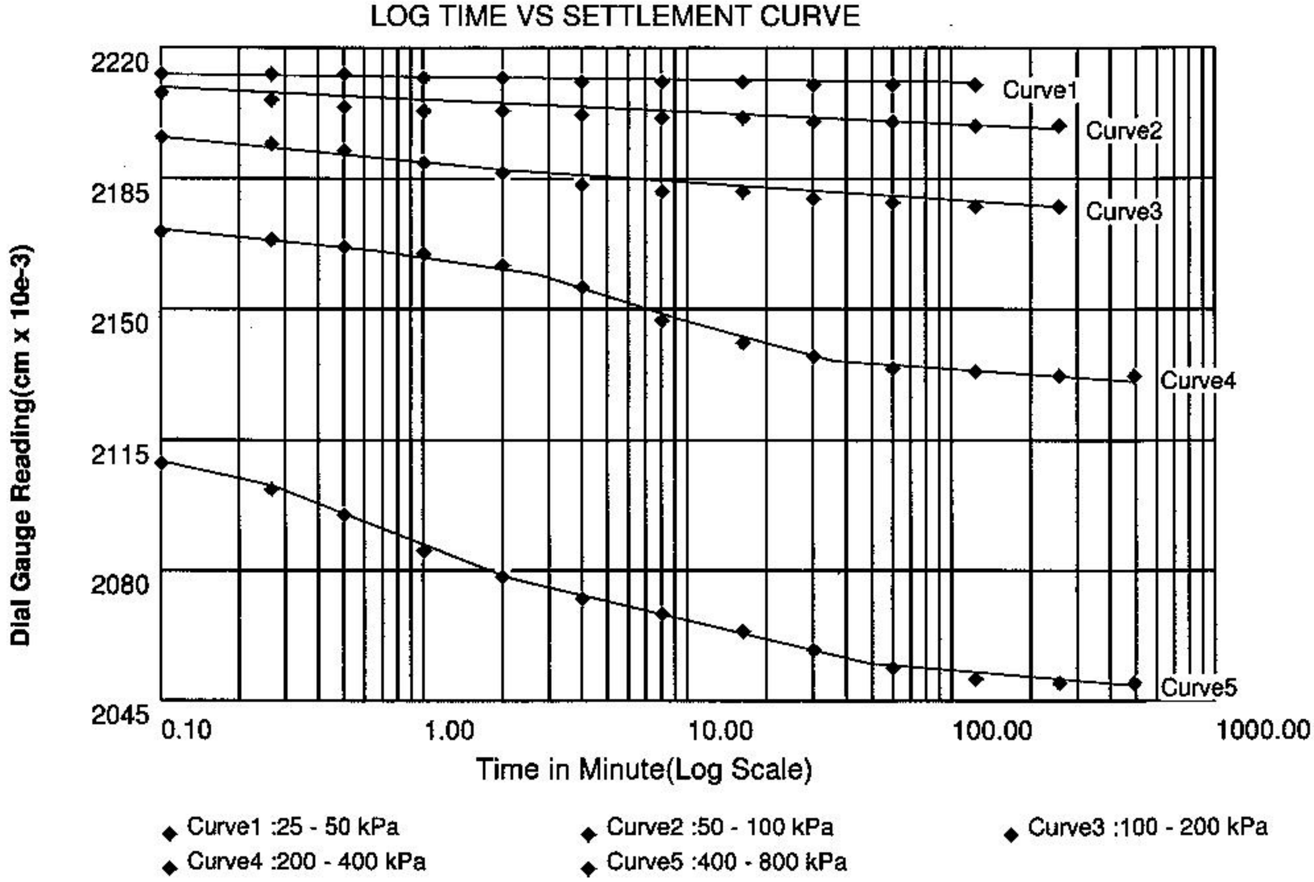


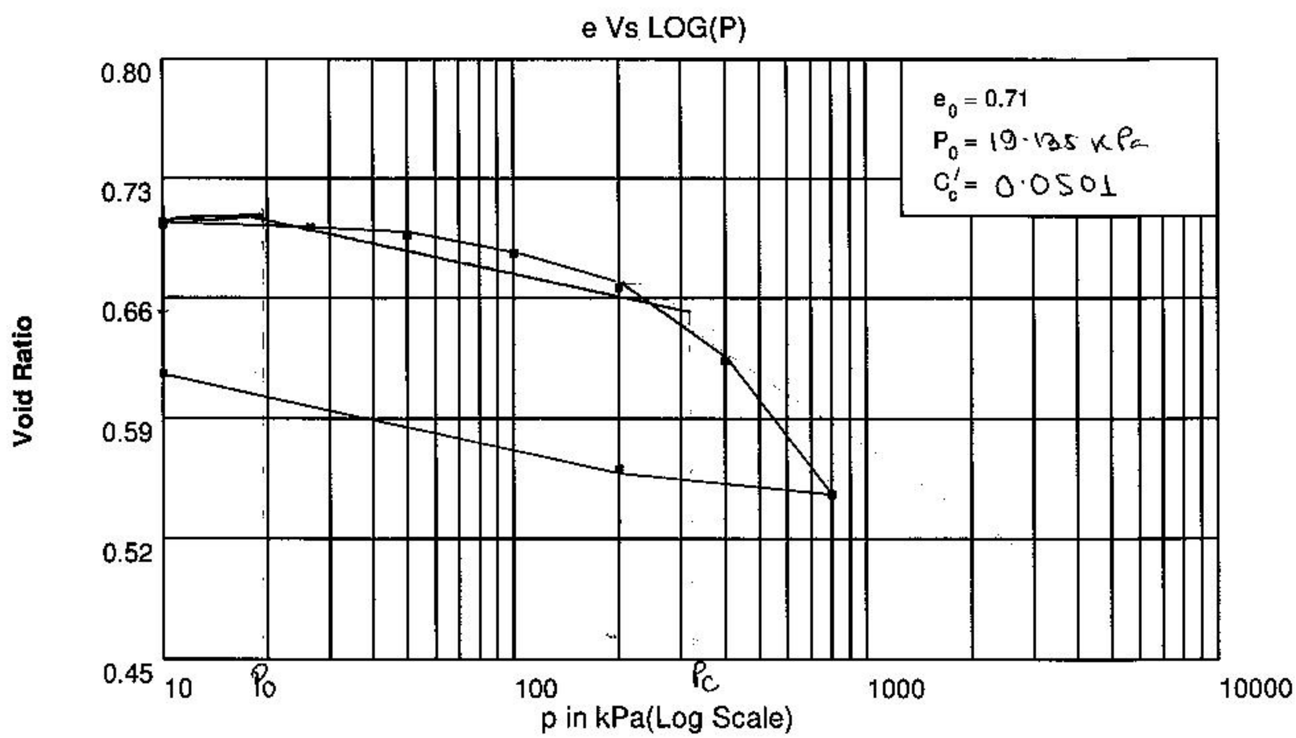


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :20 Depth(m) :2.00-2.45 Sample No. :120103



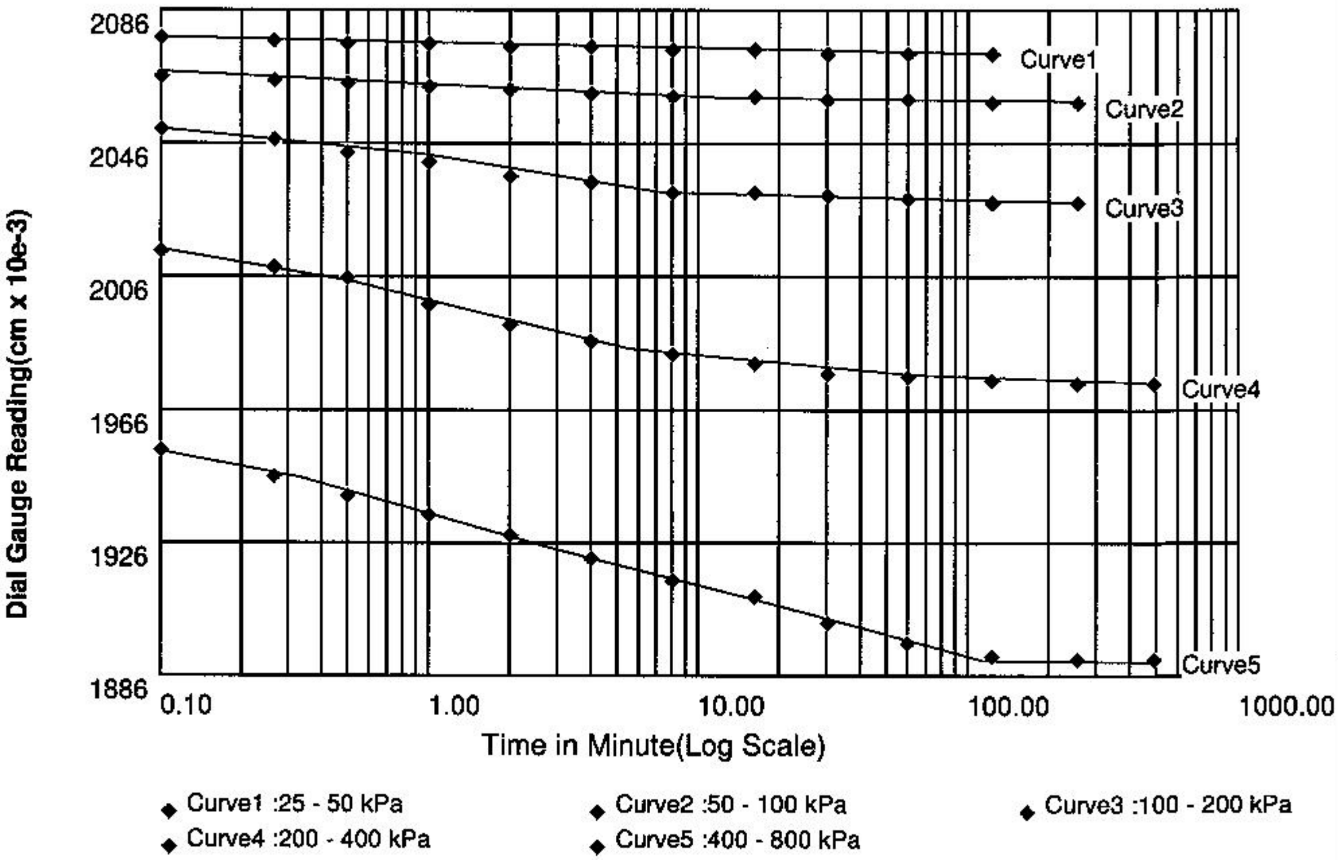


CONSOLIDATION TEST CURVES

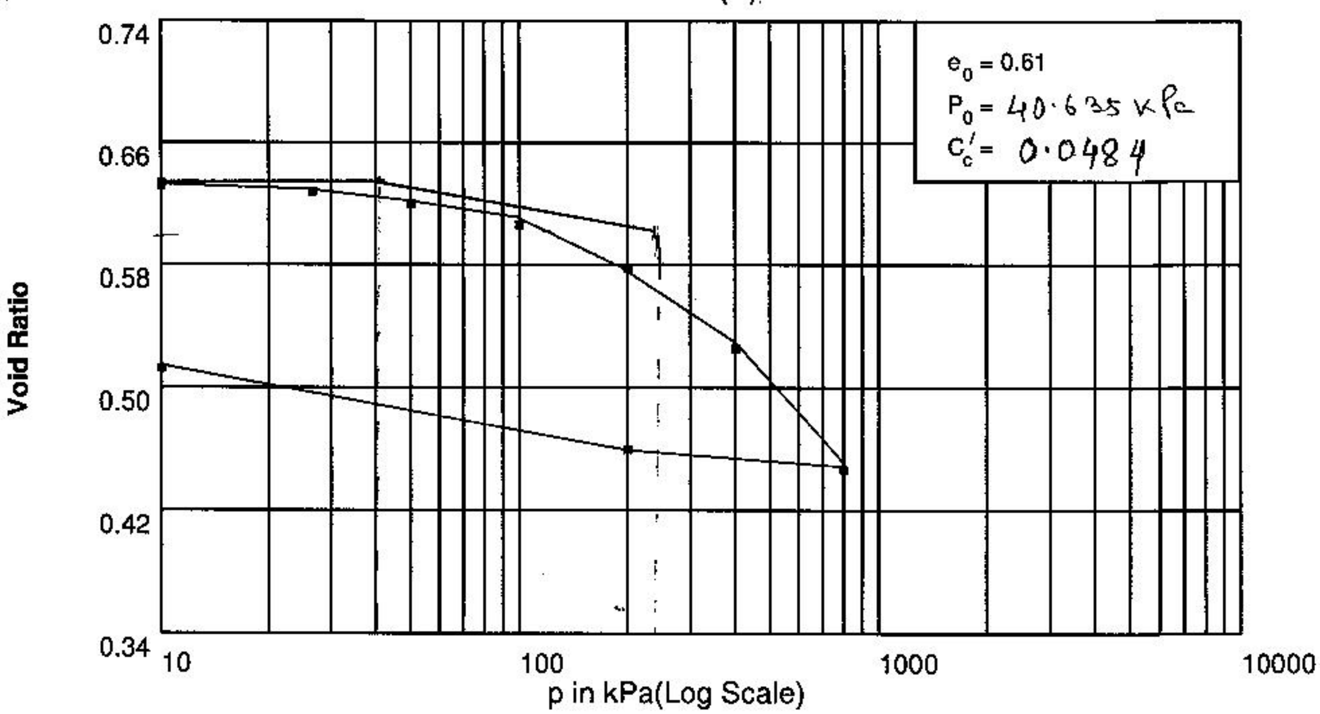
Job No. :30796

Borehole No :21 Depth(m) :4.50-4.95 Sample No. :120117

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)



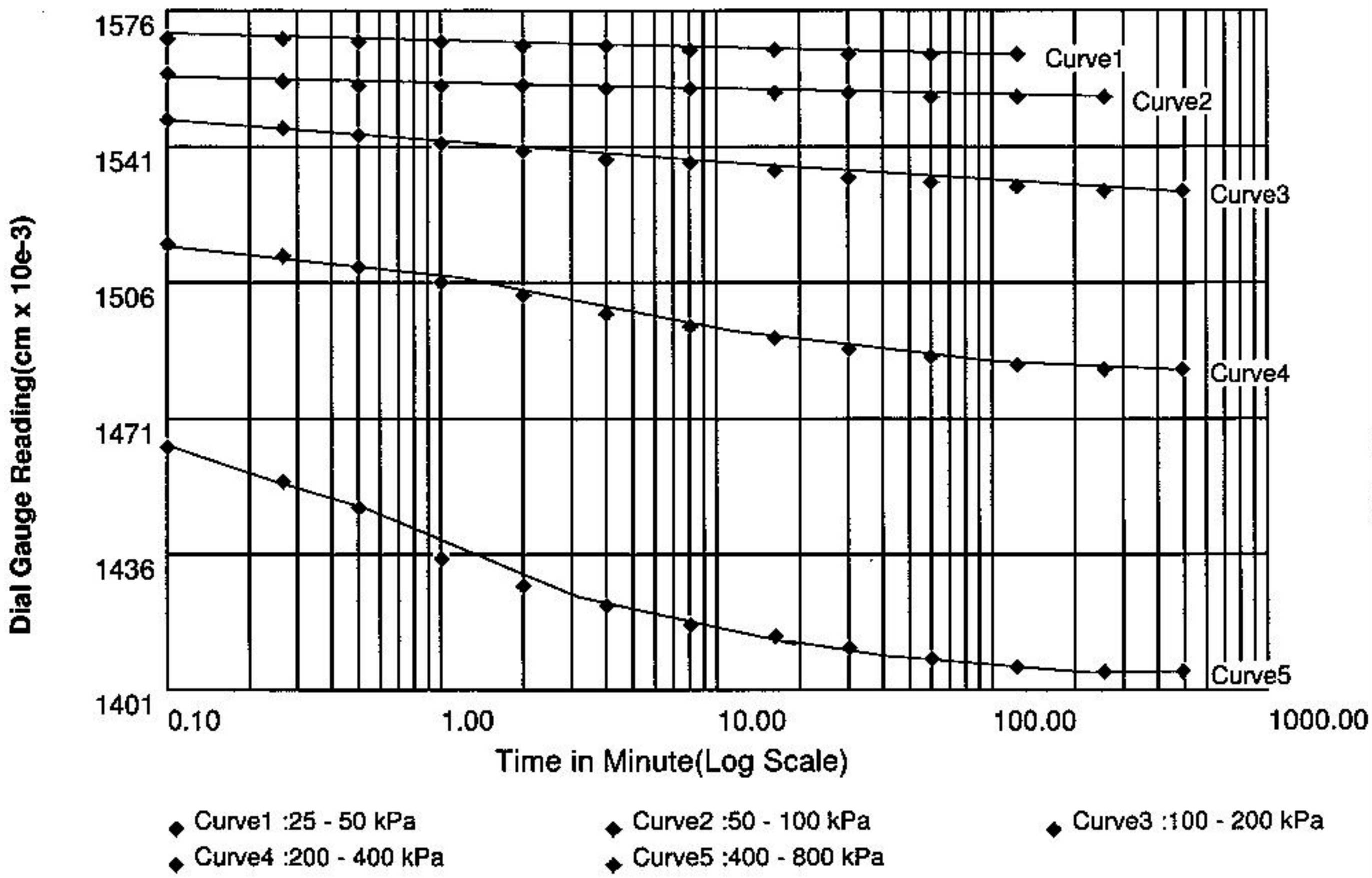
CONSOLIDATION TEST CURVES

Job No. :30796

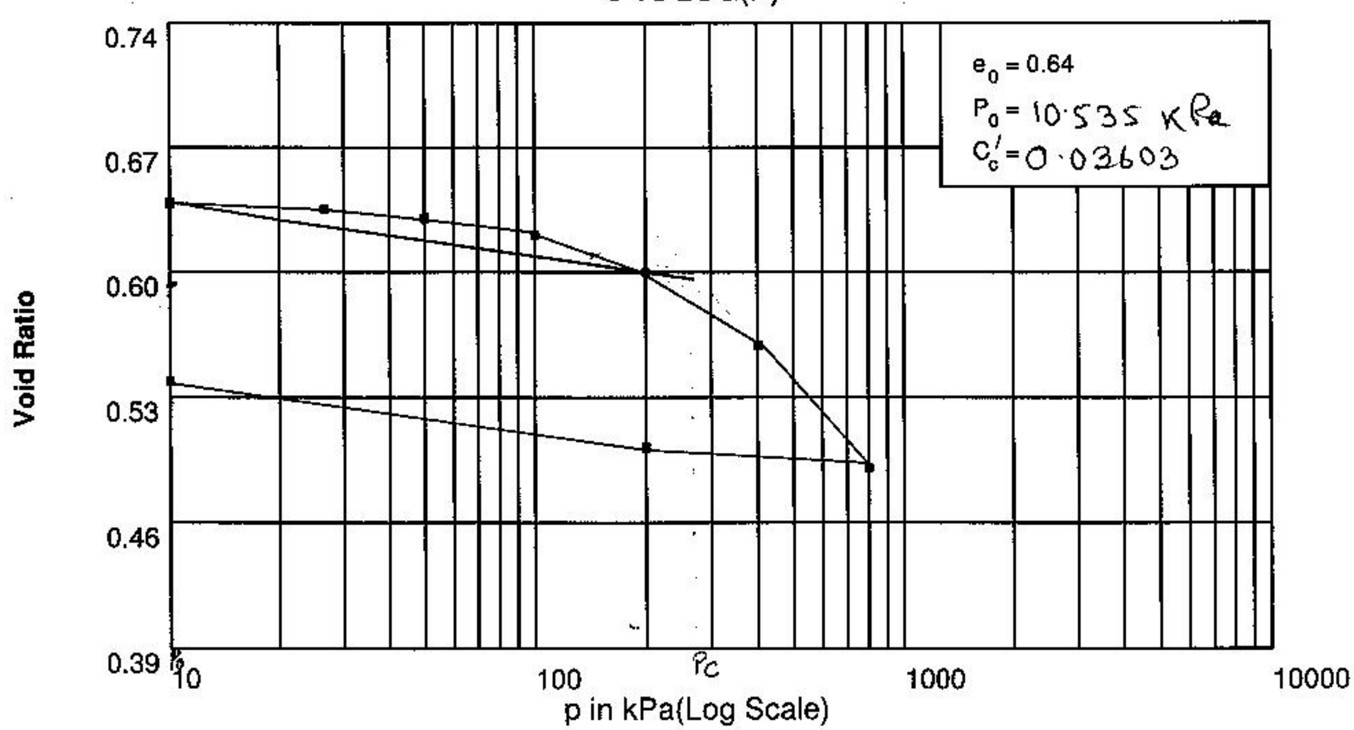
SKM Geosurvey

Borehole No :22 Depth(m) :1.00-1.45 Sample No. :165101

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)

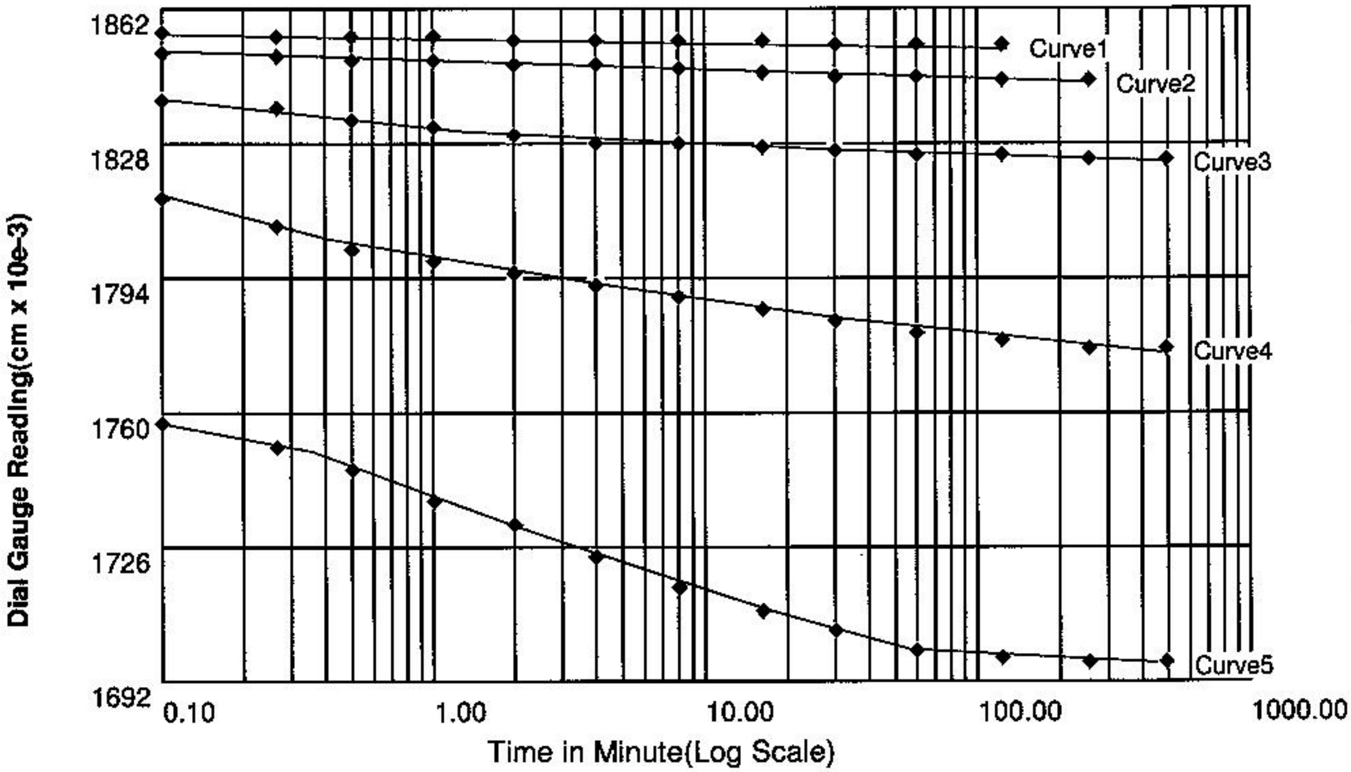


CONSOLIDATION TEST CURVES

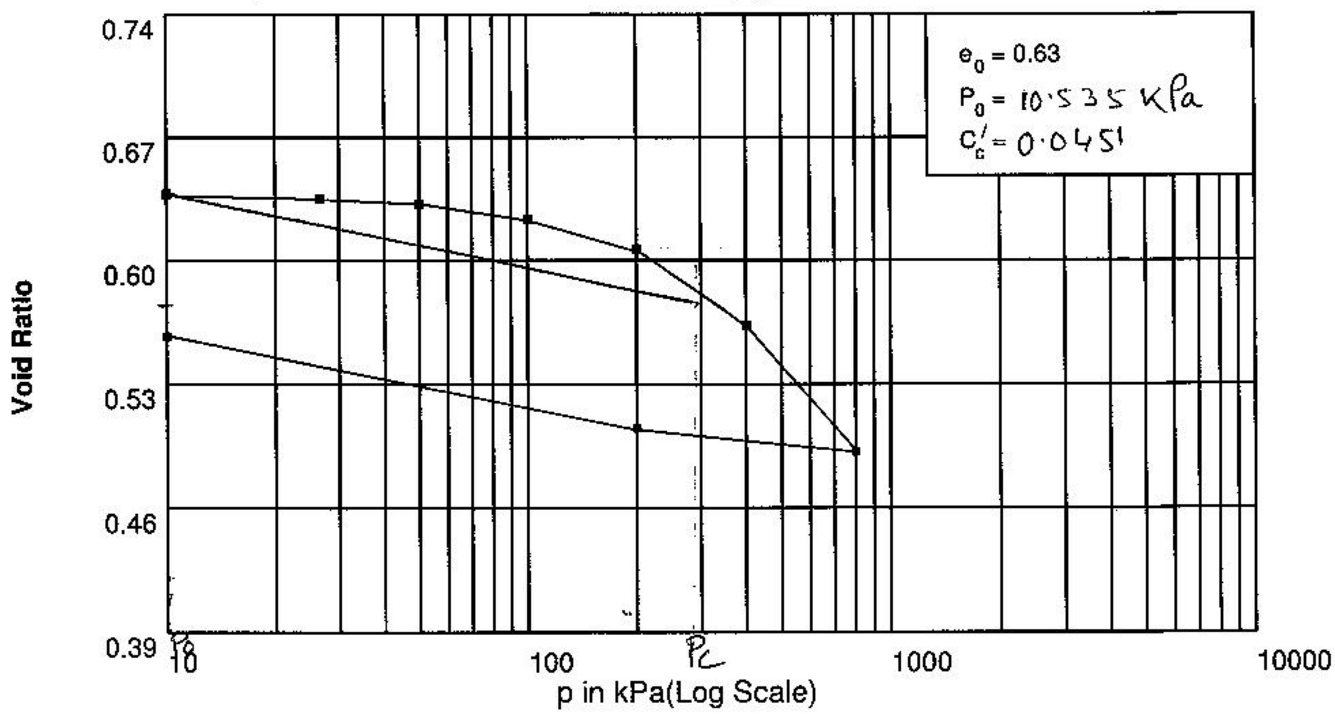
Job No. :30796

Borehole No :23 Depth(m) :1.00-1.45 Sample No. :100251

LOG TIME VS SETTLEMENT CURVE



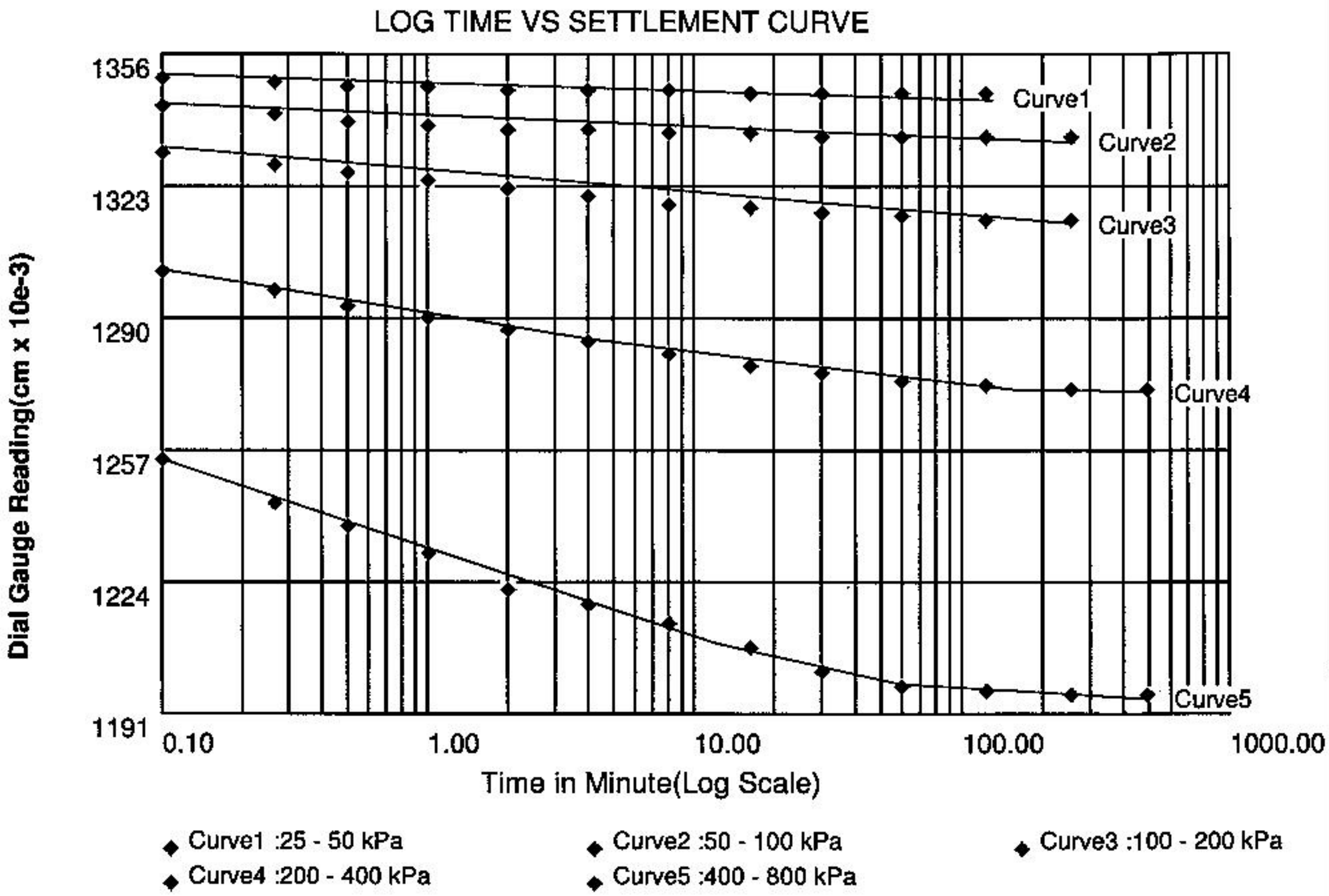
e Vs LOG(P)

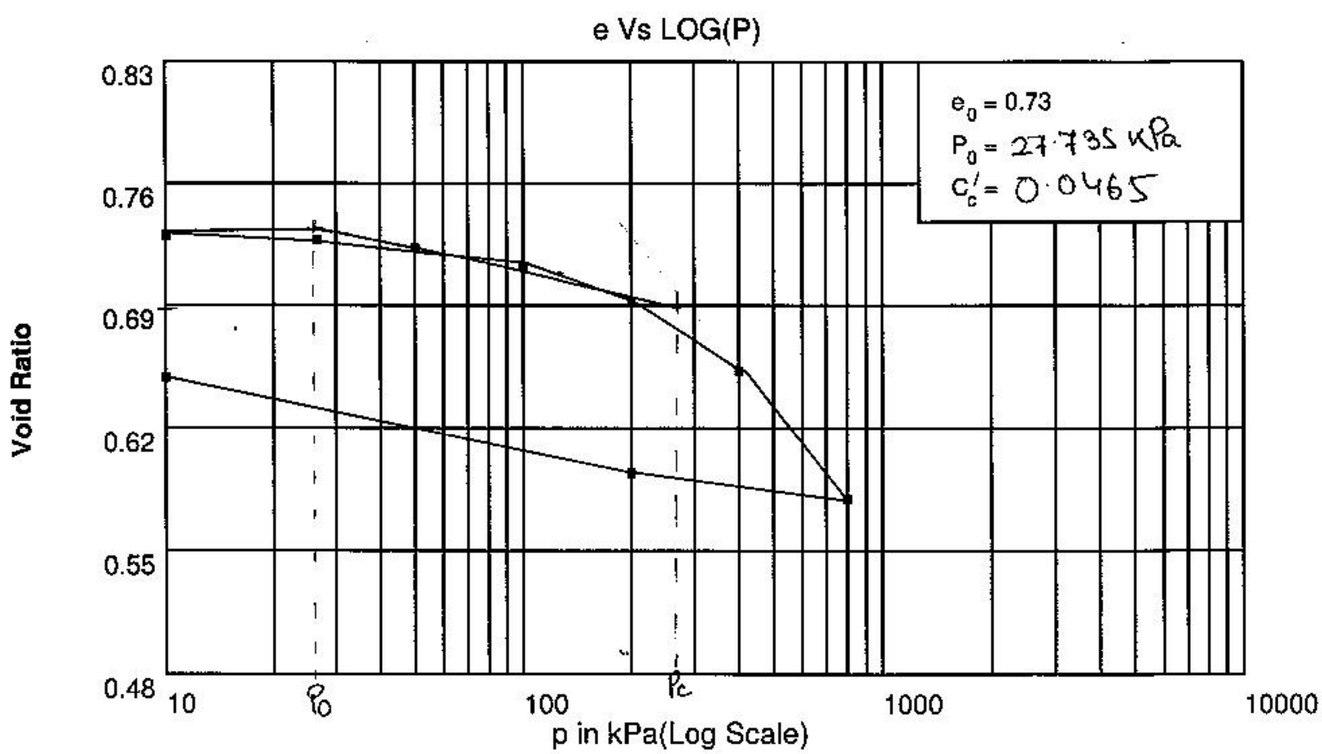


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :24   Depth(m) :3.00-3.45   Sample No. :100106





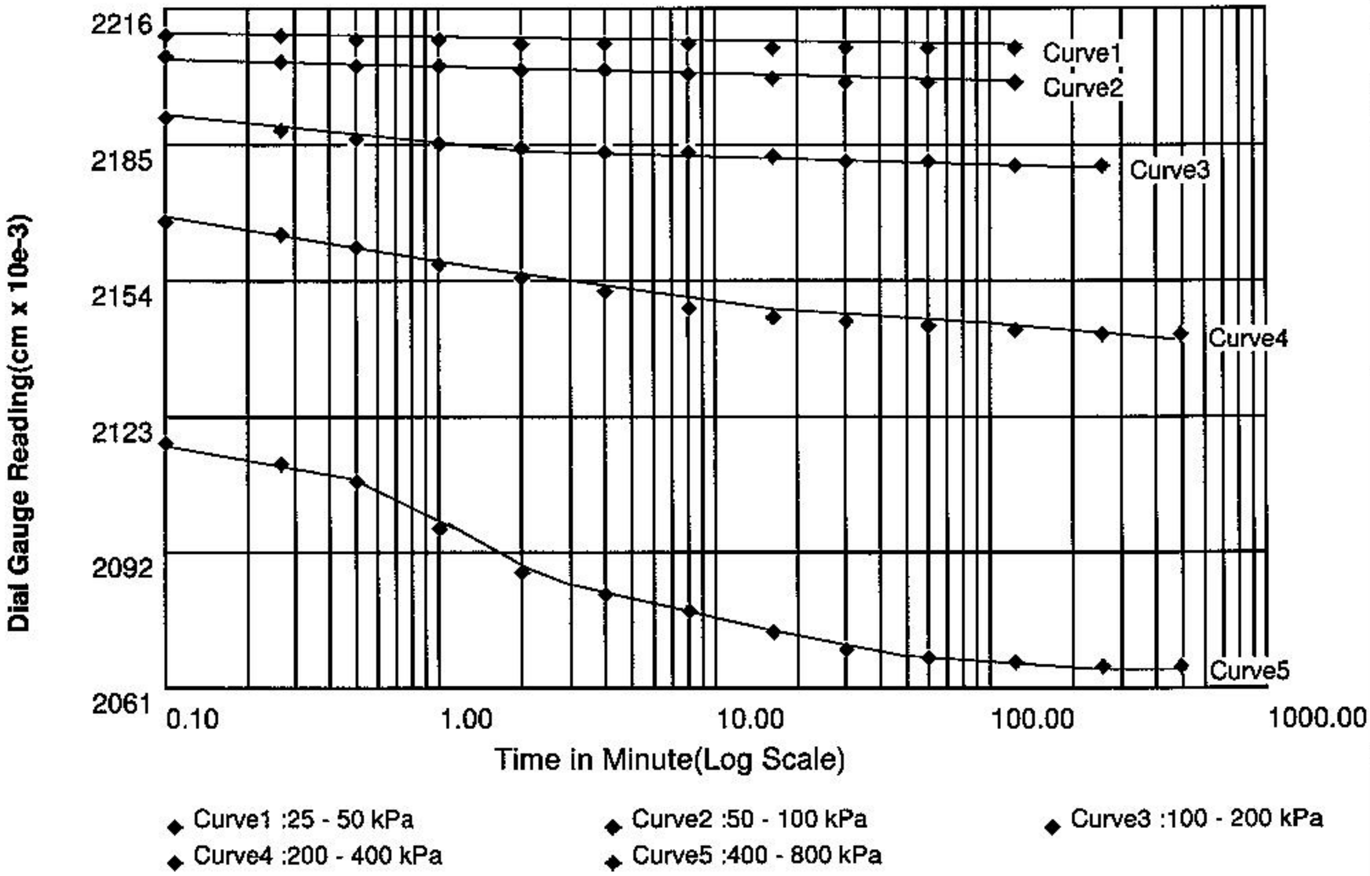
CONSOLIDATION TEST CURVES

Job No. :30796

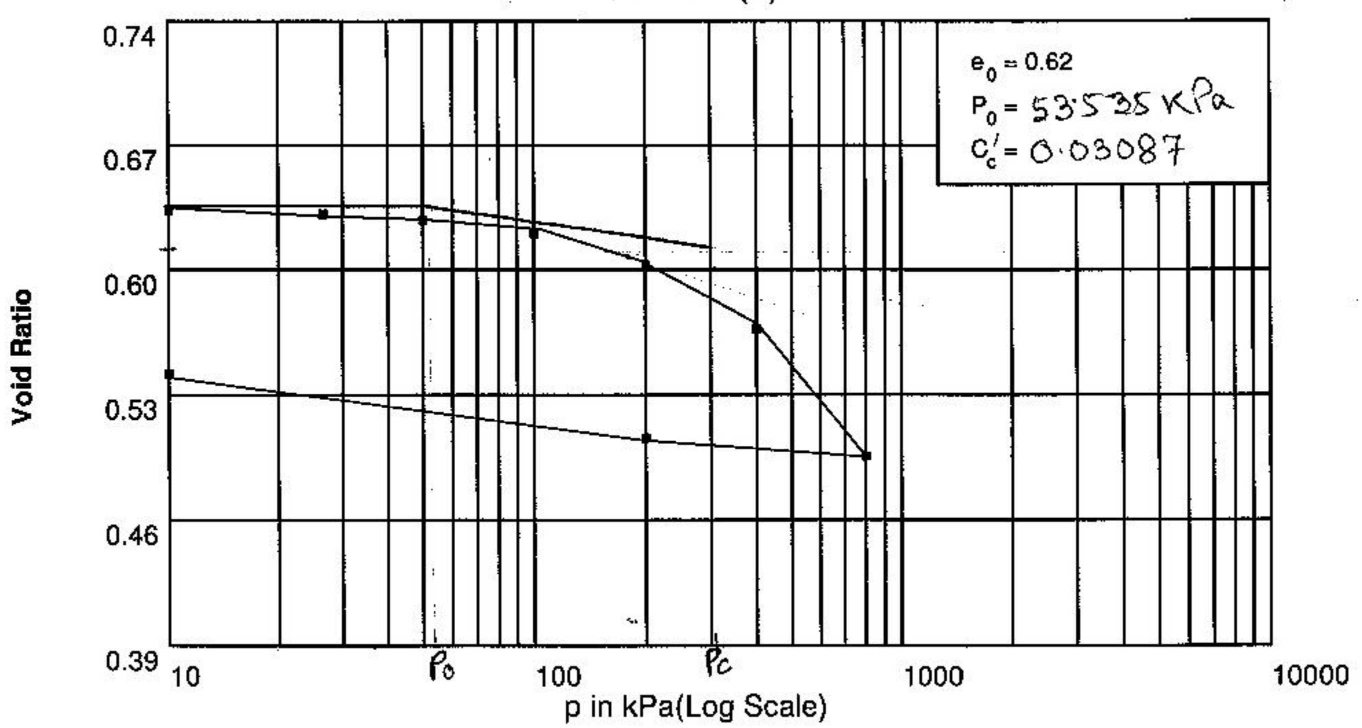
SKM Geosurvey

Borehole No :25 Depth(m) :6.00-6.45 Sample No. :170027

LOG TIME VS SETTLEMENT CURVE



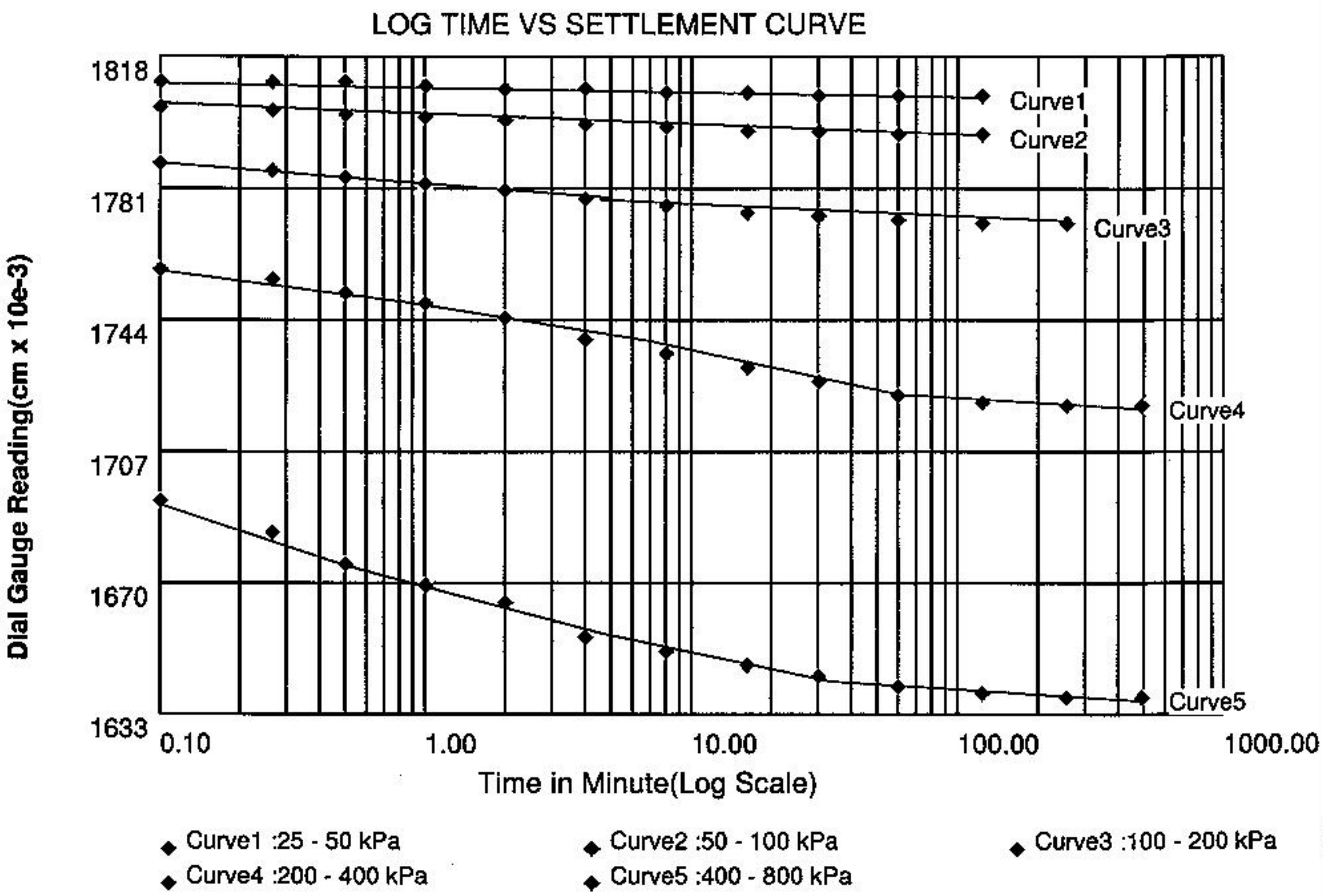
e Vs LOG(P)

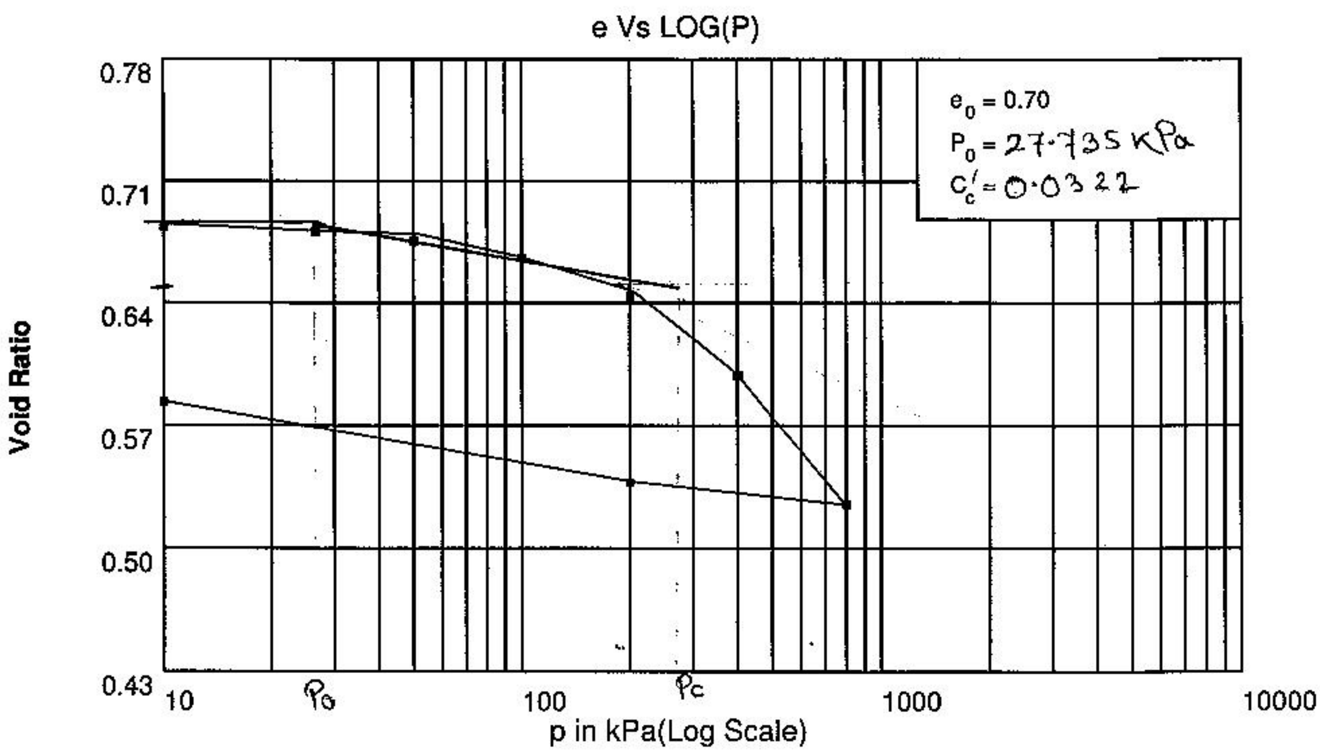


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :26 | Depth(m) :3.00-3.45 | Sample No. :182160

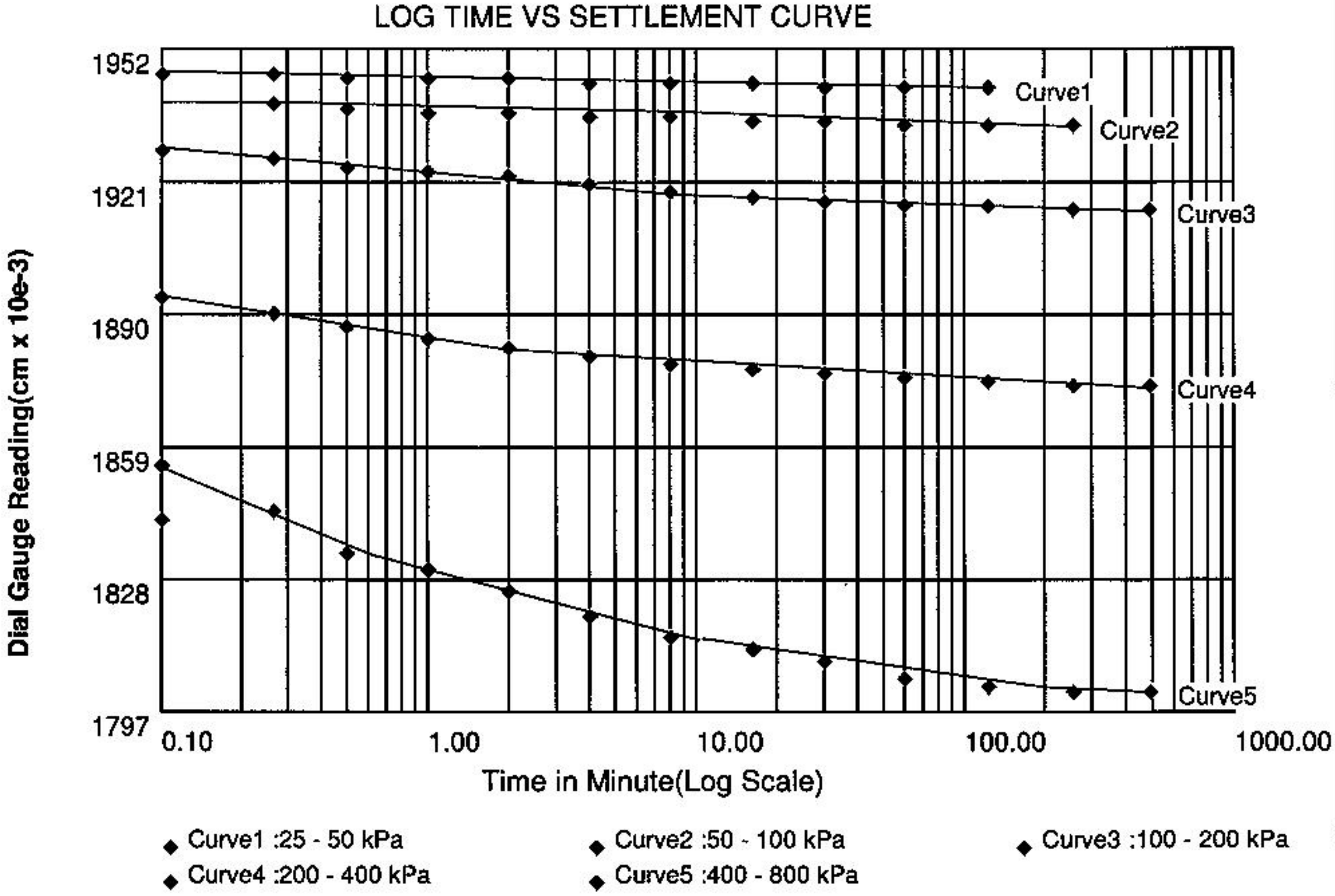


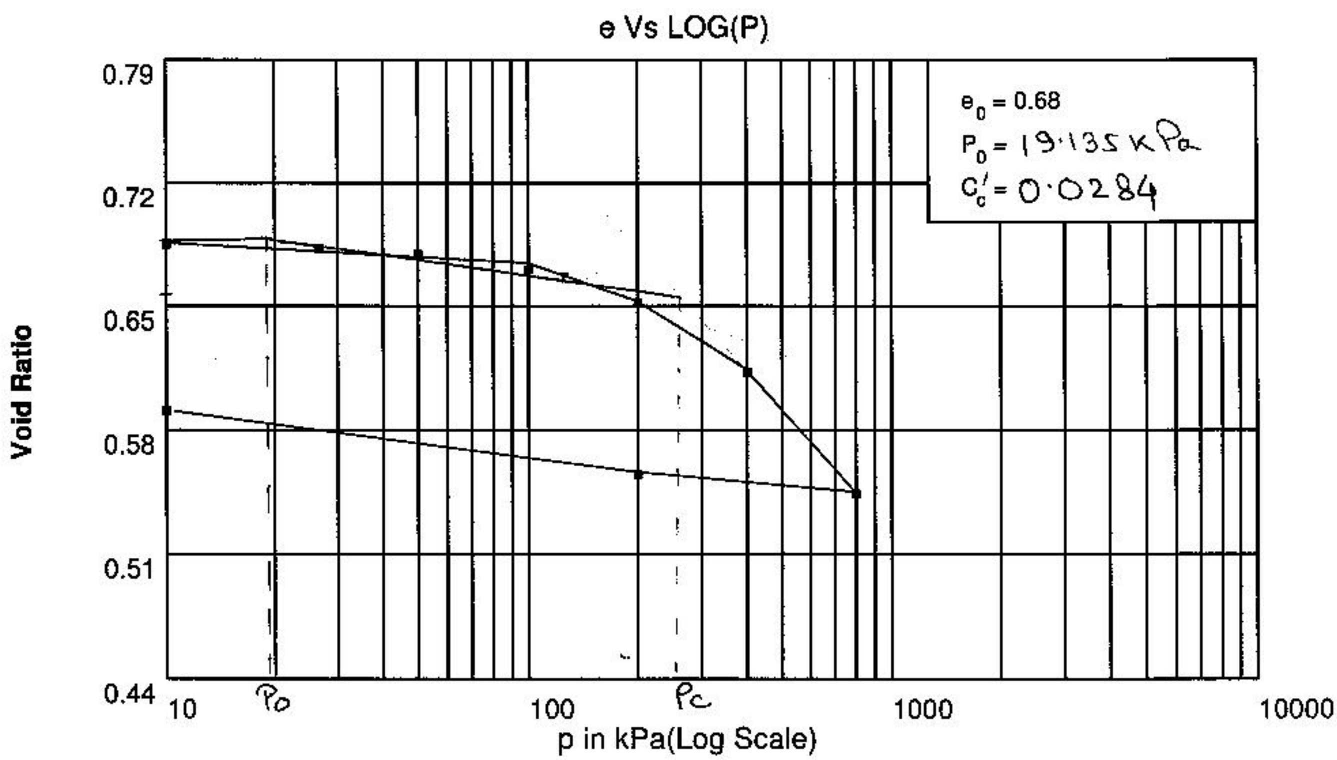


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :27 | Depth(m) :2.00-2.45 | Sample No. :170663

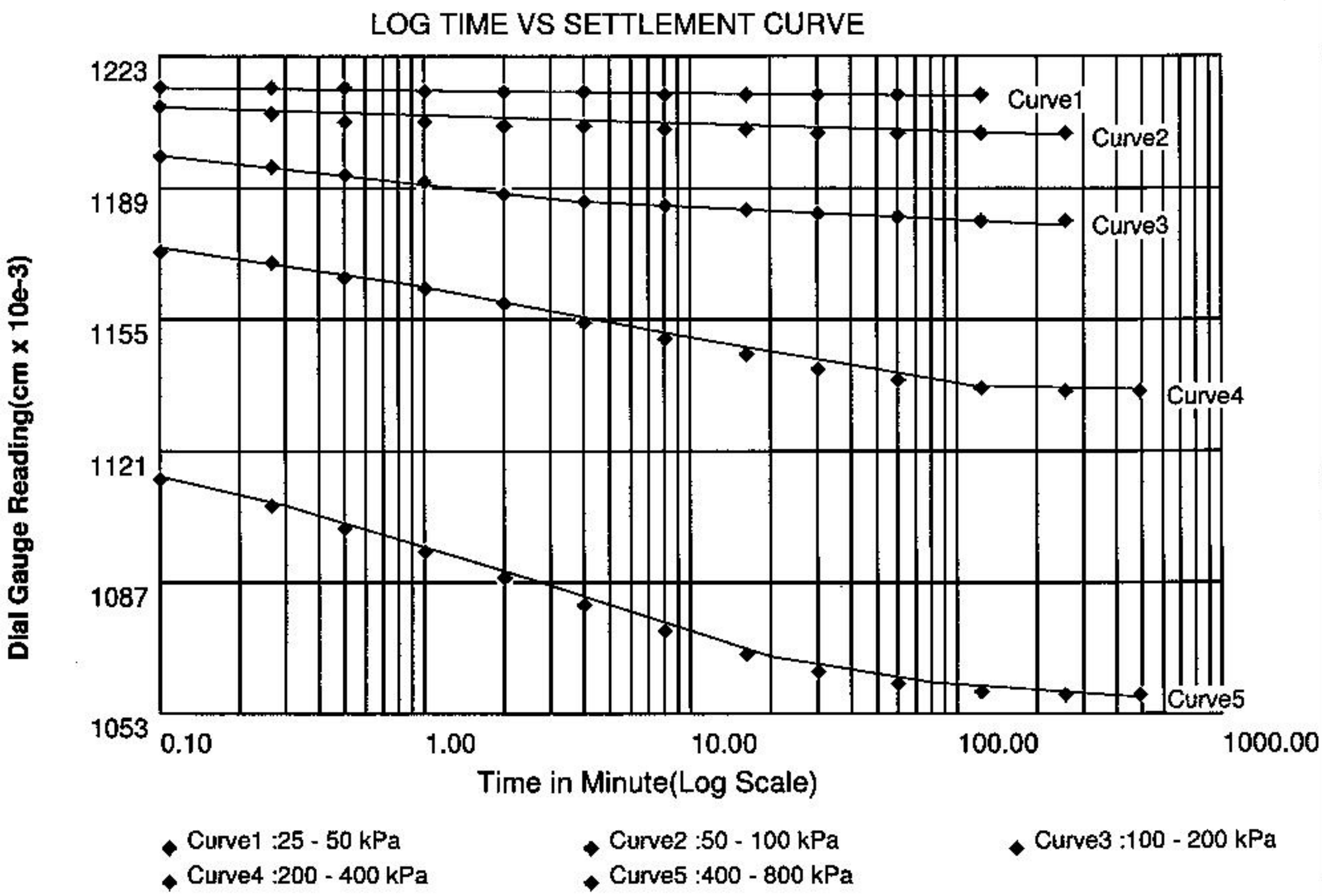


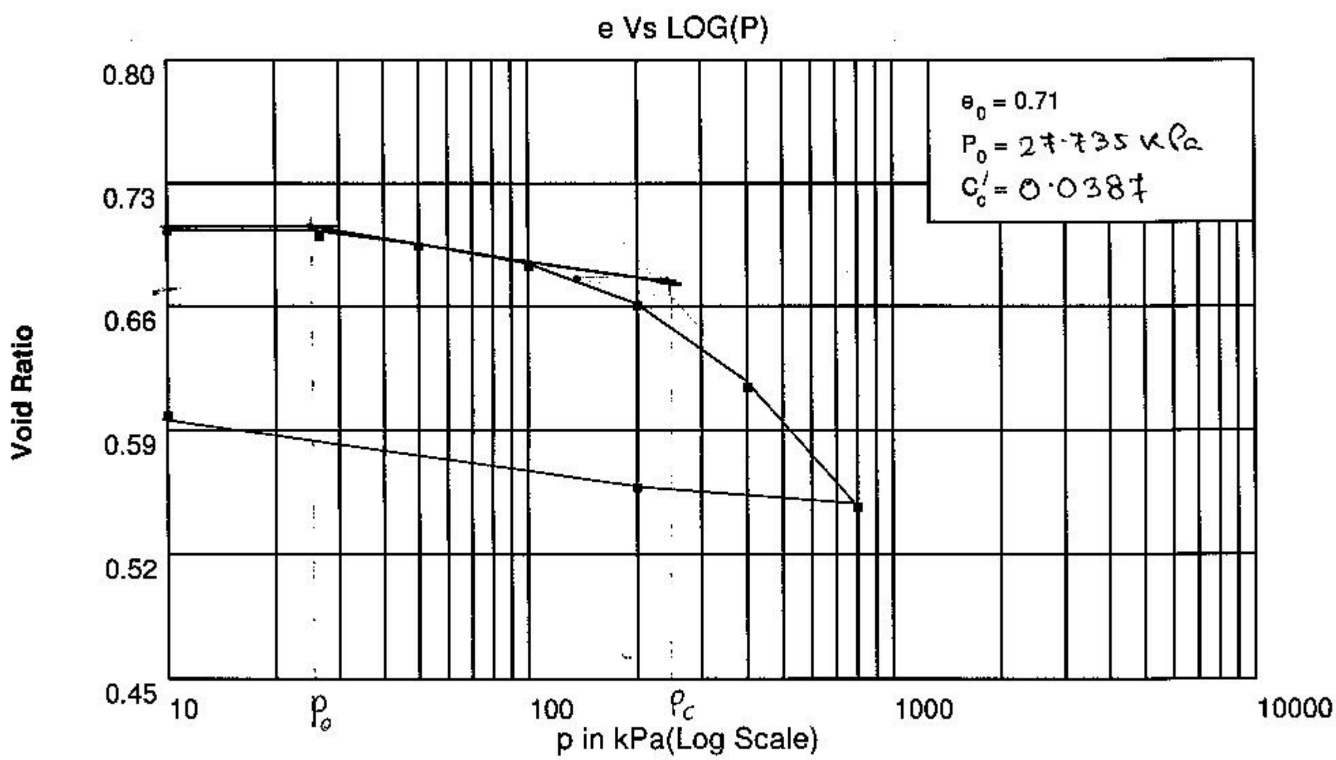


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :28 Depth(m) :3.00-3.45 Sample No. :160775

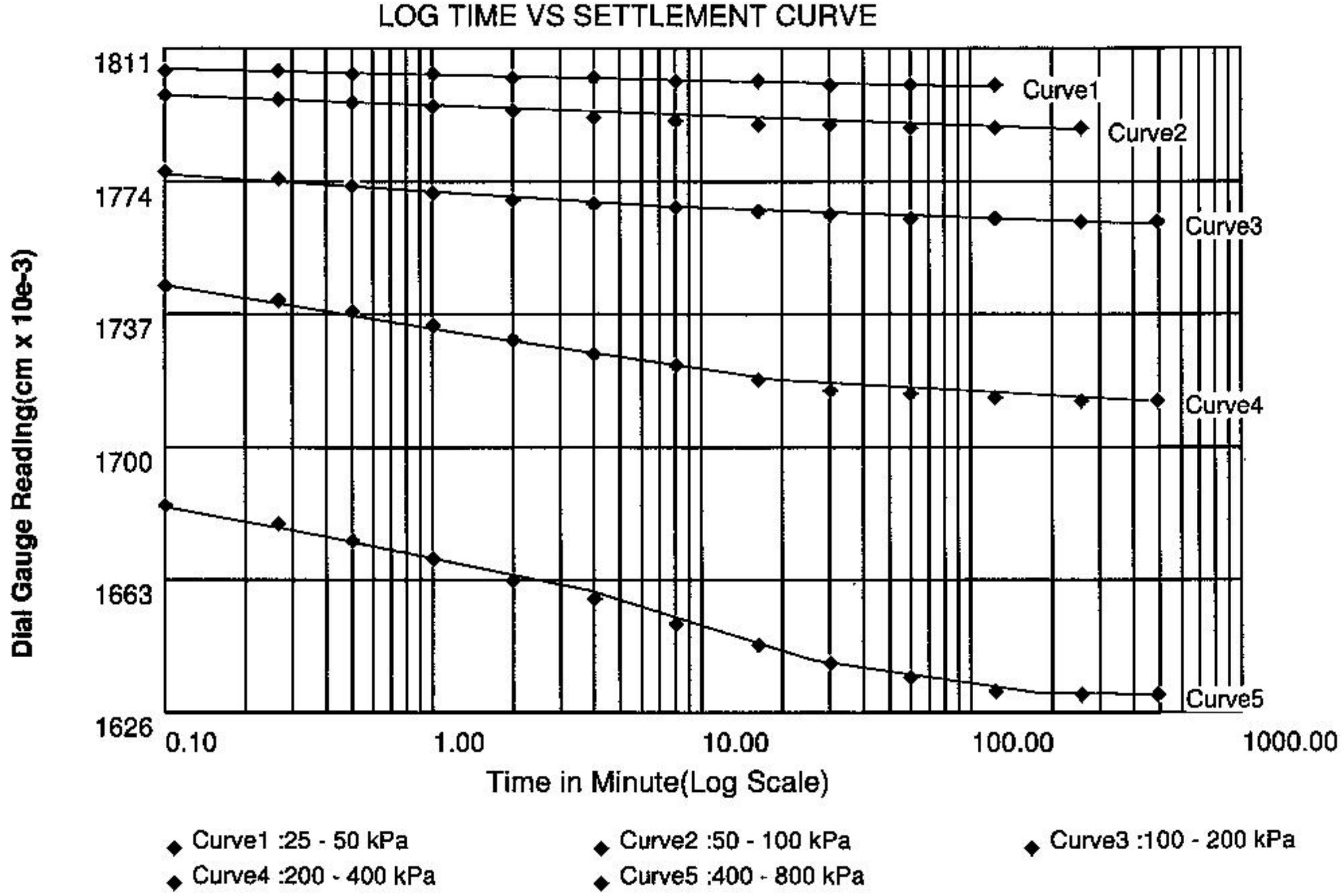


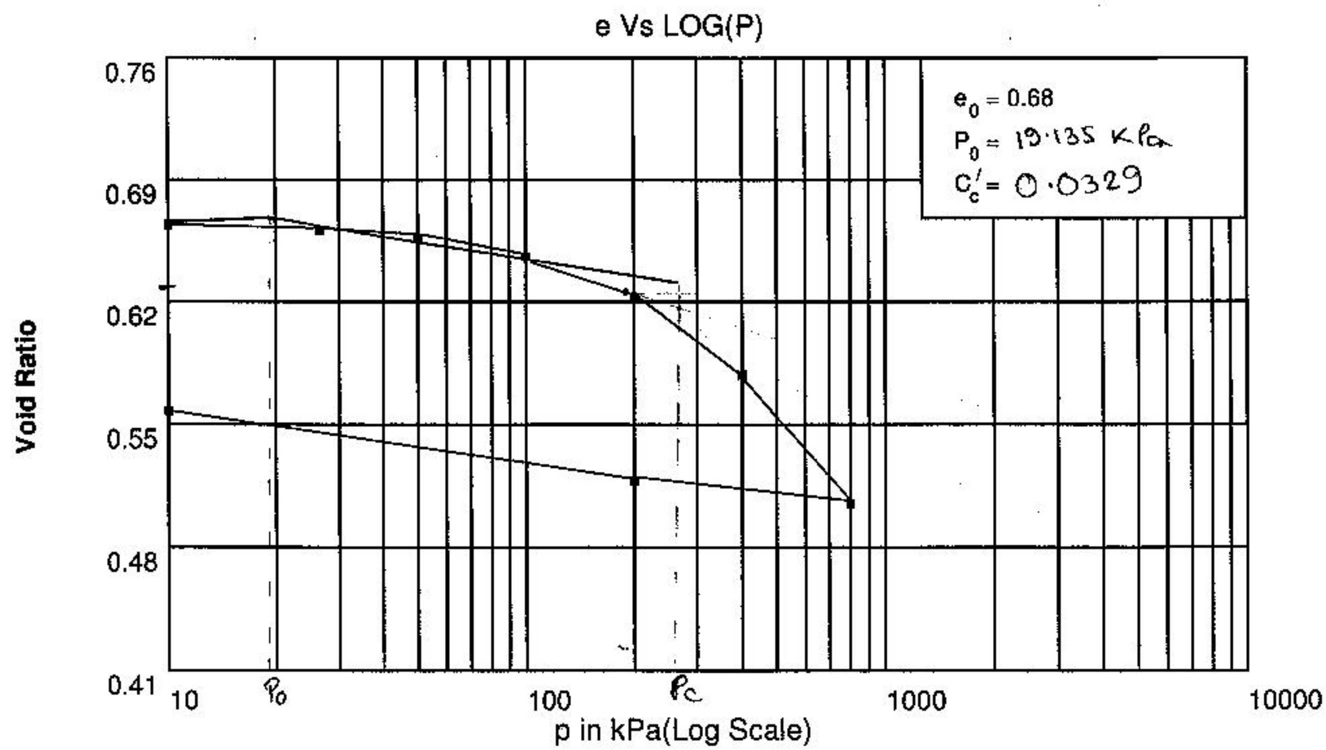


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :29 Depth(m) :2.00-2.45 Sample No. :130154

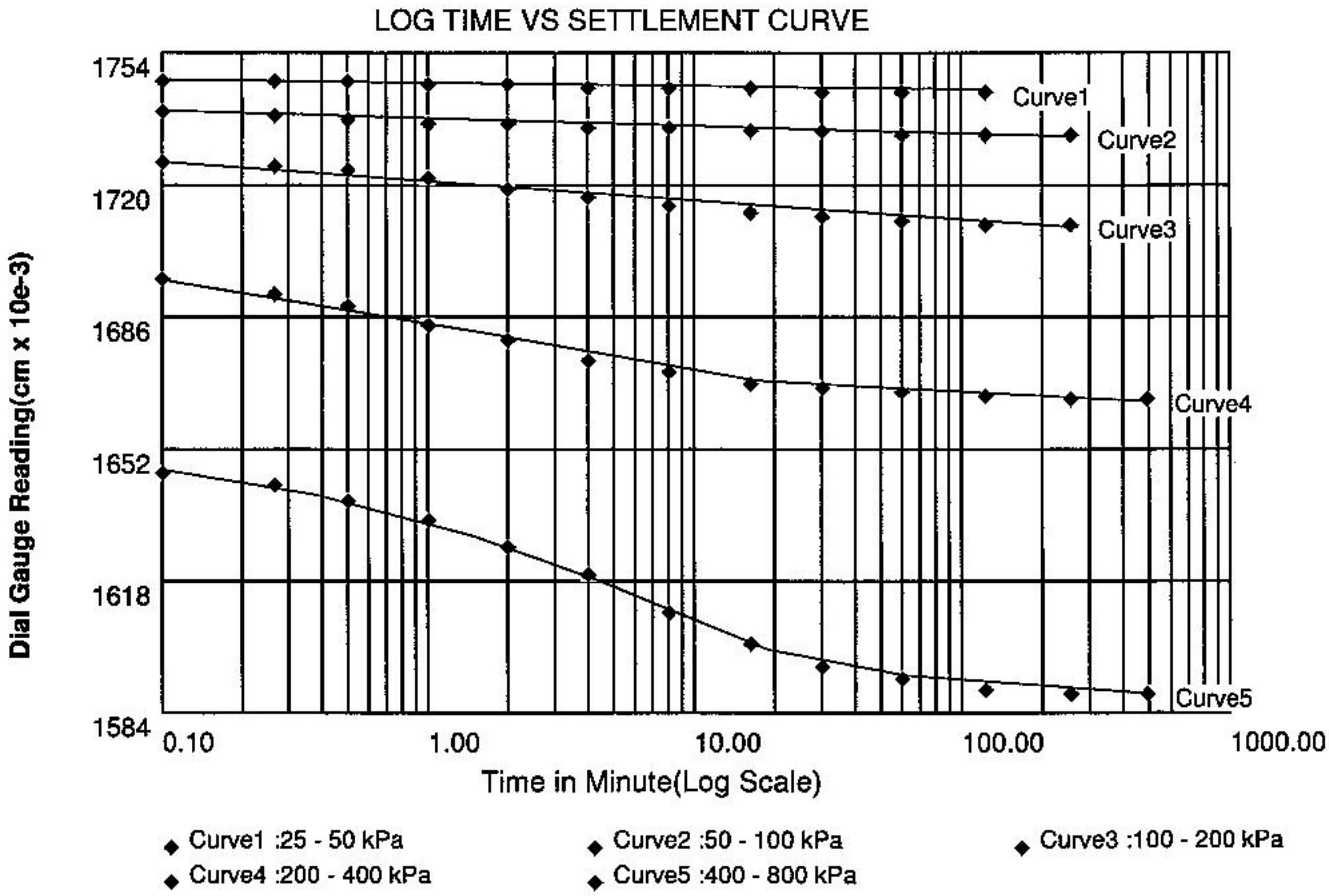


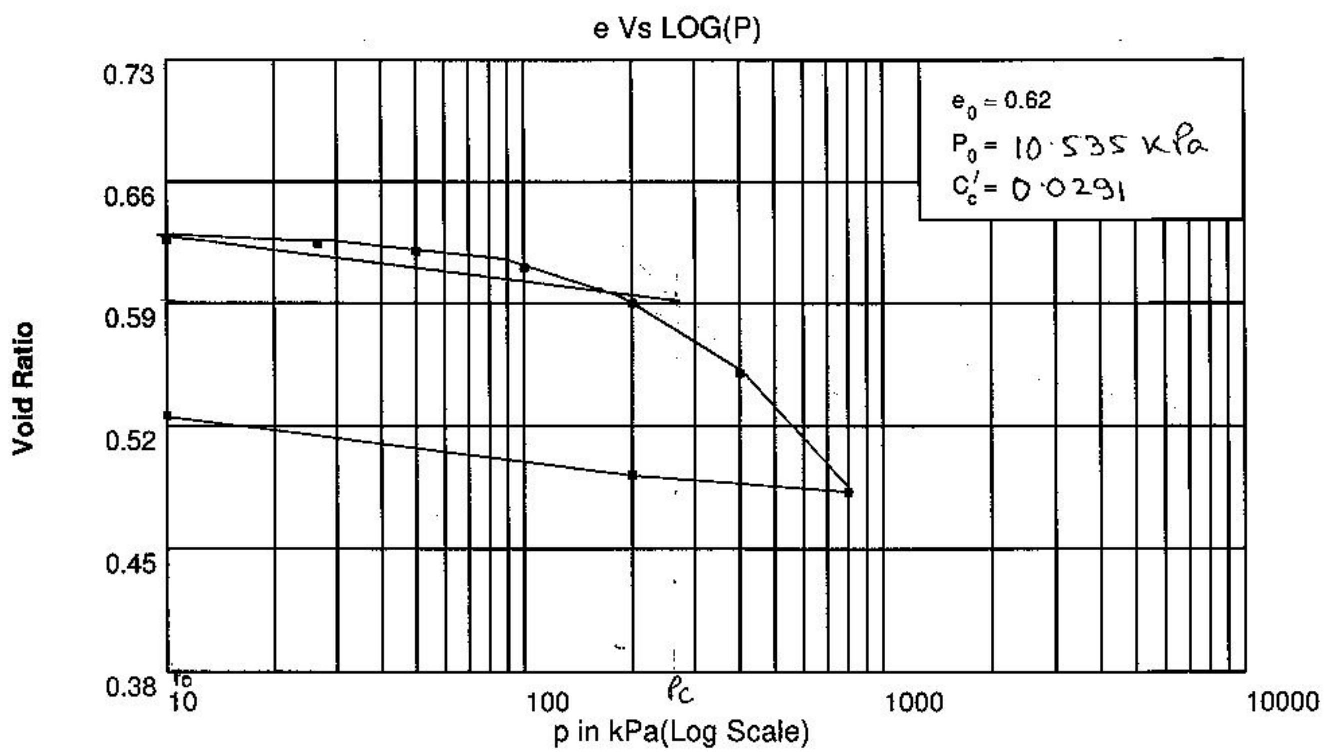


CONSOLIDATION TEST CURVES

Job No. :30796

Borehole No :30 Depth(m) :1.00-1.45 Sample No. :180111



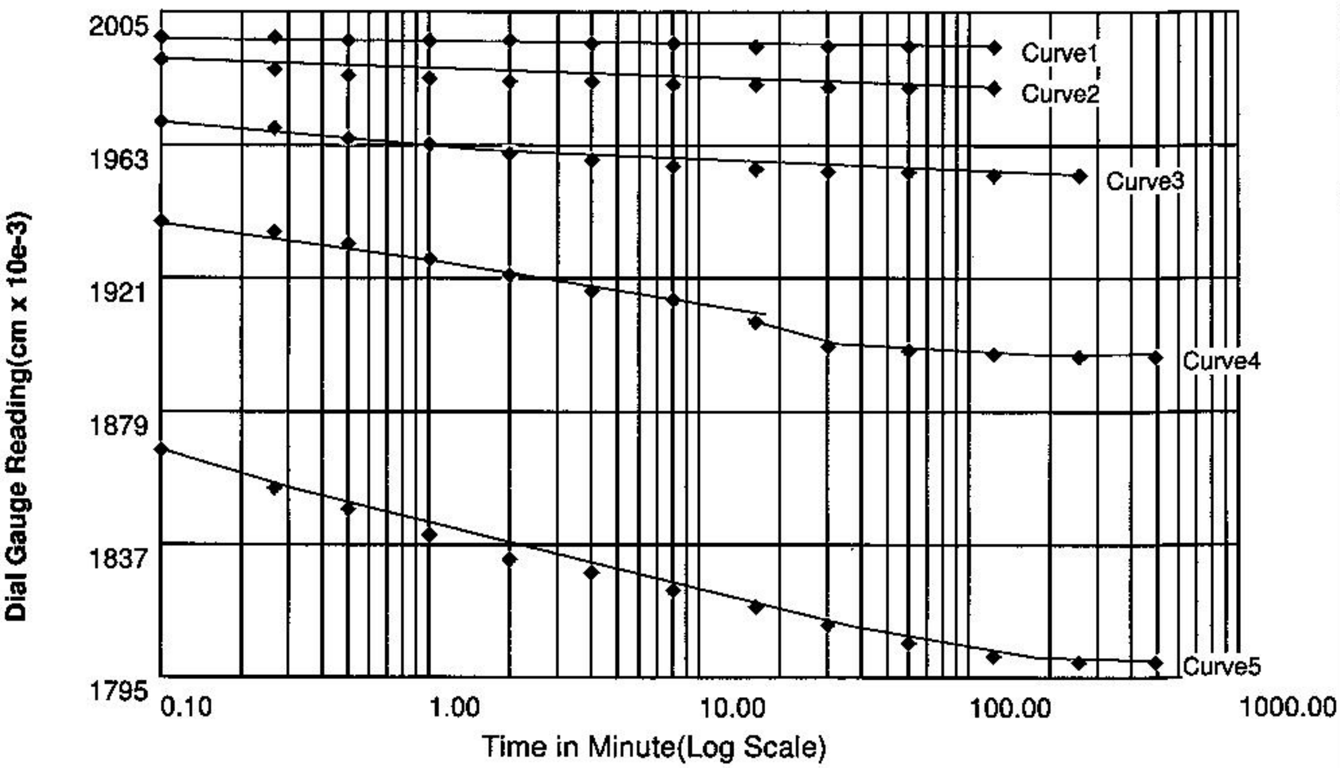


CONSOLIDATION TEST CURVES

Job No. :30796

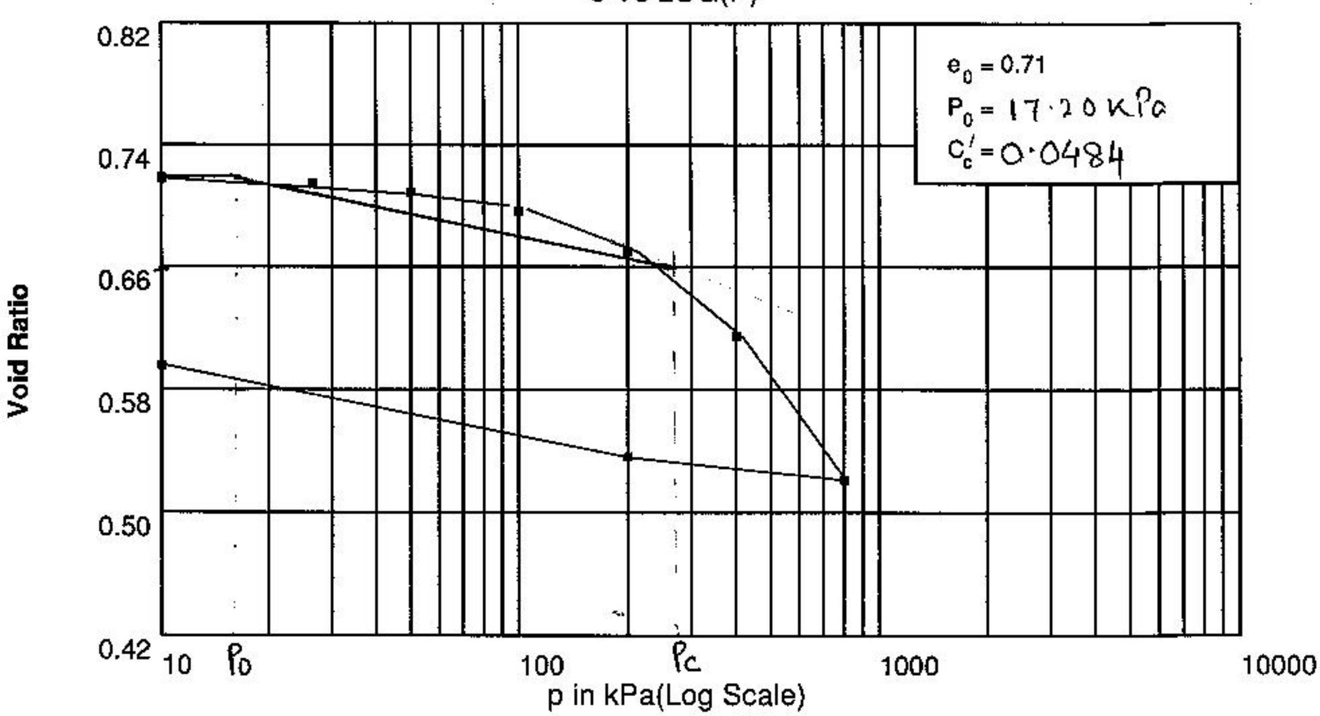
Borehole No :TP-3 Depth(m) :2.00 Sample No. :106101

LOG TIME VS SETTLEMENT CURVE



◆ Curve1 :25 - 50 kPa ◆ Curve2 :50 - 100 kPa ◆ Curve3 :100 - 200 kPa
◆ Curve4 :200 - 400 kPa ◆ Curve5 :400 - 800 kPa

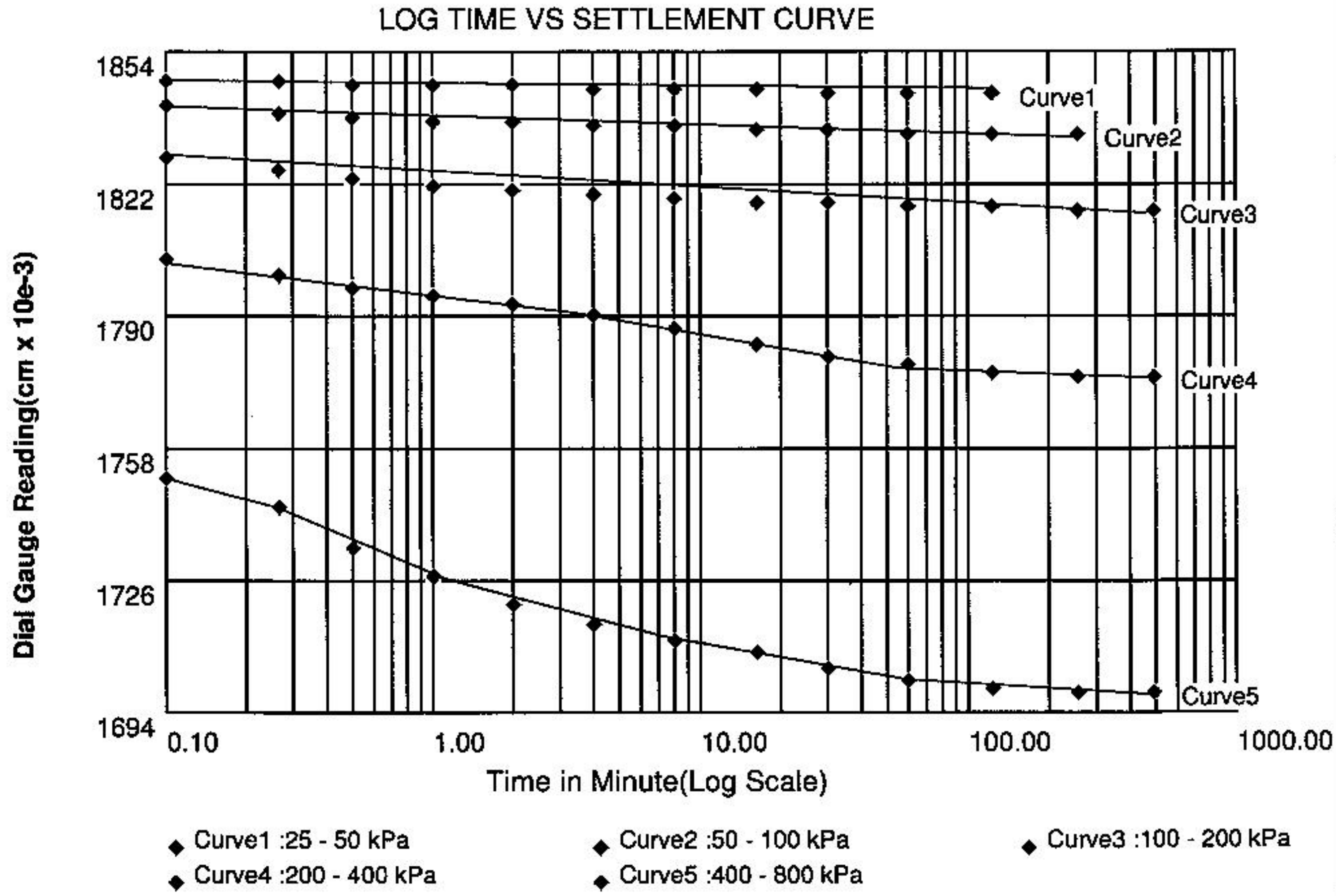
e Vs LOG(P)

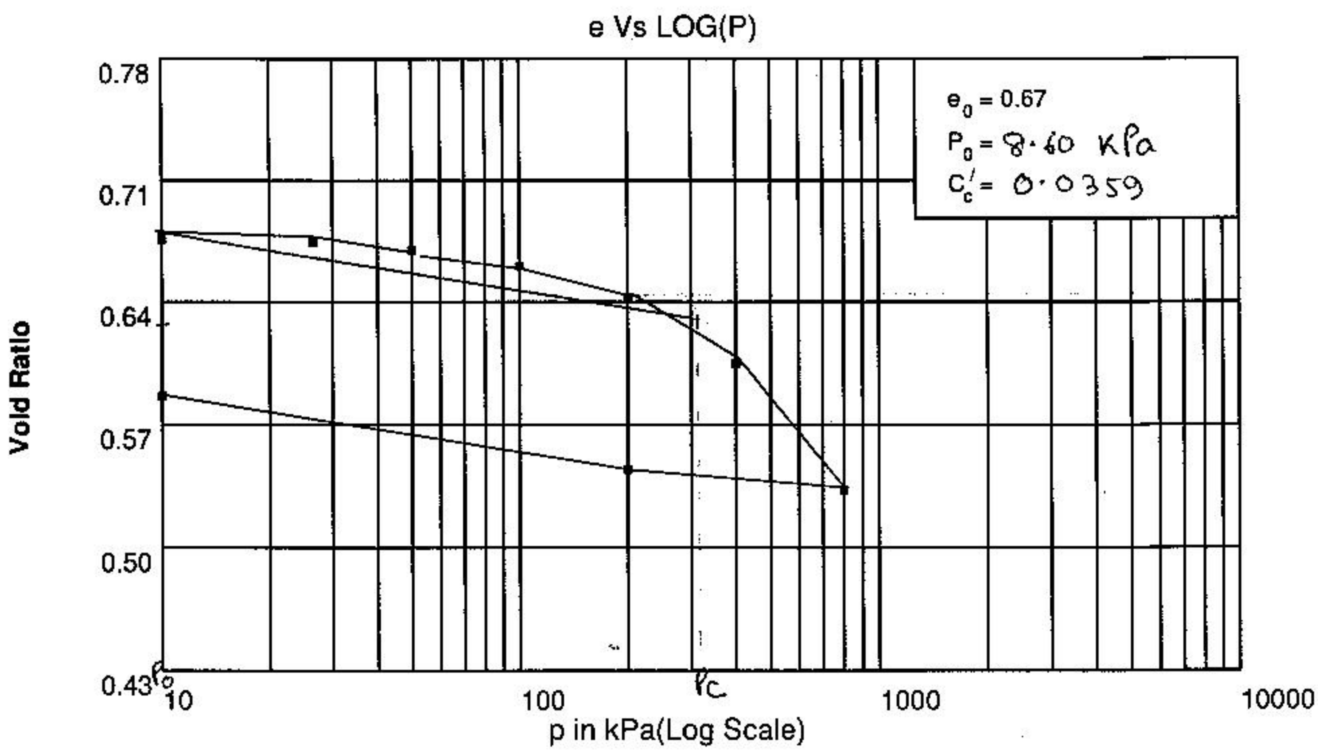


CONSOLIDATION TEST CURVES

Job No. :30796-

Borehole No :TP-6 Depth(m) :1.00 Sample No. :171620



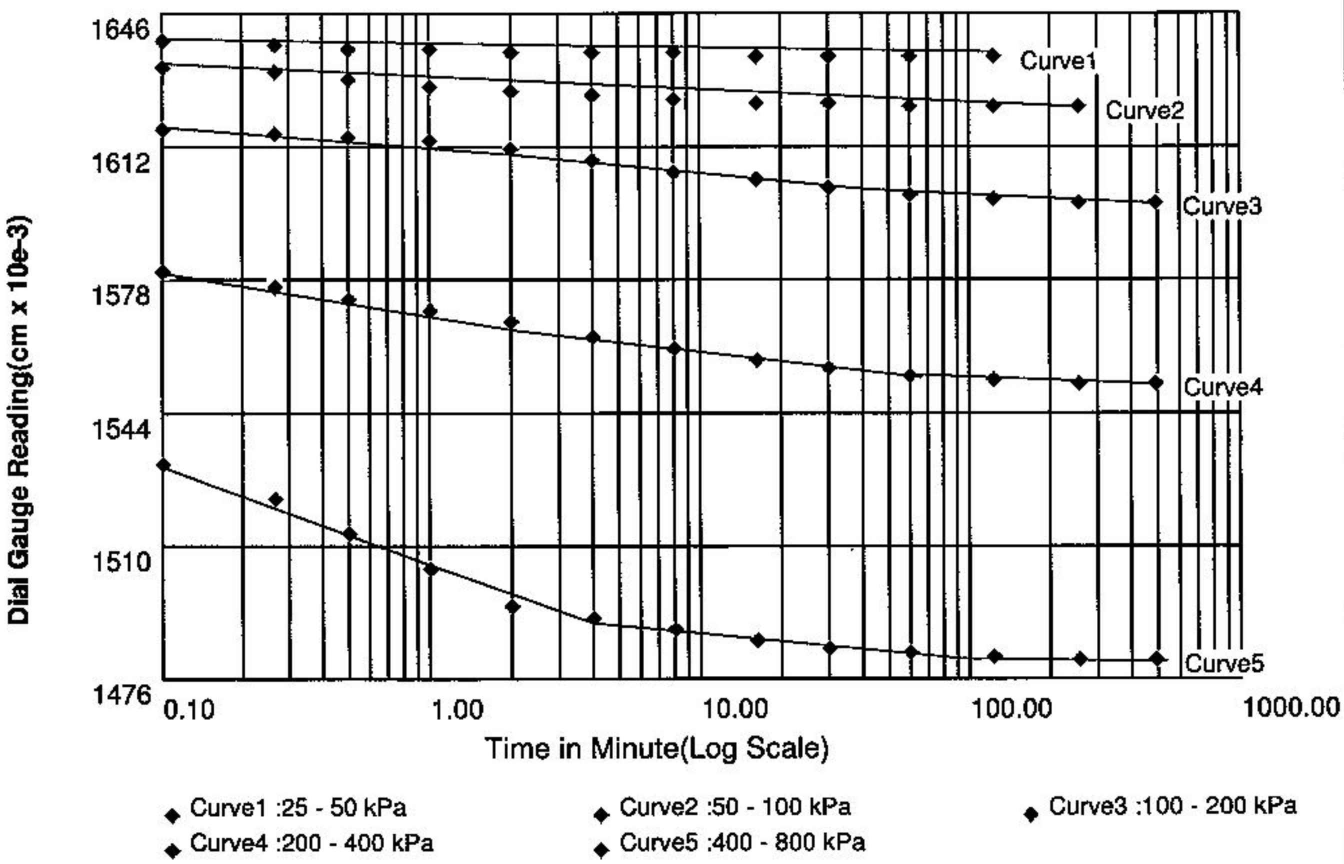


CONSOLIDATION TEST CURVES

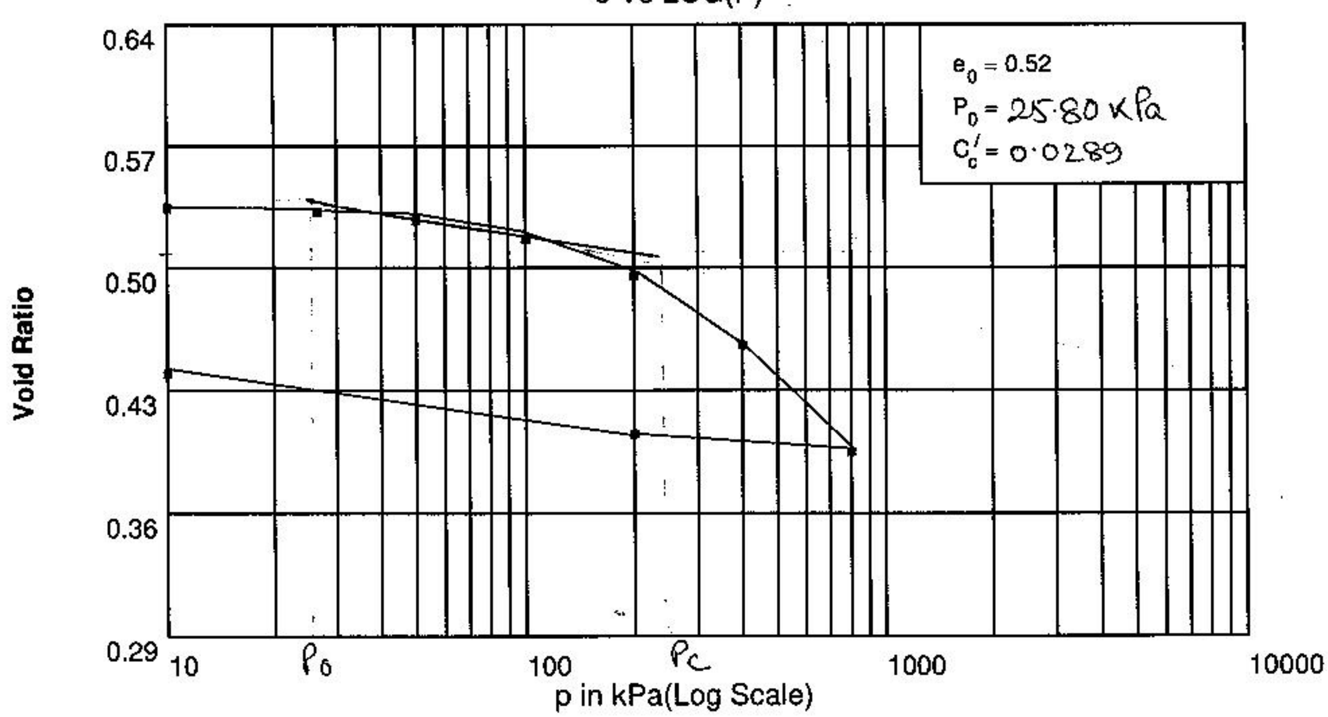
Job No. :30796-

Borehole No :TP-9 Depth(m) :3.00 Sample No. :120152

LOG TIME VS SETTLEMENT CURVE



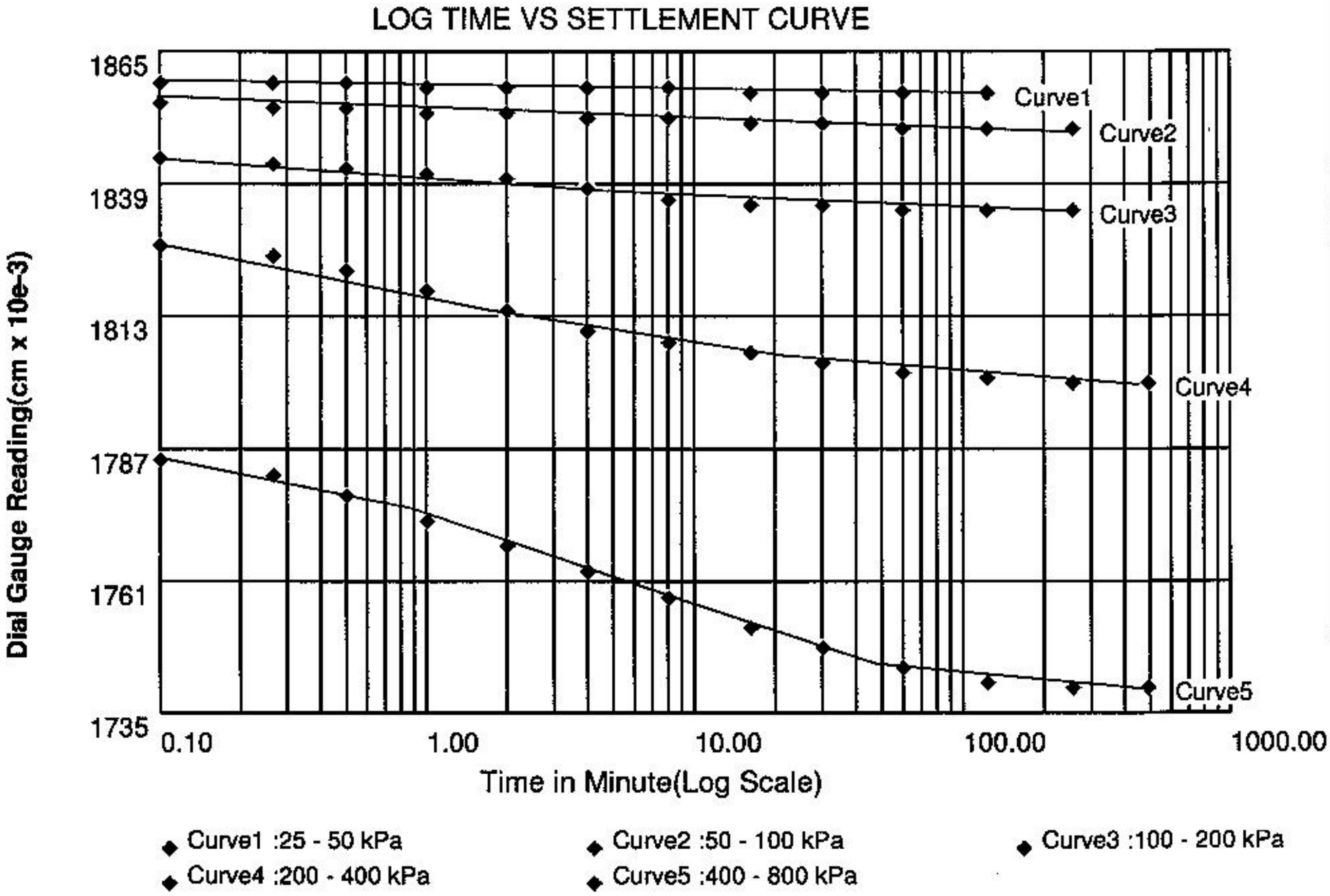
e Vs LOG(P)

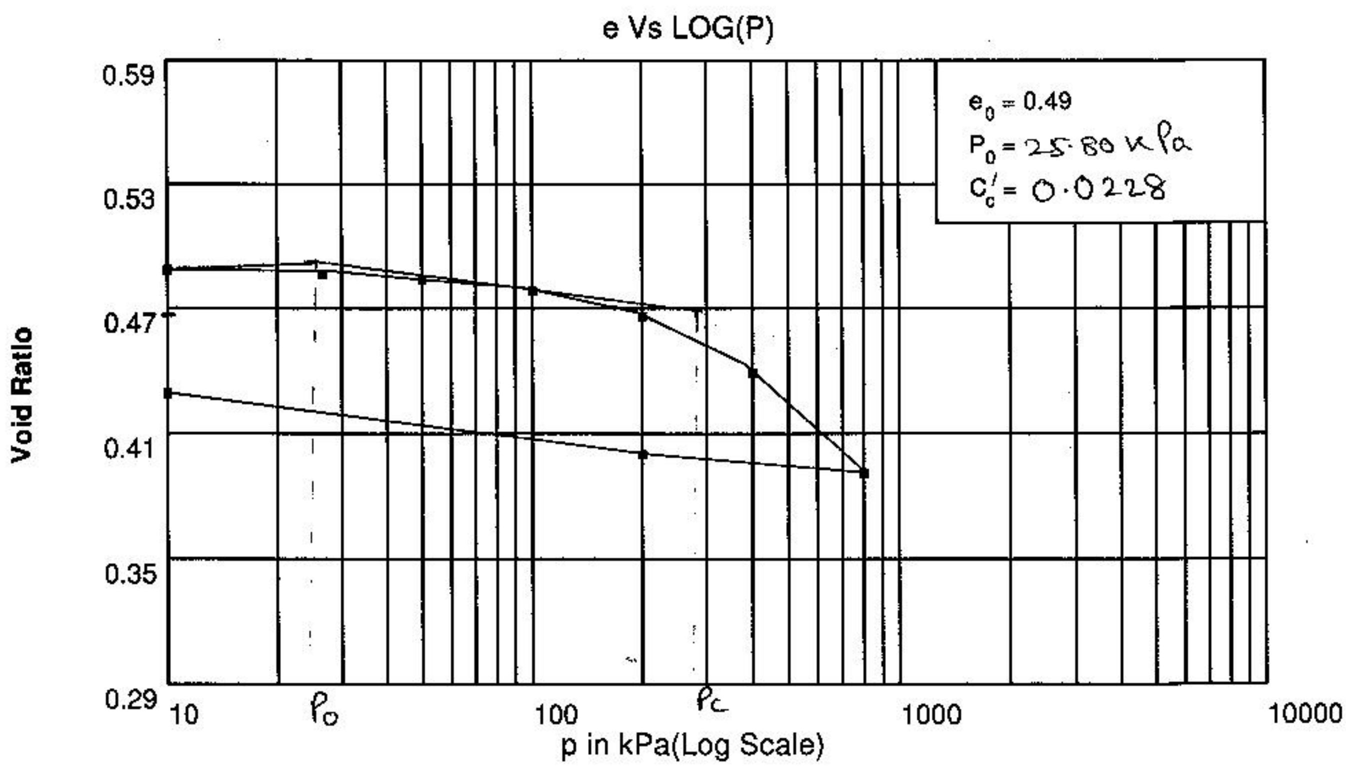


CONSOLIDATION TEST CURVES

Job No. :30796-

Borehole No :TP-12 Depth(m) :3.00 Sample No. :106114

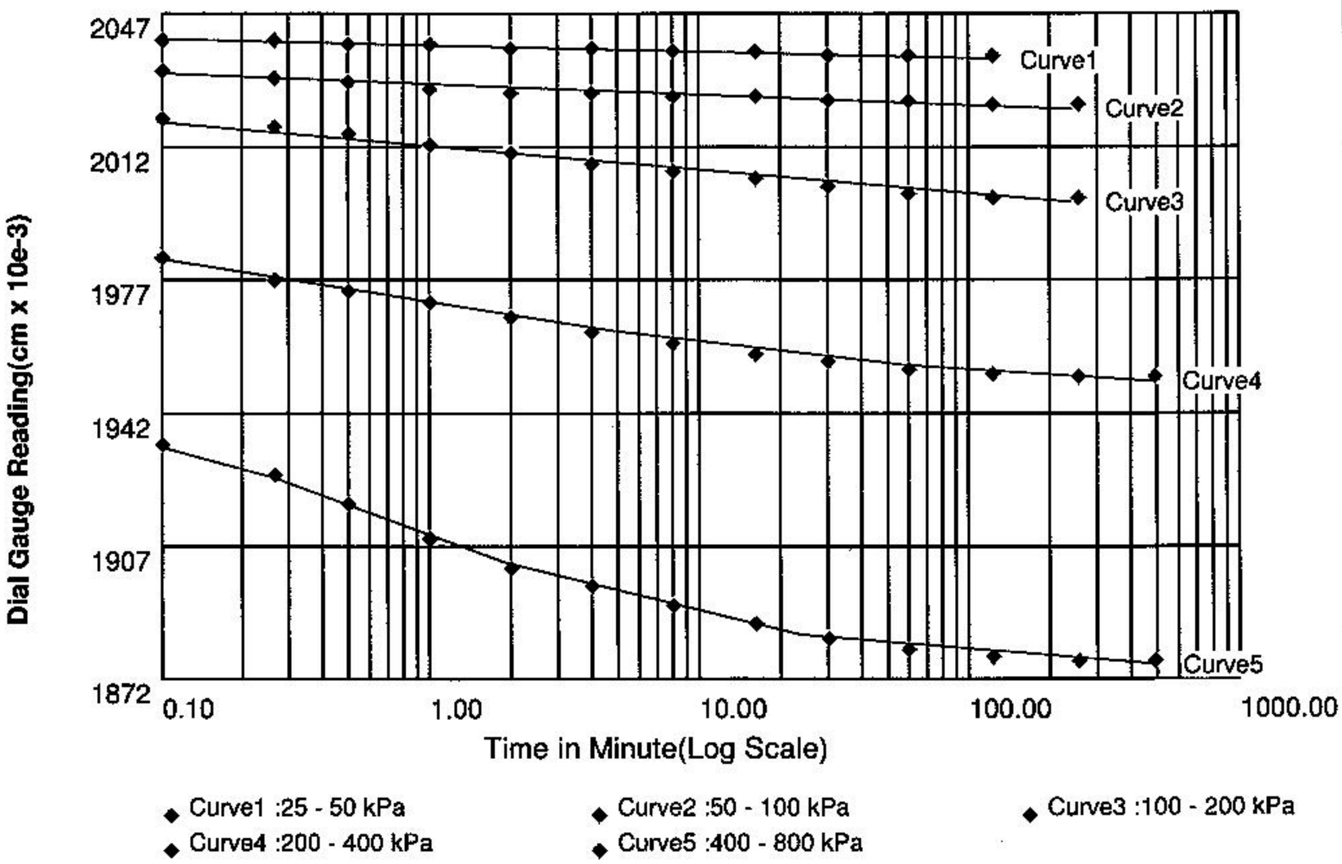




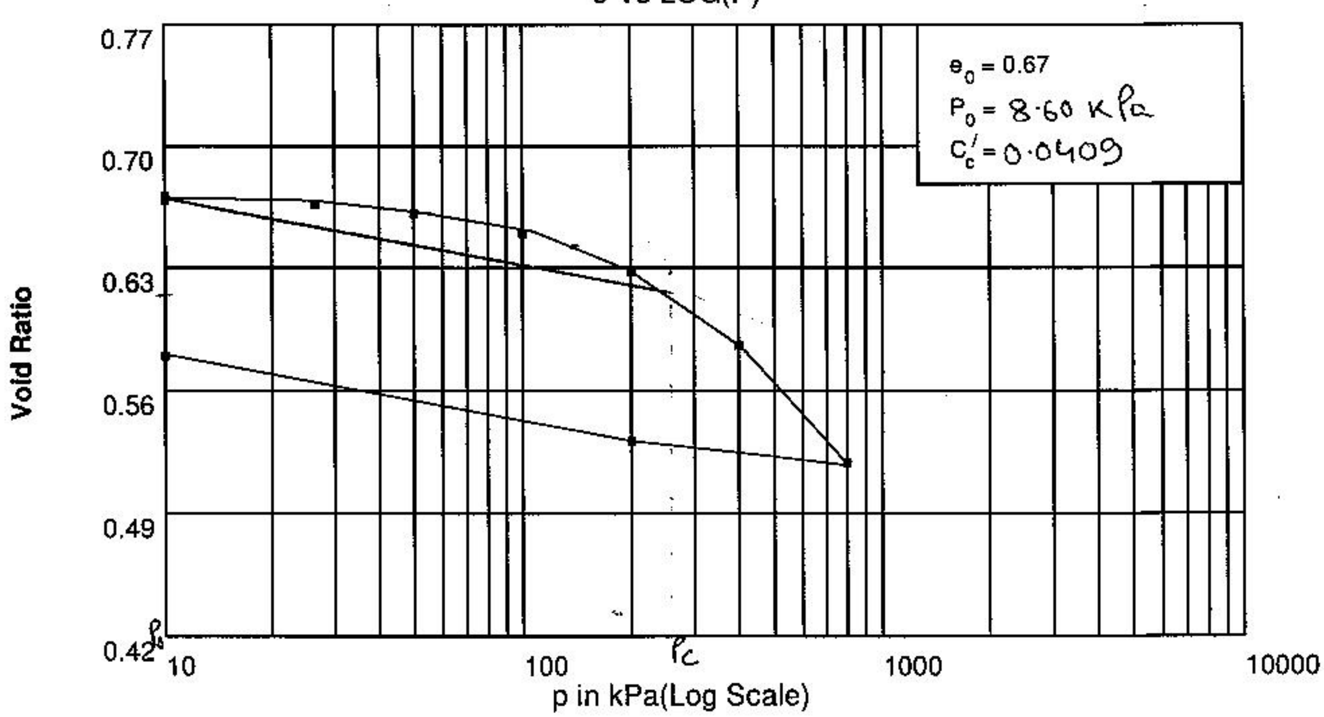
CONSOLIDATION TEST CURVES

Borehole No :TP-15 Depth(m) :1.00 Sample No. :106108

LOG TIME VS SETTLEMENT CURVE



e Vs LOG(P)

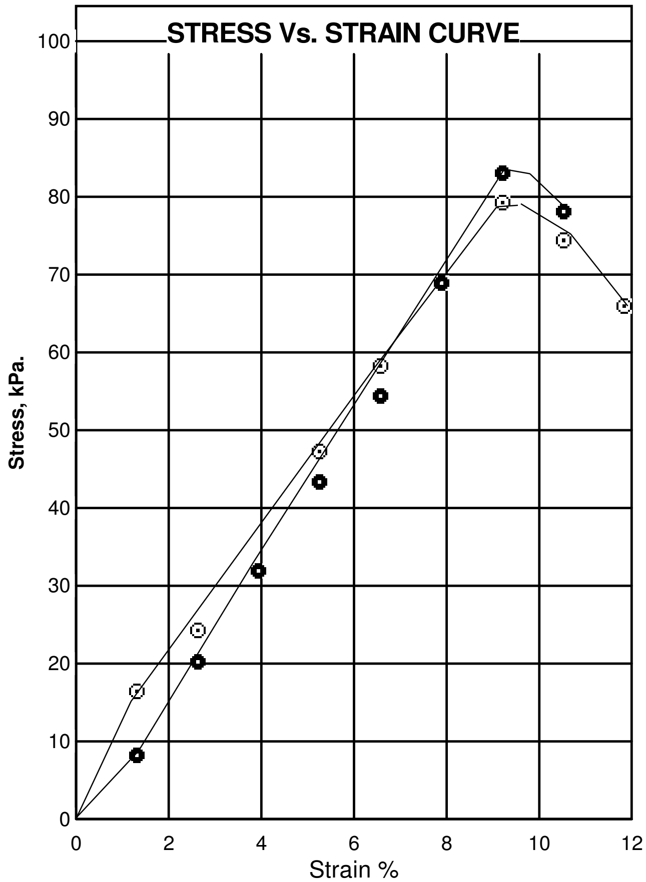


CONSOLIDATION TEST CURVES

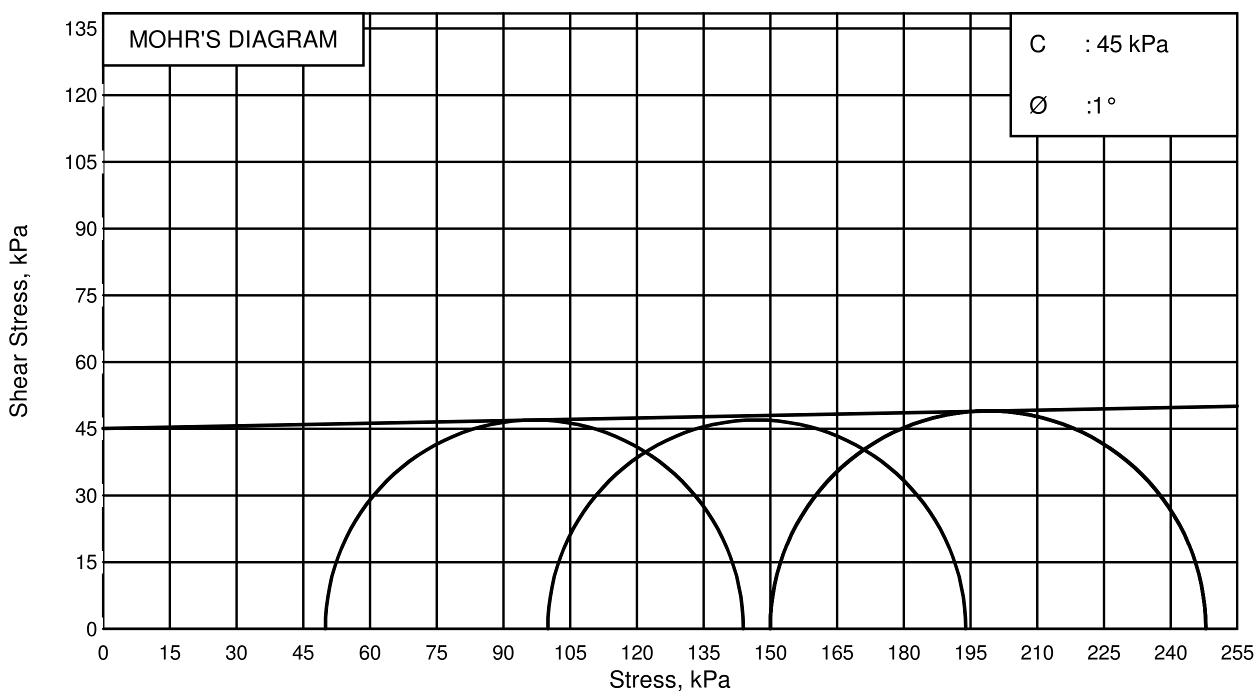
Job No. :30796-

Sample Number : 177121
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 1

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

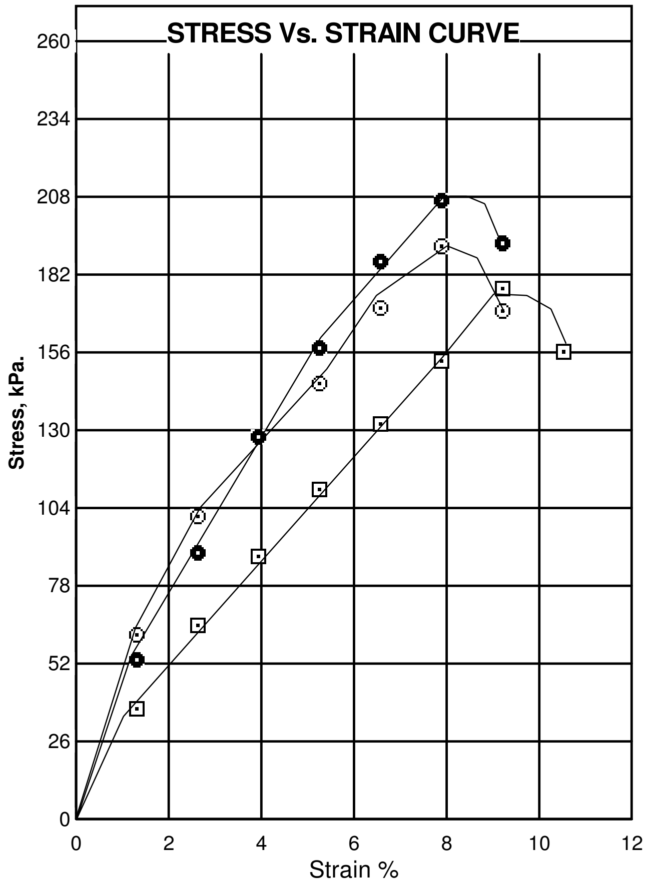


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 177128
Sample Depth : 6.00 - 6.45m.
Bore Hole Number : 1

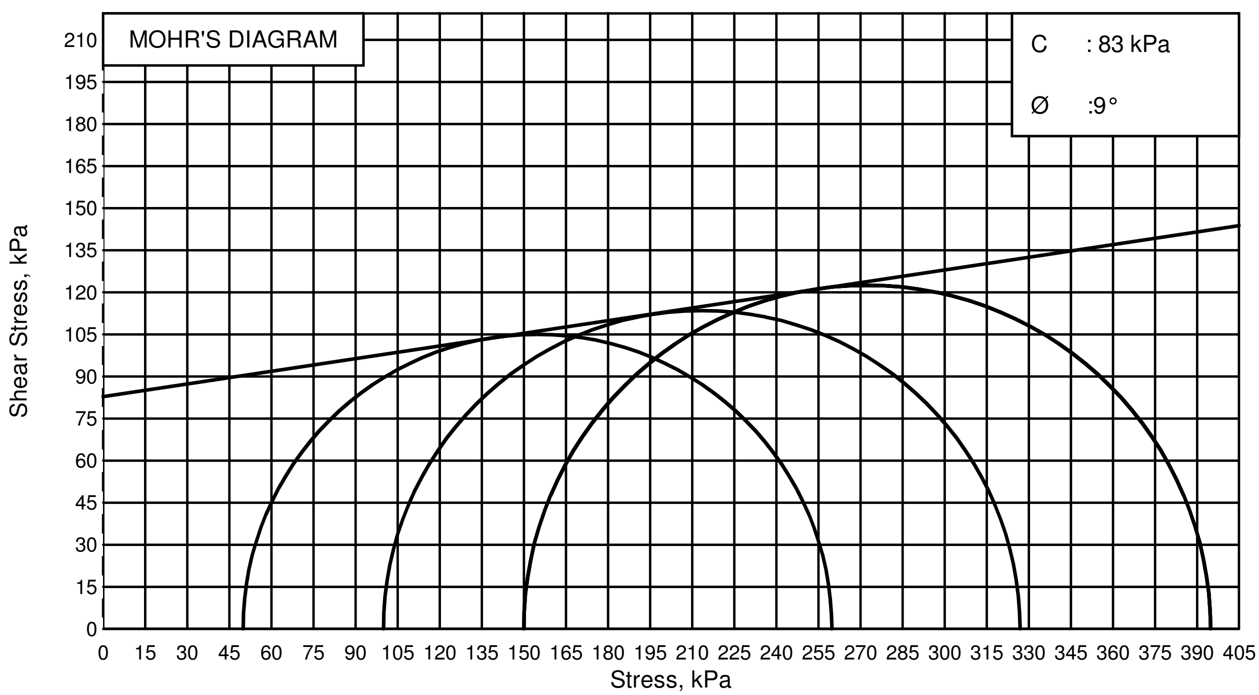
Site :
Type of Test : uu



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3 ●
Cell Pressure : 150 kPa

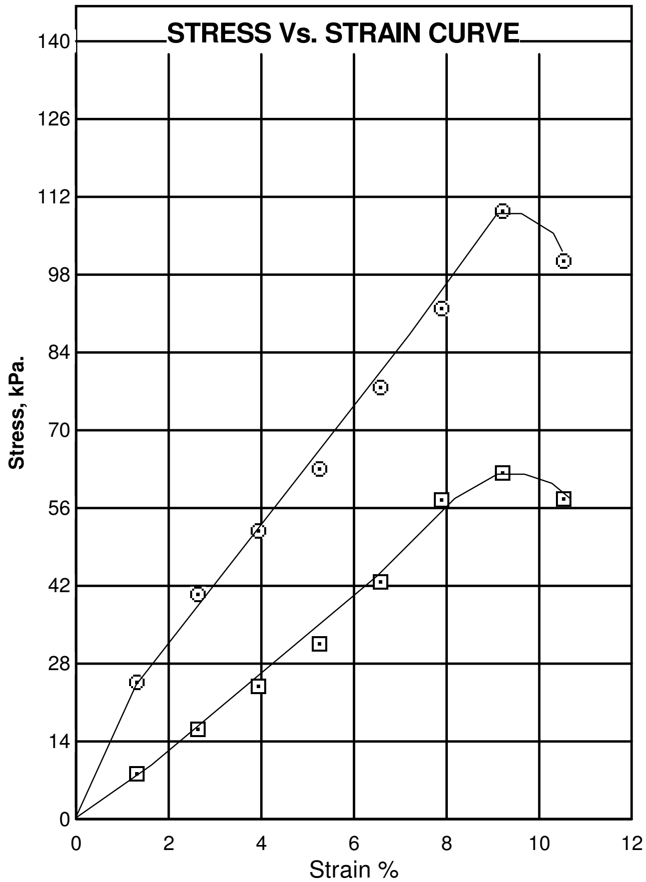


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 160128
Sample Depth : 4.50 - 4.95m.
Bore Hole Number : 2

Site :
Type of Test : cd



Mode of Failure :

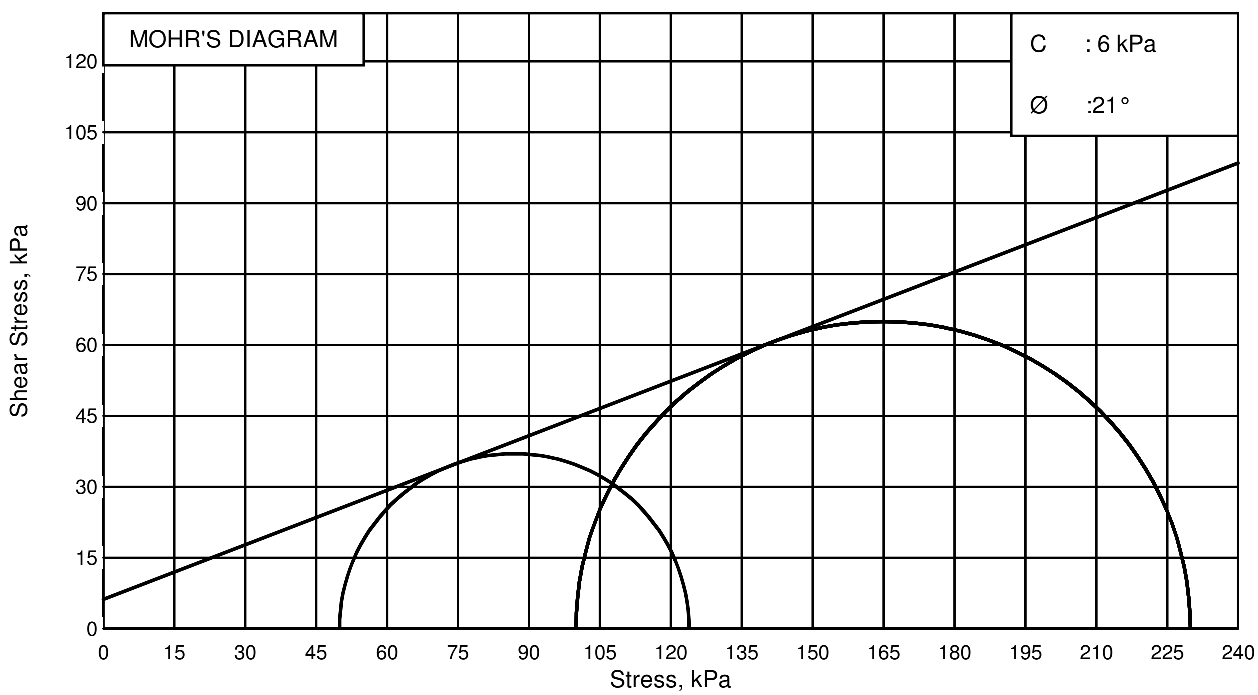
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

Cell Pressure : 100 kPa

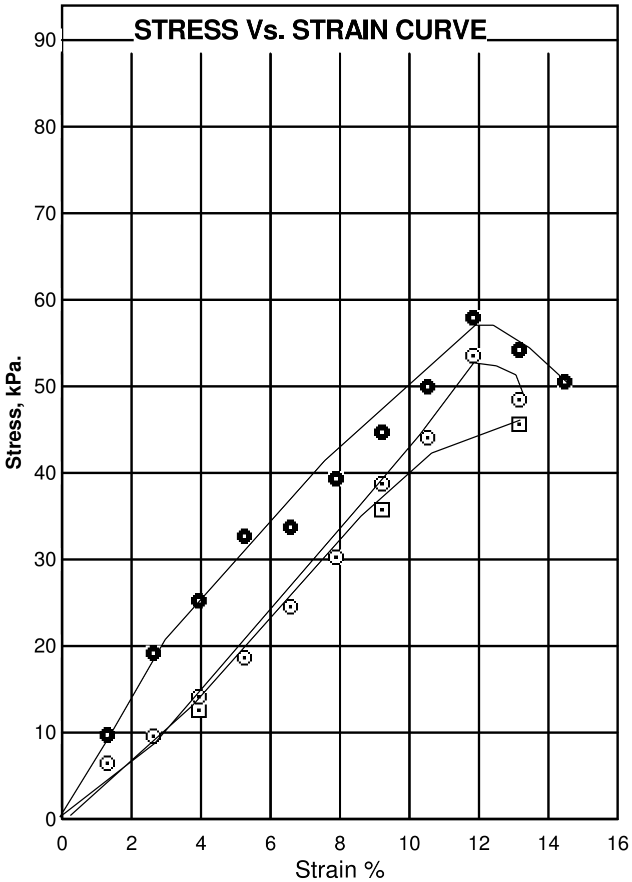


TRIAXIAL TEST CURVES

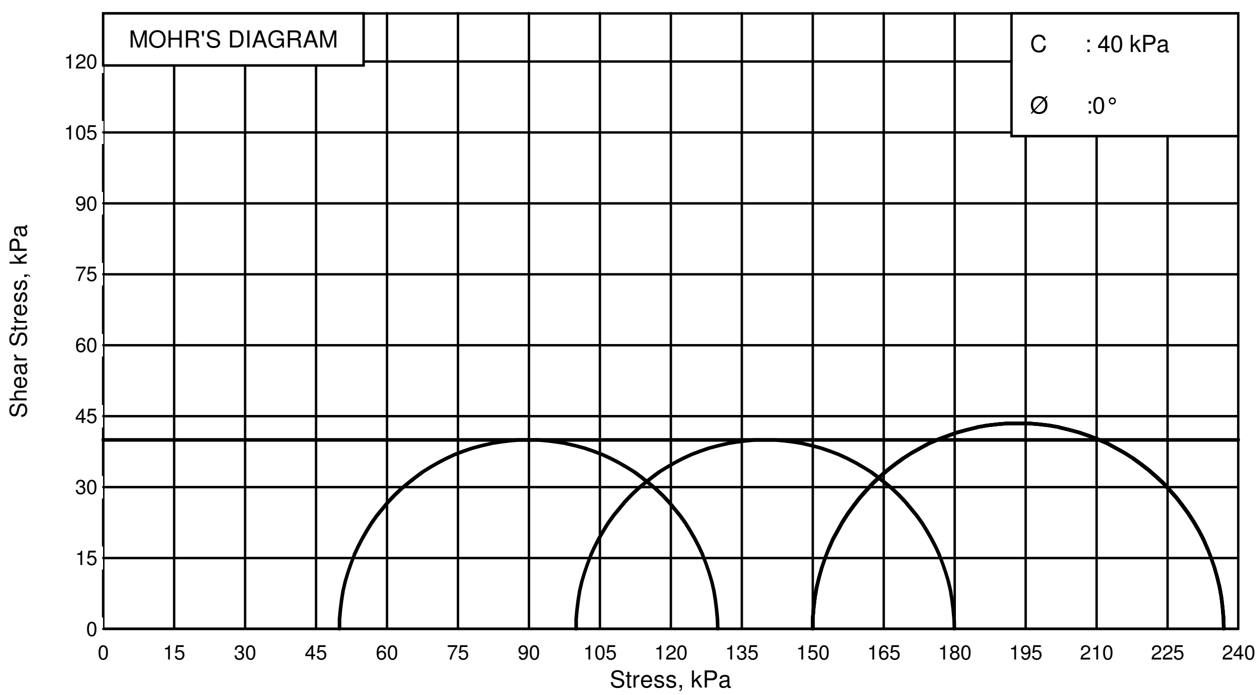
Job No. : 30796

Sample Number : 100869
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 3

Site :
Type of Test : UU



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

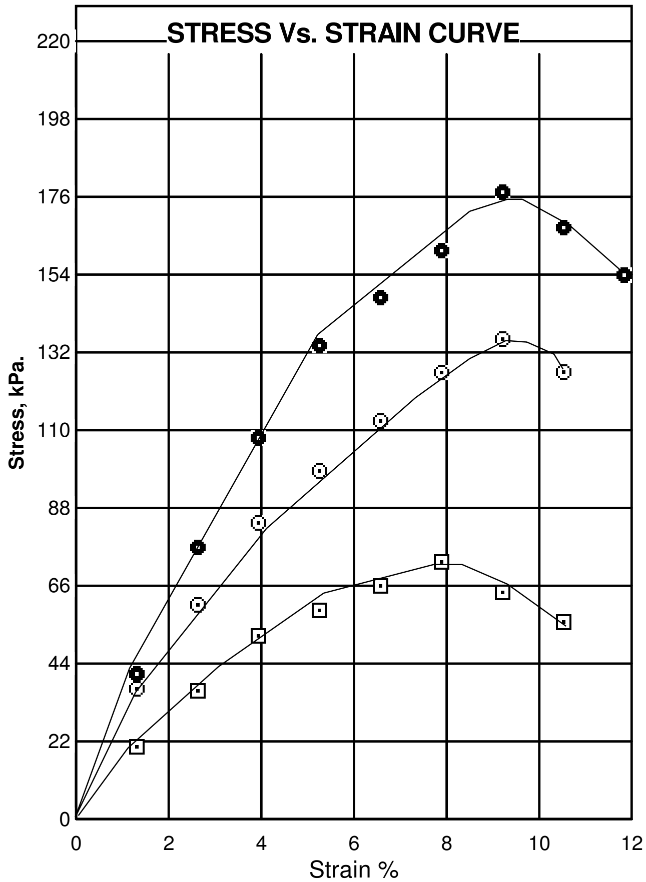


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100879
Sample Depth : 8.00 - 8.45m.
Bore Hole Number : 3

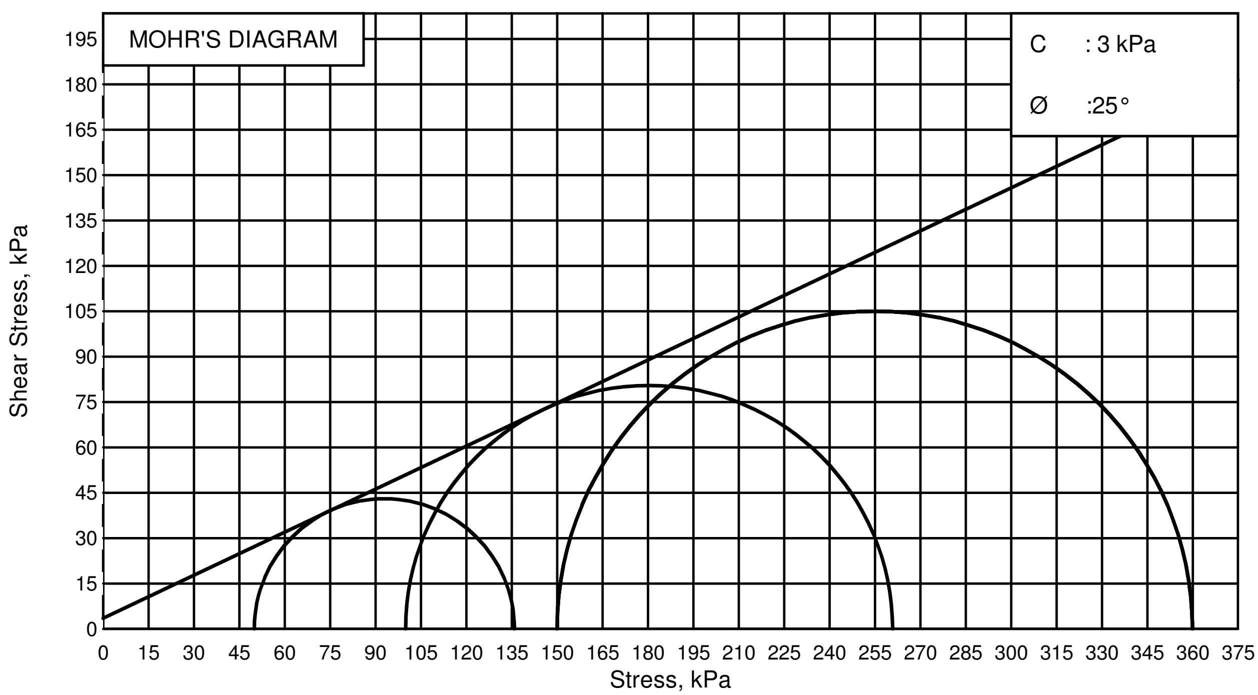
Site :
Type of Test : CD



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3 ●
Cell Pressure : 150 kPa

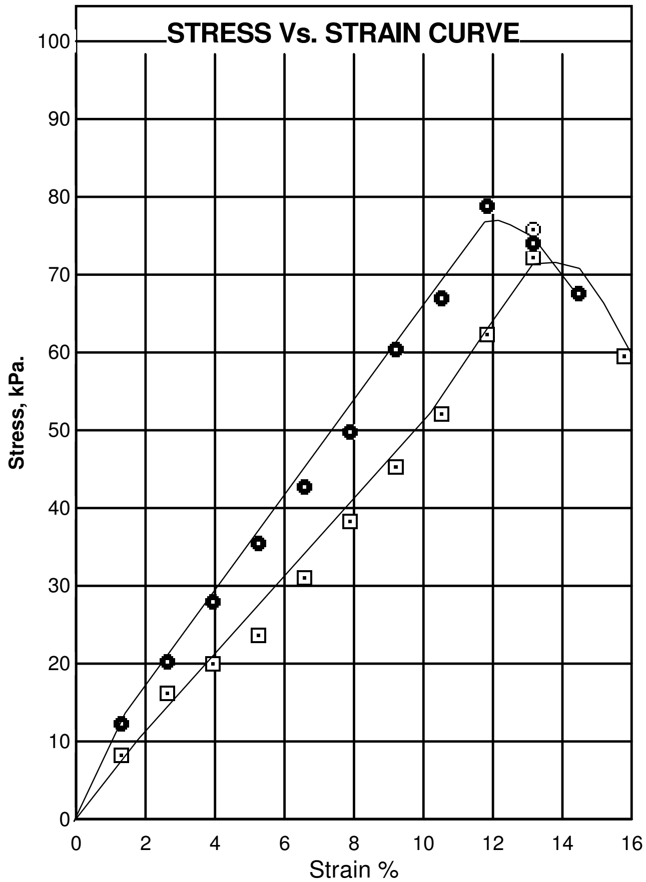


TRIAXIAL TEST CURVES

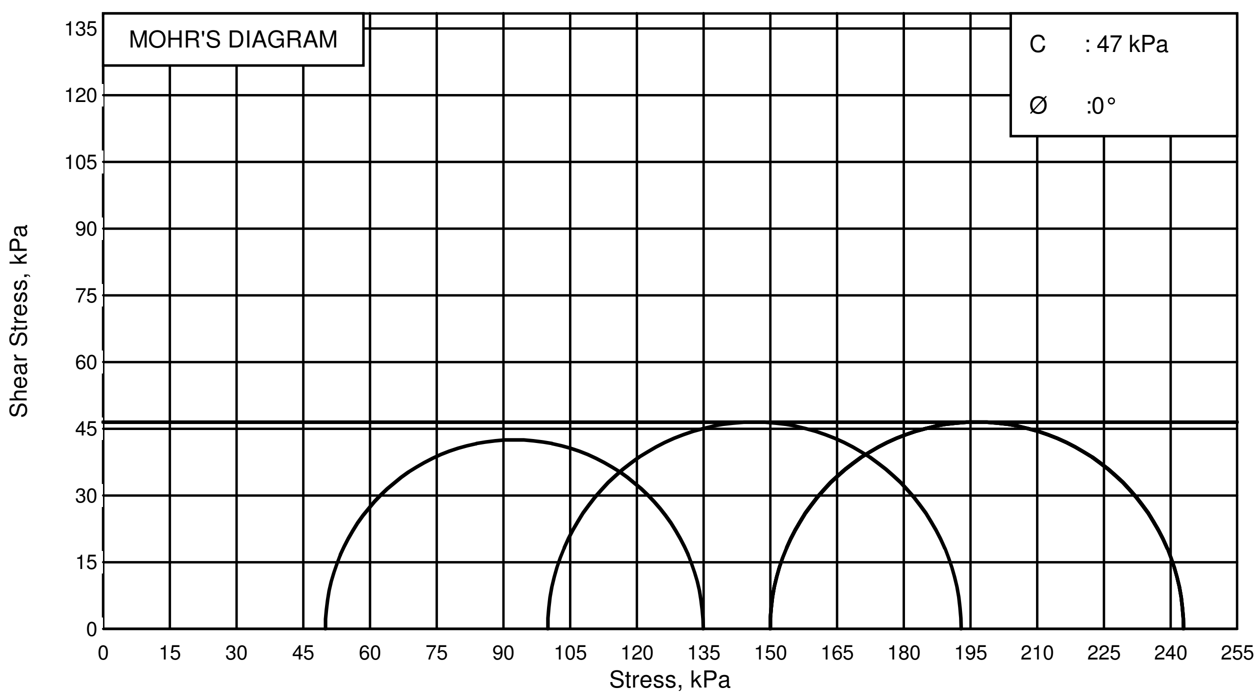
Job No. : 30796

Sample Number : 100902
Sample Depth : 1.50-1.95
Bore Hole Number : 4

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

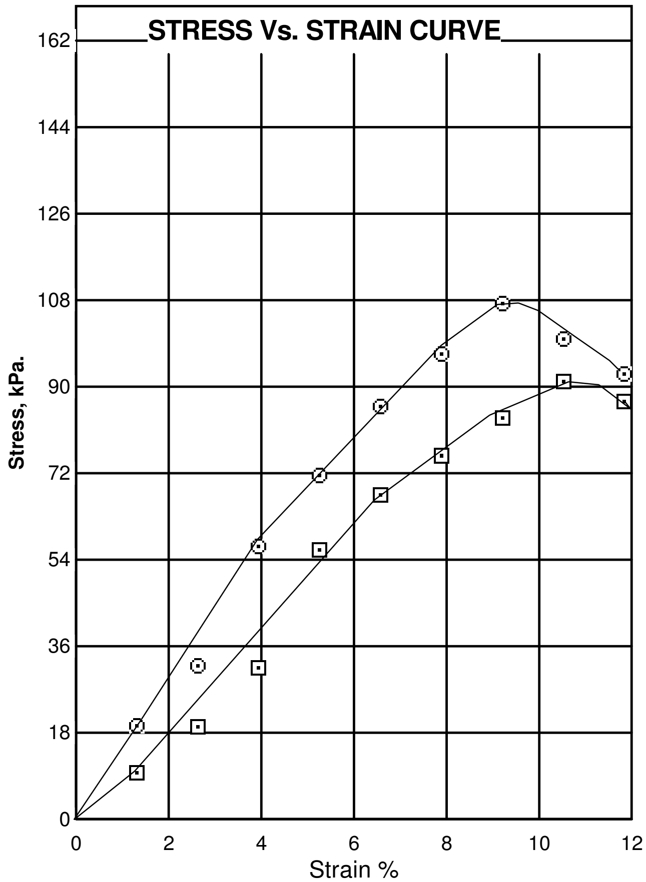


TRIAXIAL TEST CURVES

Job No. : 30796

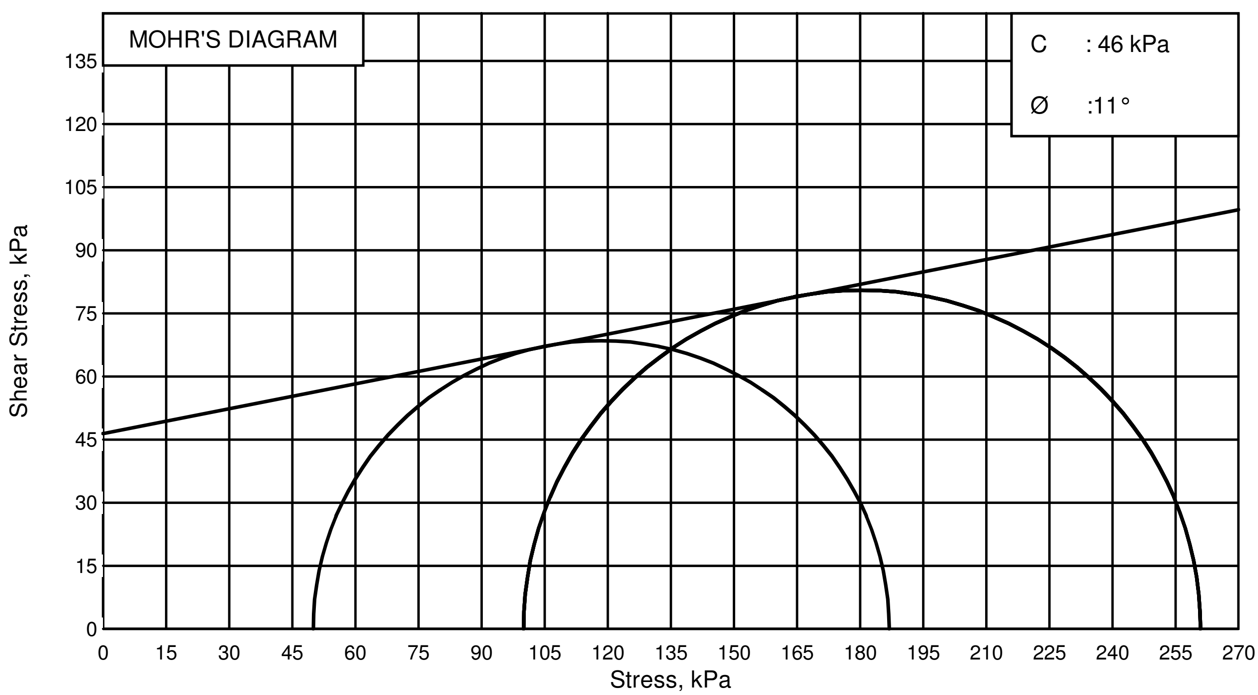
Sample Number : 105112
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 6

Site :
Type of Test : cu



Mode of Failure	:
Specimen	: 1 ⊡
Cell Pressure	: 50 kPa

Mode of Failure	:
Specimen	: 2 ⊙
Cell Pressure	: 100 kPa

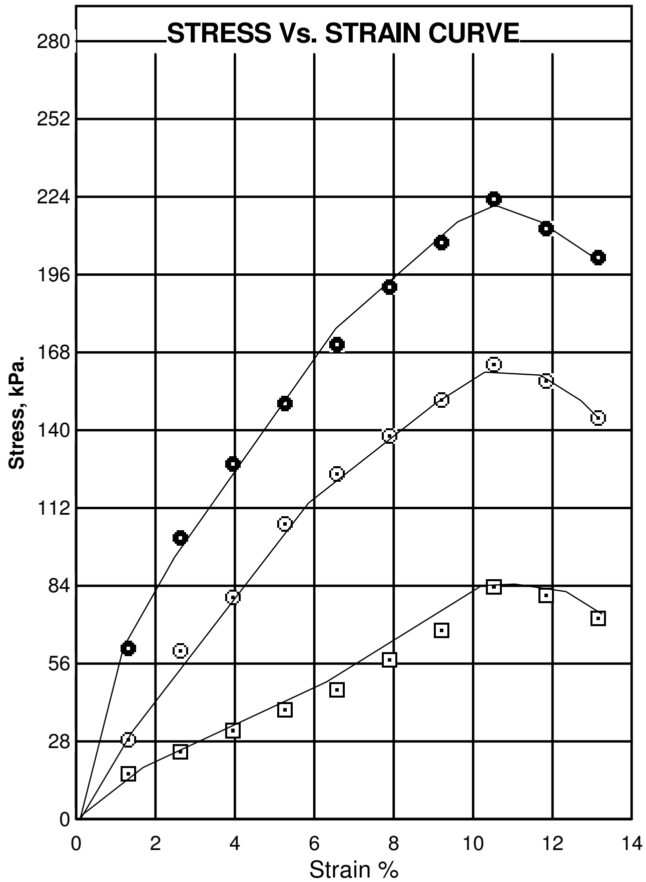


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100968
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 8

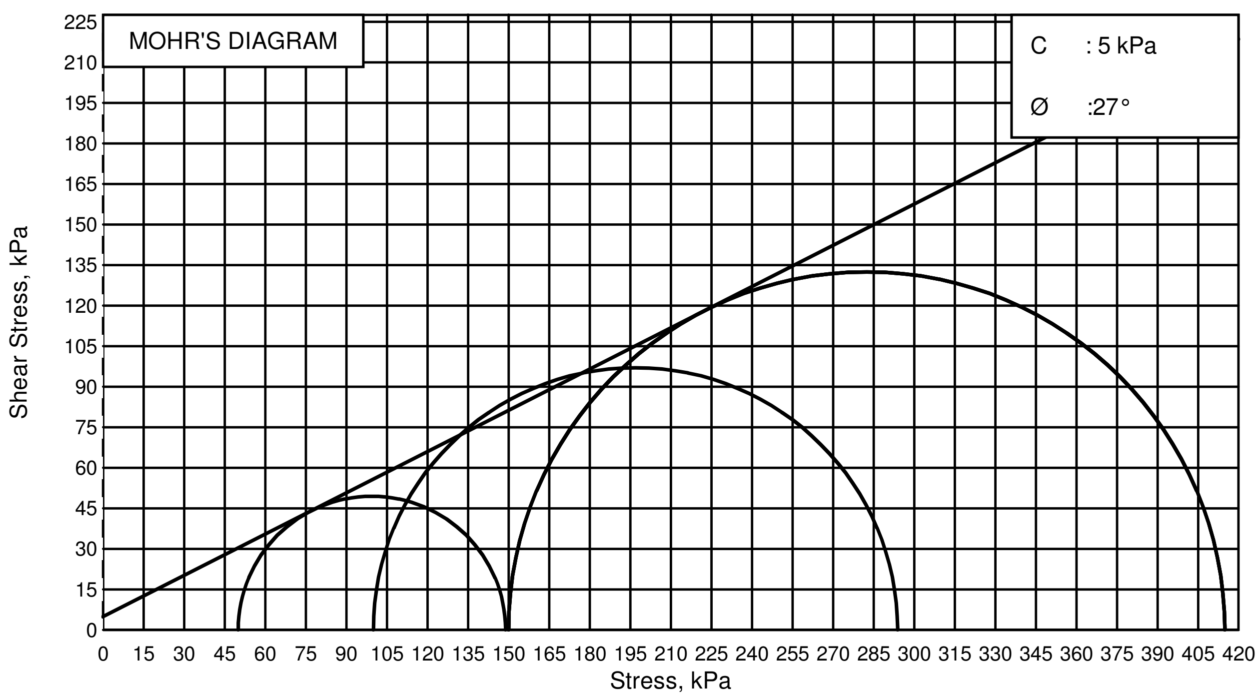
Site :
Type of Test : CD



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3 ●
Cell Pressure : 150 kPa

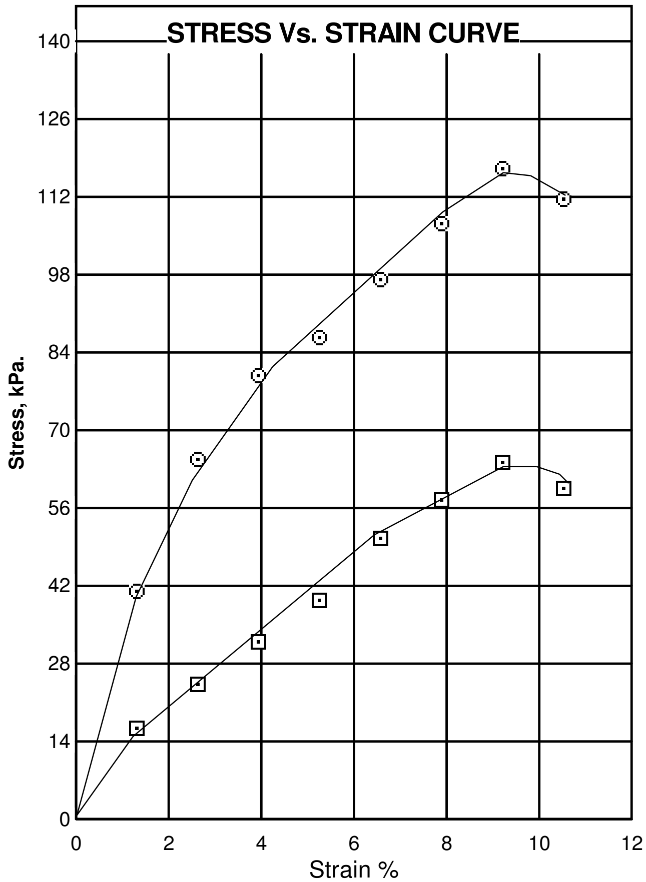


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100972
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 8

Site :
Type of Test : cd



Mode of Failure :

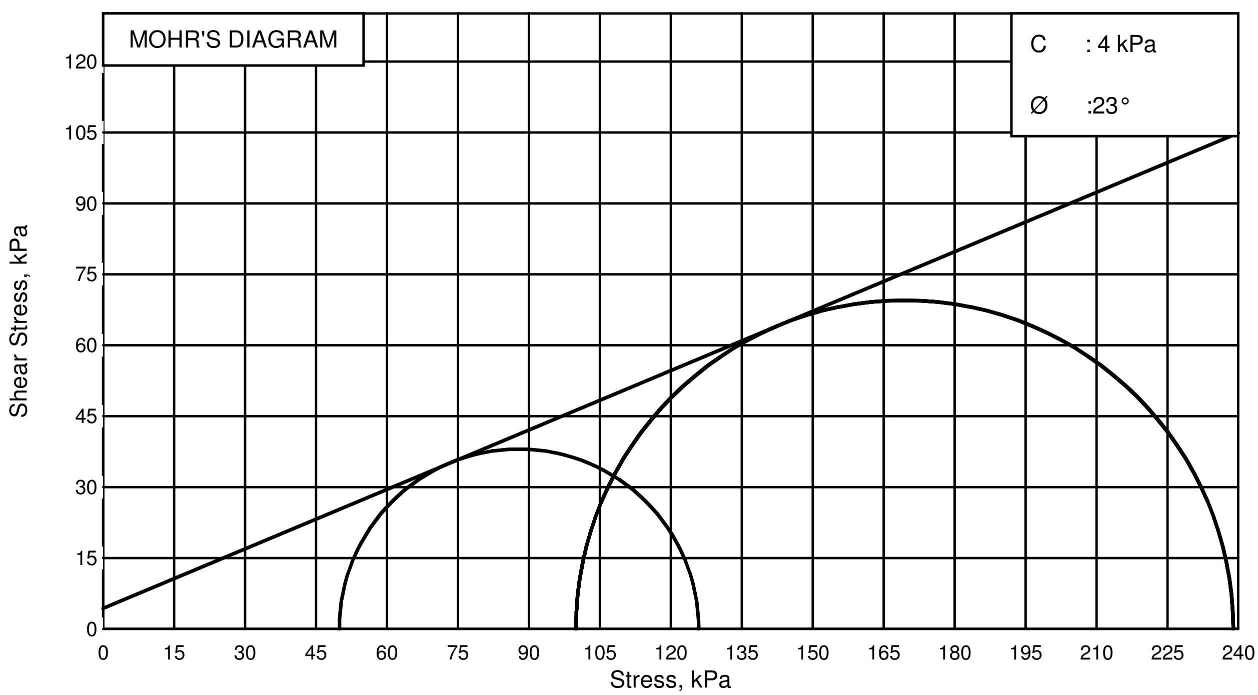
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

Cell Pressure : 100 kPa

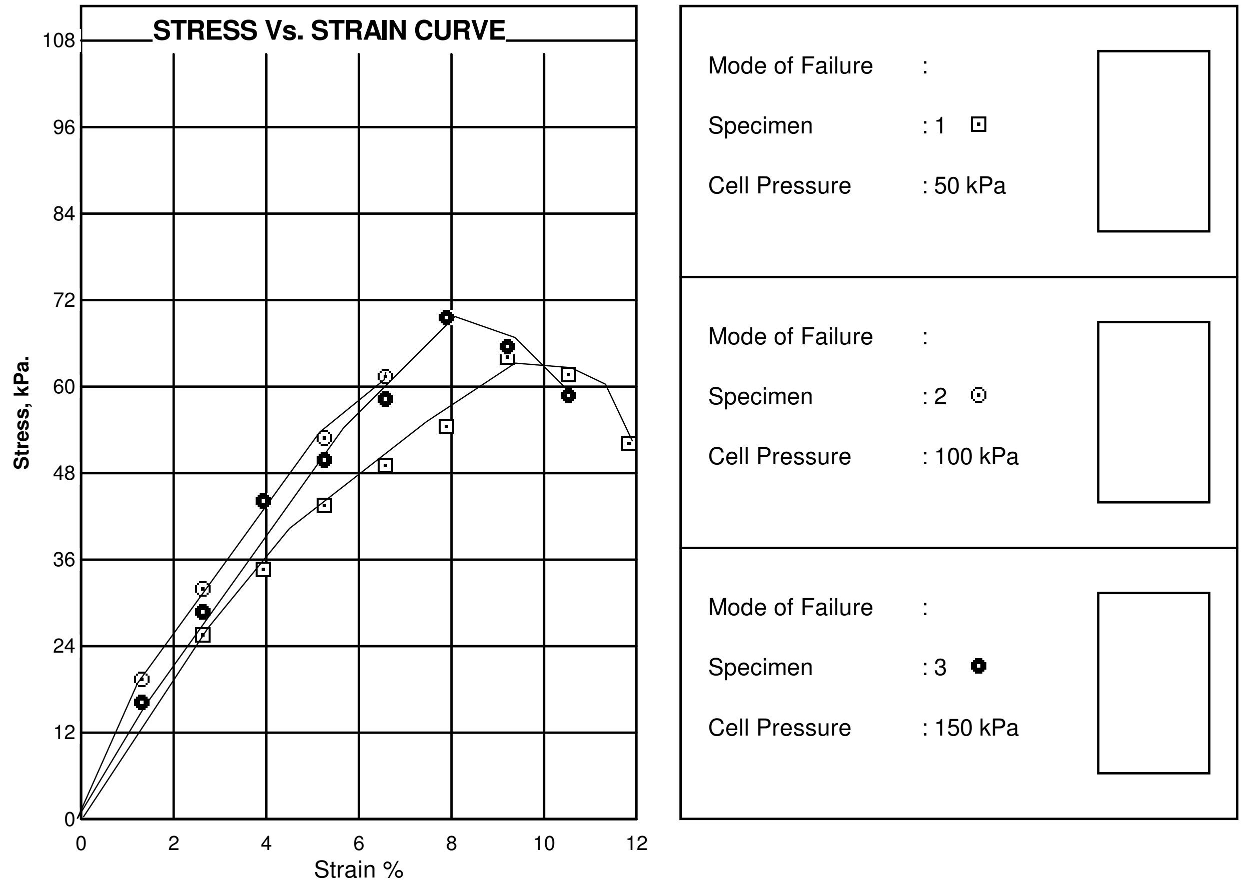


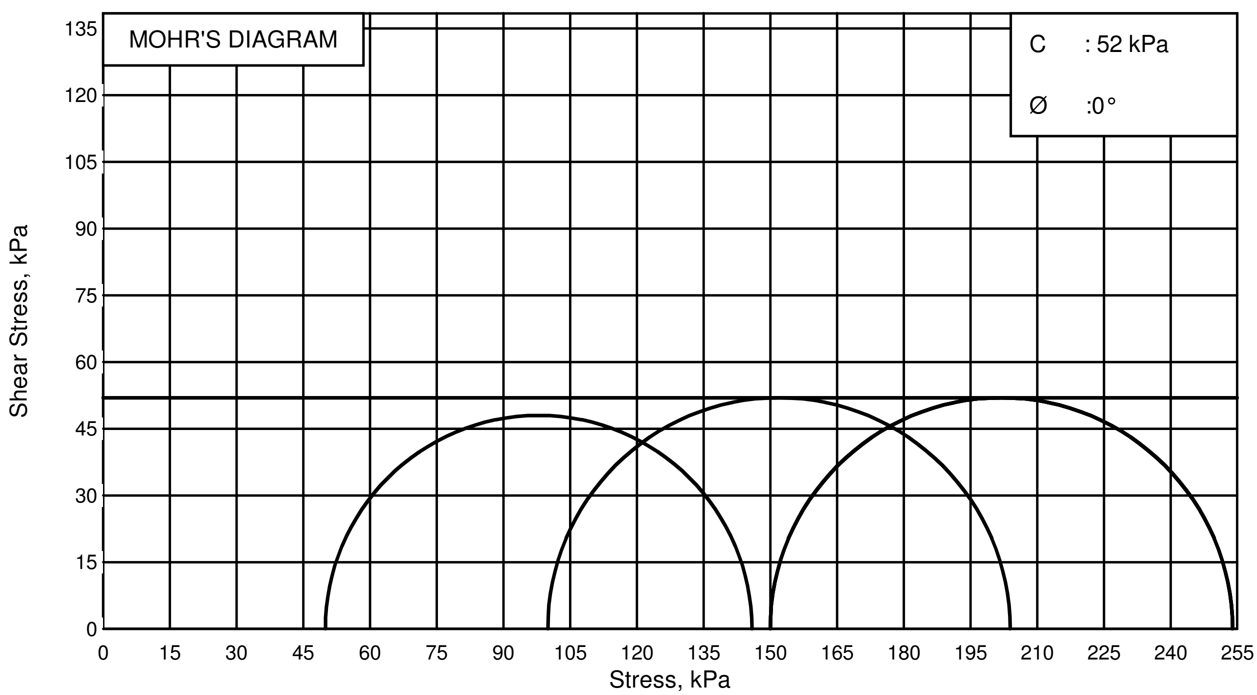
TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100878
Sample Depth : 2.00 - 2.45m.
Bore Hole Number : 9

Site :
Type of Test : uu



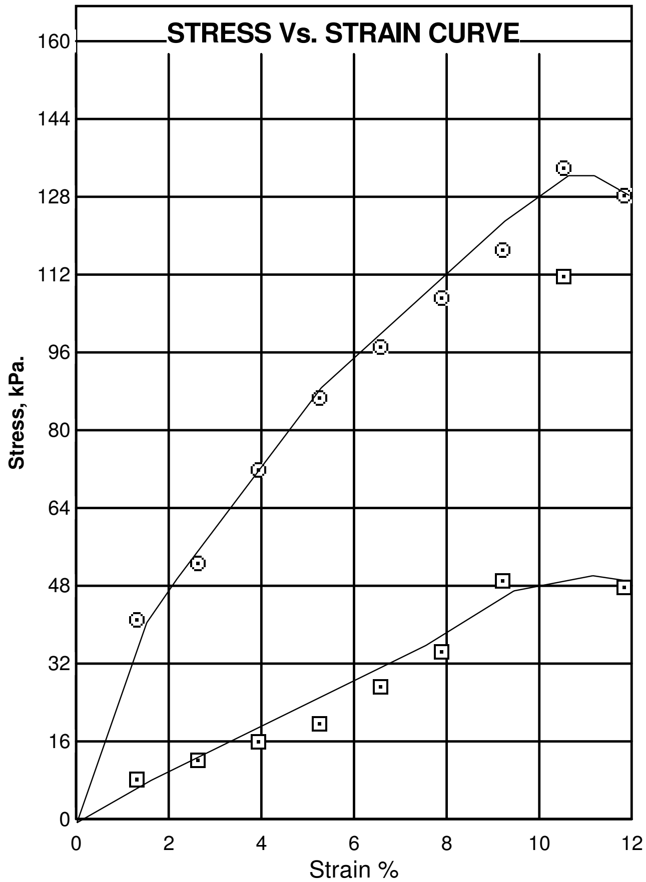


TRIAXIAL TEST CURVES

Job No. : 30796

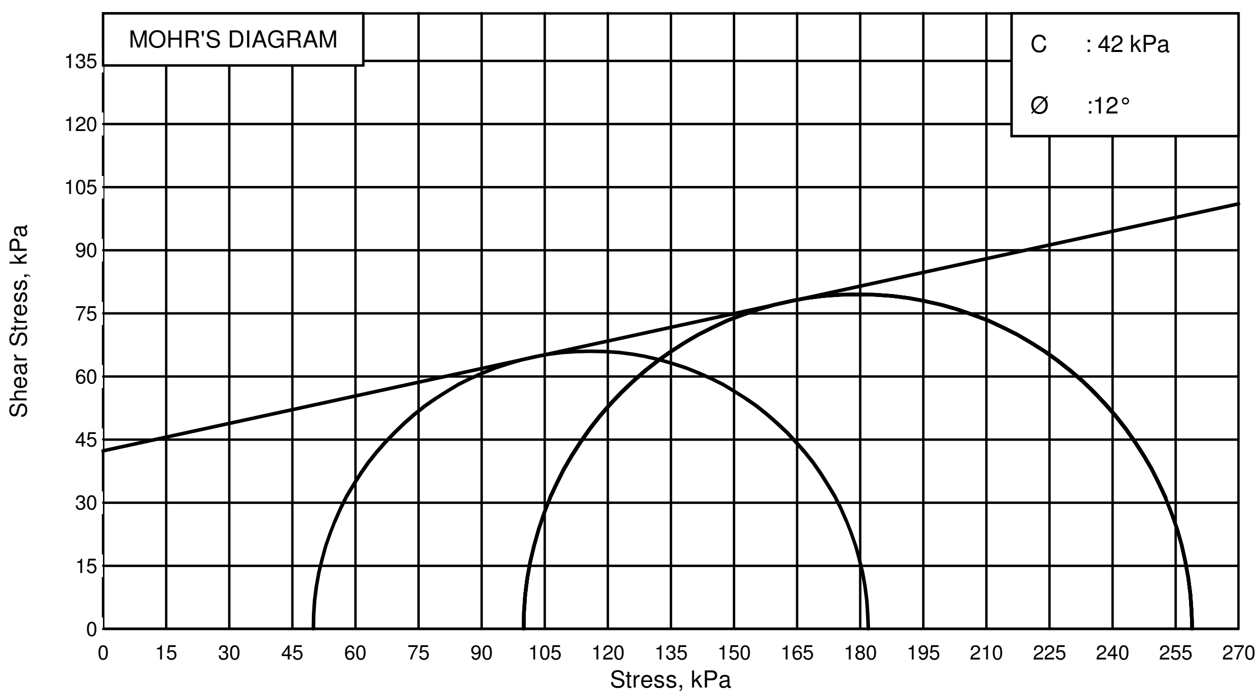
Sample Number : 100882
Sample Depth : 4.50 - 4.95m.
Bore Hole Number : 9

Site :
Type of Test : cu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	

Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	

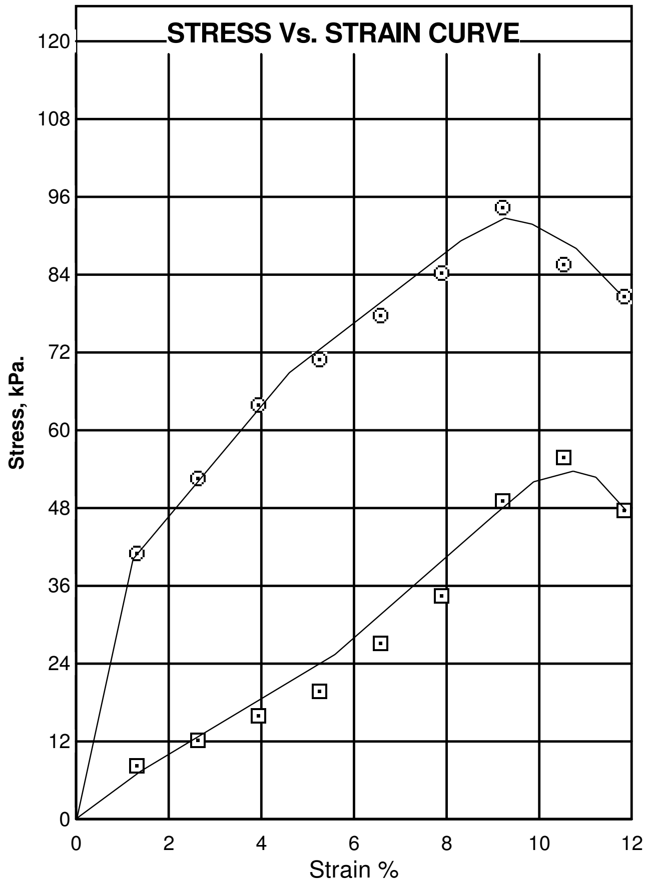


TRIAXIAL TEST CURVES

Job No. : 30796

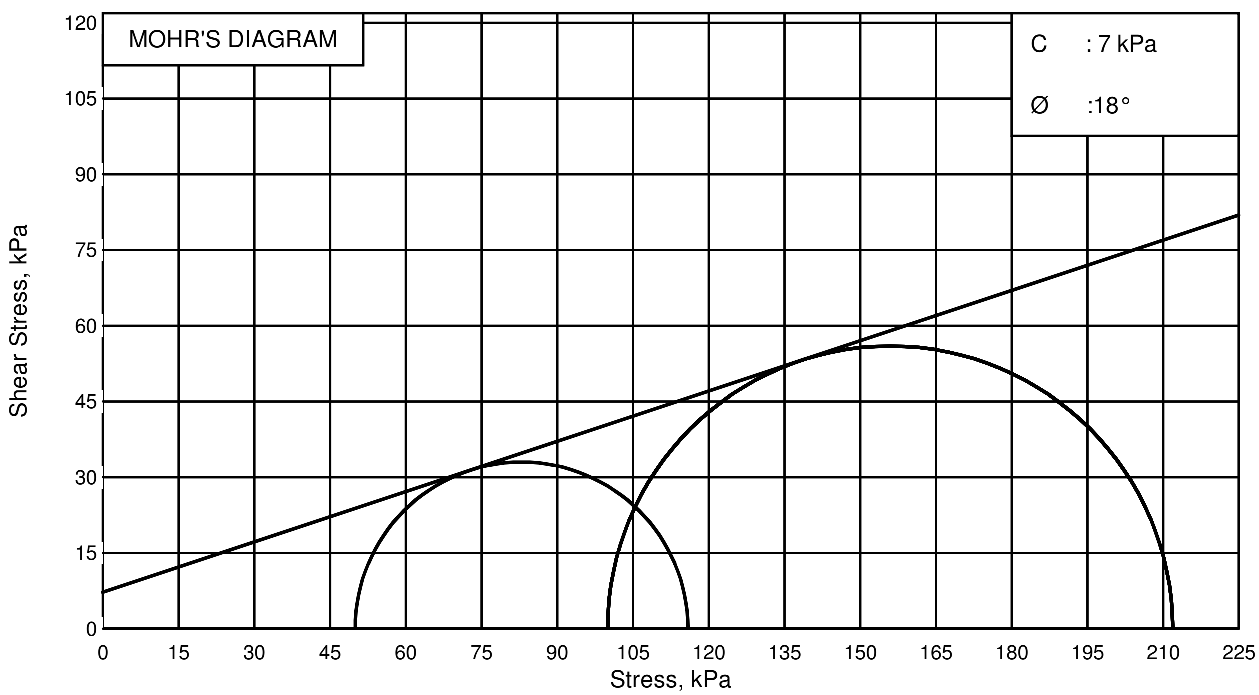
Sample Number : 100882
Sample Depth : 4.50 - 4.95m.
Bore Hole Number : 9

Site :
Type of Test : cu



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa



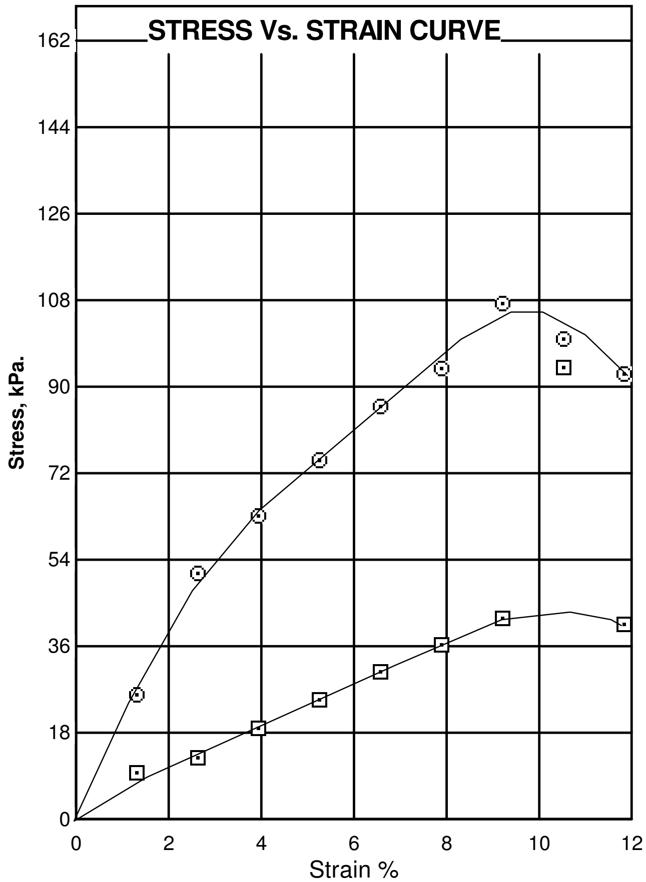
C : 7 kPa
Ø :18°

TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100852
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 11

Site :
Type of Test : cu



Mode of Failure :

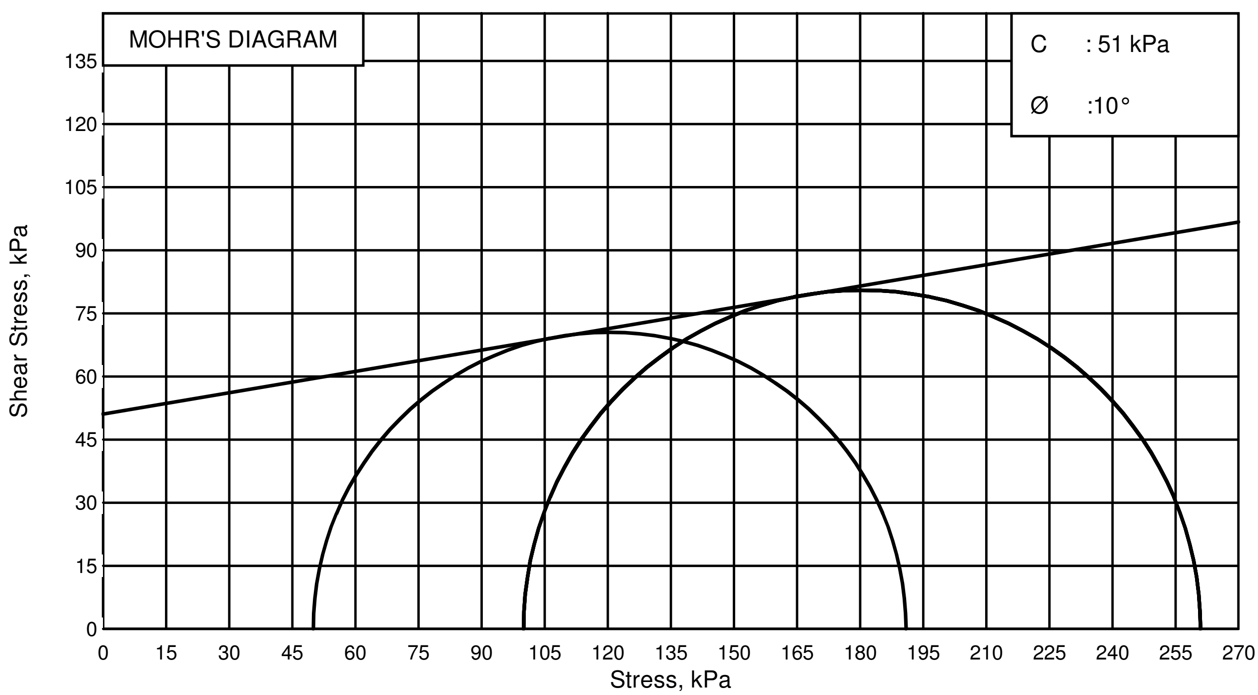
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

Cell Pressure : 100 kPa

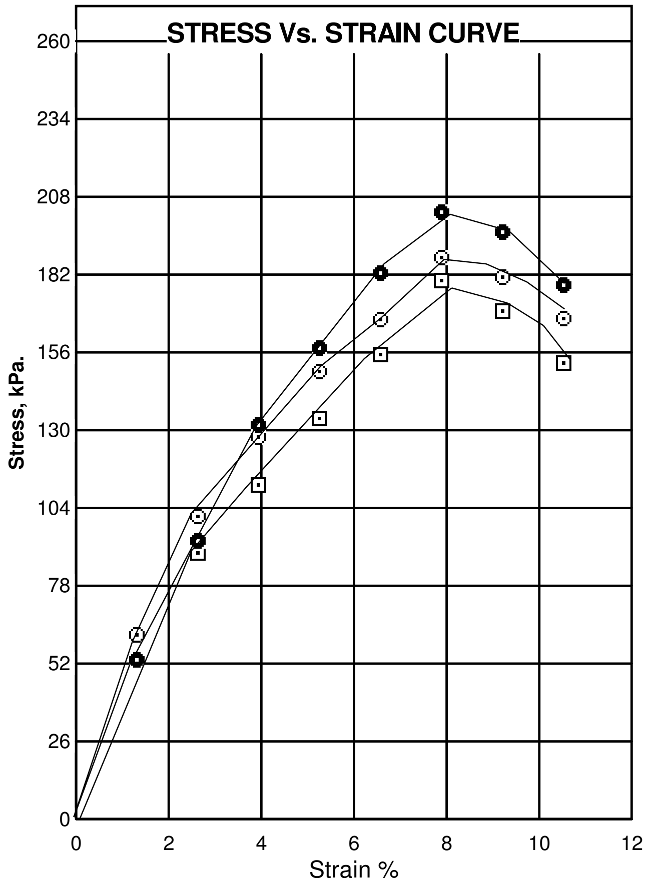


TRIAXIAL TEST CURVES

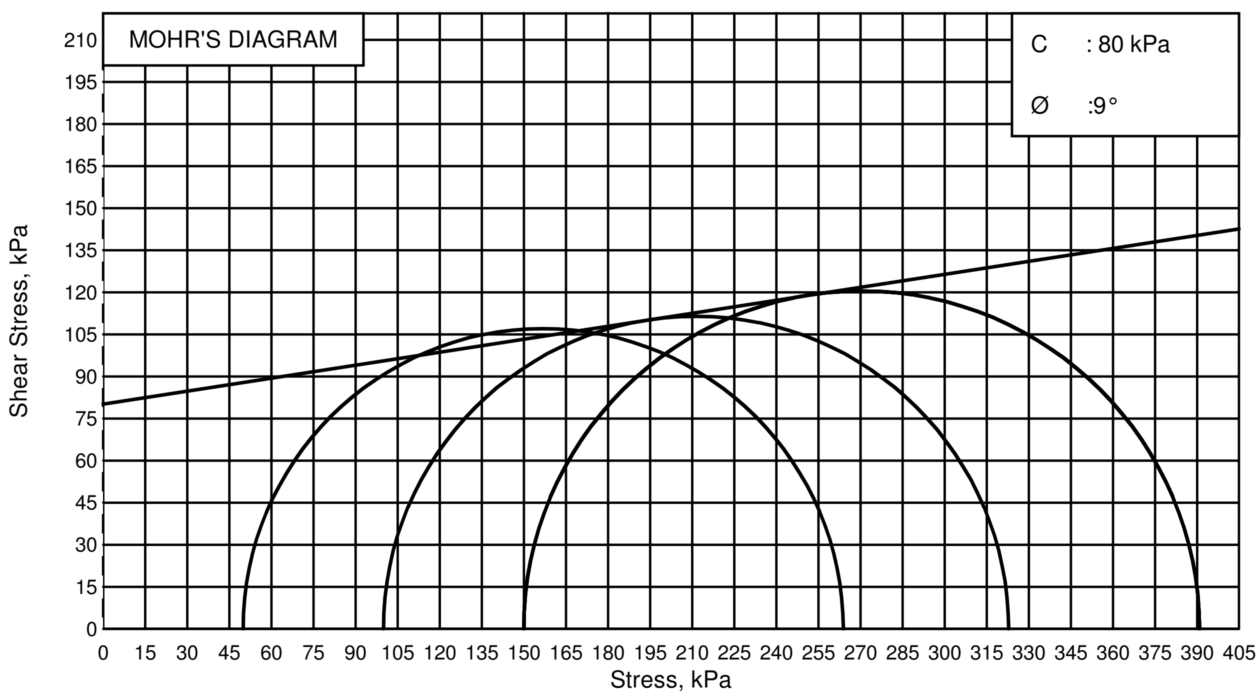
Job No. : 30796

Sample Number : 100856
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 11

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

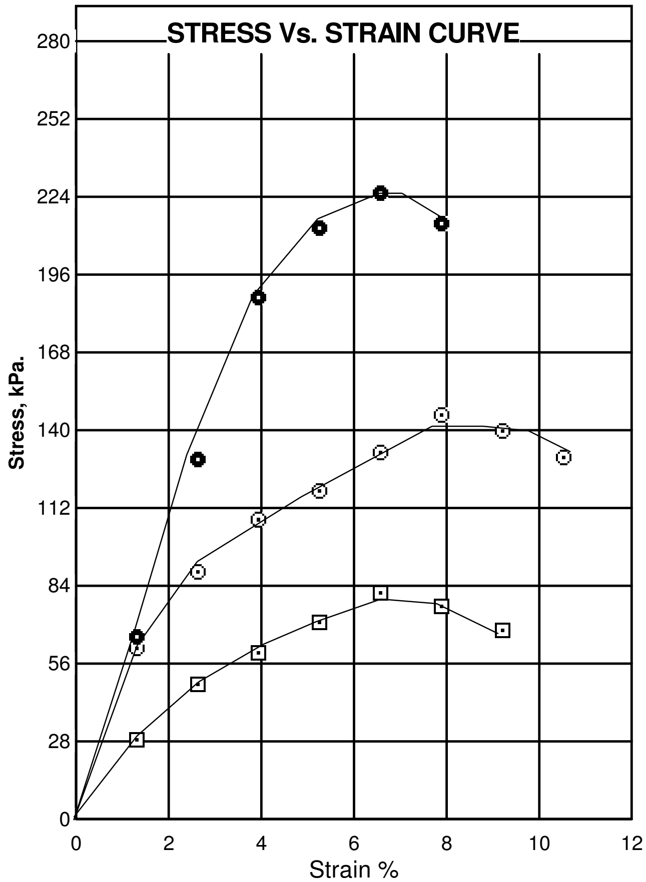


TRIAXIAL TEST CURVES

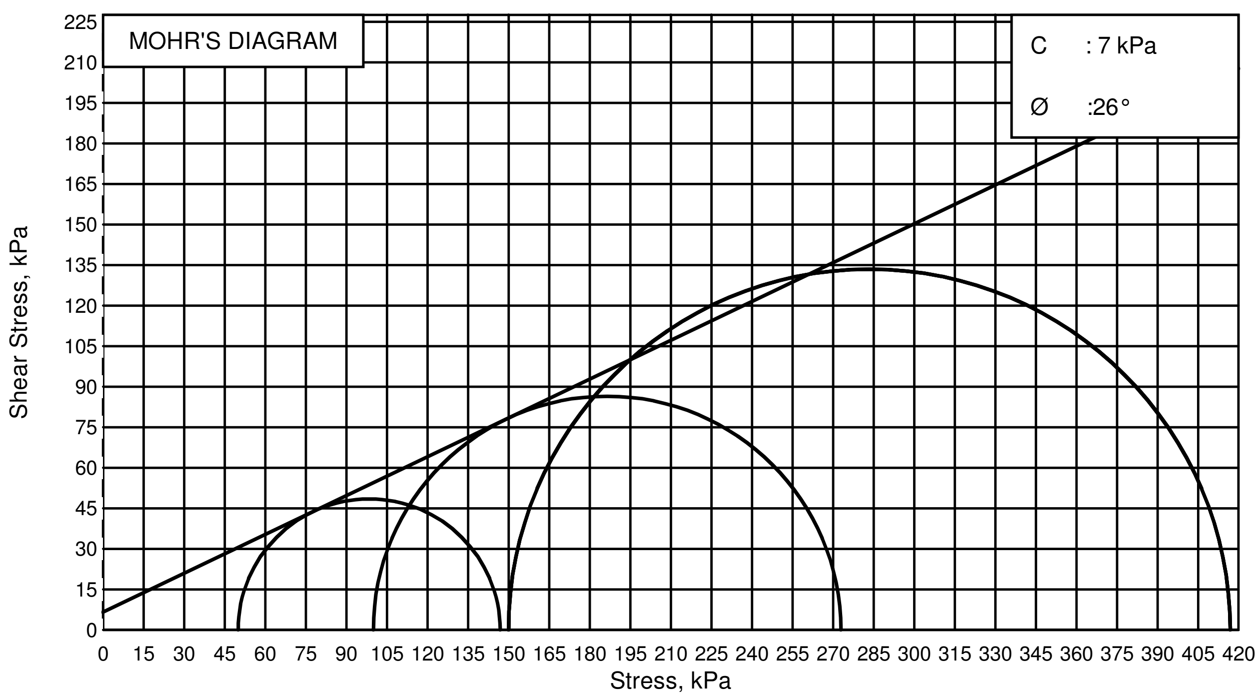
Job No. : 30796

Sample Number : 100978
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 12

Site :
Type of Test : CD



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

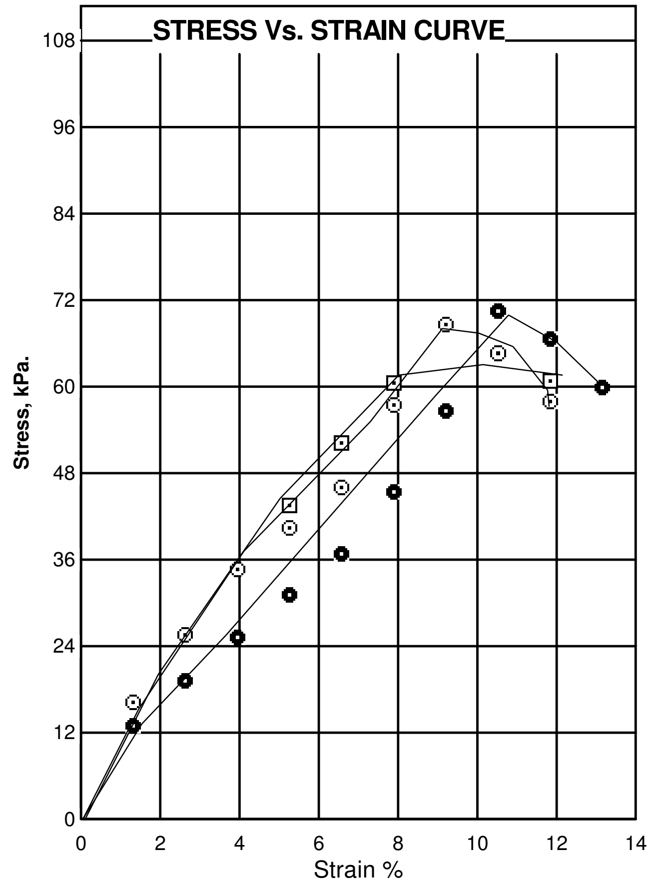


TRIAXIAL TEST CURVES

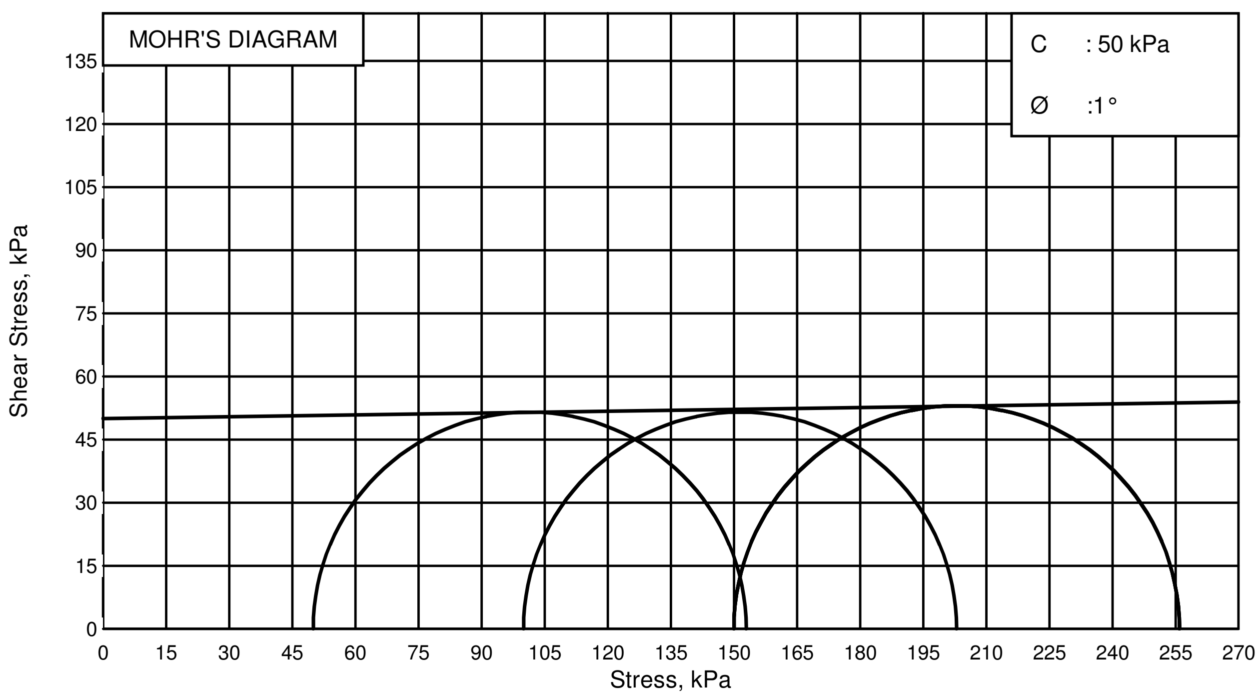
Job No. : 30796

Sample Number : 100954
Sample Depth : 2.00 - 2.45m.
Bore Hole Number : 16

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

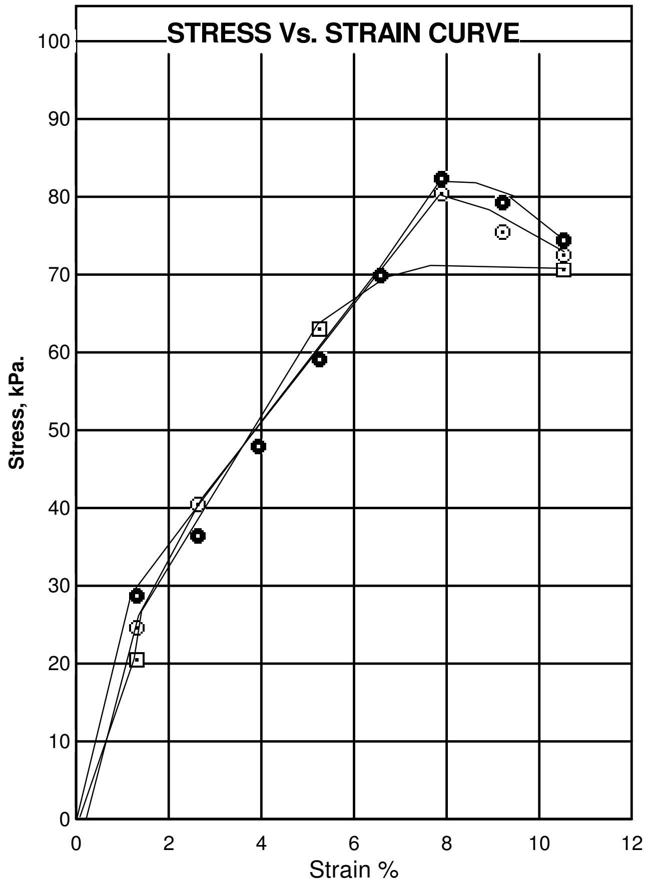


TRIAXIAL TEST CURVES

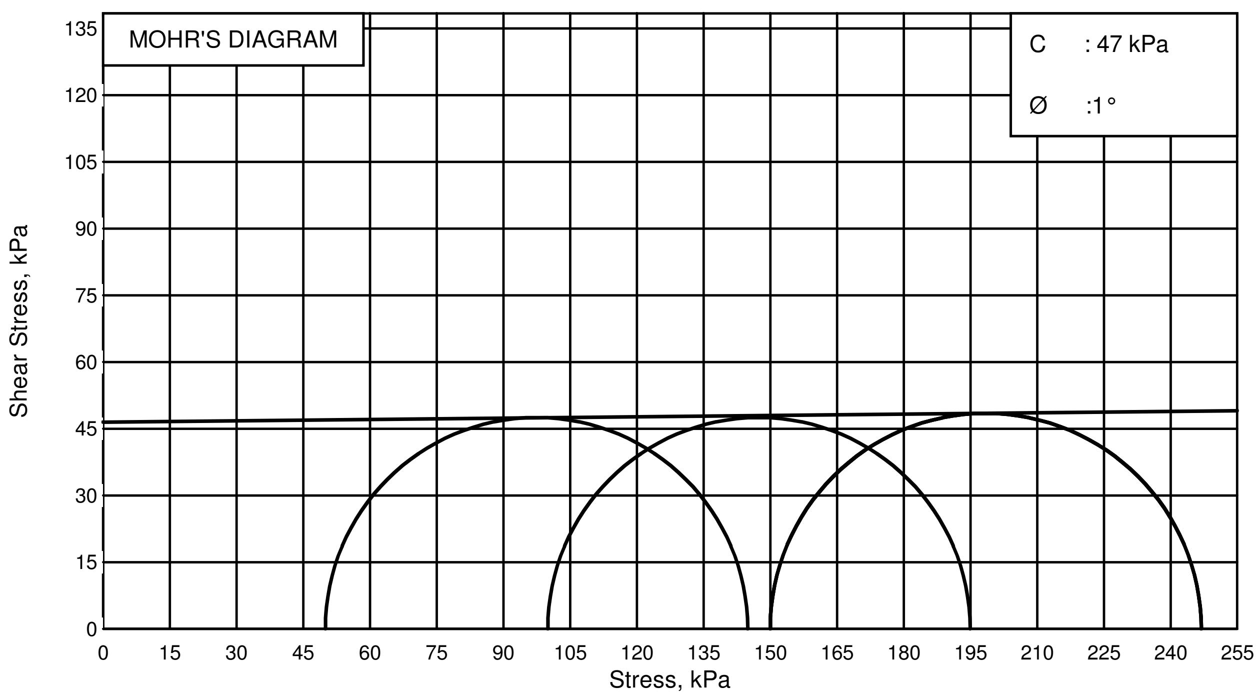
Job No. : 30796

Sample Number : 100517
Sample Depth : 2.00 - 2.45m.
Bore Hole Number : 17

Site :
Type of Test : UU



Mode of Failure	:
Specimen	: 1 ⊡
Cell Pressure	: 50 kPa
Mode of Failure	:
Specimen	: 2 ⊙
Cell Pressure	: 100 kPa
Mode of Failure	:
Specimen	: 3 ●
Cell Pressure	: 150 kPa

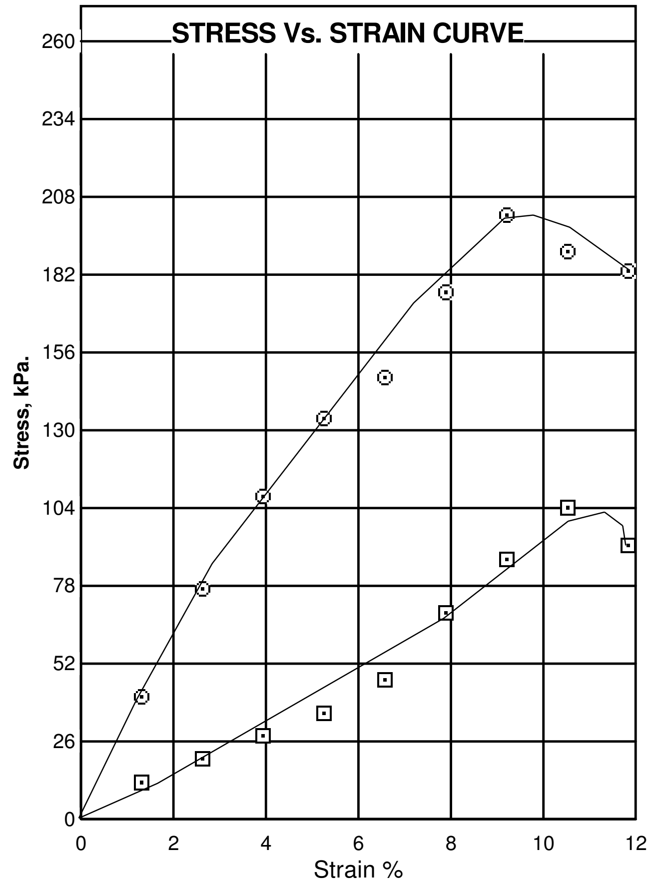


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100524
Sample Depth : 7.50 - 7.95m.
Bore Hole Number : 17

Site :
Type of Test : cu



Mode of Failure :

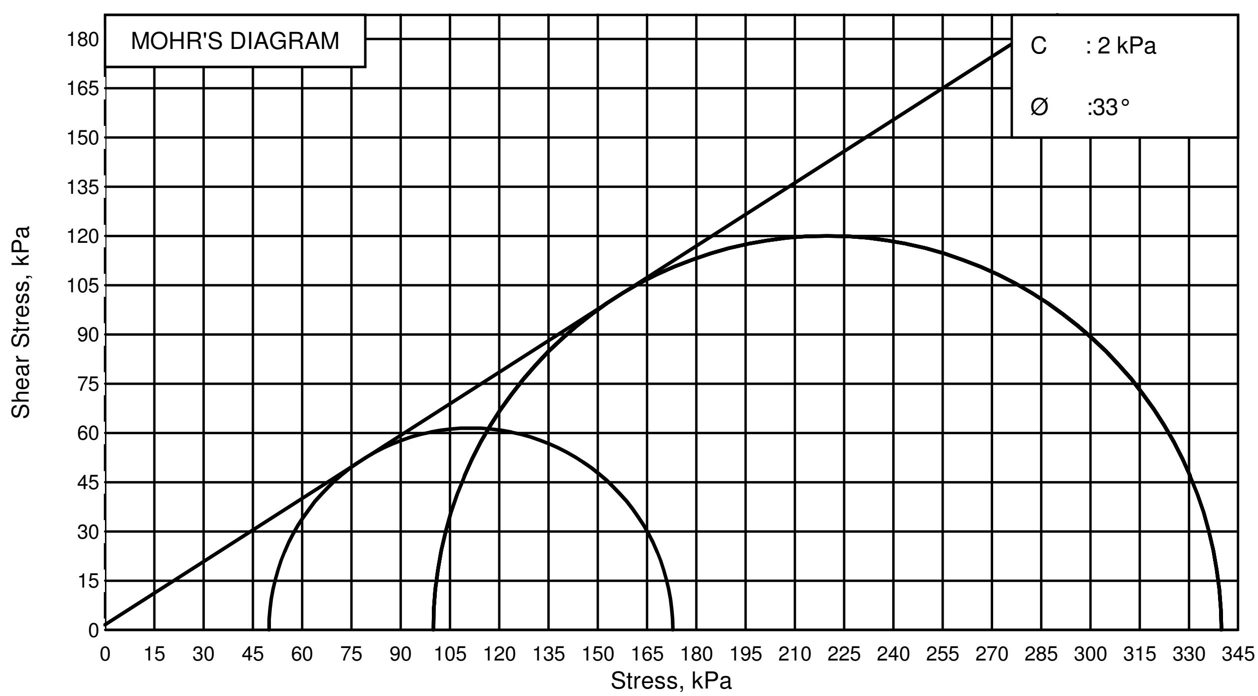
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

Cell Pressure : 100 kPa

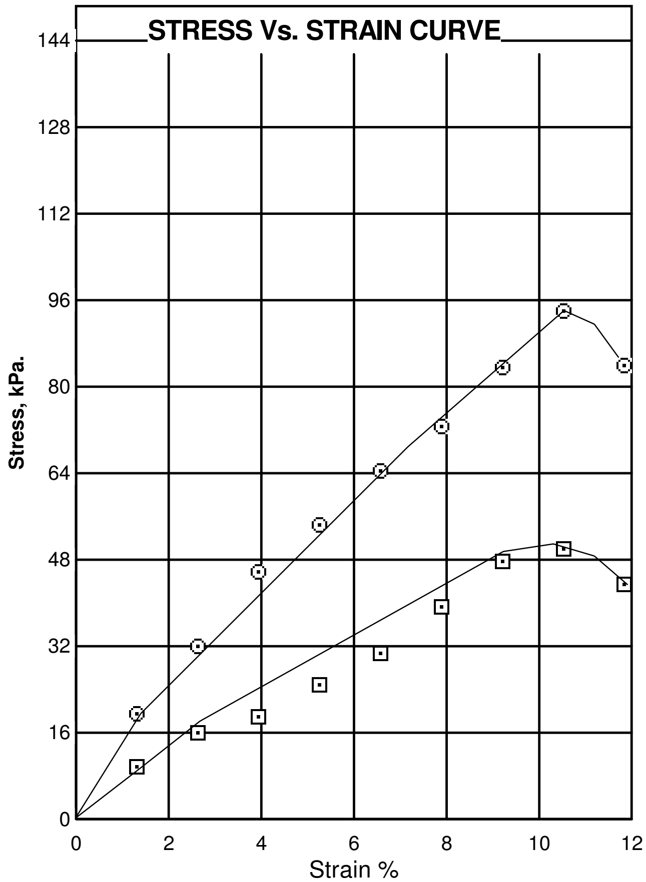


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100535
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 18

Site :
Type of Test : CD



Mode of Failure :

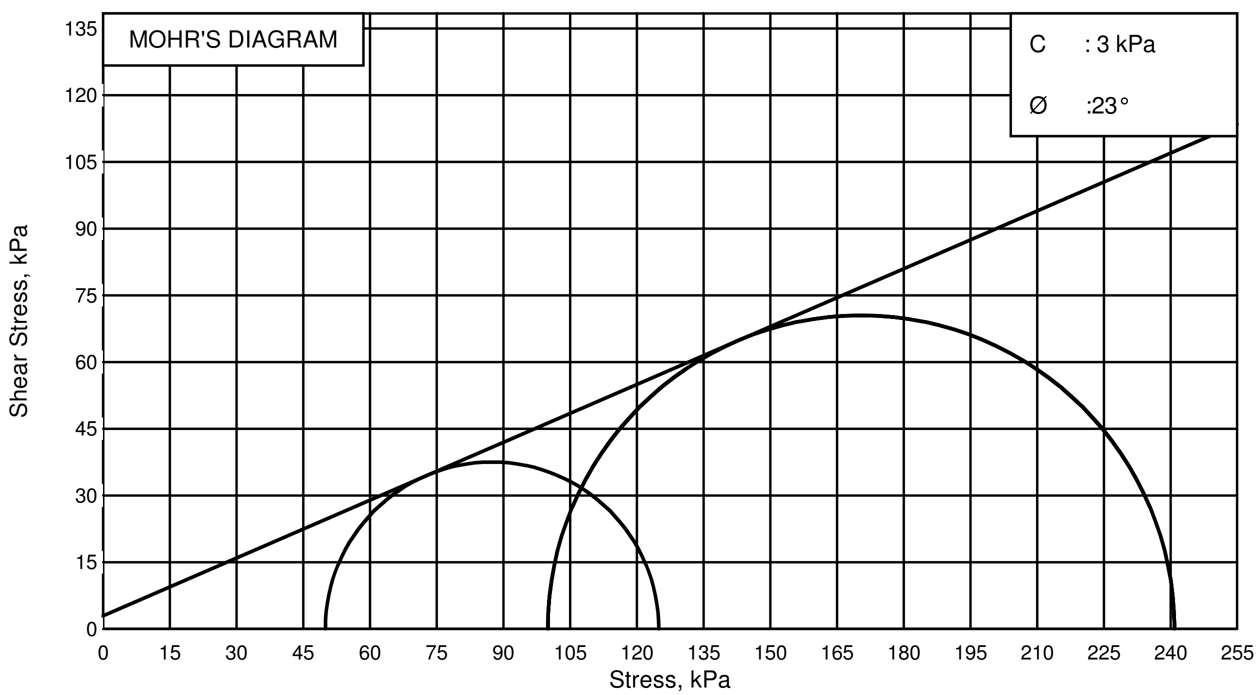
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

Cell Pressure : 100 kPa

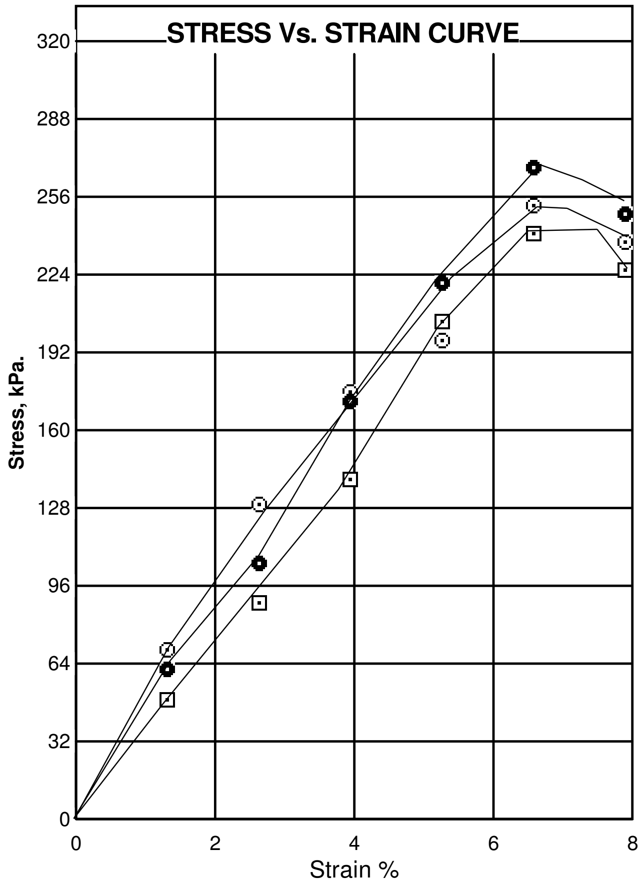


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100507
Sample Depth : 4.00 - 4.45m.
Bore Hole Number : 19

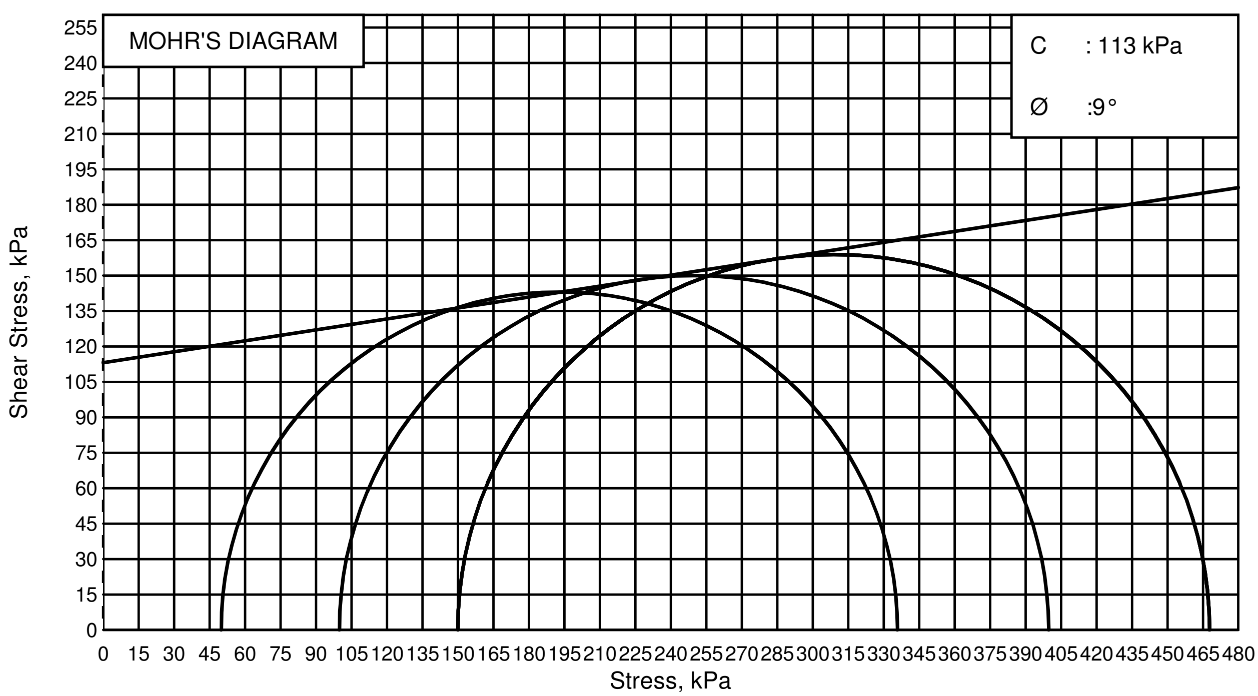
Site :
Type of Test : uu



Mode of Failure :
Specimen : 1
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3
Cell Pressure : 150 kPa

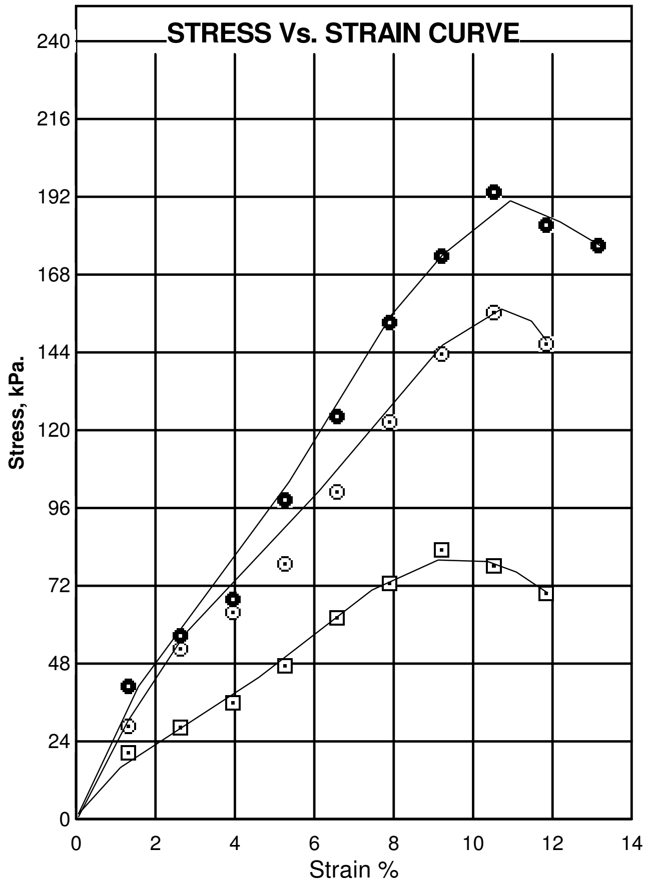


TRIAXIAL TEST CURVES

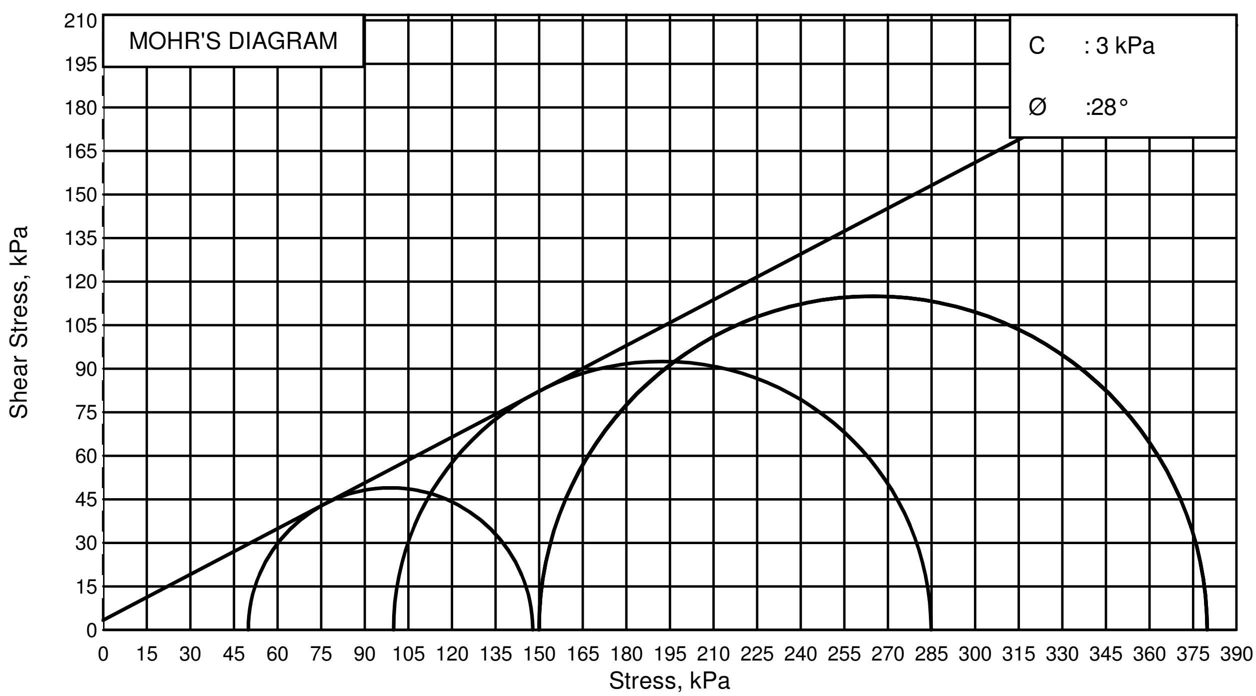
Job No. : 30796

Sample Number : 120103
Sample Depth : 2.00 -2.45m.
Bore Hole Number : 20

Site :
Type of Test : CD



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

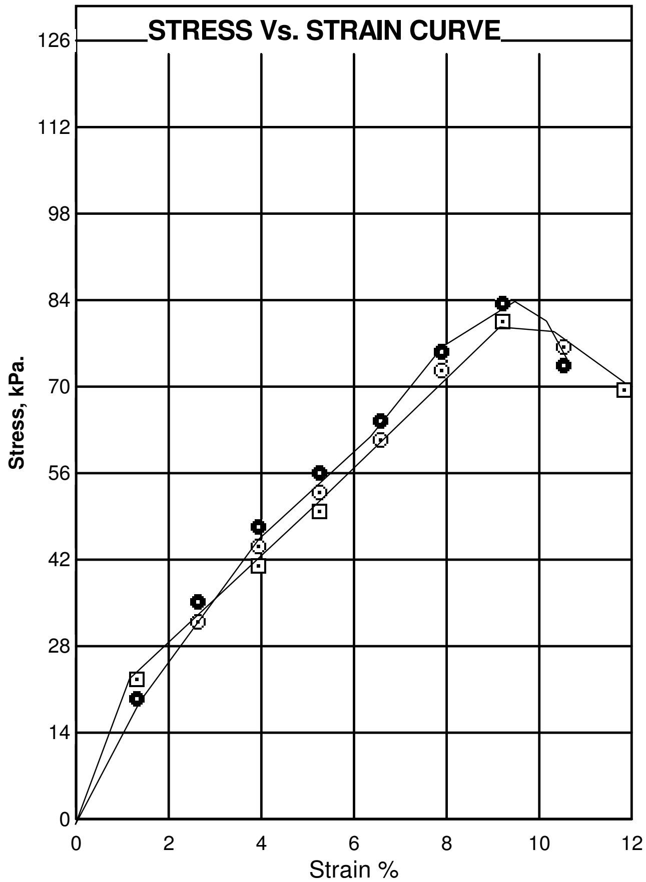


TRIAXIAL TEST CURVES

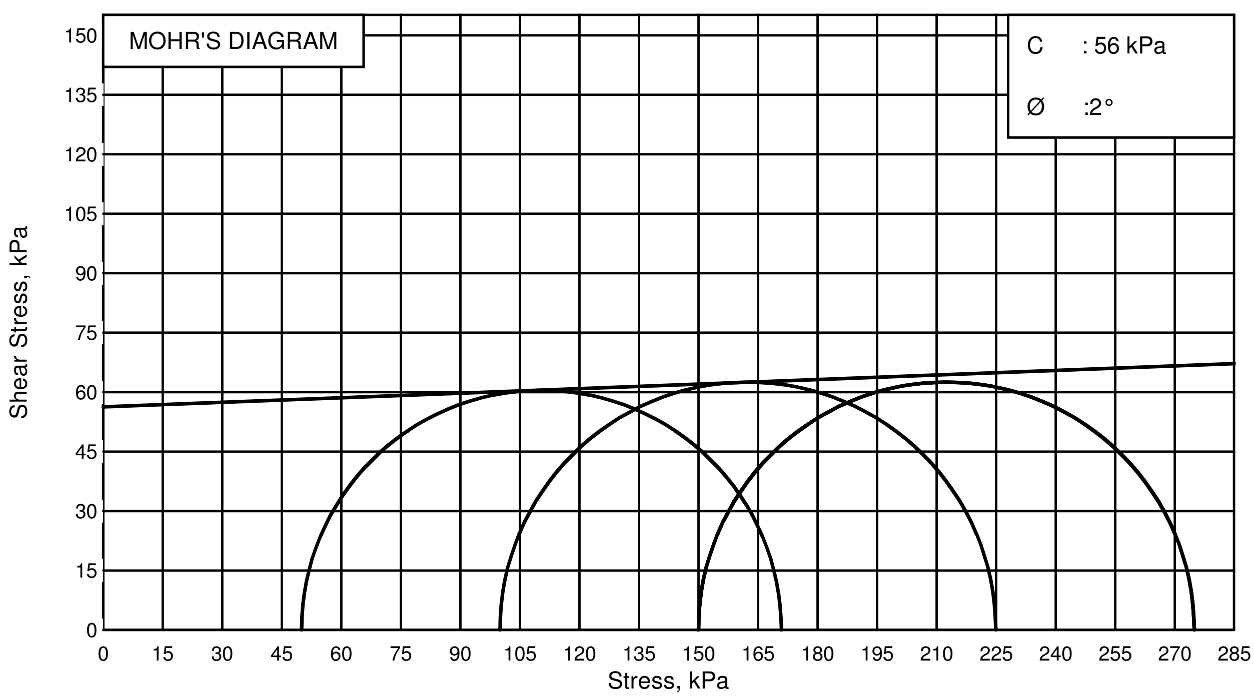
Job No. : 30796

Sample Number : 165105
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 22

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

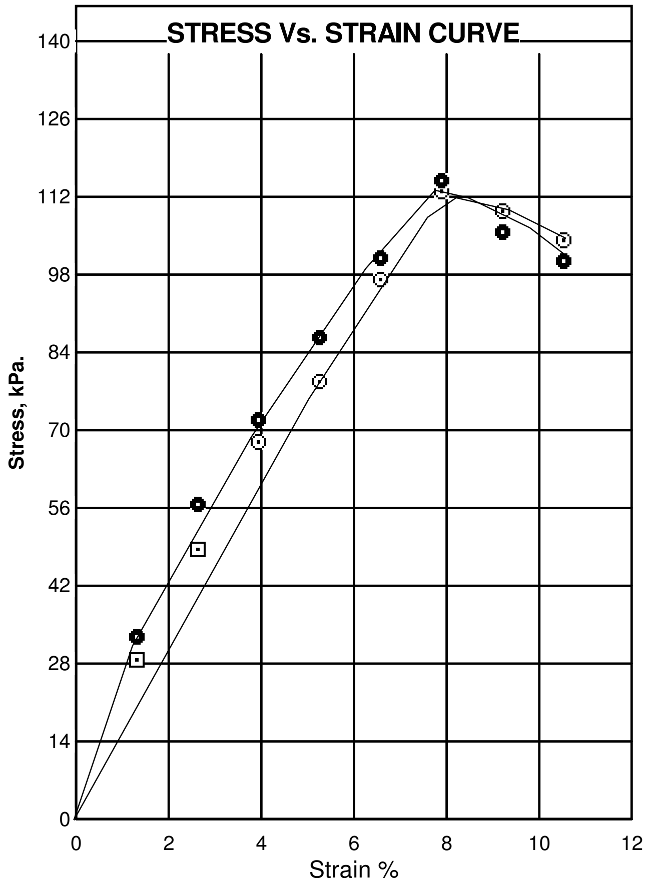


TRIAXIAL TEST CURVES

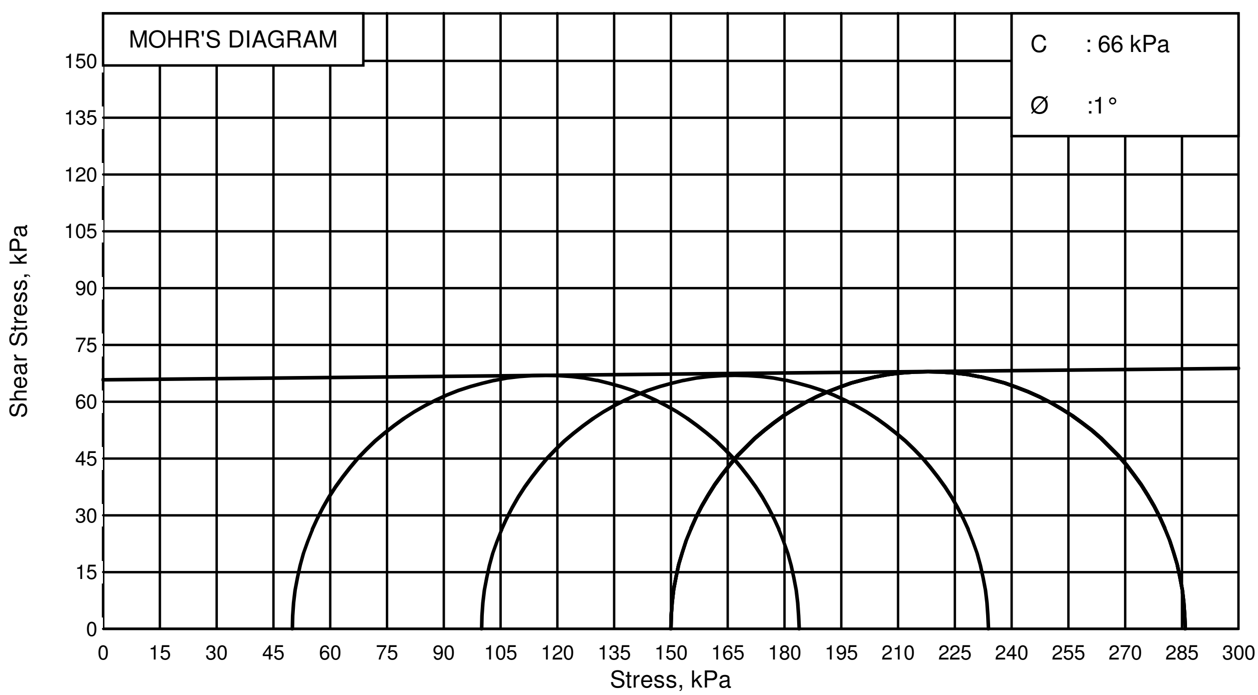
Job No. : 30796

Sample Number : 100251
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 23

Site :
Type of Test : UU



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

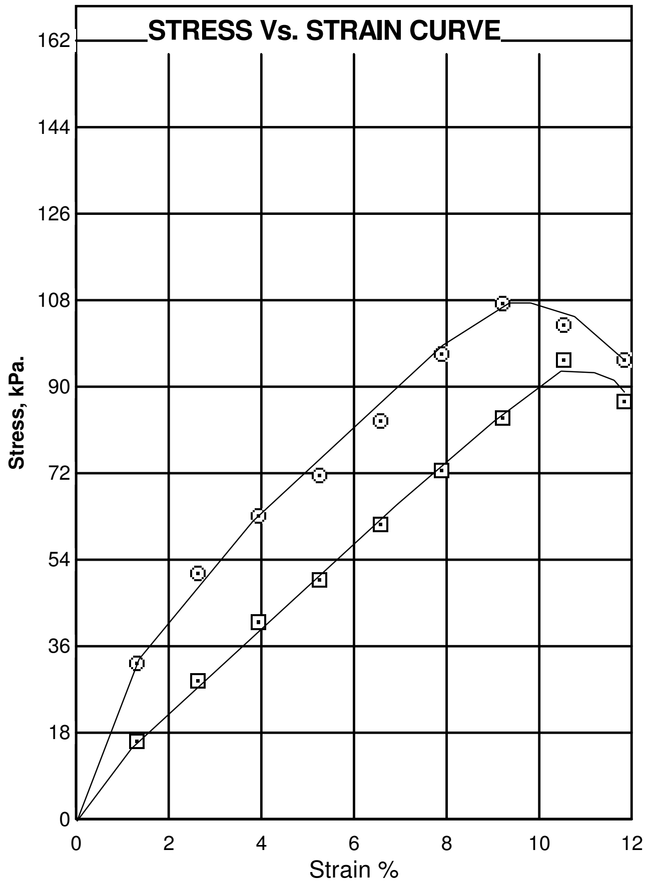


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100254
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 23

Site :
Type of Test : cu



Mode of Failure :

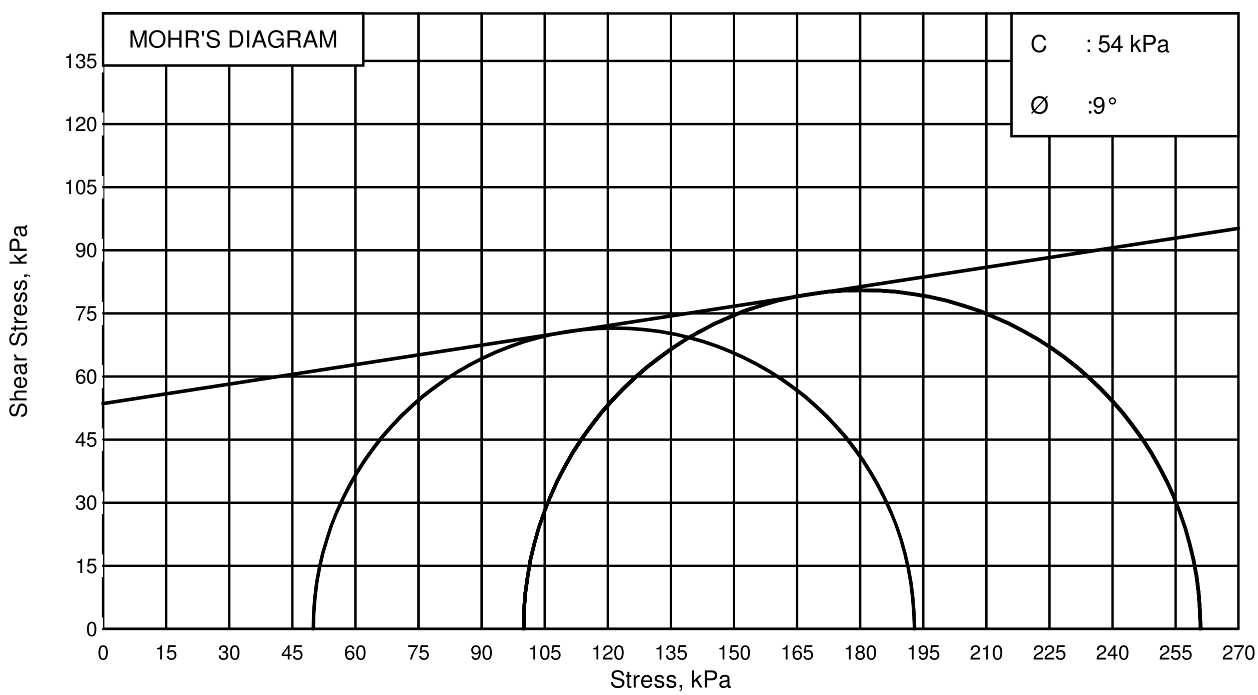
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

Cell Pressure : 100 kPa



C : 54 kPa

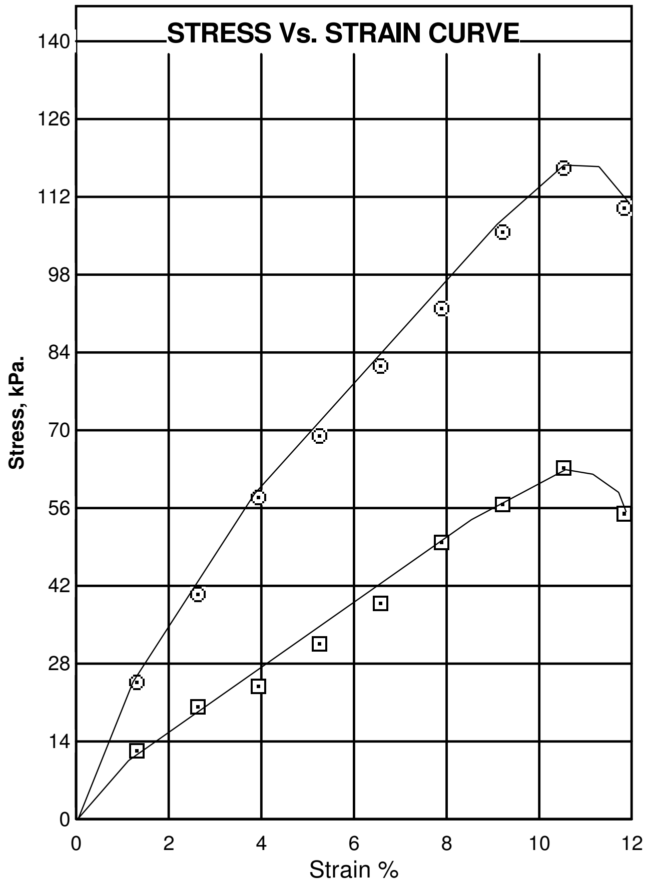
Ø :9°

TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100102
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 24

Site :
Type of Test : CD



Mode of Failure :

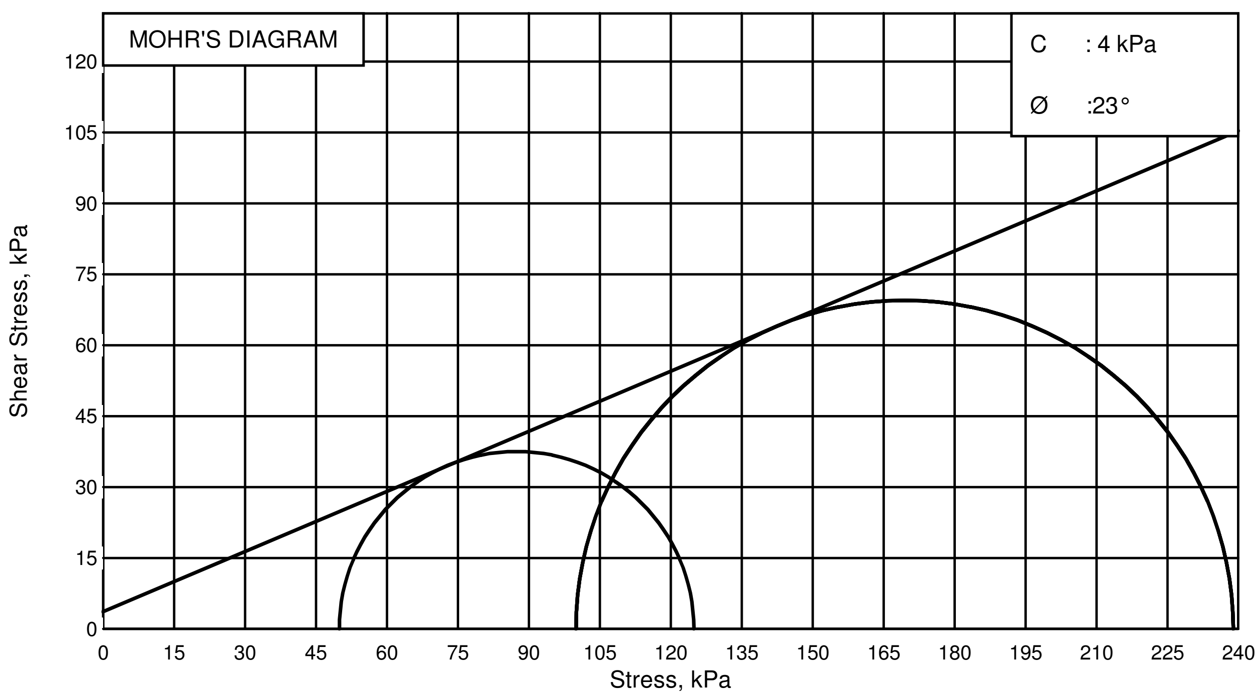
Specimen : 1

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2

Cell Pressure : 100 kPa

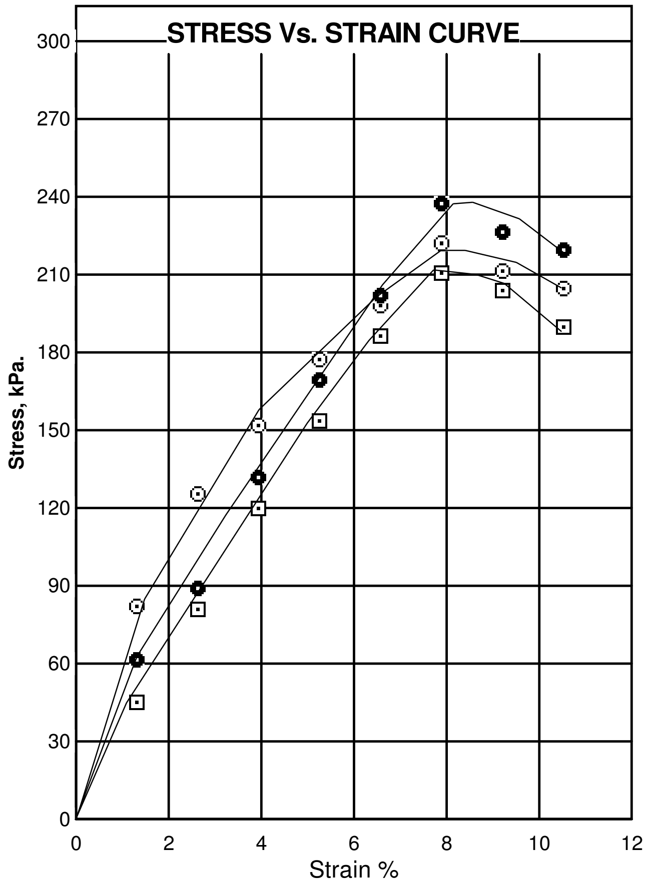


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 100106
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 24

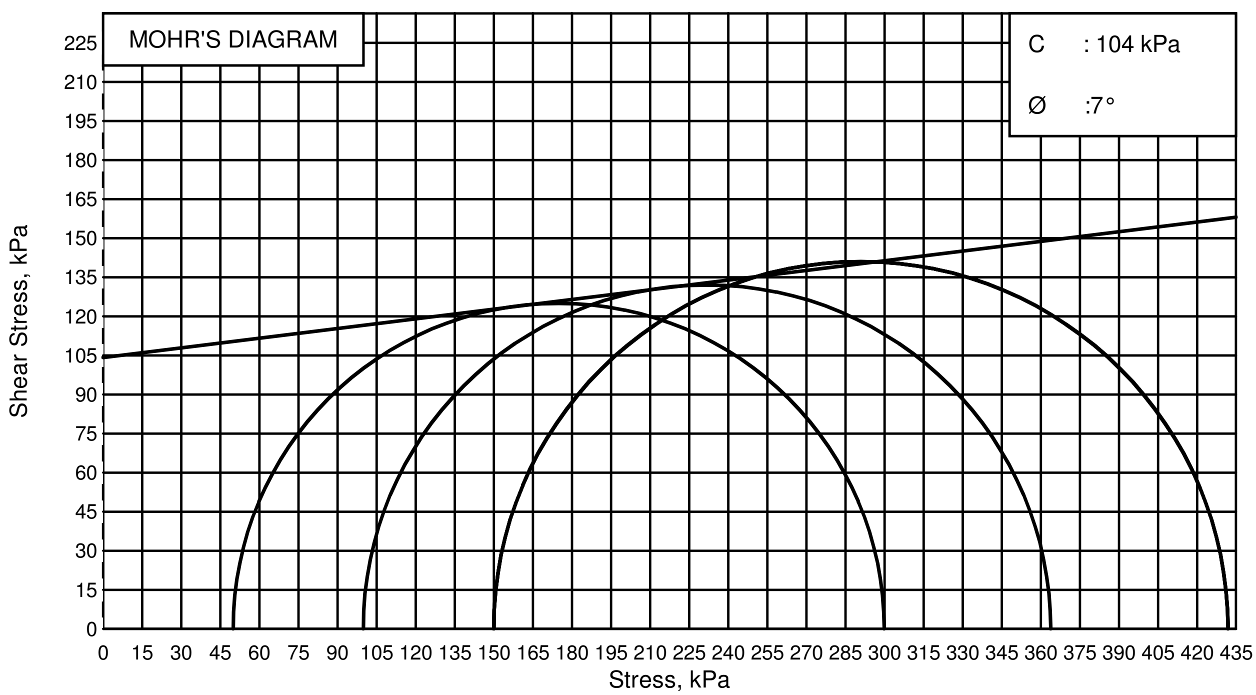
Site :
Type of Test : UU



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3 ●
Cell Pressure : 150 kPa

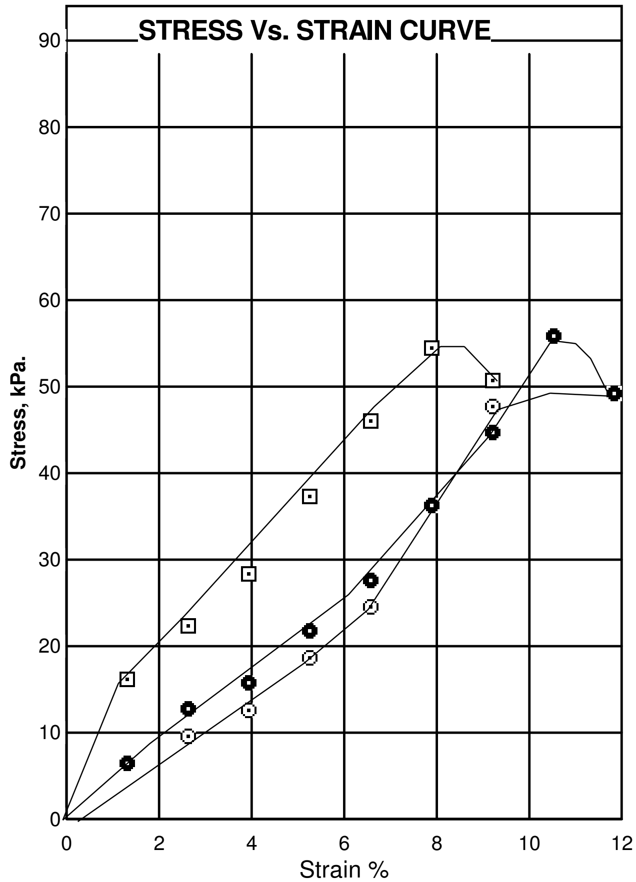


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 170020
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 25

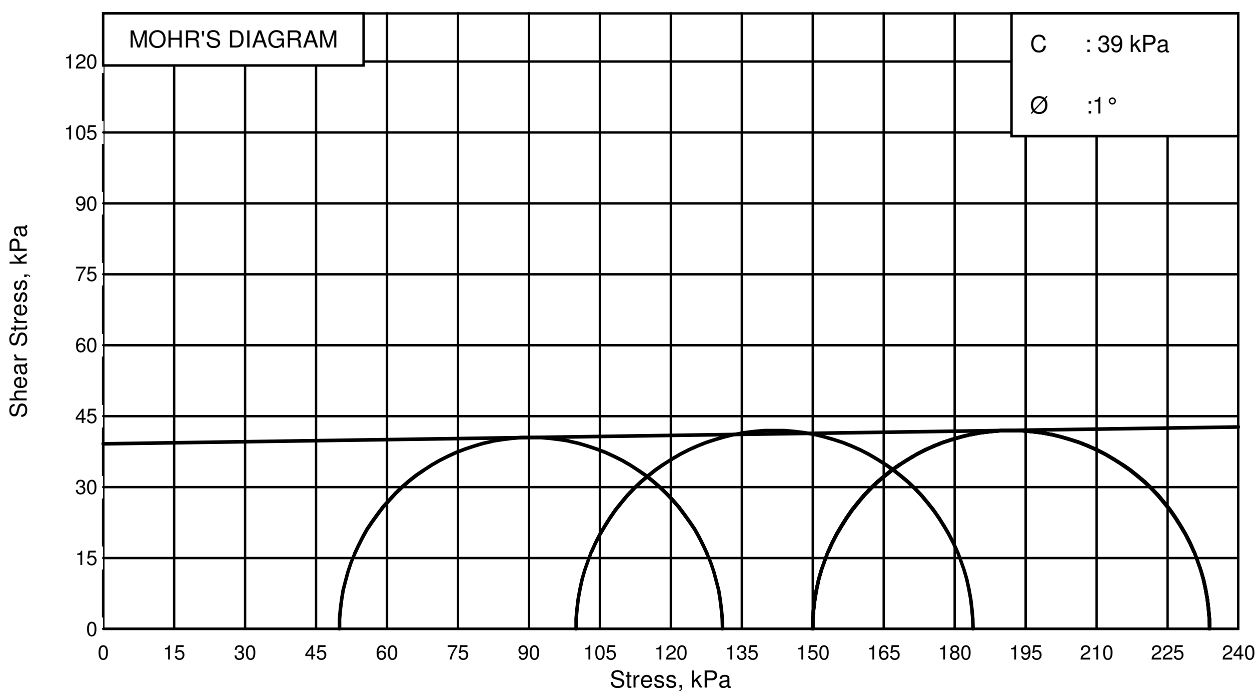
Site :
Type of Test : uu



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3 ●
Cell Pressure : 150 kPa

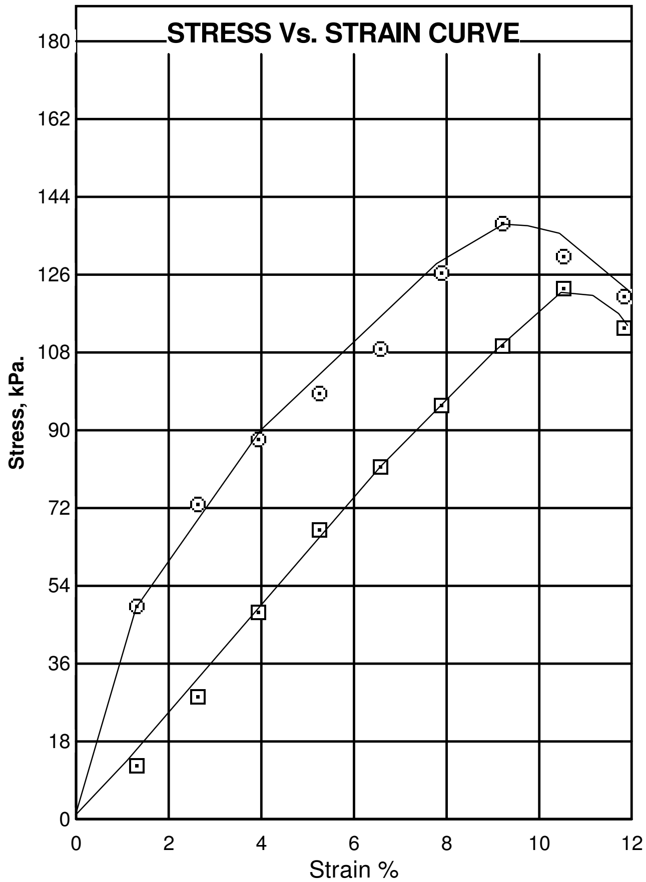


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 170027
Sample Depth : 6.00 - 6.45m.
Bore Hole Number : 25

Site :
Type of Test : cu



Mode of Failure :

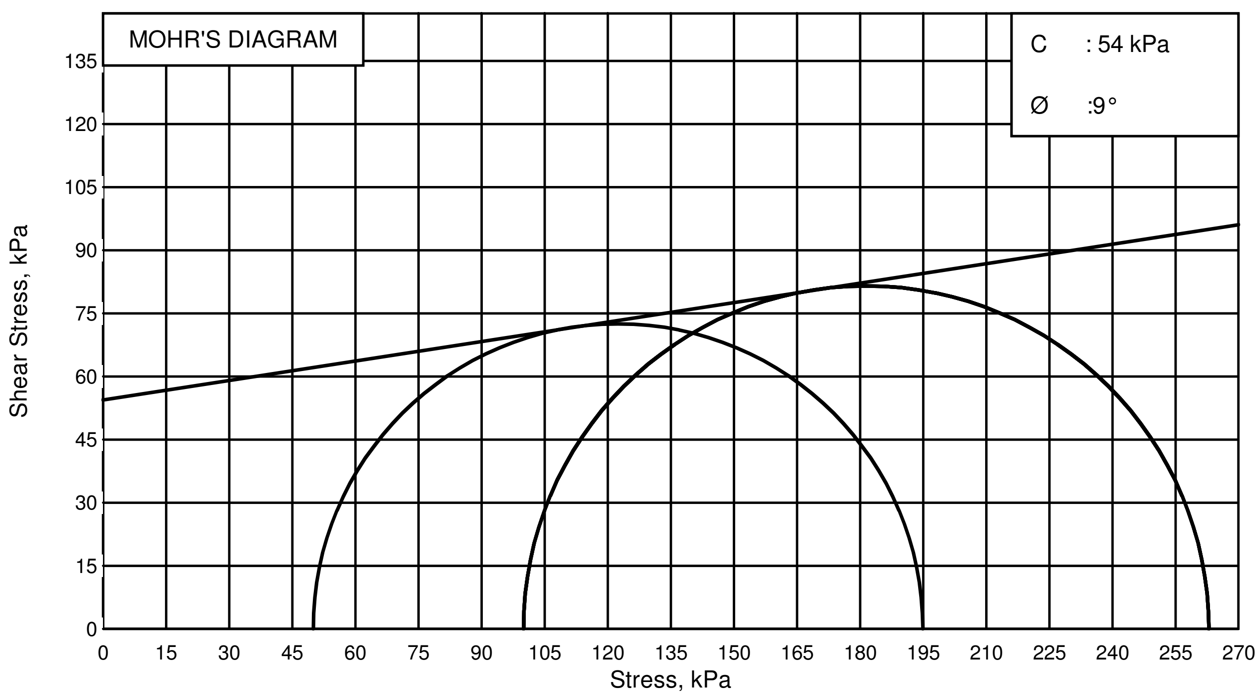
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

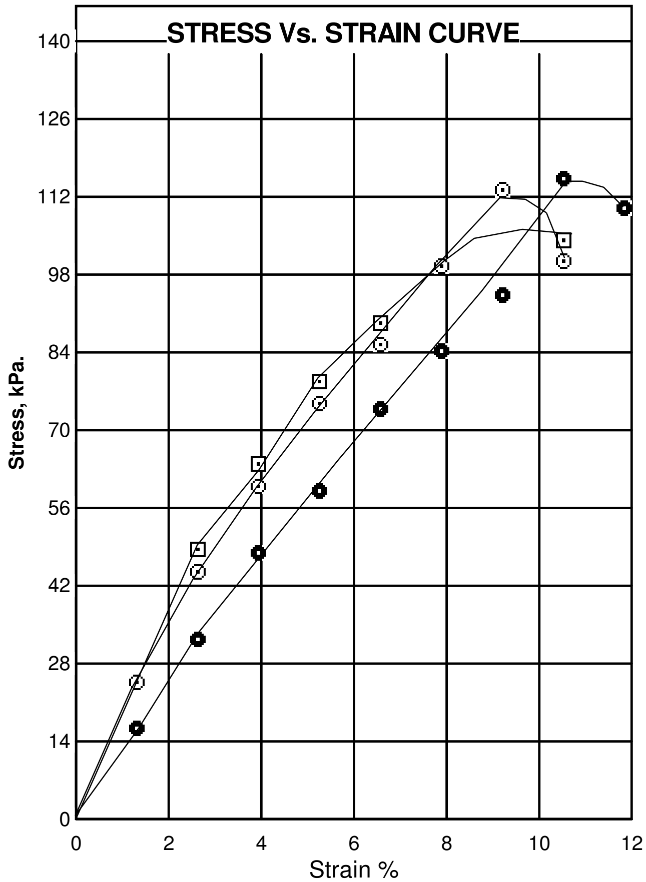
Cell Pressure : 100 kPa



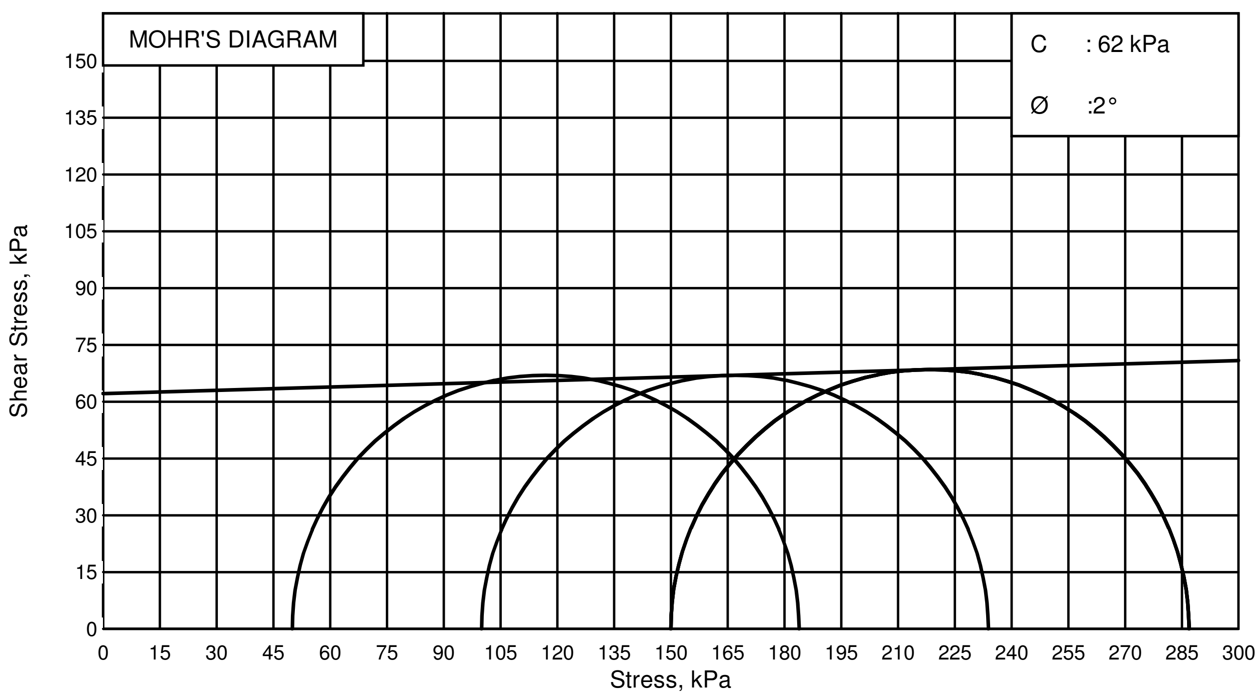
TRIAXIAL TEST CURVES

Sample Number : 182160
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 26

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

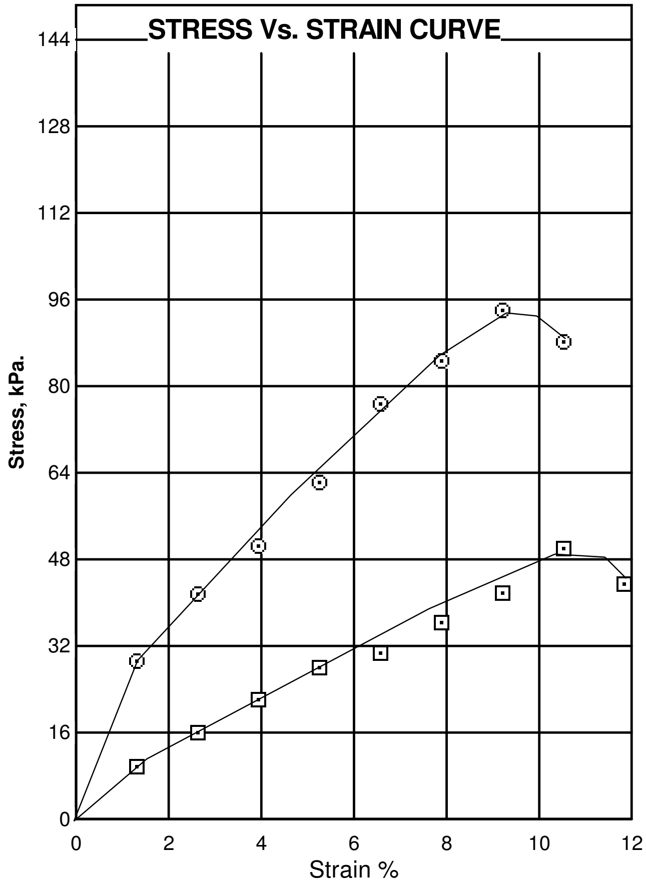


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 170667
Sample Depth : 4.50 - 4.95m.
Bore Hole Number : 27

Site :
Type of Test : cd



Mode of Failure :

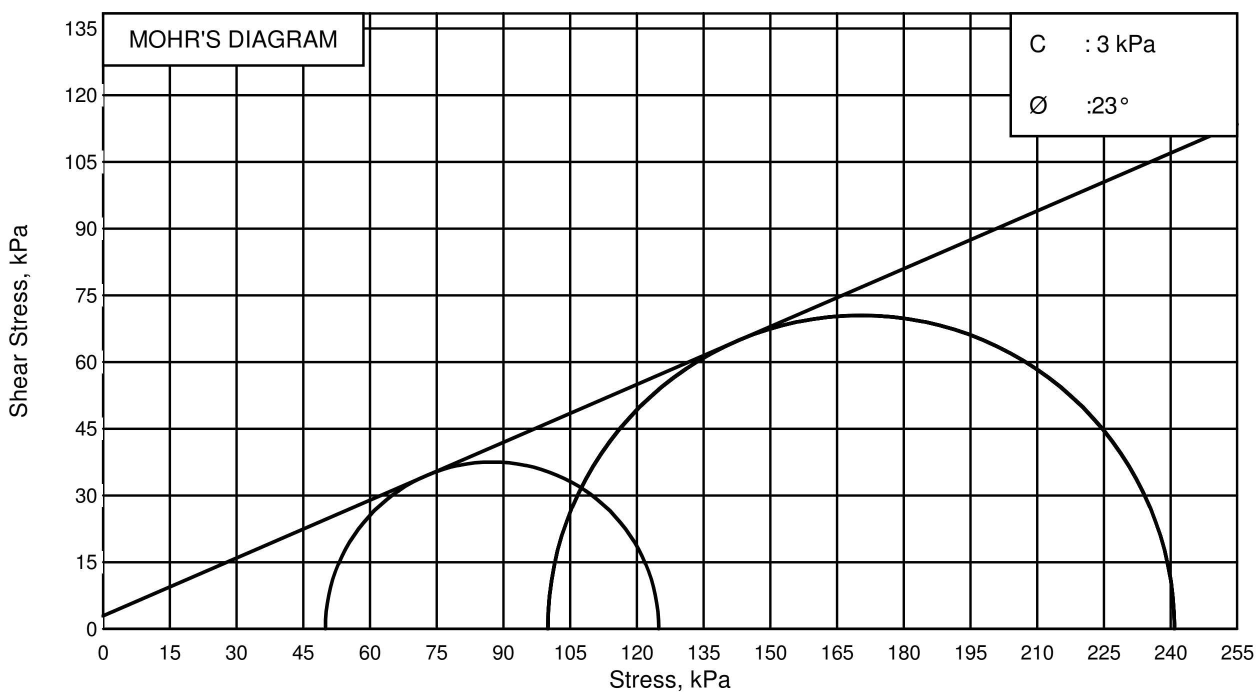
Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2 ⊙

Cell Pressure : 100 kPa

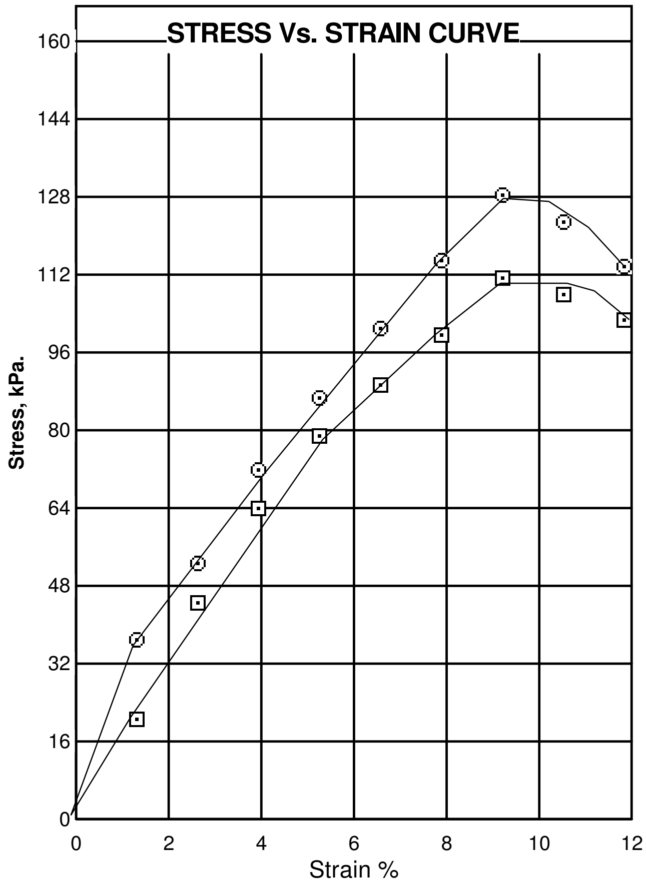


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 160775
Sample Depth : 3.00 - 3.45m.
Bore Hole Number : 28

Site :
Type of Test : cu



Mode of Failure :

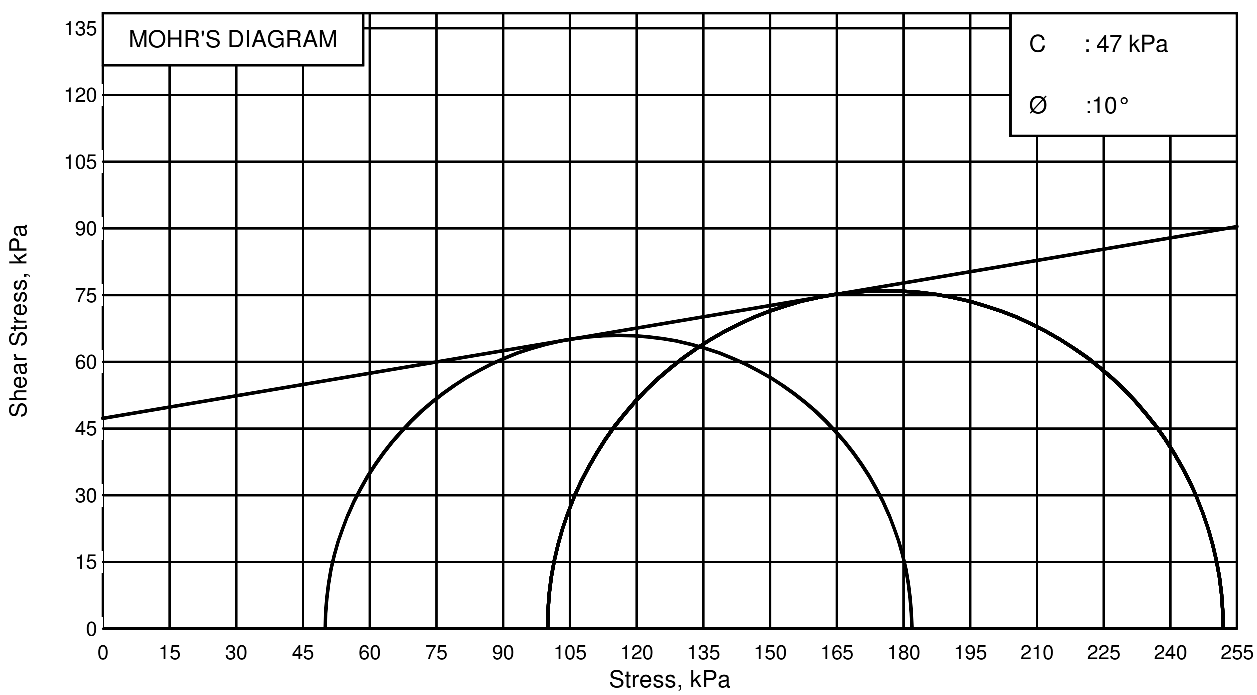
Specimen : 1

Cell Pressure : 50 kPa

Mode of Failure :

Specimen : 2

Cell Pressure : 100 kPa

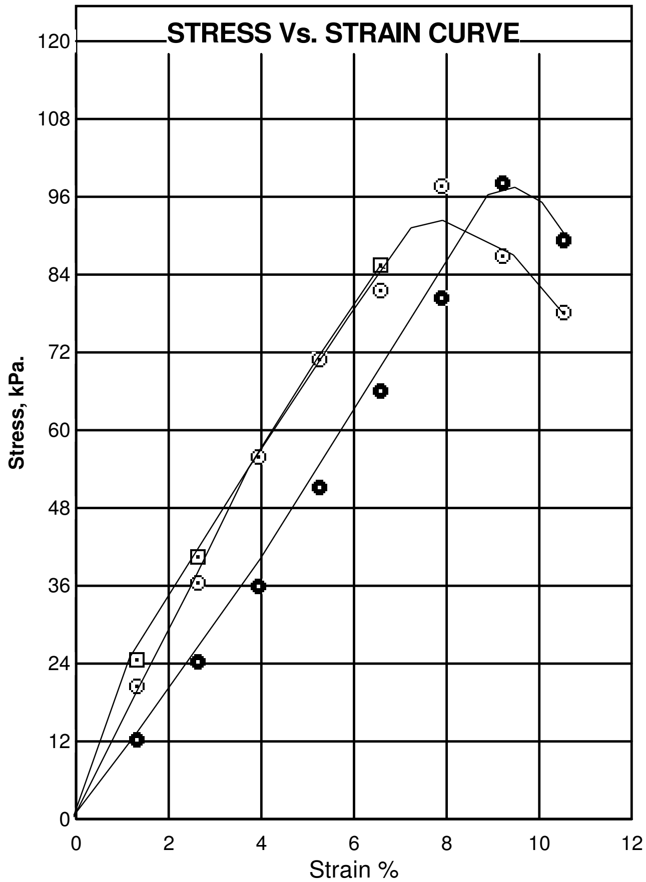


TRIAXIAL TEST CURVES

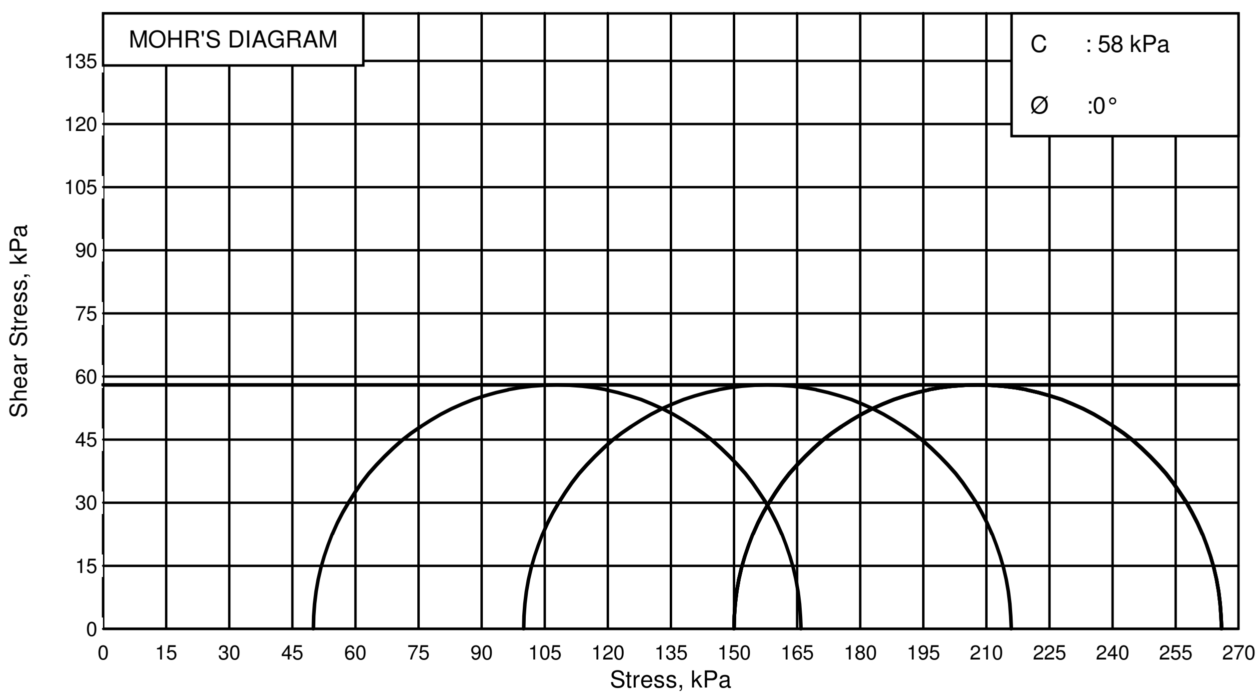
Job No. : 30796

Sample Number : 130154
Sample Depth : 2.00 - 2.45m.
Bore Hole Number : 29

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1	⊡
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2	⊙
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3	●
Cell Pressure	: 150 kPa	



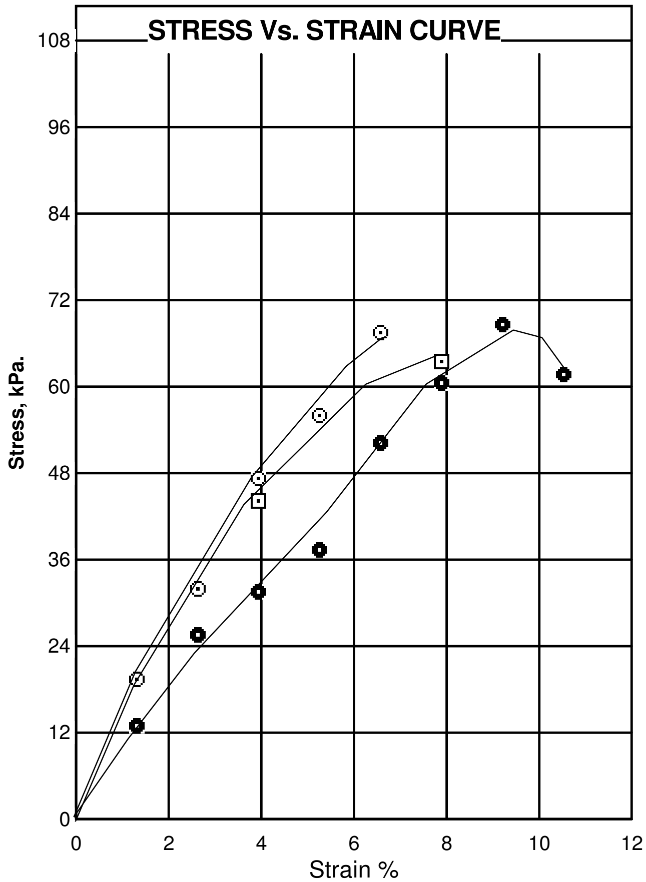
C : 58 kPa
Ø :0°

TRIAXIAL TEST CURVES

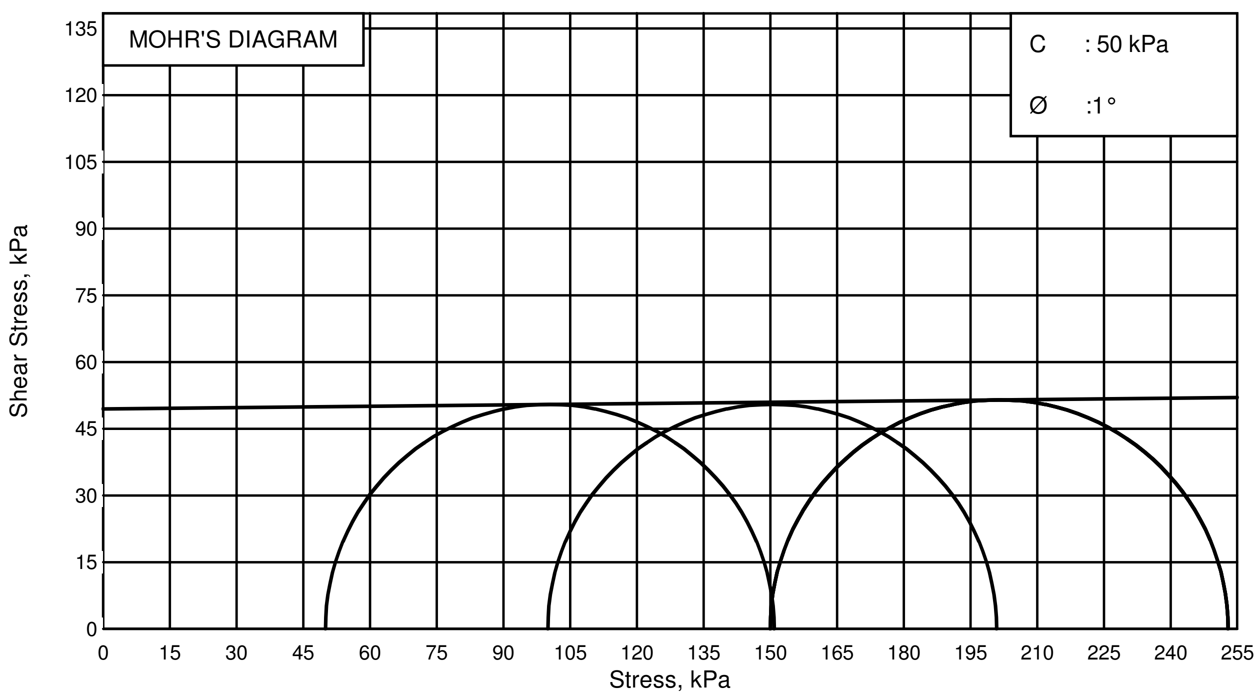
Job No. : 30796

Sample Number : 180111
Sample Depth : 1.00 - 1.45m.
Bore Hole Number : 30

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

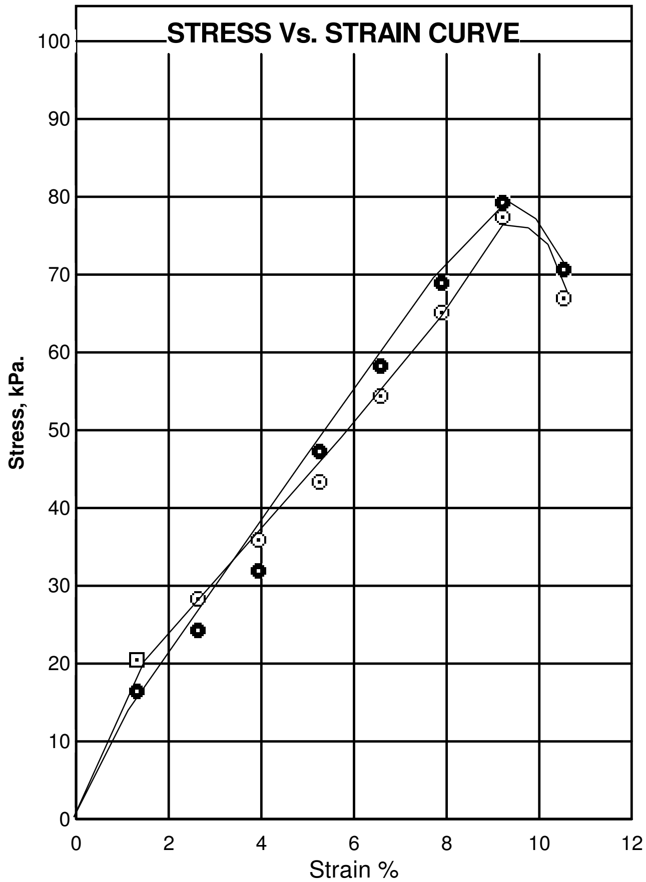


TRIAXIAL TEST CURVES

Job No. : 30796

Sample Number : 162192
Sample Depth : 2.00m.
Bore Hole Number : TP-1

Site :
Type of Test : uu



Mode of Failure :

Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

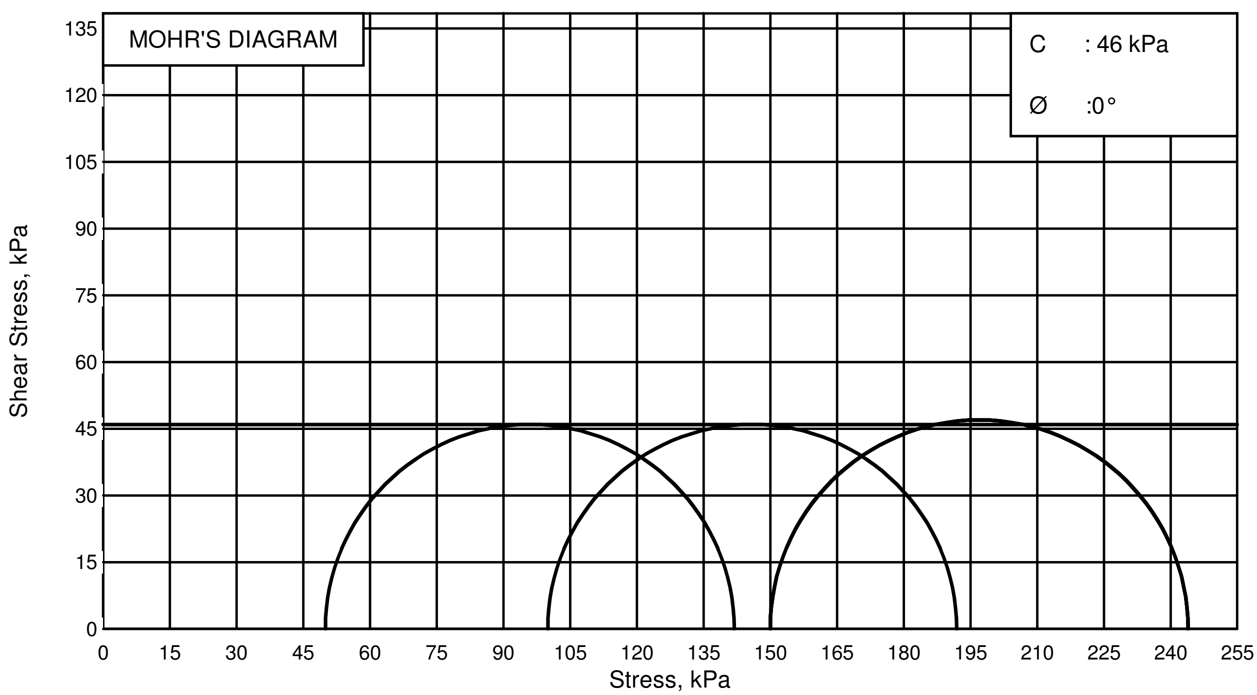
Specimen : 2 ⊙

Cell Pressure : 100 kPa

Mode of Failure :

Specimen : 3 ●

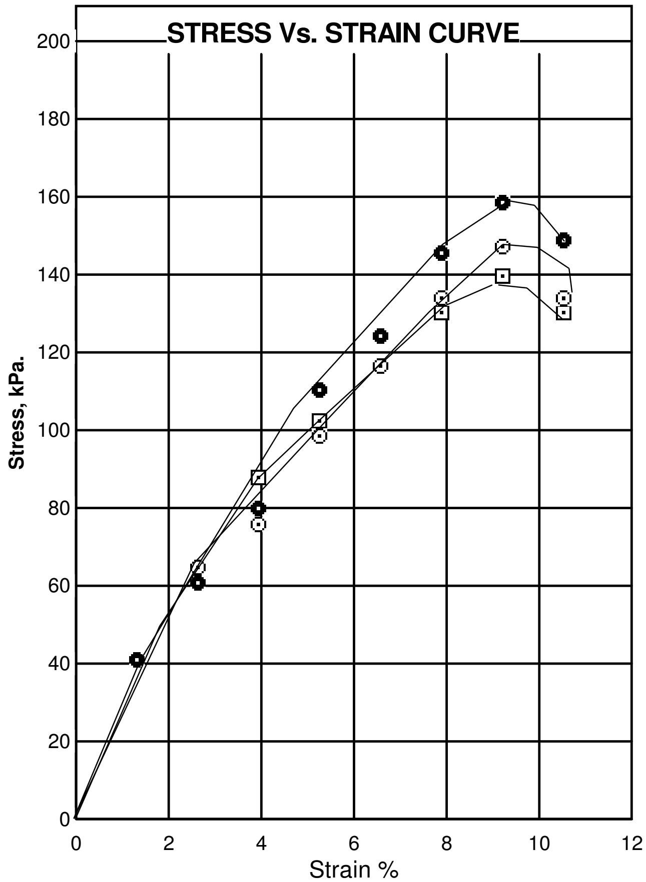
Cell Pressure : 150 kPa



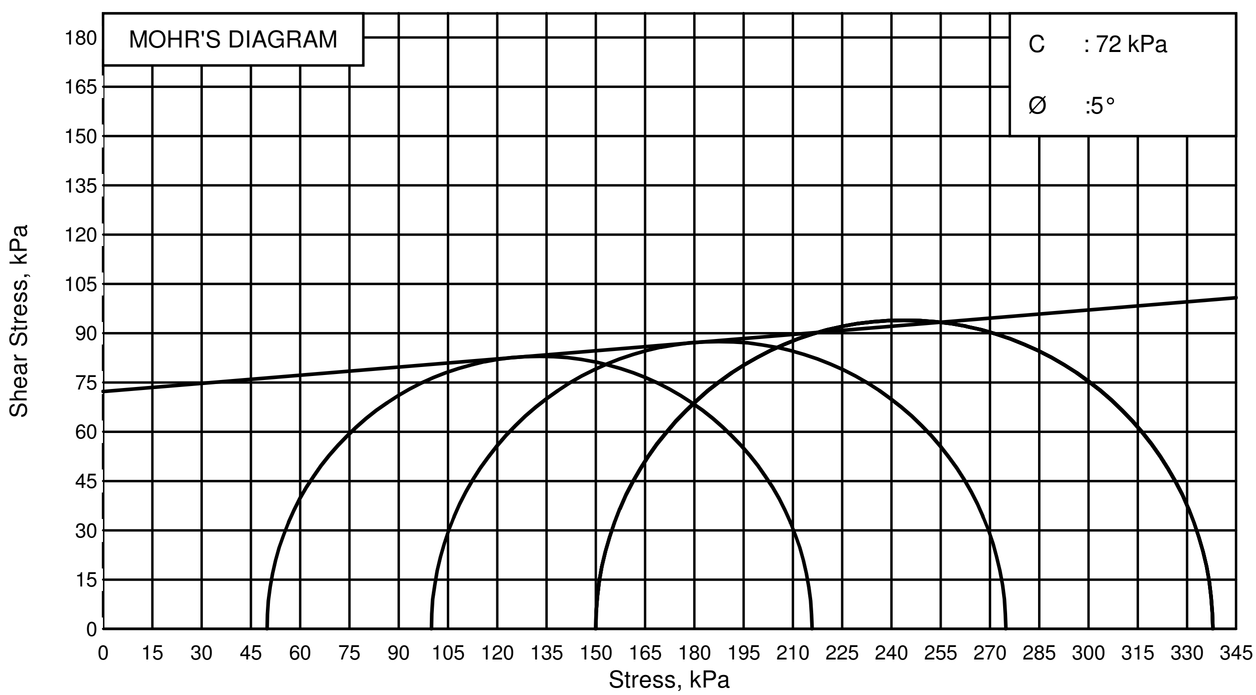
TRIAXIAL TEST CURVES

Sample Number : 162194
Sample Depth : 4.00m.
Bore Hole Number : TP-1

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

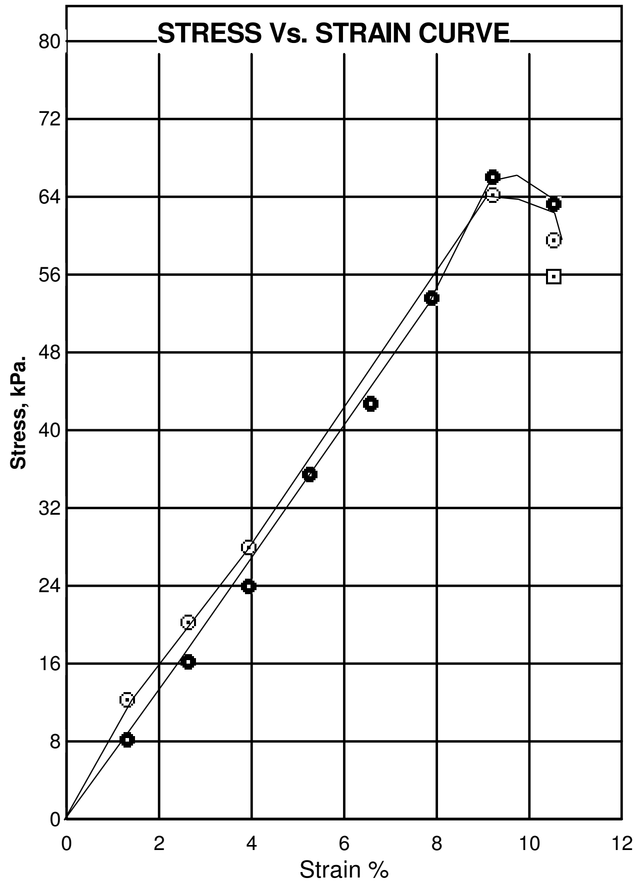


TRIAXIAL TEST CURVES

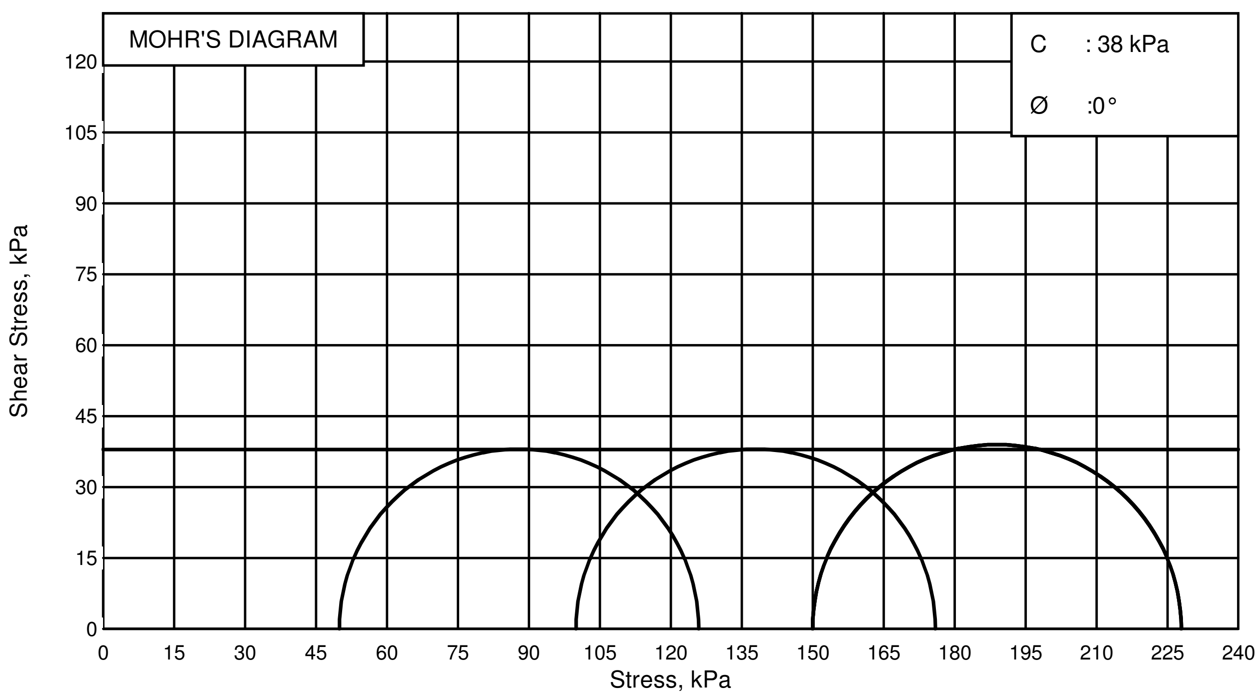
Job No. : 30796-TP

Sample Number : 100676
Sample Depth : 2.00m.
Bore Hole Number : TP-2

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

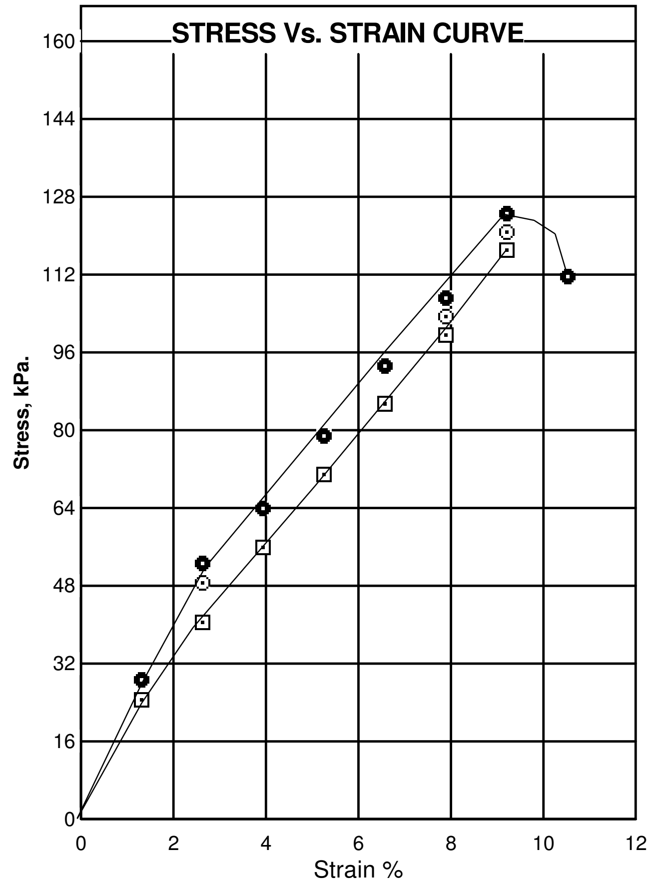


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 100678
Sample Depth : 4.00m.
Bore Hole Number : TP-2

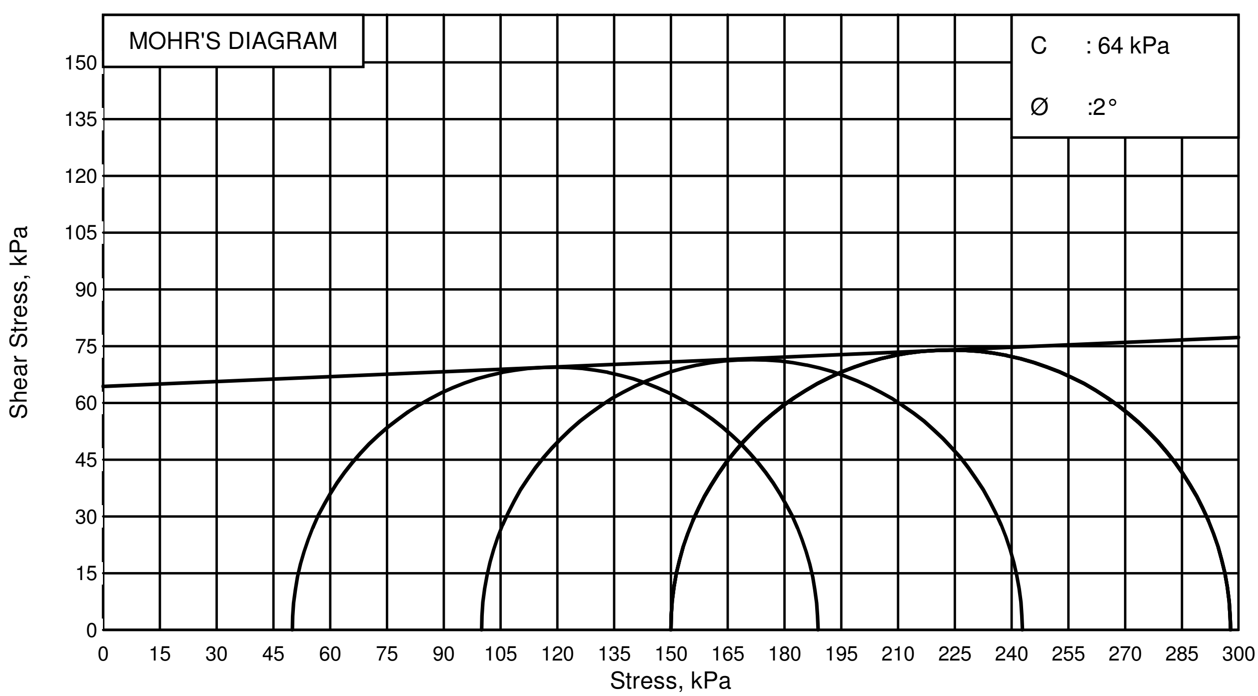
Site :
Type of Test : uu



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3 ●
Cell Pressure : 150 kPa

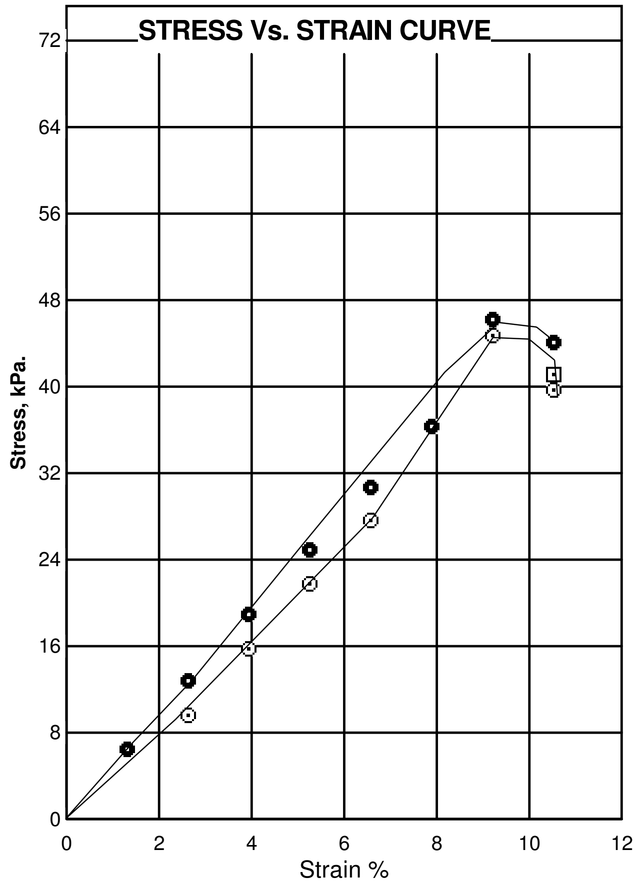


TRIAXIAL TEST CURVES

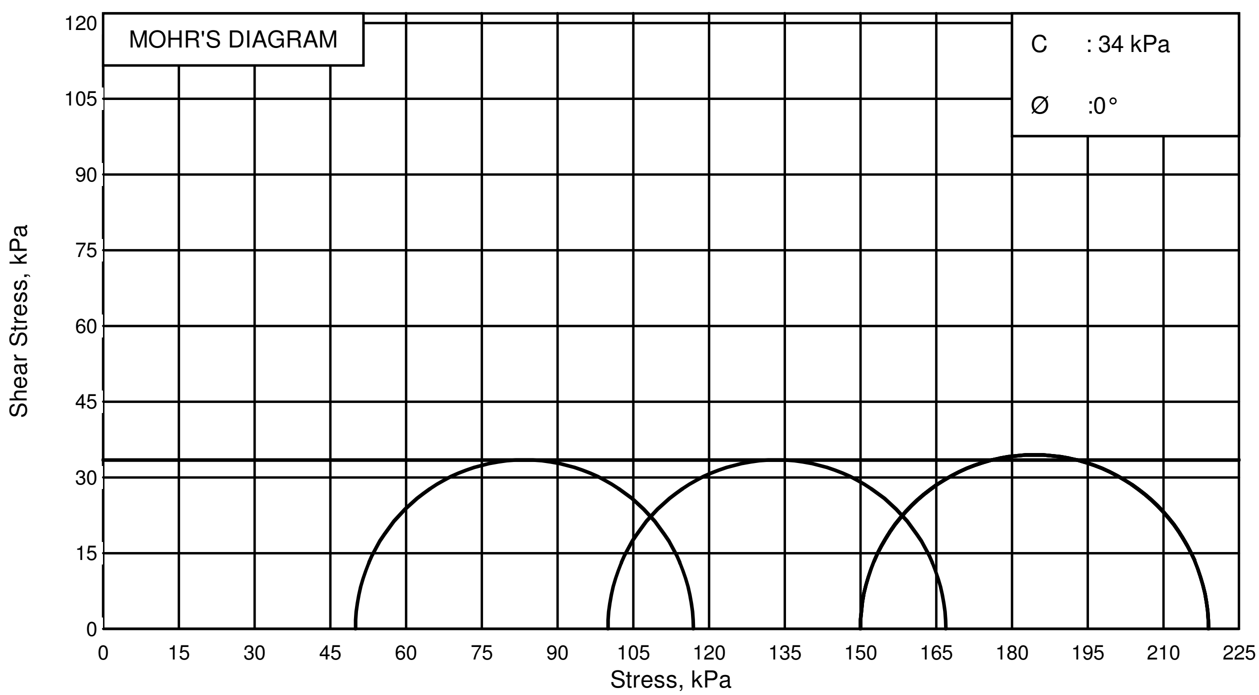
Job No. : 30796-TP

Sample Number : 106101
Sample Depth : 2.00m.
Bore Hole Number : TP-3

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

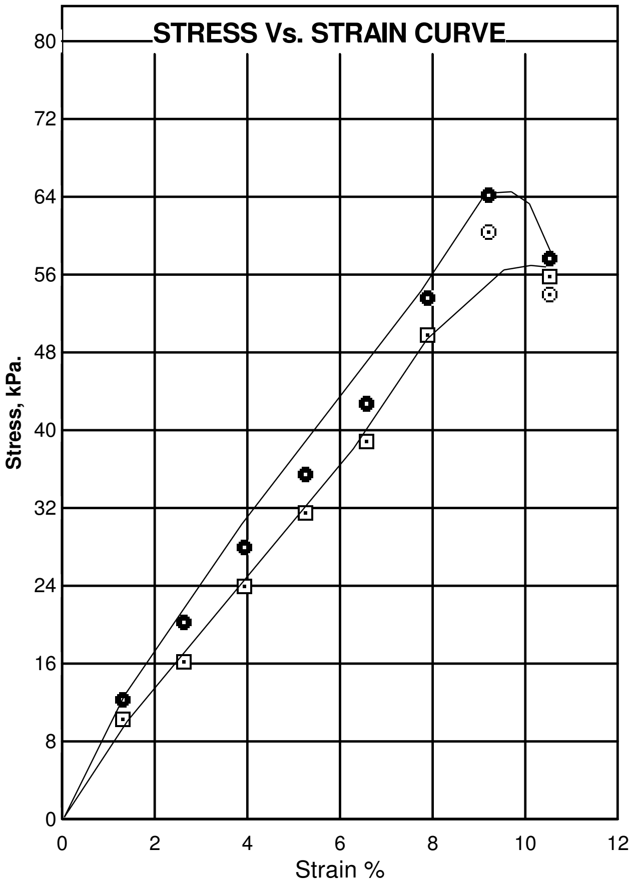


TRIAXIAL TEST CURVES

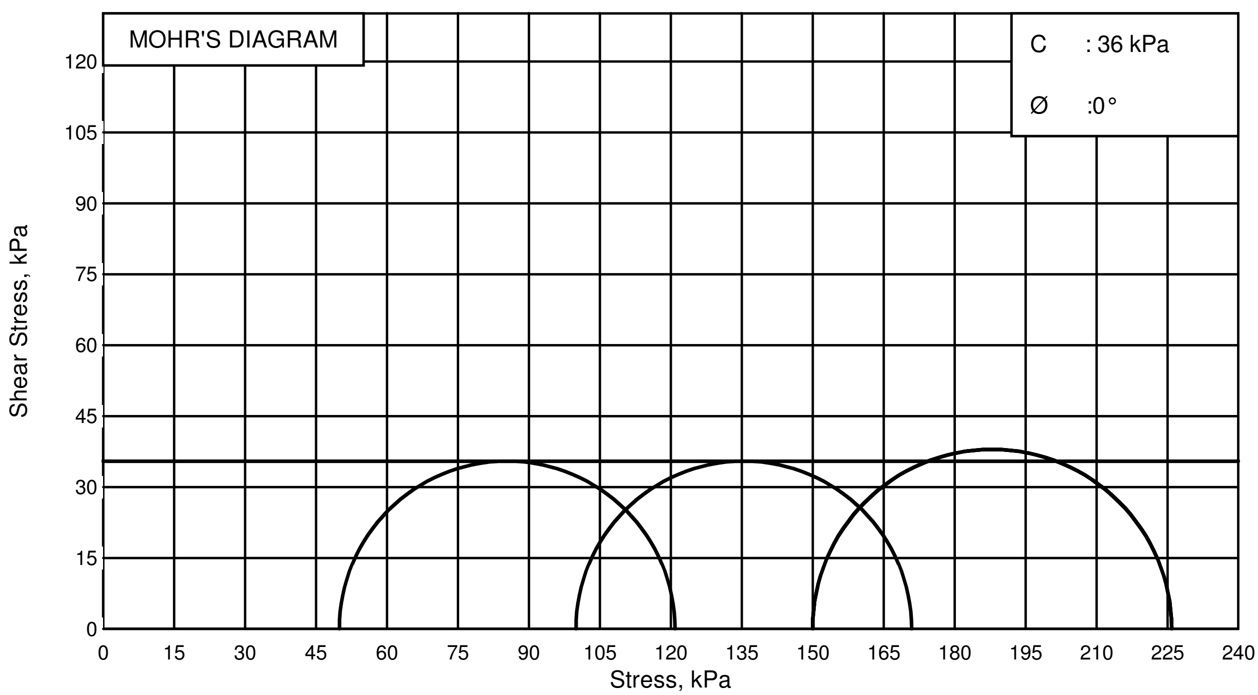
Job No. : 30796-TP

Sample Number : 106103
Sample Depth : 4.00m.
Bore Hole Number : TP-3

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1	⊡
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2	⊙
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3	●
Cell Pressure	: 150 kPa	

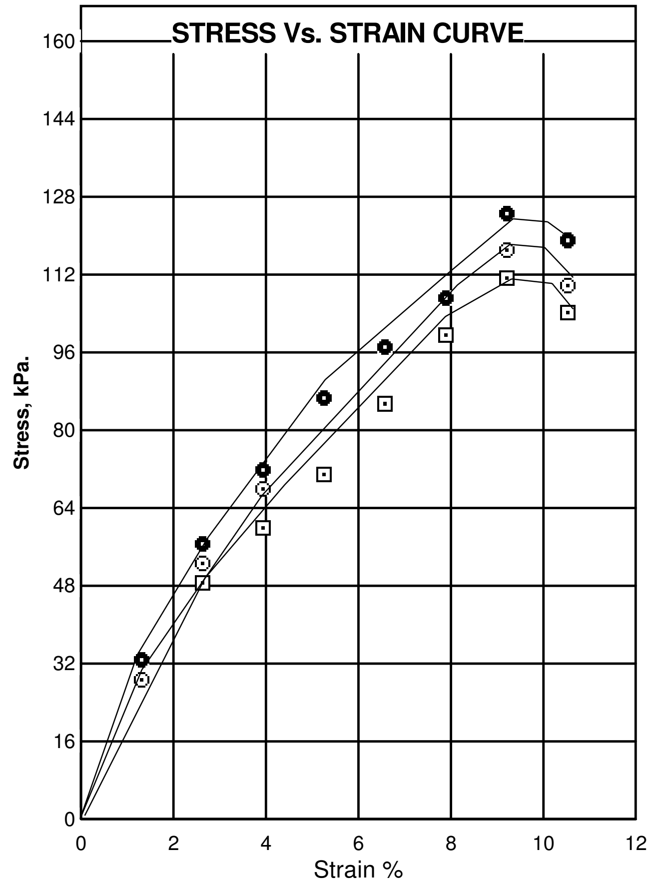


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 106105
Sample Depth : 2.00m.
Bore Hole Number : TP-4

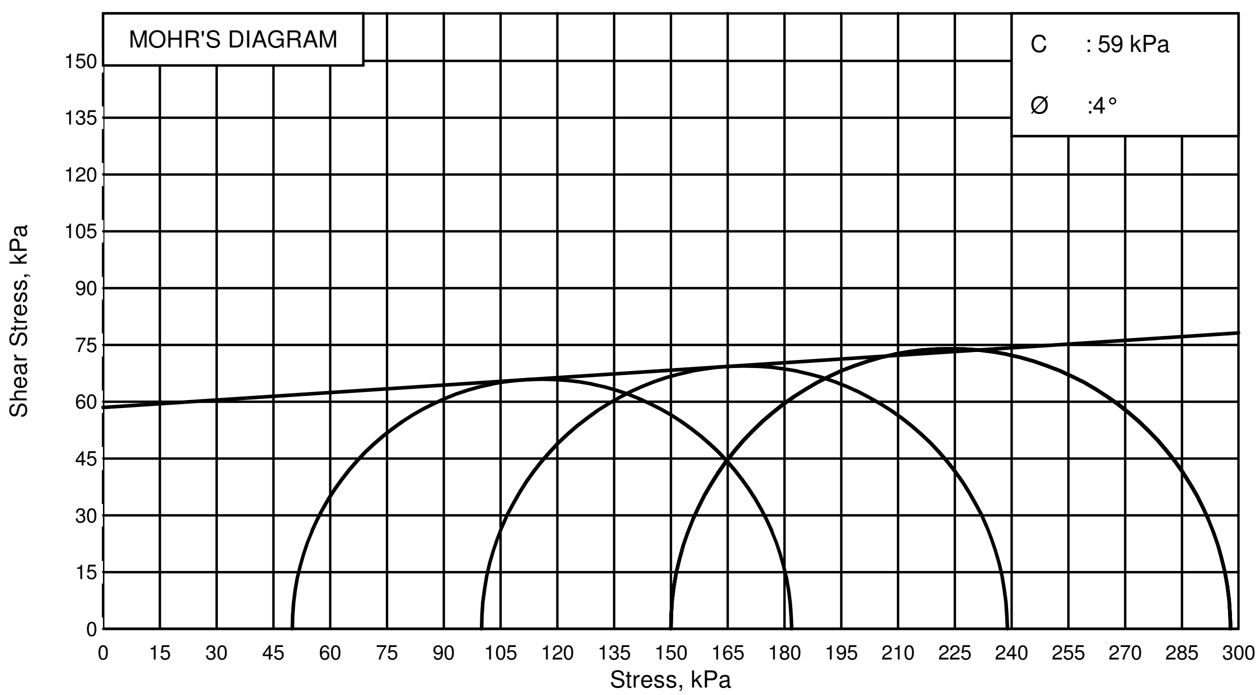
Site :
Type of Test : uu



Mode of Failure :
Specimen : 1
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3
Cell Pressure : 150 kPa

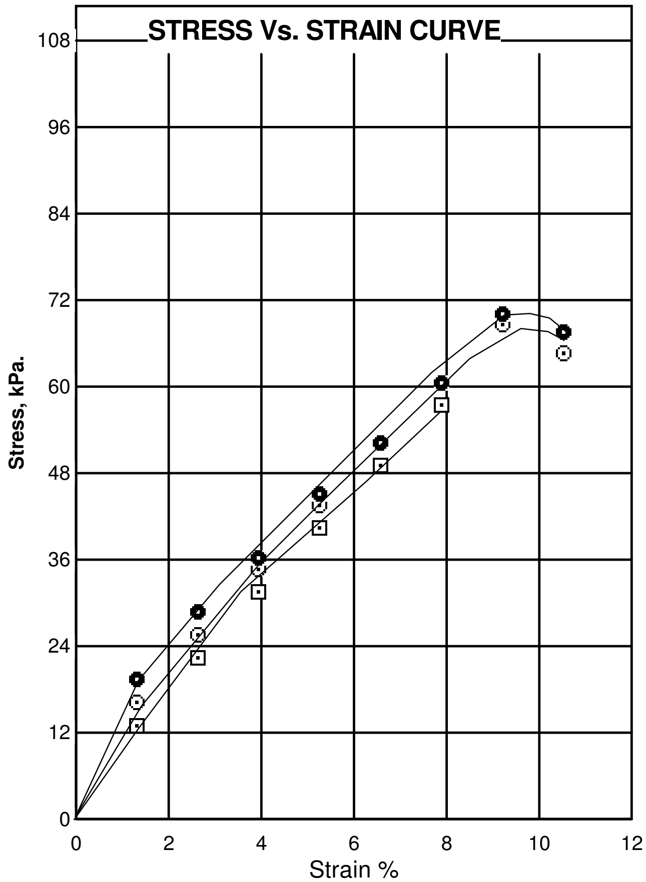


TRIAXIAL TEST CURVES

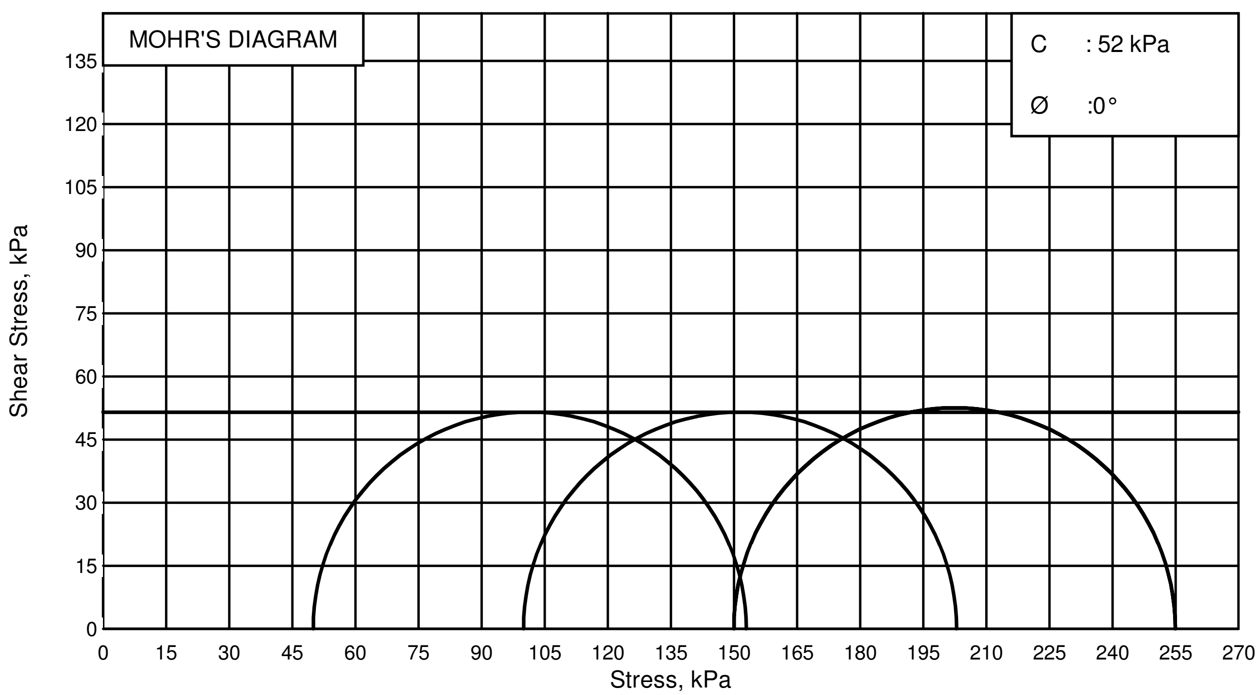
Job No. : 30796-TP

Sample Number : 151251
Sample Depth : 1.00m.
Bore Hole Number : TP-5

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1	⊡
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2	⊙
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3	●
Cell Pressure	: 150 kPa	

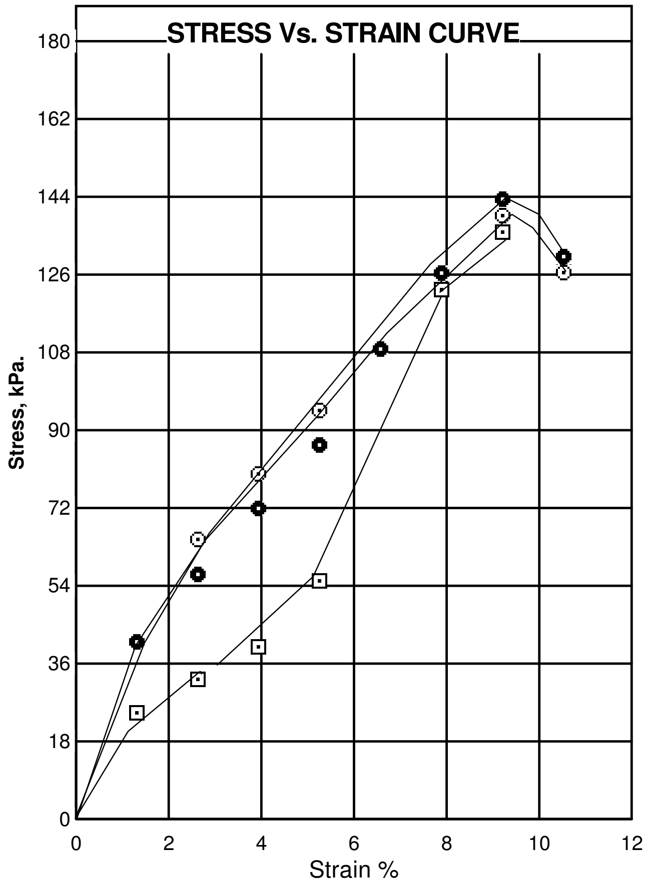


TRIAXIAL TEST CURVES

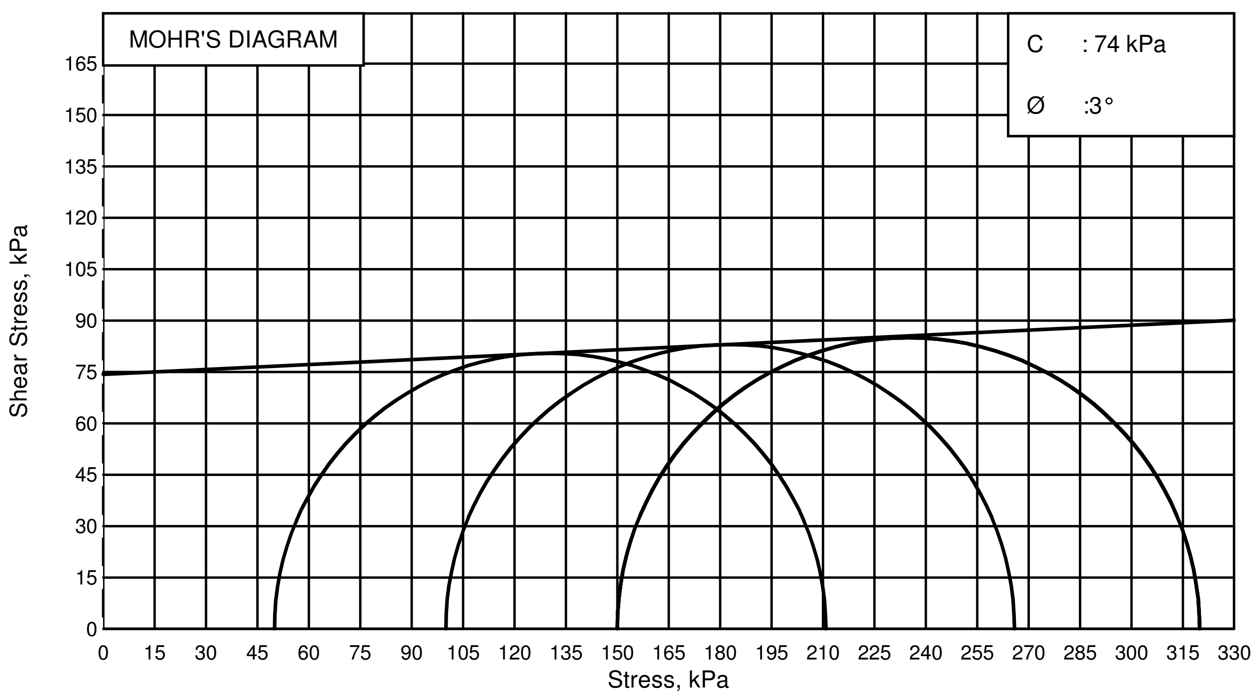
Job No. : 30796-TP

Sample Number : 151253
Sample Depth : 3.00 m.
Bore Hole Number : TP-5

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

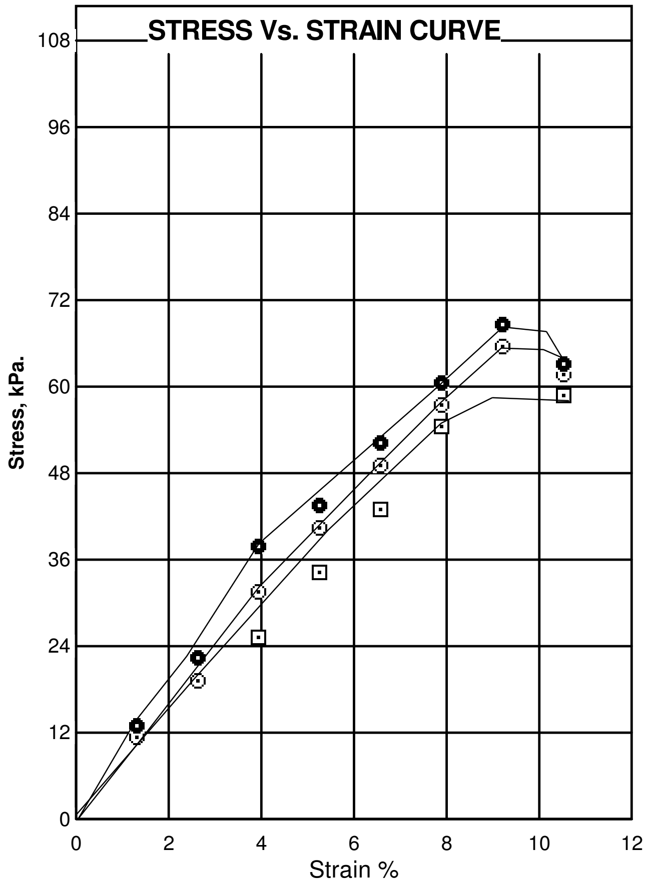


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 171620
Sample Depth : 1.00m.
Bore Hole Number : TP-6

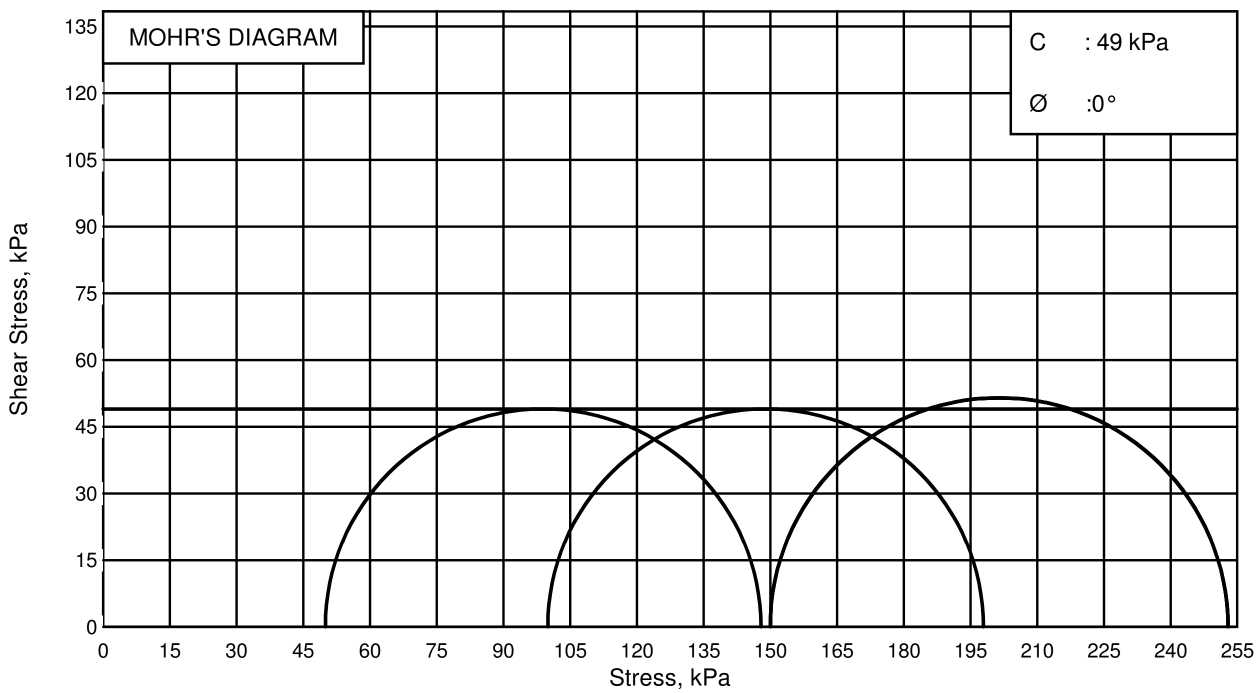
Site :
Type of Test : uu



Mode of Failure :
Specimen : 1 ⊡
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2 ⊙
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3 ●
Cell Pressure : 150 kPa



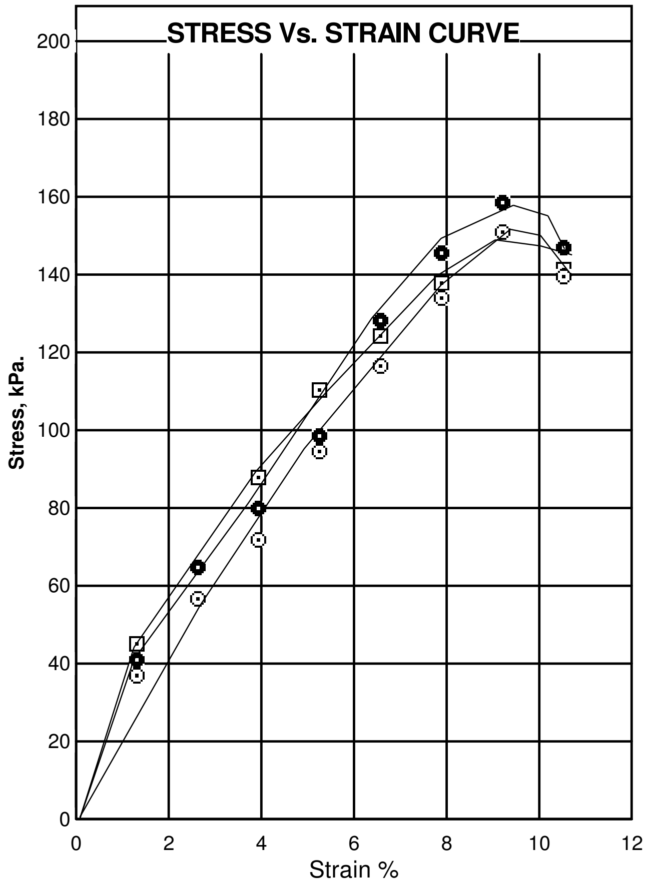
C : 49 kPa
Ø :0°

TRIAXIAL TEST CURVES

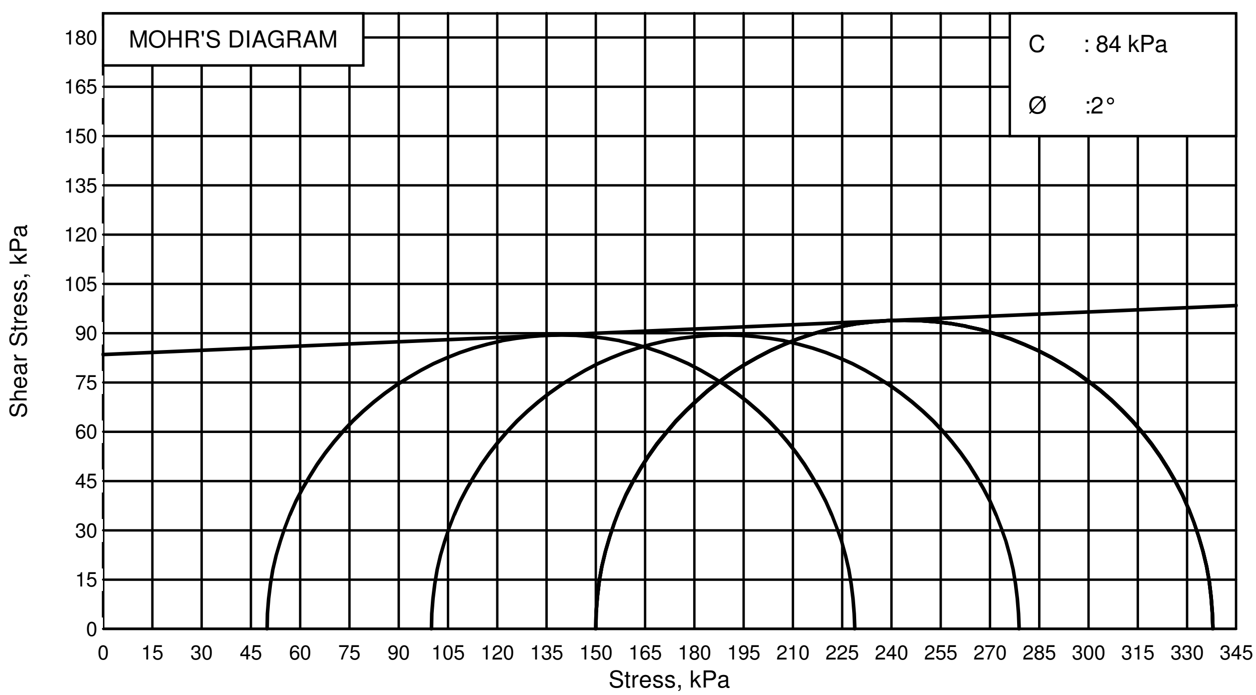
Job No. : 30796-TP

Sample Number : 171622
Sample Depth : 3.00m.
Bore Hole Number : TP-6

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

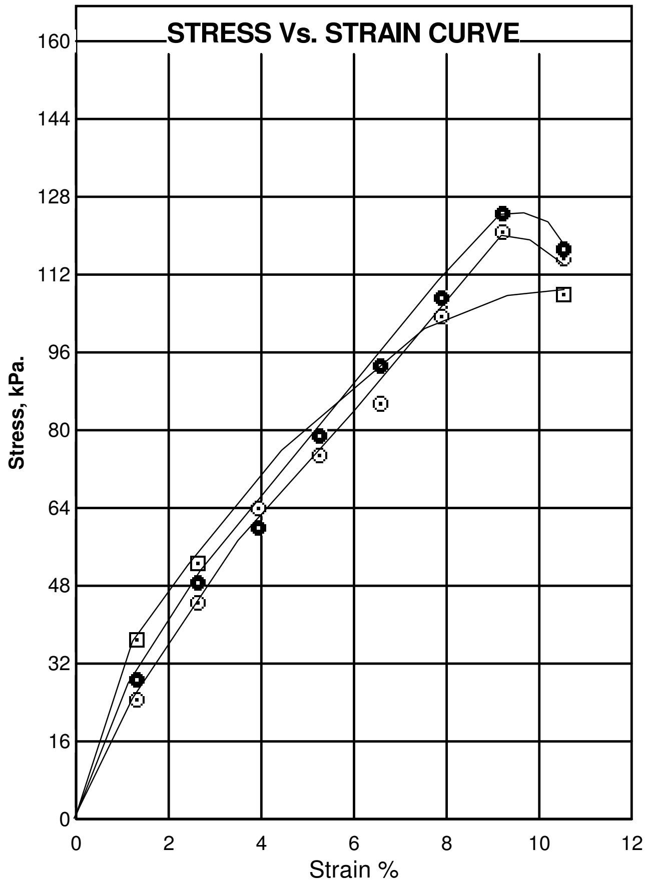


TRIAXIAL TEST CURVES

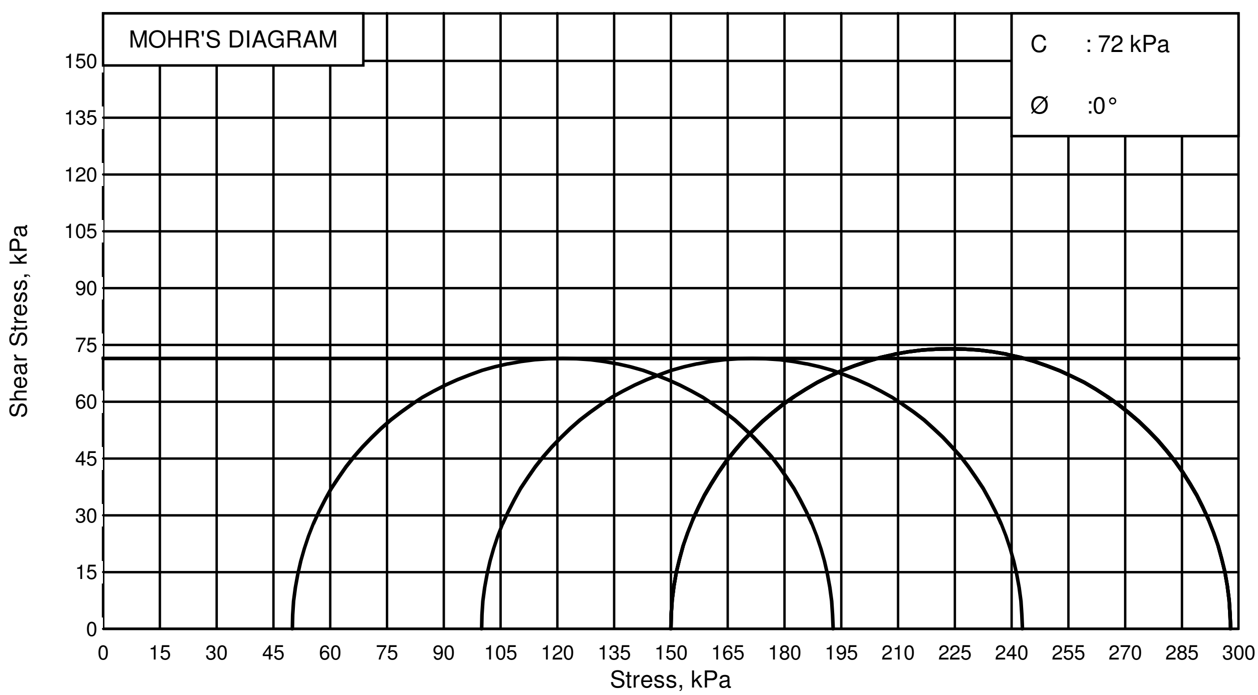
Job No. : 30796-TP

Sample Number : 100711
Sample Depth : 2.00m.
Bore Hole Number : TP-7

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

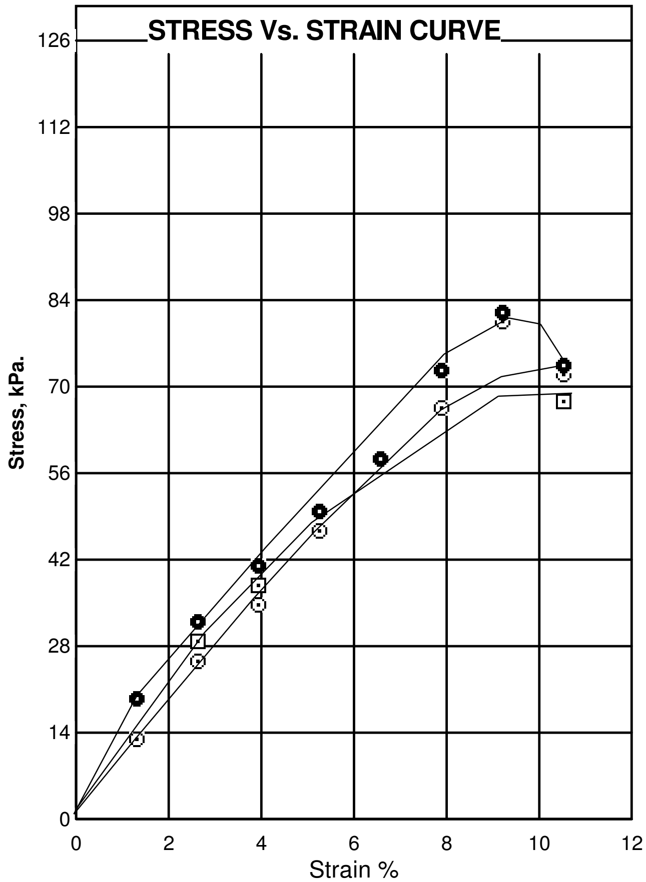


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 105130
Sample Depth : 2.00m.
Bore Hole Number : TP-8

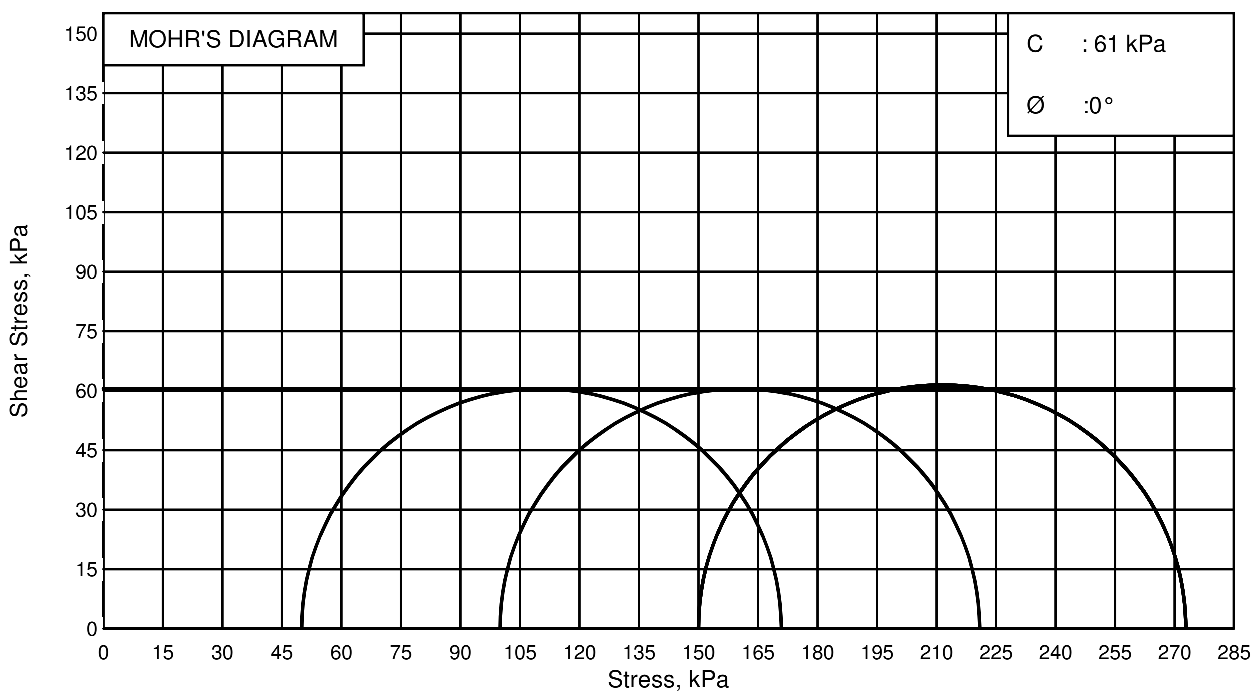
Site :
Type of Test : uu



Mode of Failure :
Specimen : 1
Cell Pressure : 50 kPa

Mode of Failure :
Specimen : 2
Cell Pressure : 100 kPa

Mode of Failure :
Specimen : 3
Cell Pressure : 150 kPa

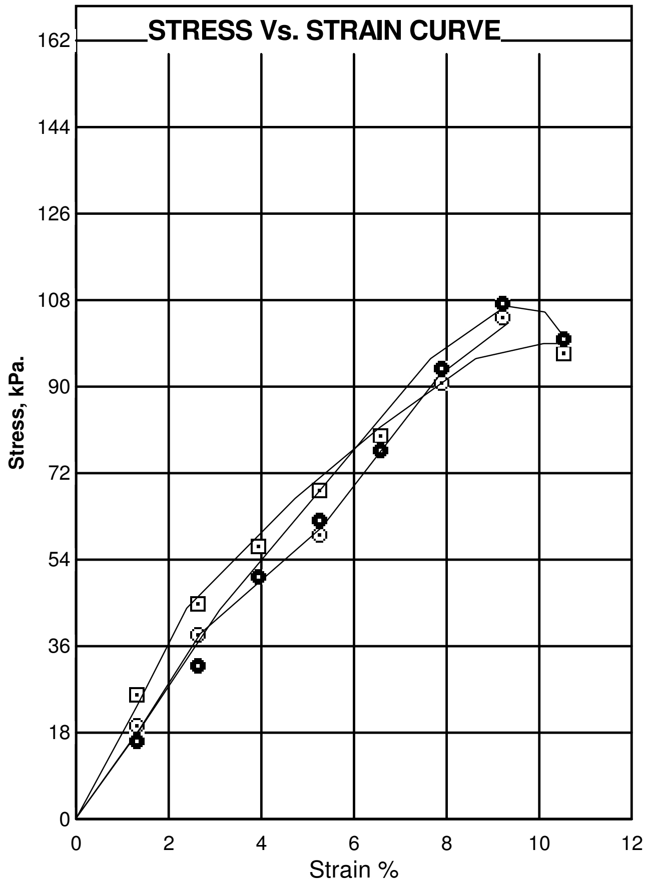


TRIAXIAL TEST CURVES

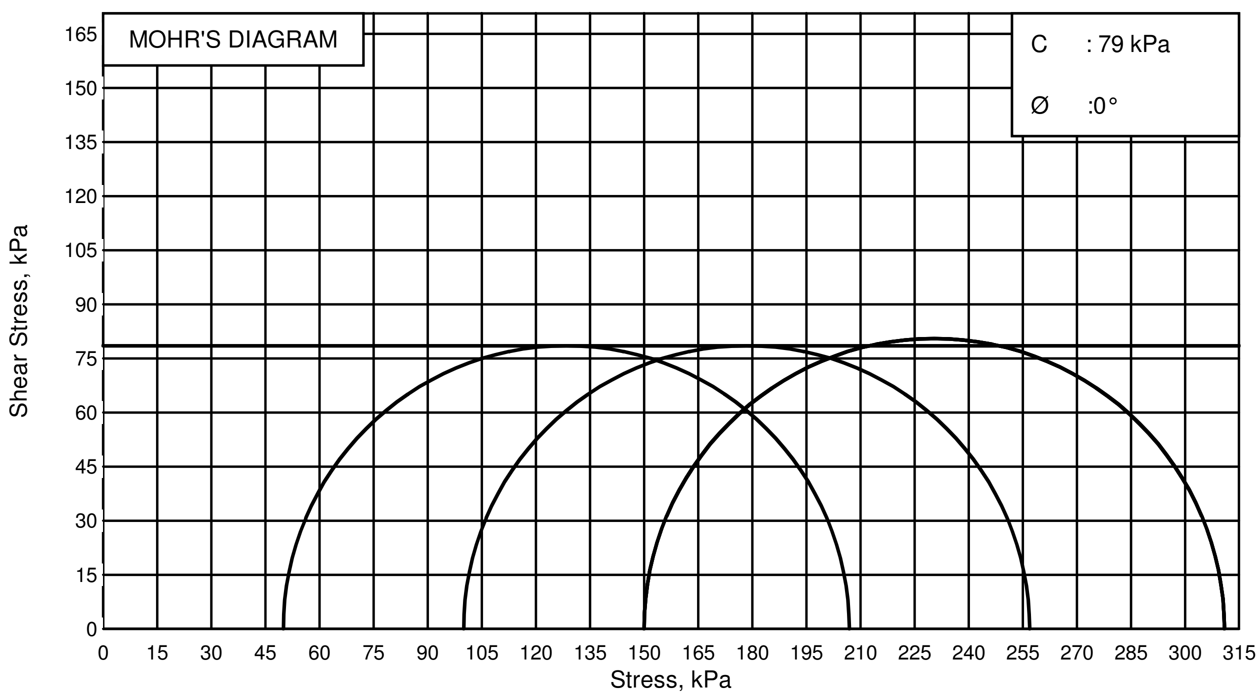
Job No. : 30796-TP

Sample Number : 105131
Sample Depth : 3.00m.
Bore Hole Number : TP-8

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

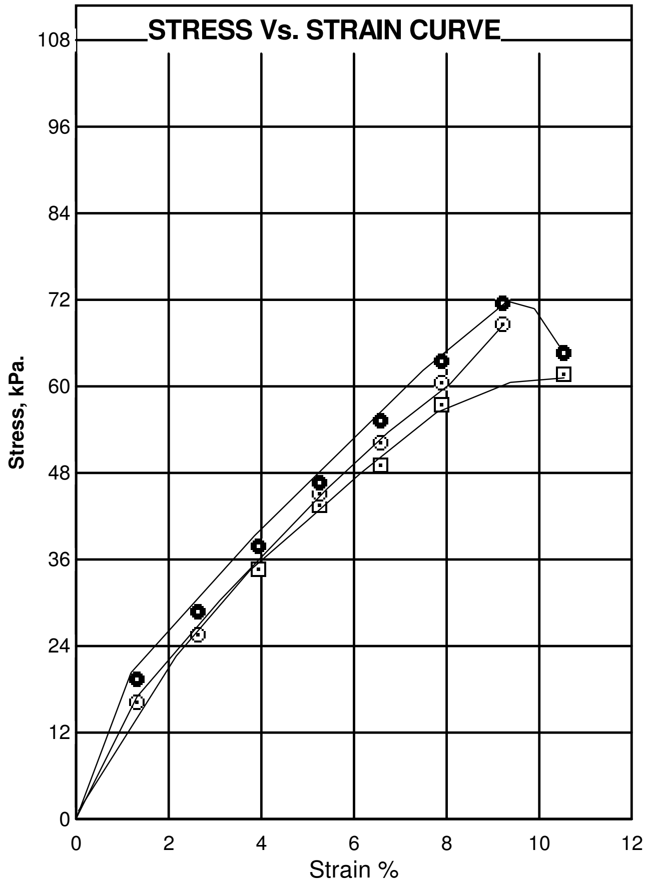


TRIAXIAL TEST CURVES

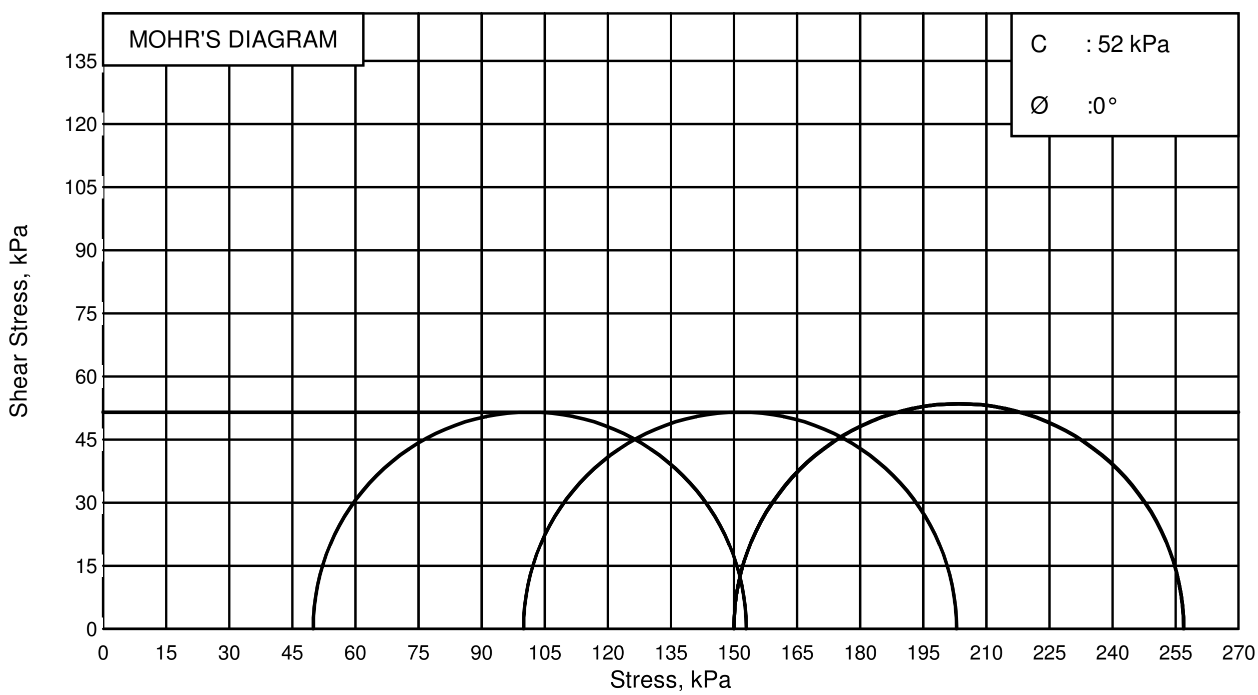
Job No. : 30796-TP

Sample Number : 120150
Sample Depth : 1.00m.
Bore Hole Number : TP-9

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

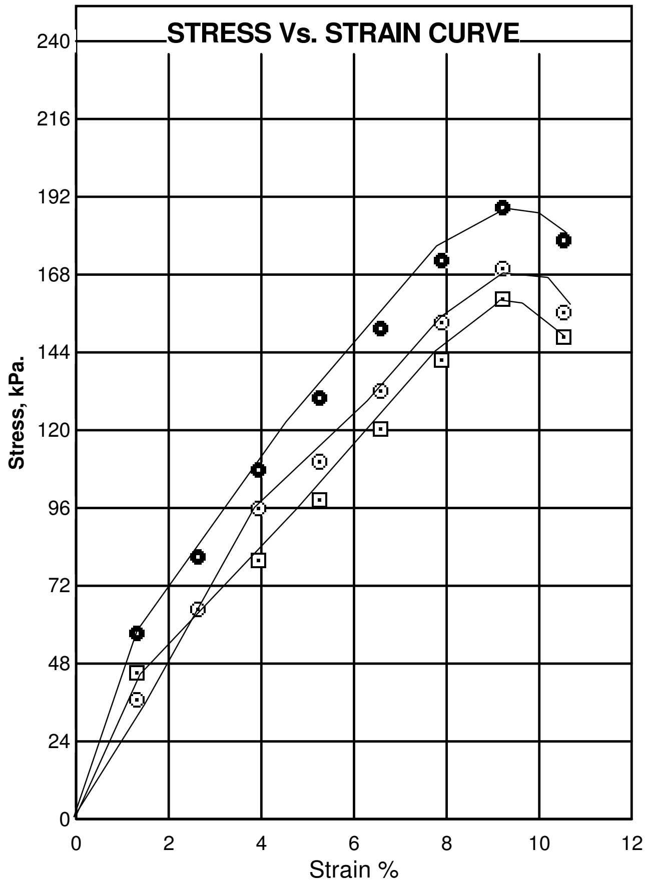


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 120152
Sample Depth : 3.00m.
Bore Hole Number : TP-9

Site :
Type of Test : uu



Mode of Failure :

Specimen : 1

Cell Pressure : 50 kPa

Mode of Failure :

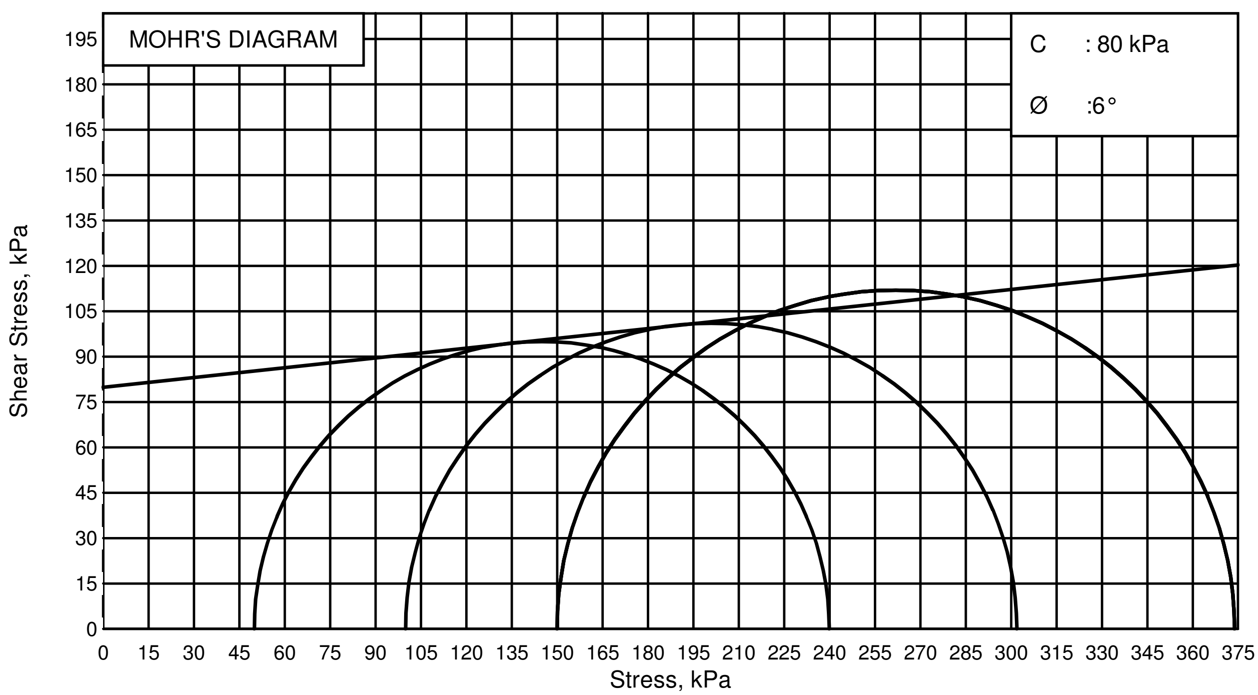
Specimen : 2

Cell Pressure : 100 kPa

Mode of Failure :

Specimen : 3

Cell Pressure : 150 kPa

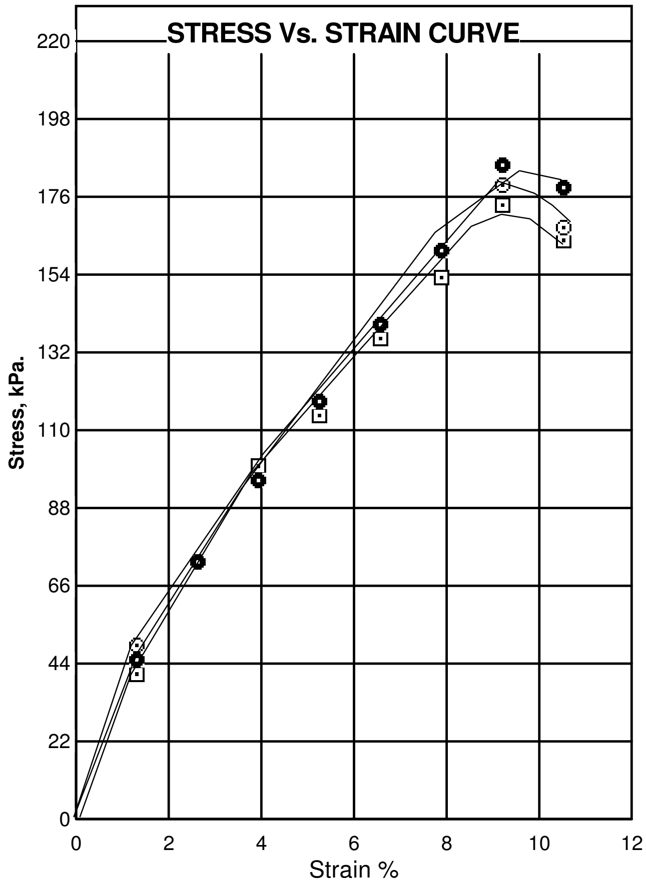


TRIAXIAL TEST CURVES

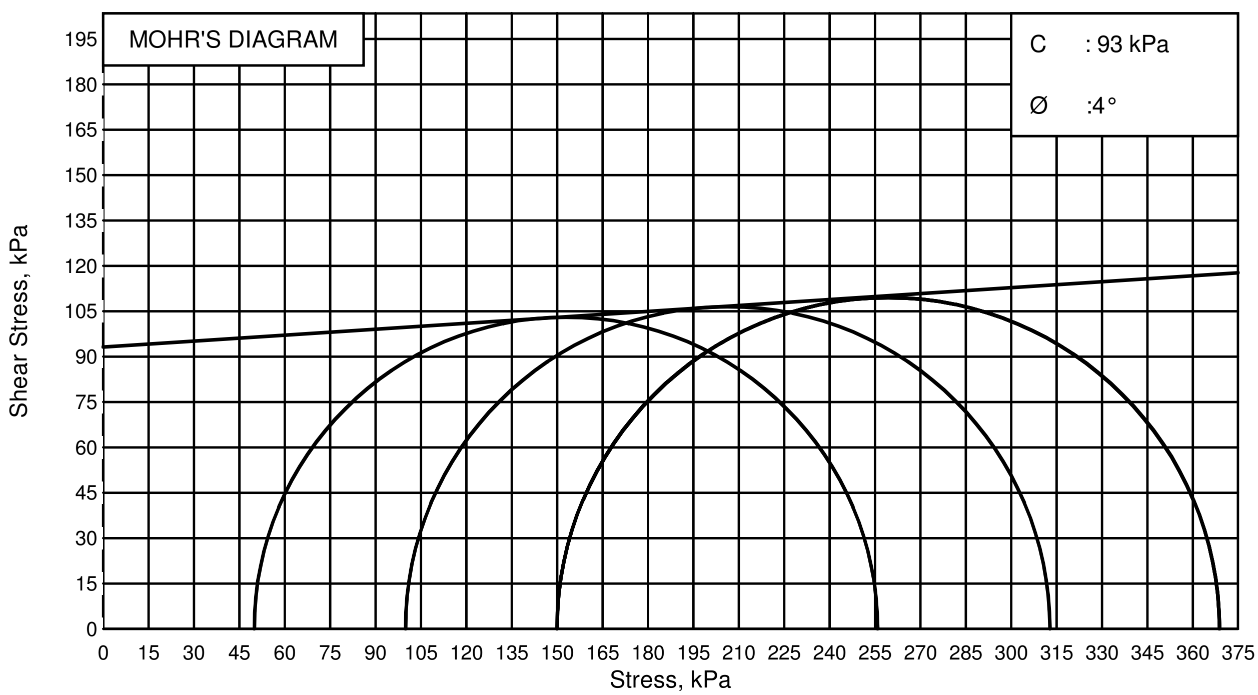
Job No. : 30796-TP

Sample Number : 105135
Sample Depth : 3.00m.
Bore Hole Number : TP-10

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

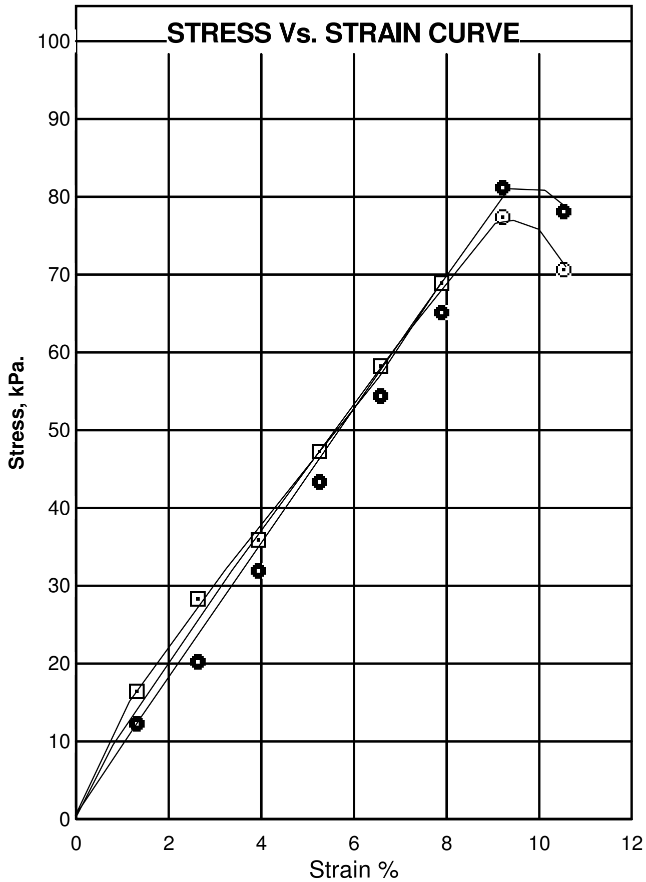


TRIAXIAL TEST CURVES

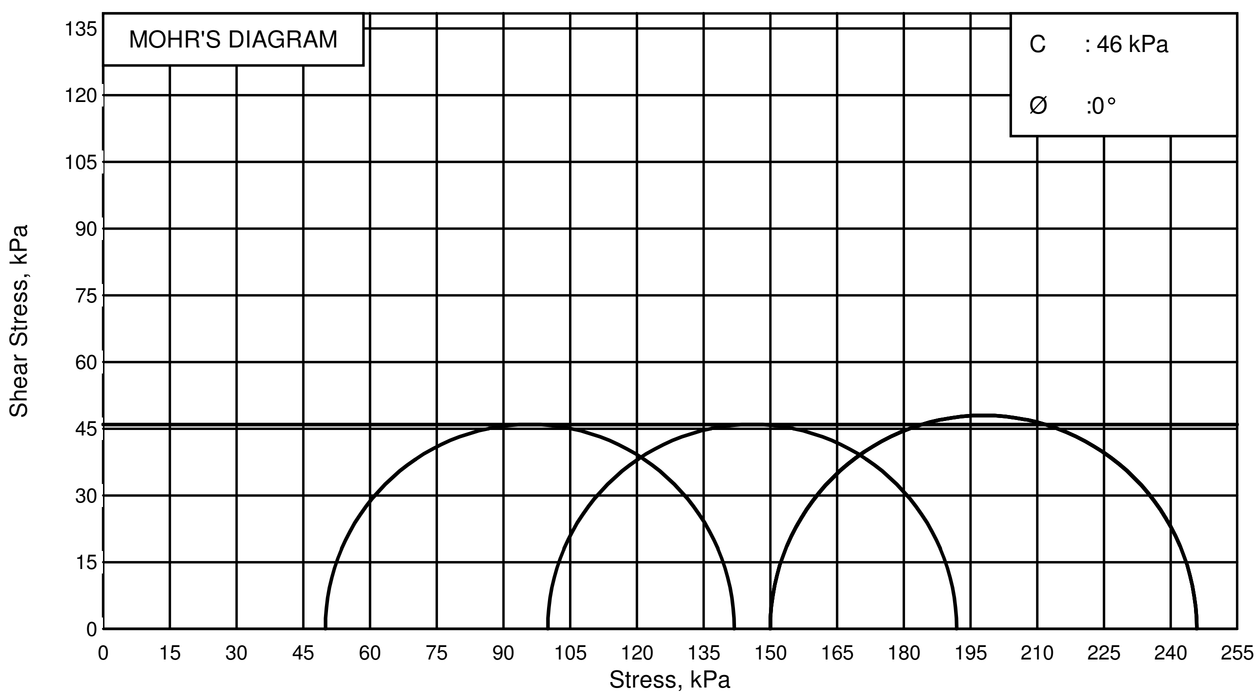
Job No. : 30796-TP

Sample Number : 150122
Sample Depth : 1.00m.
Bore Hole Number : TP-11

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

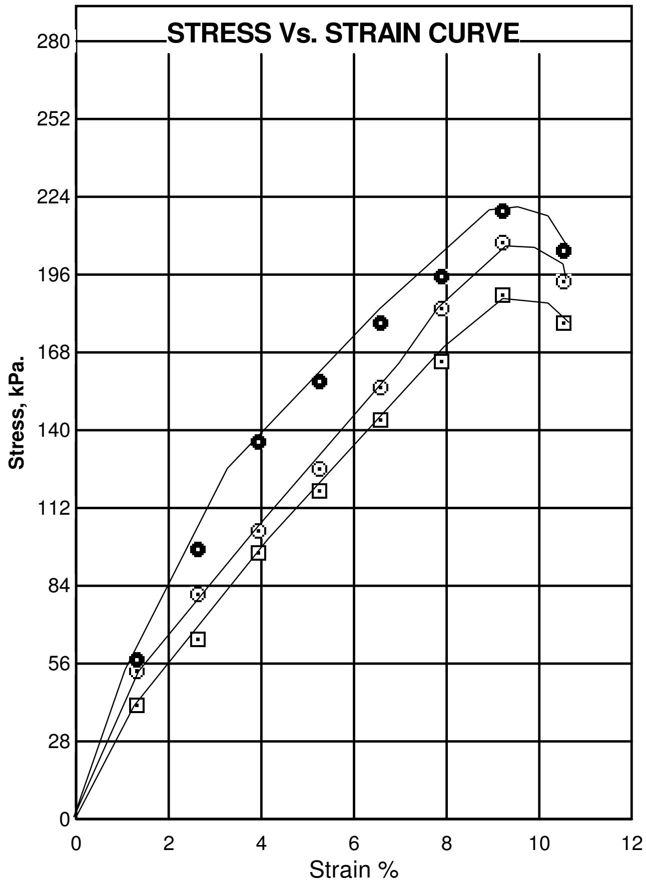


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 150124
Sample Depth : 3.00m.
Bore Hole Number : TP-11

Site :
Type of Test : uu



Mode of Failure :

Specimen : 1

Cell Pressure : 50 kPa

Mode of Failure :

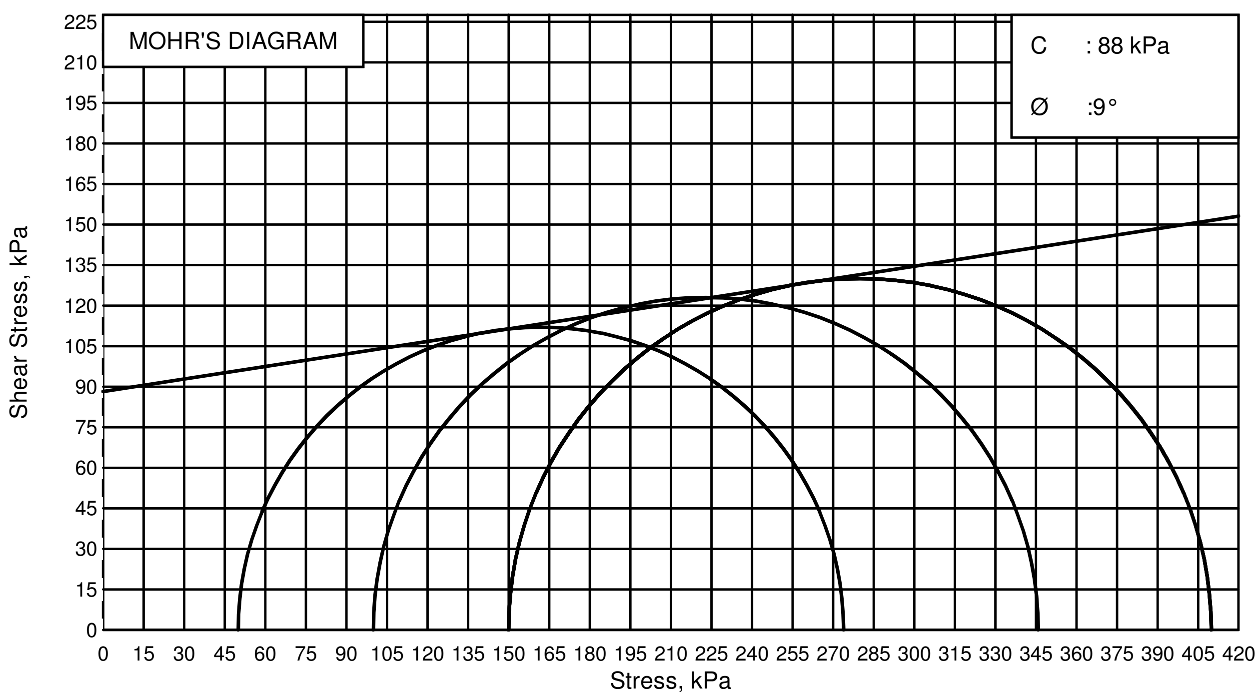
Specimen : 2

Cell Pressure : 100 kPa

Mode of Failure :

Specimen : 3

Cell Pressure : 150 kPa

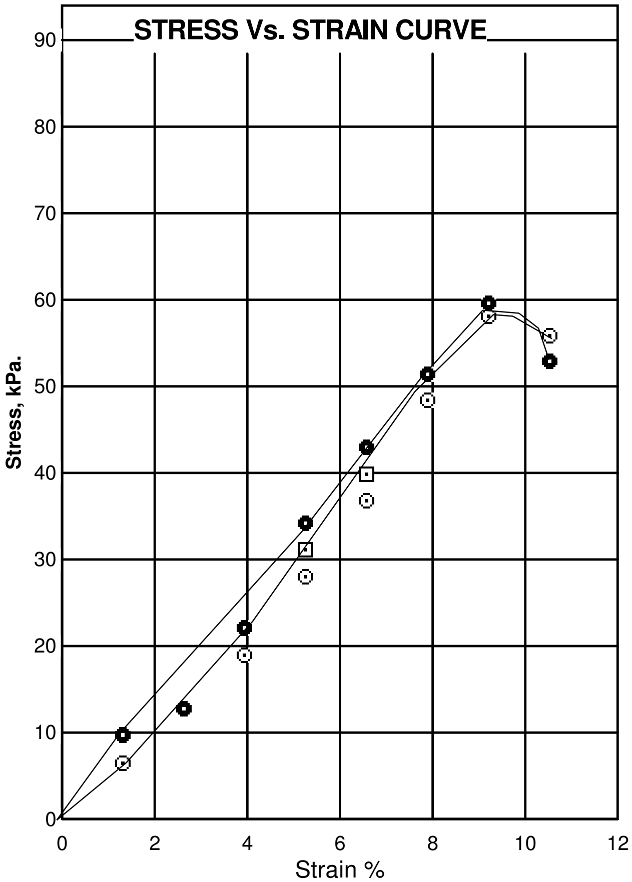


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 106112
Sample Depth : 1.00m.
Bore Hole Number : TP-12

Site :
Type of Test : uu



Mode of Failure :

Specimen : 1 ⊡

Cell Pressure : 50 kPa

Mode of Failure :

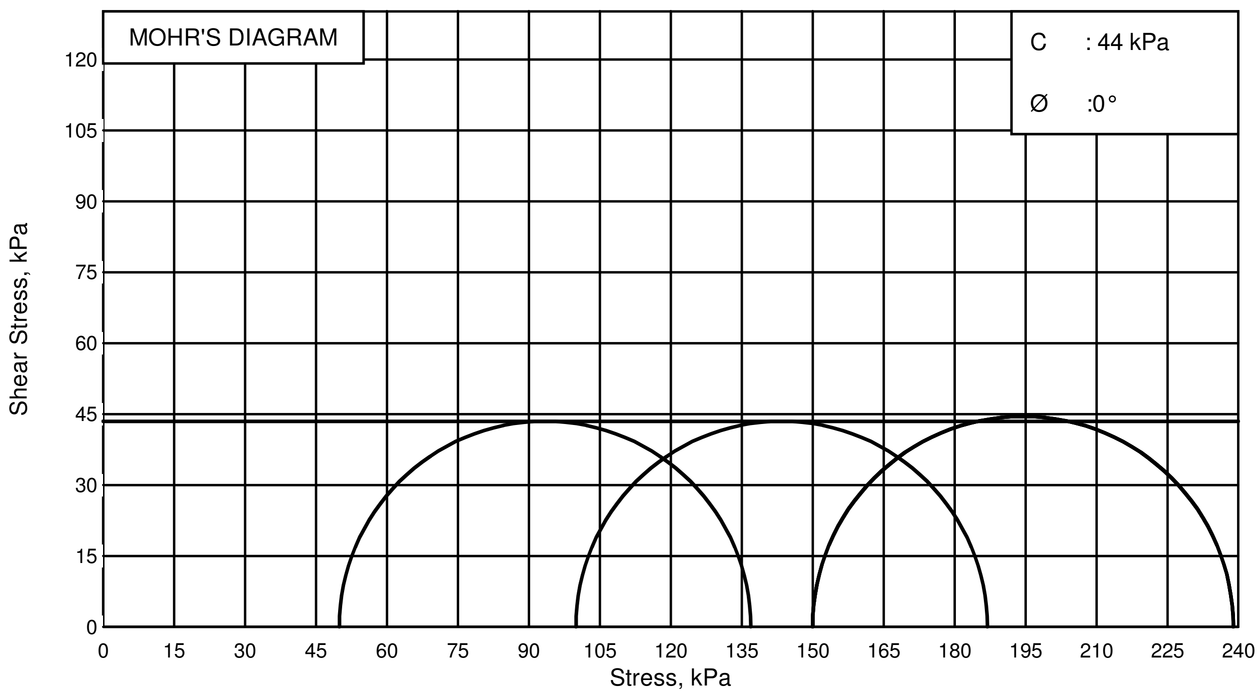
Specimen : 2 ⊙

Cell Pressure : 100 kPa

Mode of Failure :

Specimen : 3 ●

Cell Pressure : 150 kPa

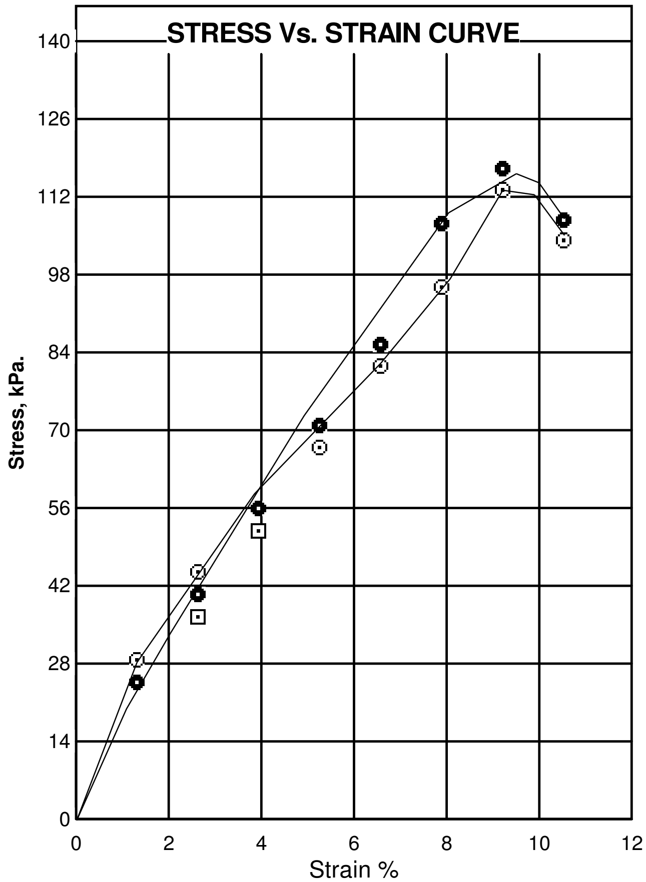


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 106114
Sample Depth : 3.00m.
Bore Hole Number : TP-12

Site :
Type of Test : uu



Mode of Failure :

Specimen : 1

Cell Pressure : 50 kPa

Mode of Failure :

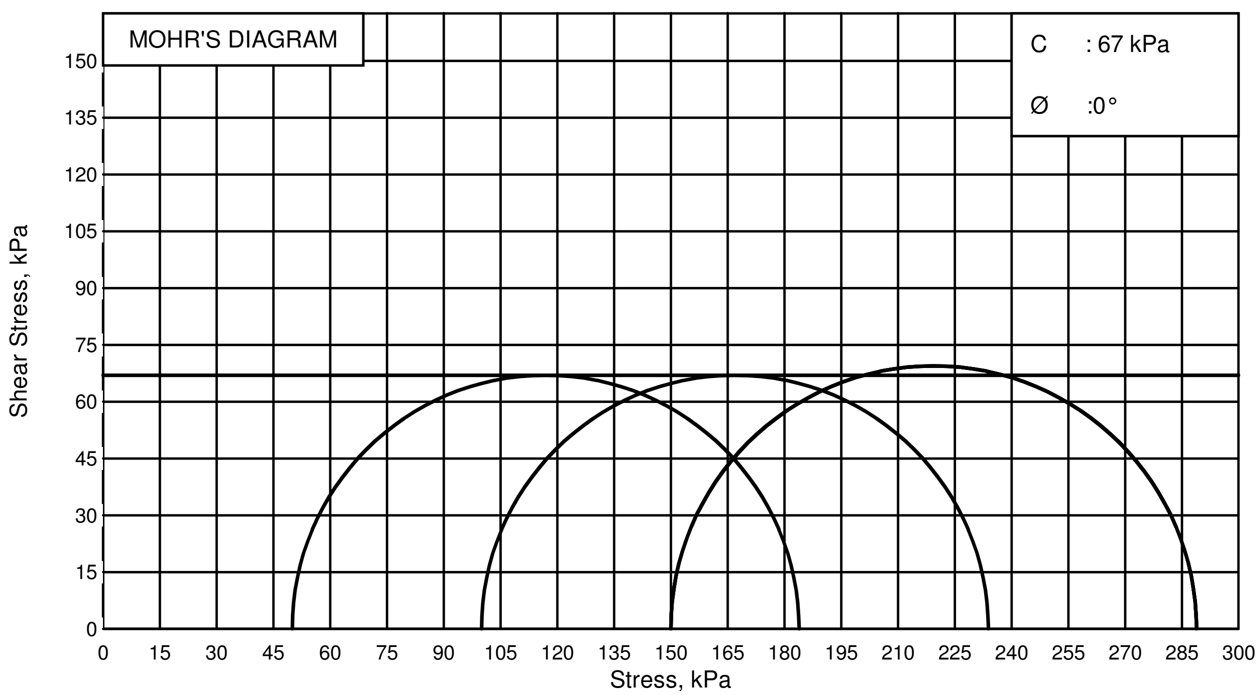
Specimen : 2

Cell Pressure : 100 kPa

Mode of Failure :

Specimen : 3

Cell Pressure : 150 kPa

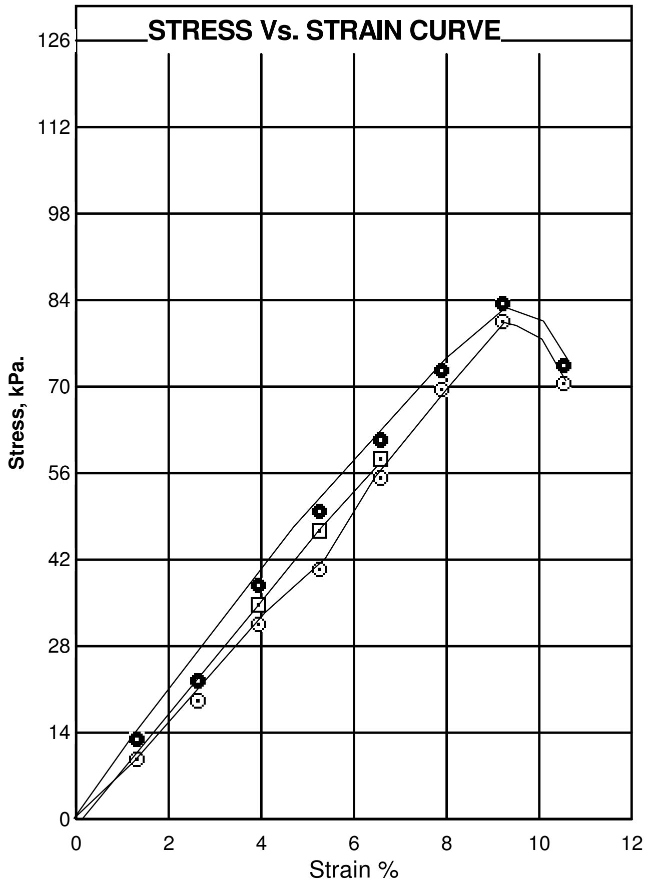


TRIAXIAL TEST CURVES

Job No. : 30796-TP

Sample Number : 105126
Sample Depth : 2.00m.
Bore Hole Number : TP-14

Site :
Type of Test : uu



Mode of Failure :

Specimen : 1

Cell Pressure : 50 kPa

Mode of Failure :

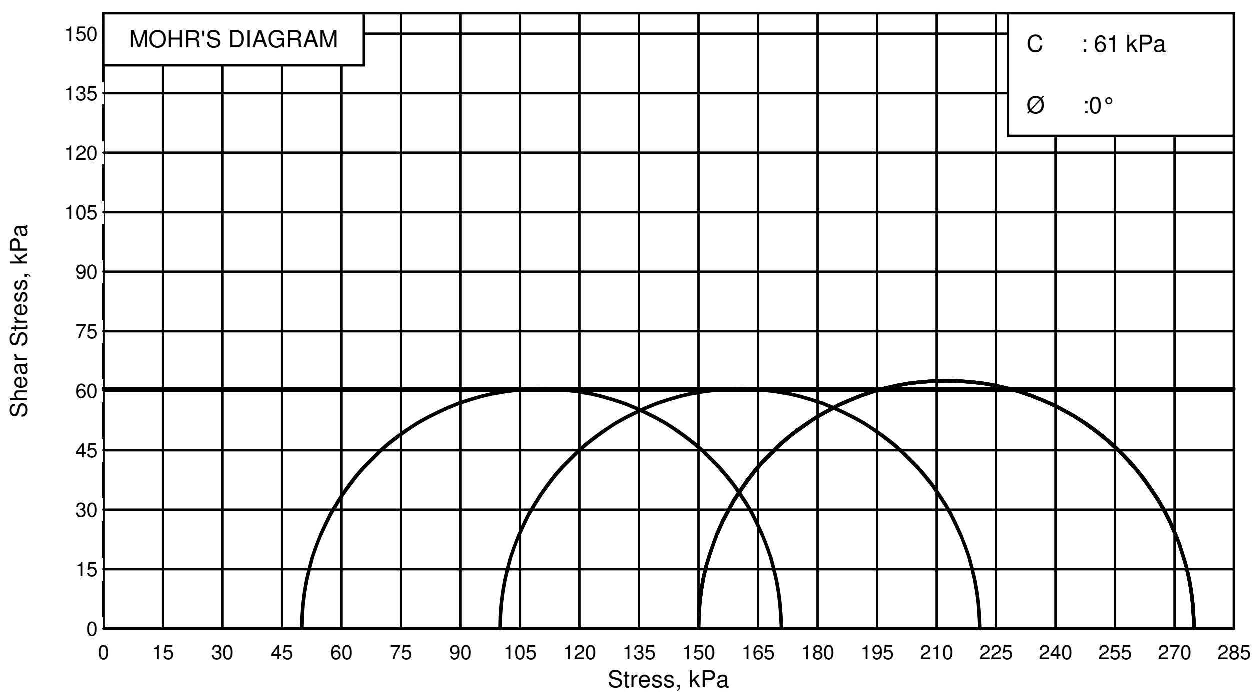
Specimen : 2

Cell Pressure : 100 kPa

Mode of Failure :

Specimen : 3

Cell Pressure : 150 kPa

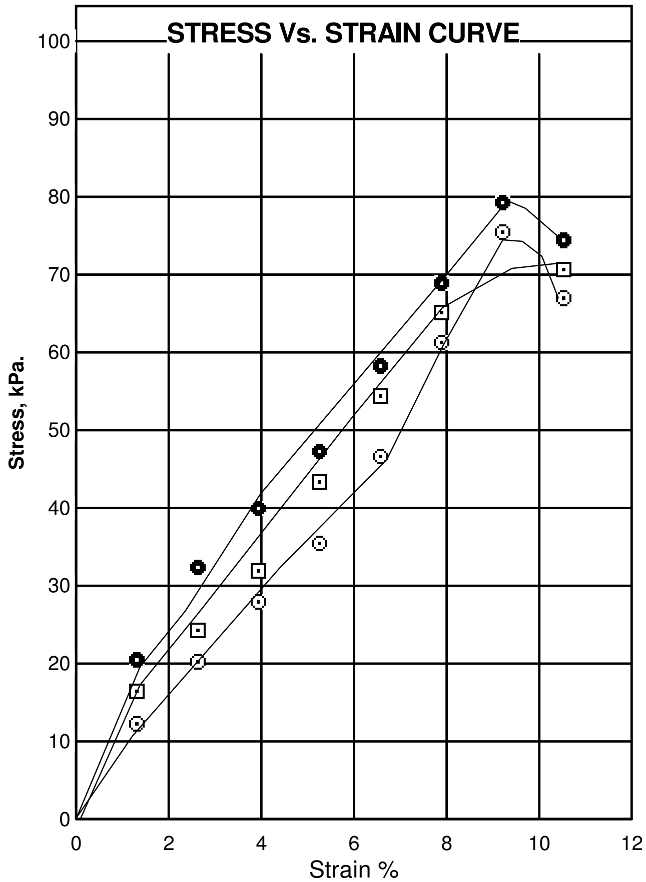


TRIAXIAL TEST CURVES

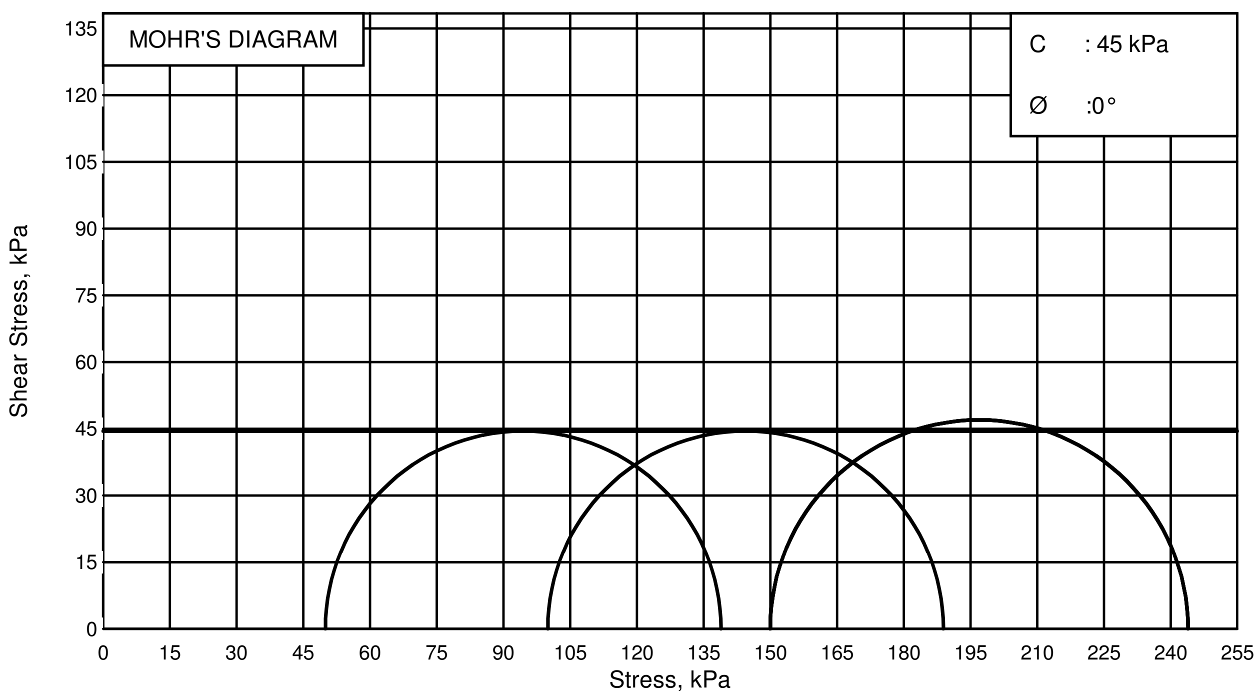
Job No. : 30796-TP

Sample Number : 106108
Sample Depth : 1.00m.
Bore Hole Number : TP-15

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1 ⊡	
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2 ⊙	
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3 ●	
Cell Pressure	: 150 kPa	

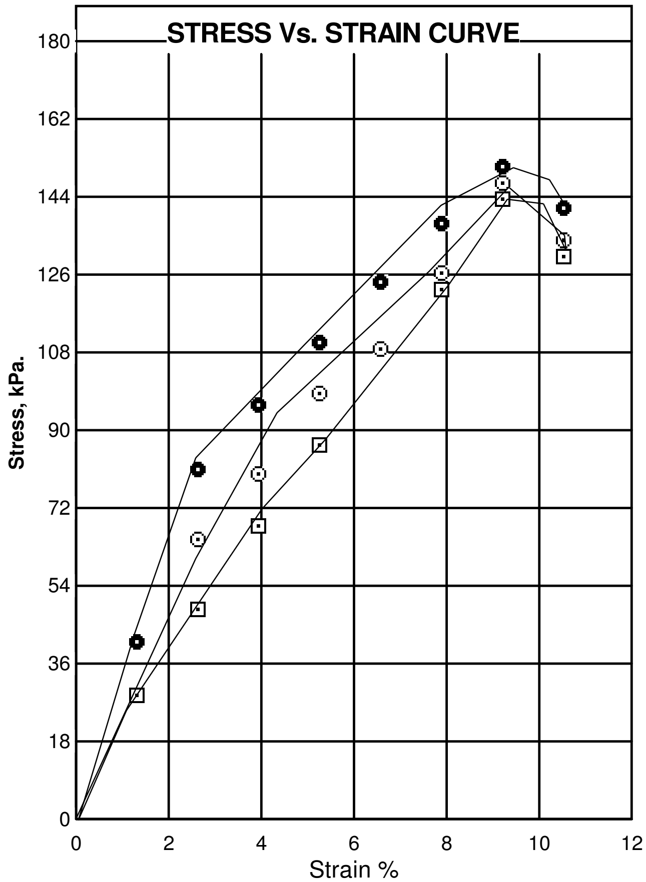


TRIAXIAL TEST CURVES

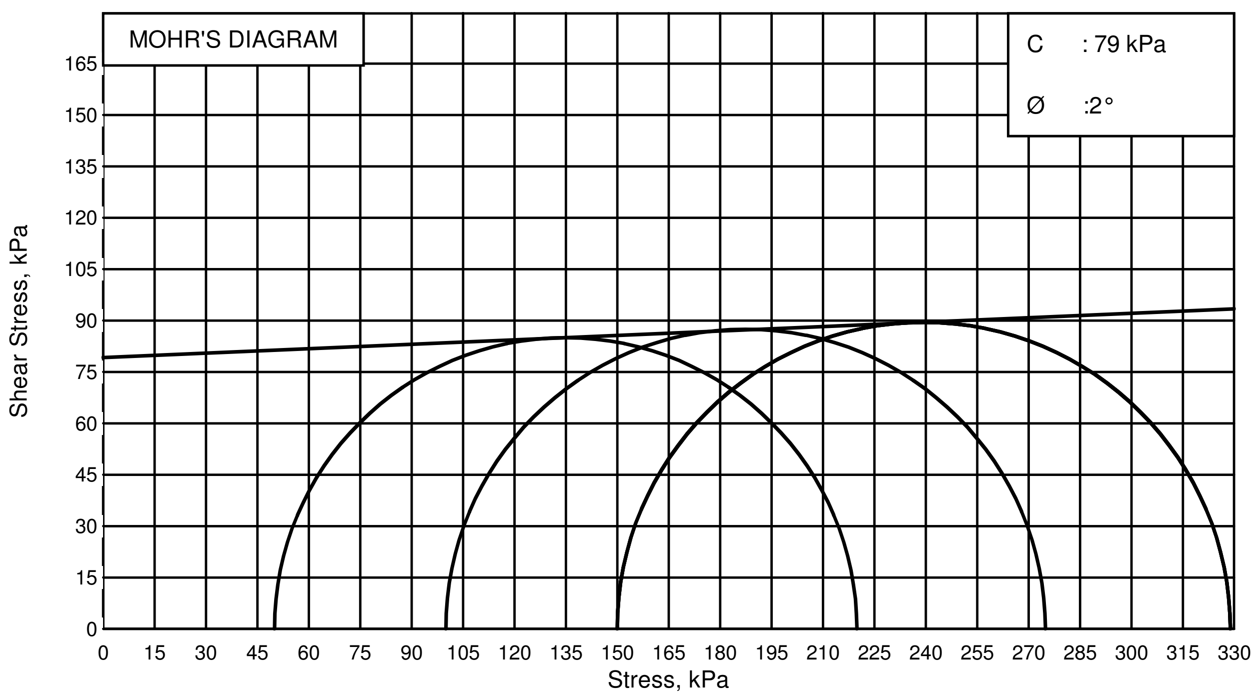
Job No. : 30796-TP

Sample Number : 106110
Sample Depth : 3.00m.
Bore Hole Number : TP-15

Site :
Type of Test : uu



Mode of Failure	:	
Specimen	: 1	⊡
Cell Pressure	: 50 kPa	
Mode of Failure	:	
Specimen	: 2	⊙
Cell Pressure	: 100 kPa	
Mode of Failure	:	
Specimen	: 3	●
Cell Pressure	: 150 kPa	

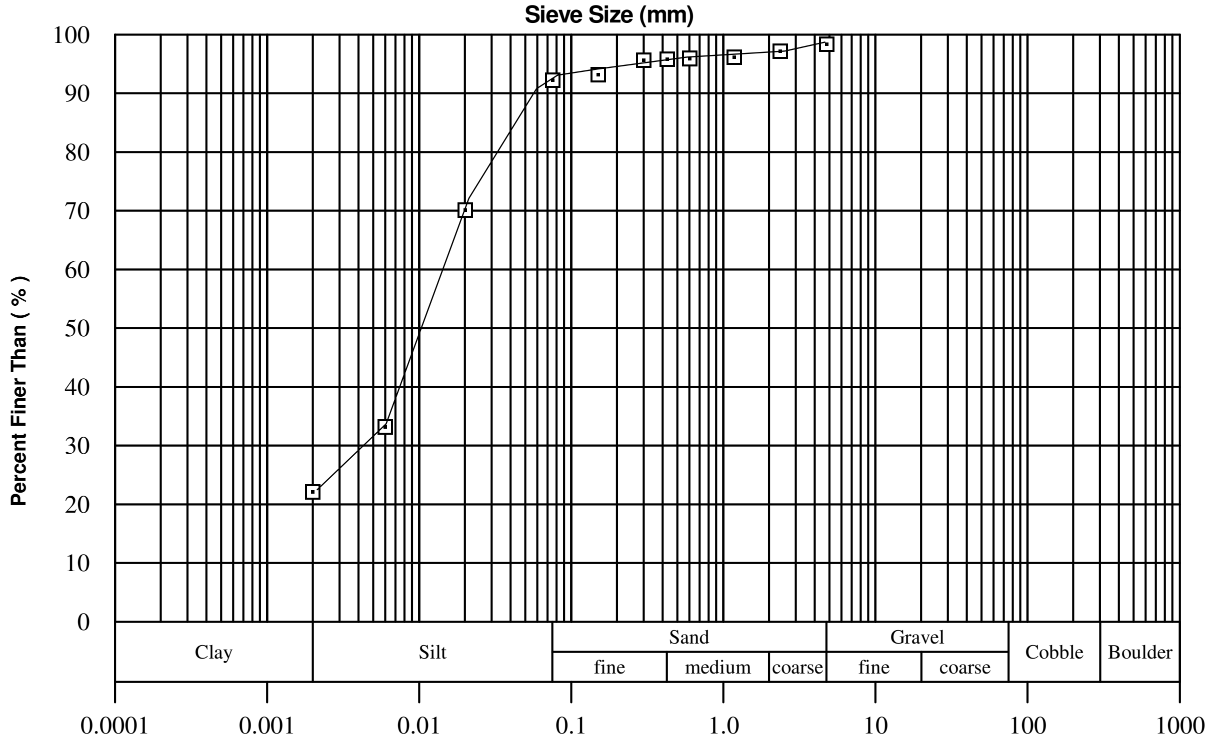


C : 79 kPa

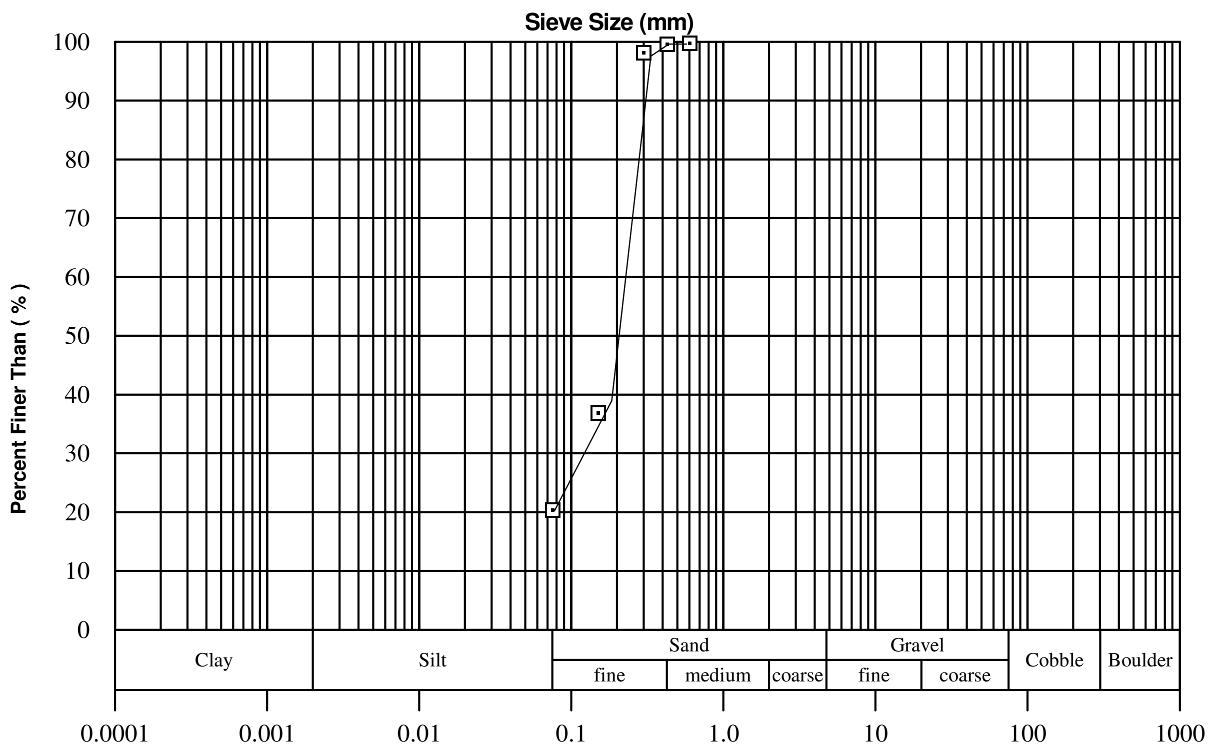
Ø :2°

TRIAXIAL TEST CURVES

Job No. : 30796-TP

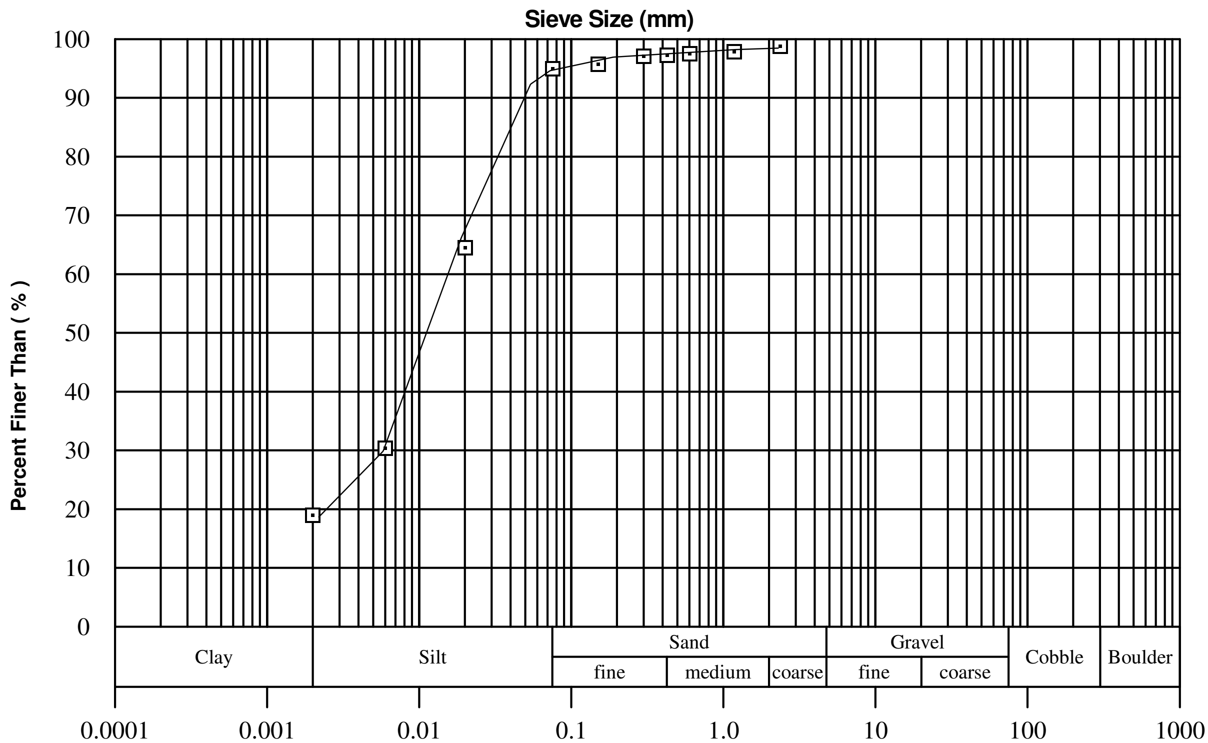


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	01	177125	3.00-3.45	1.60	6.10	70.15	22.15

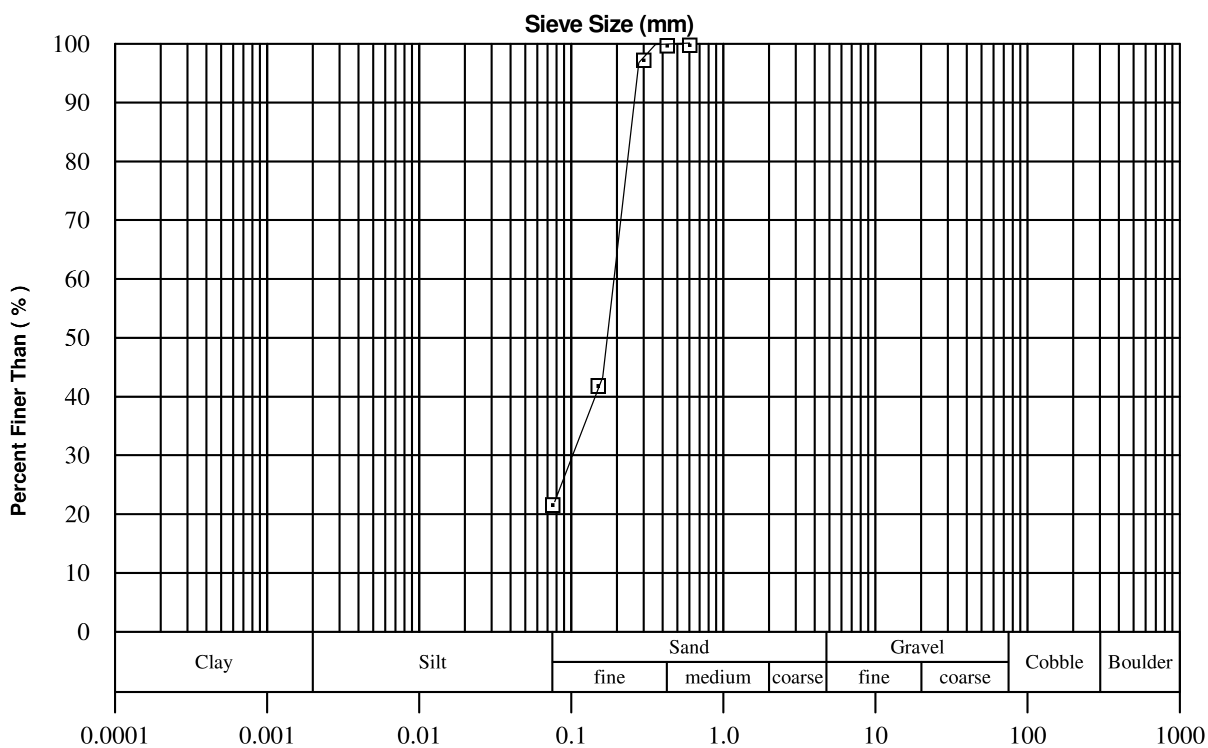


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	01	177131	9.00-9.45		79.60	20.40	

PARTICLE SIZE DISTRIBUTION CURVES

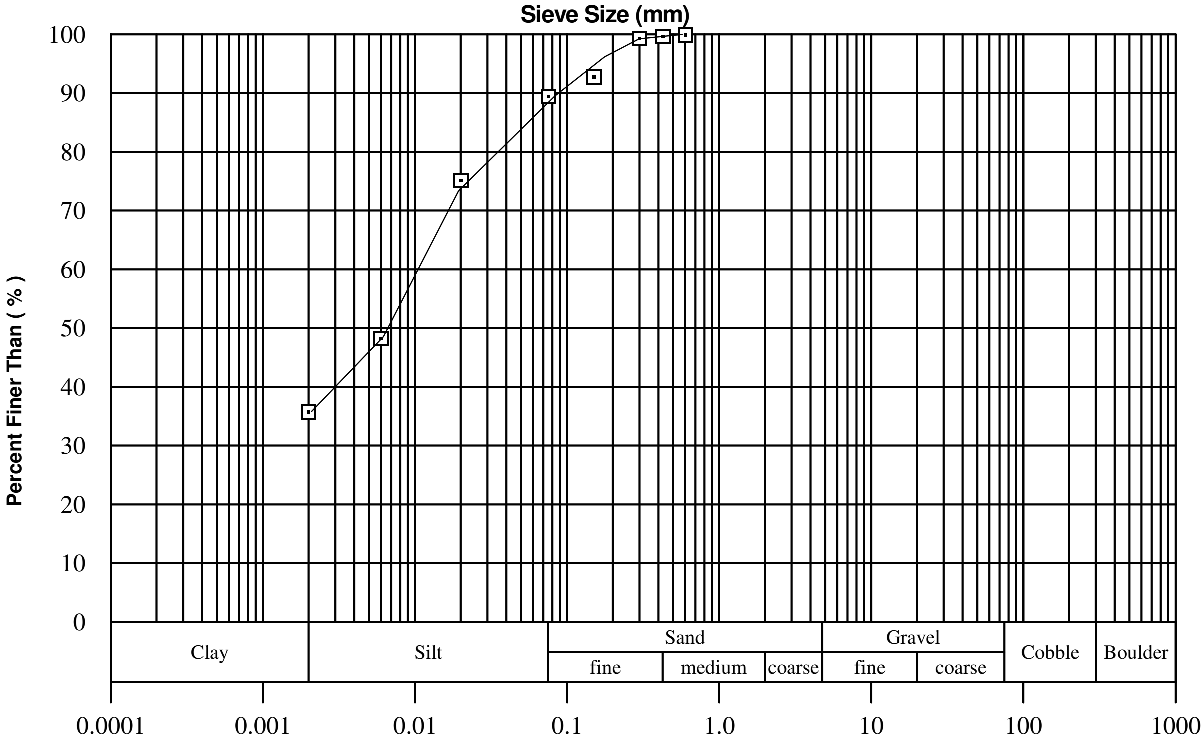


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	02	160128	4.50-4.95		5.00	76.00	19.00

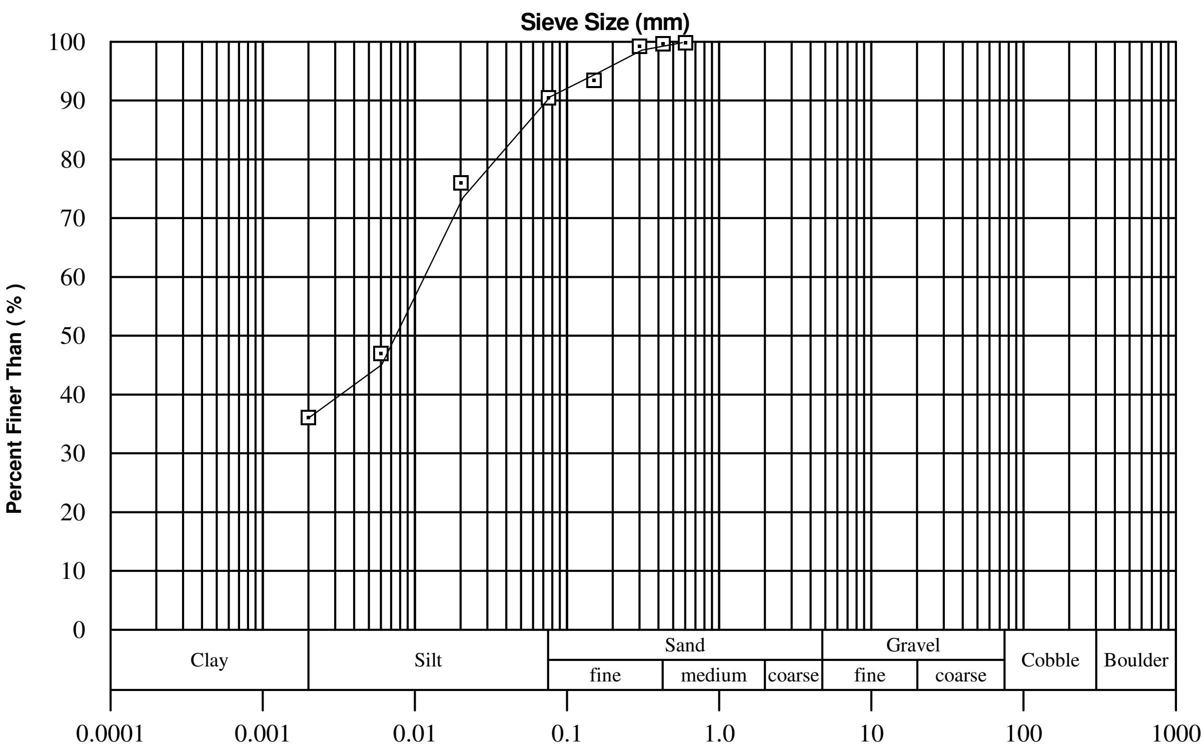


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	02	160134	12.00-12.45		78.40	21.60	

PARTICLE SIZE DISTRIBUTION CURVES

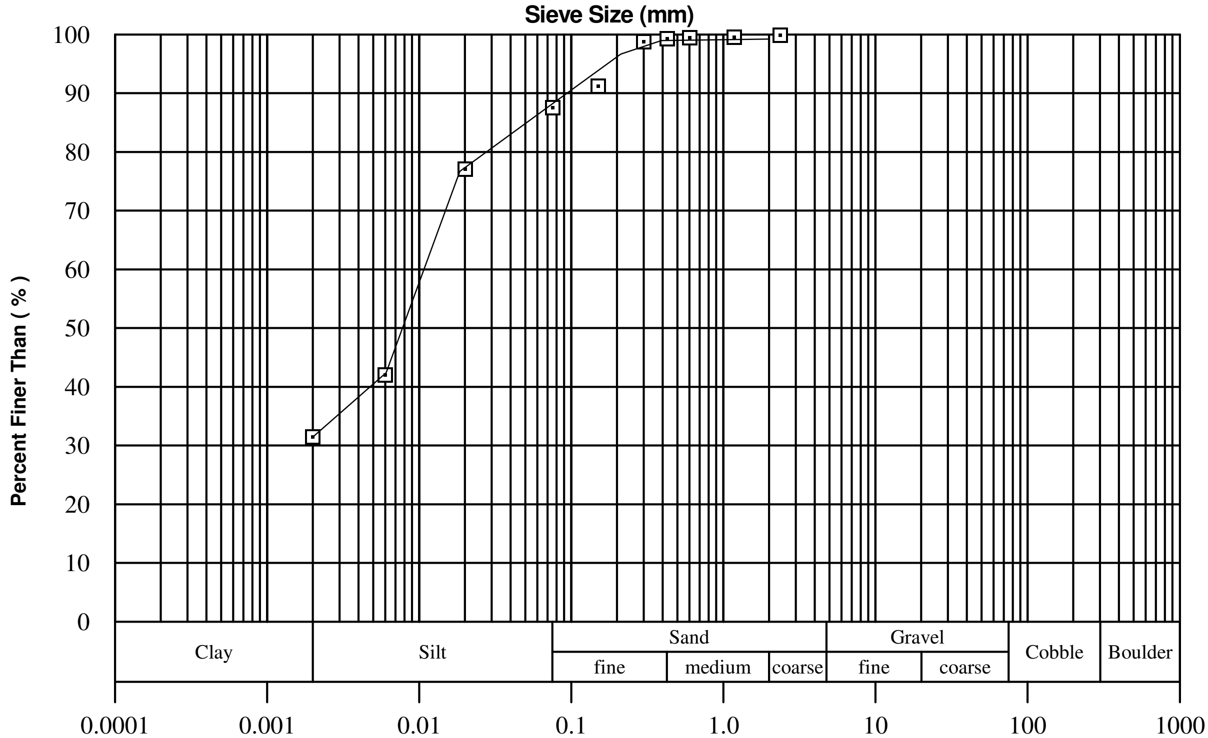


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	03	100869	1.00-1.45		10.50	53.70	35.80

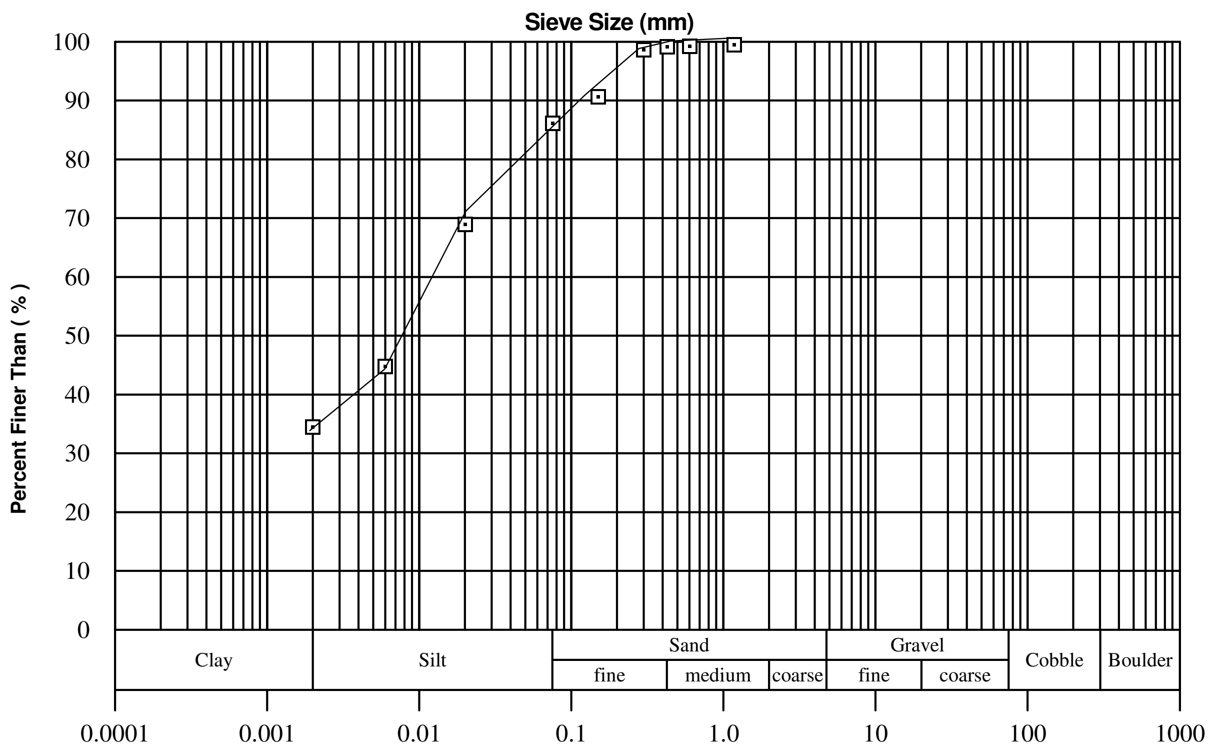


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	03	100873	3.00-3.45		9.50	54.30	36.20

PARTICLE SIZE DISTRIBUTION CURVES

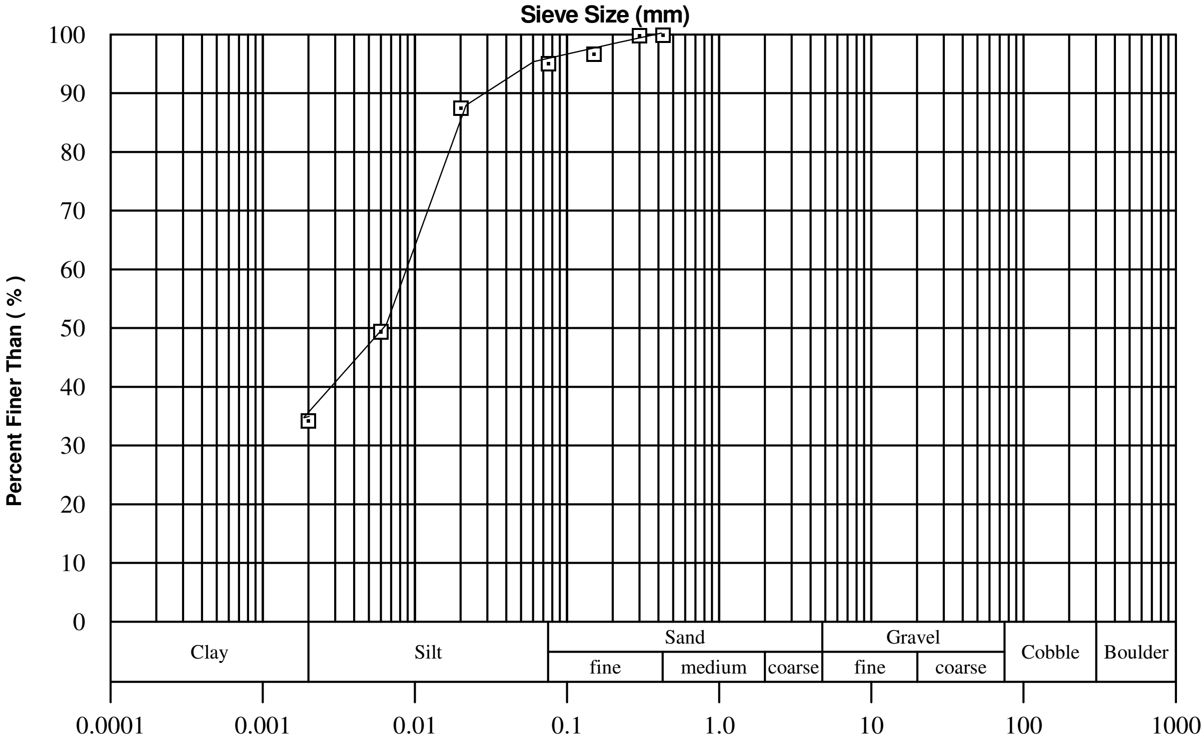


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	03	100877	6.00-6.45		12.40	56.06	31.54

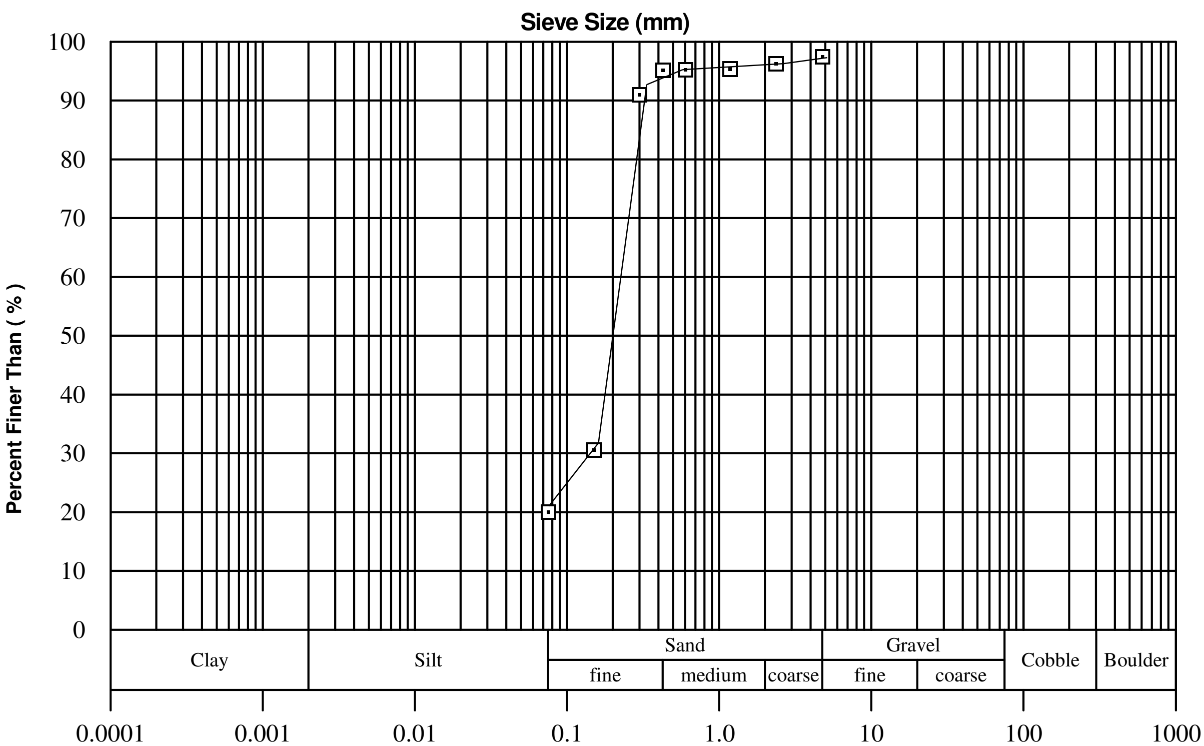


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	03	100879	8.00-8.45		13.80	51.72	34.48

PARTICLE SIZE DISTRIBUTION CURVES

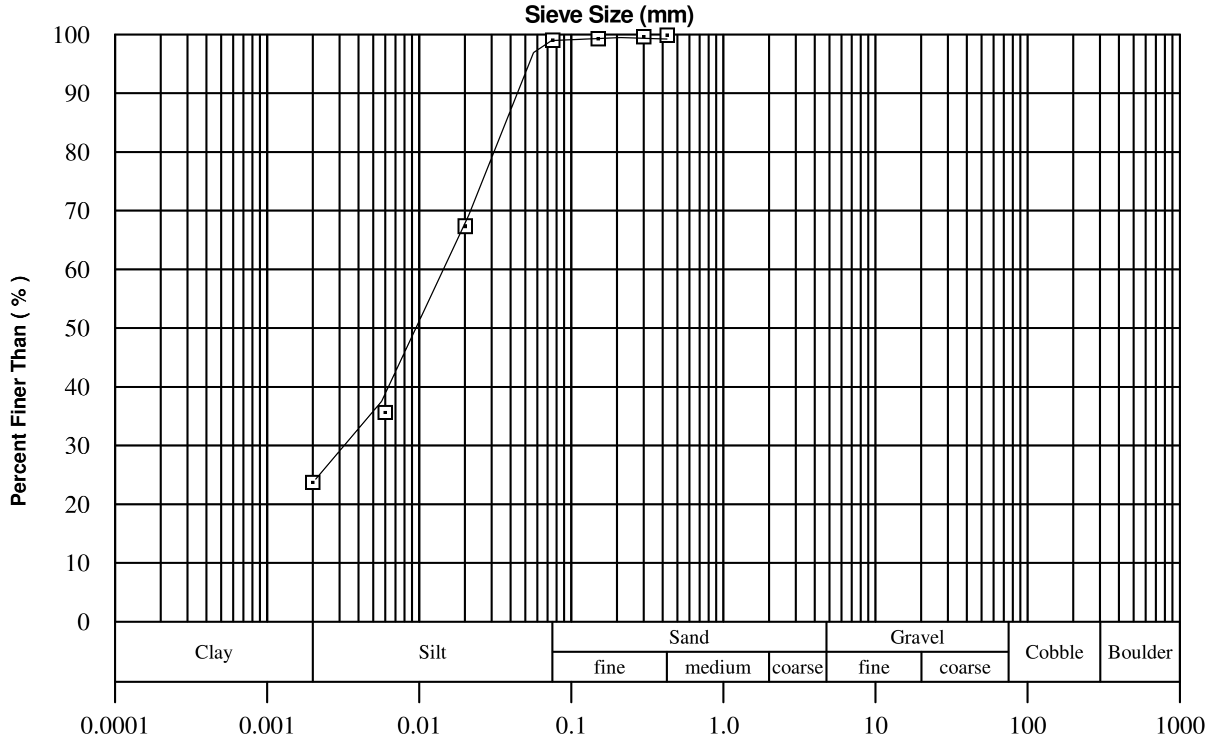


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	03	100881	11.00-11.45		4.90	60.86	34.24

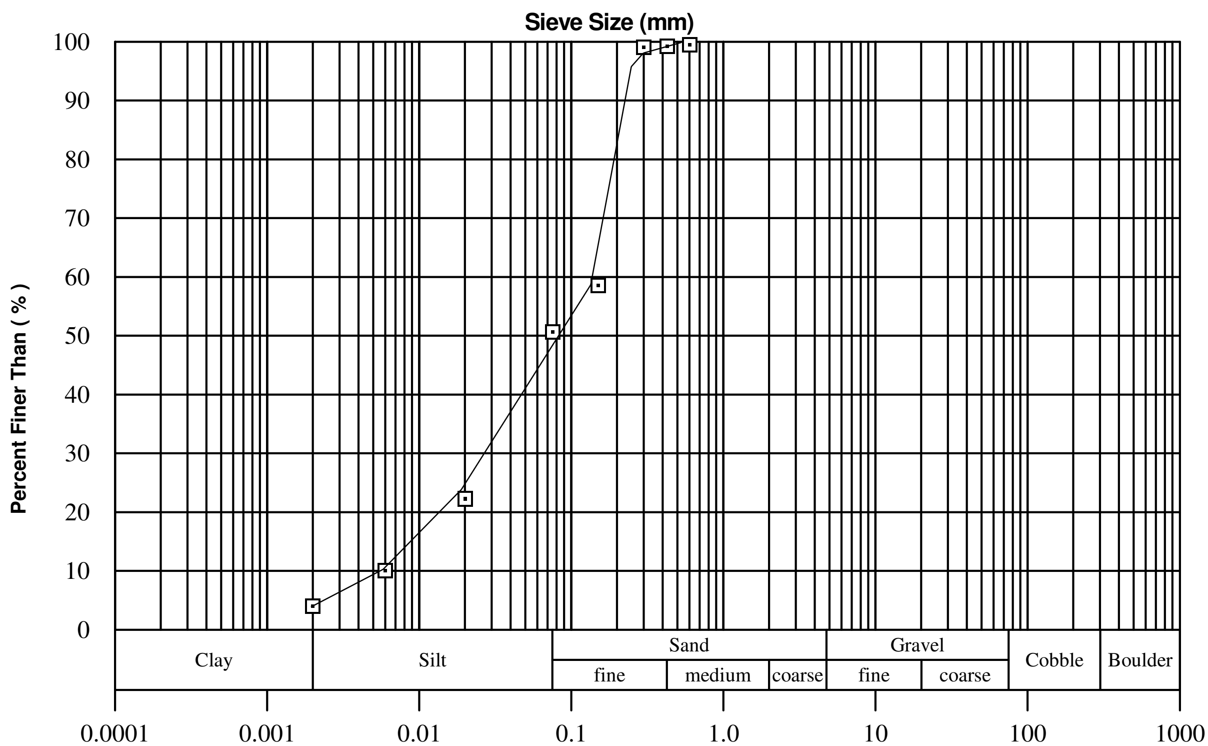


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	03	100884	12.50-12.95	2.50	77.40	20.10	

PARTICLE SIZE DISTRIBUTION CURVES

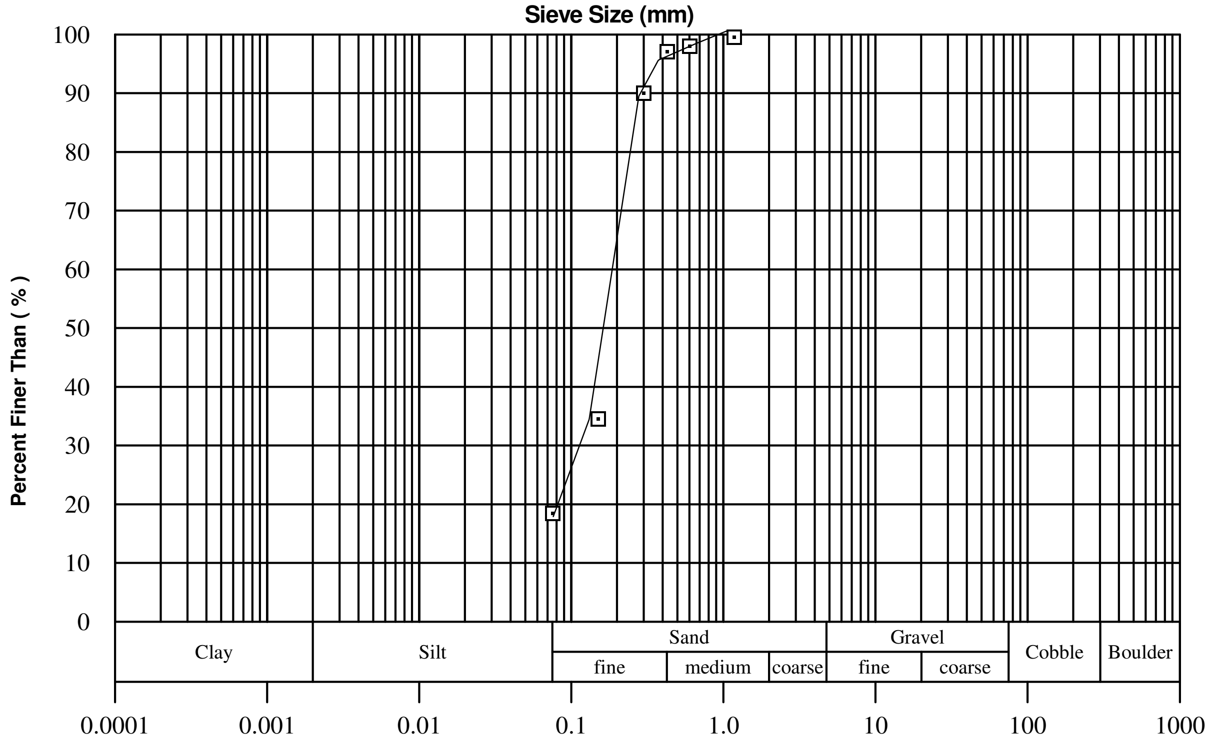


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	04	100902	1.50-1.95		0.90	75.32	23.78

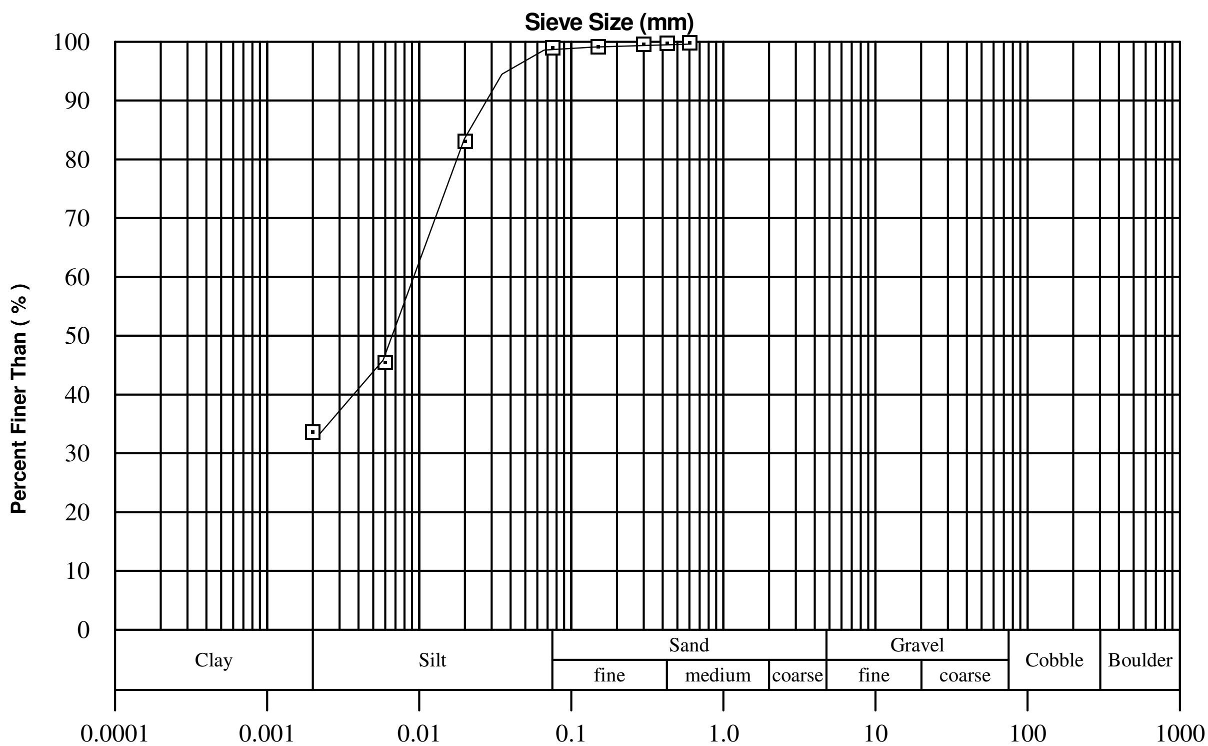


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	04	100906	3.50-3.95		49.30	46.64	4.06

PARTICLE SIZE DISTRIBUTION CURVES

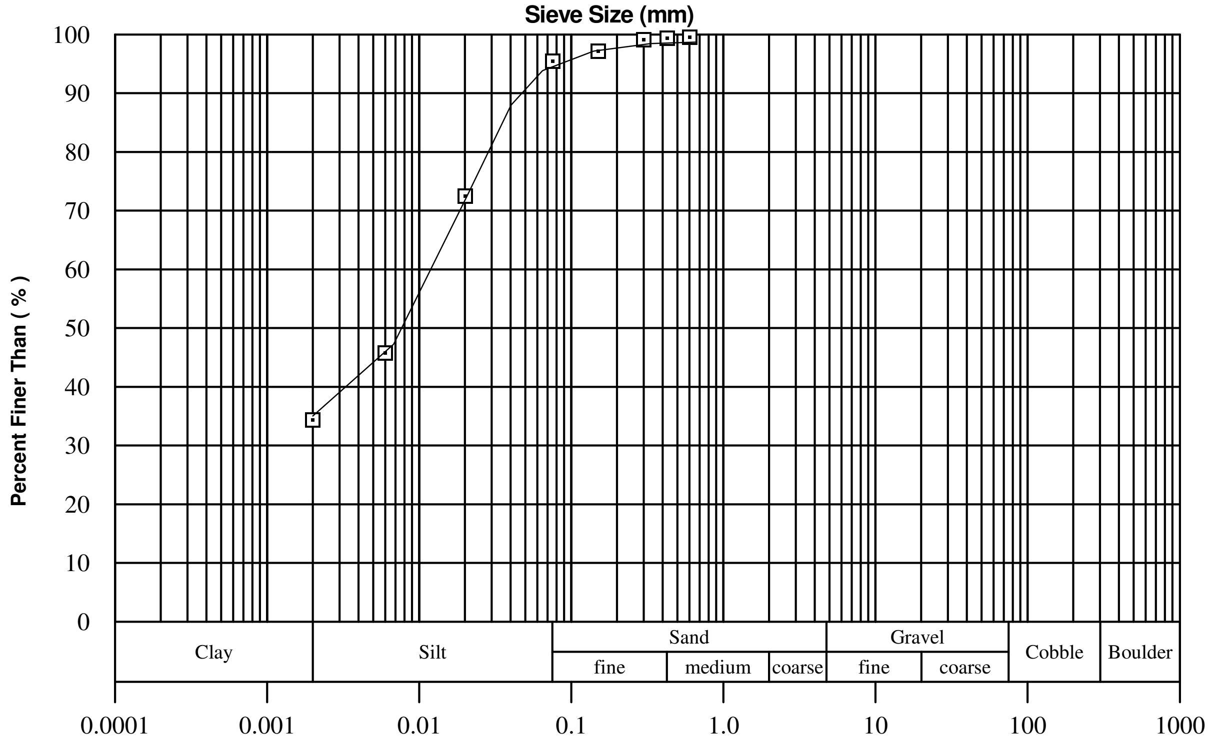


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	04	100908	5.00-5.45		81.50	18.50	

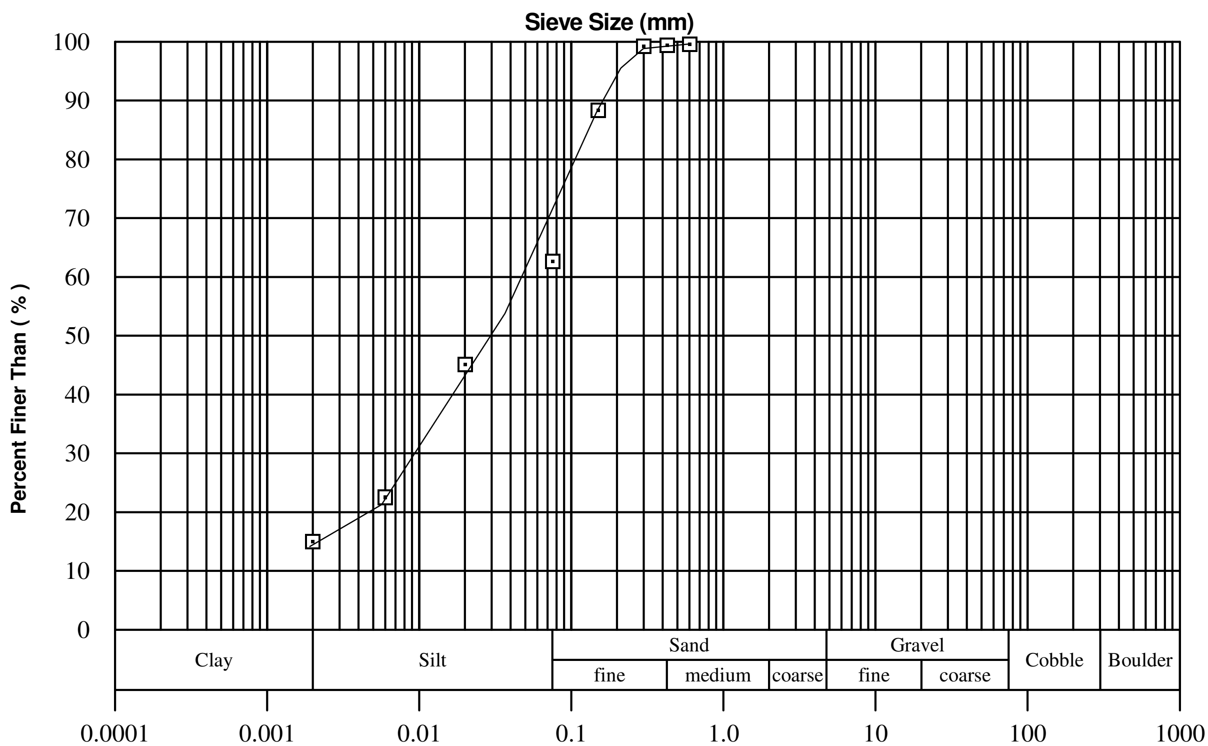


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	05	100453	1.50-1.95		1.00	65.34	33.66

PARTICLE SIZE DISTRIBUTION CURVES

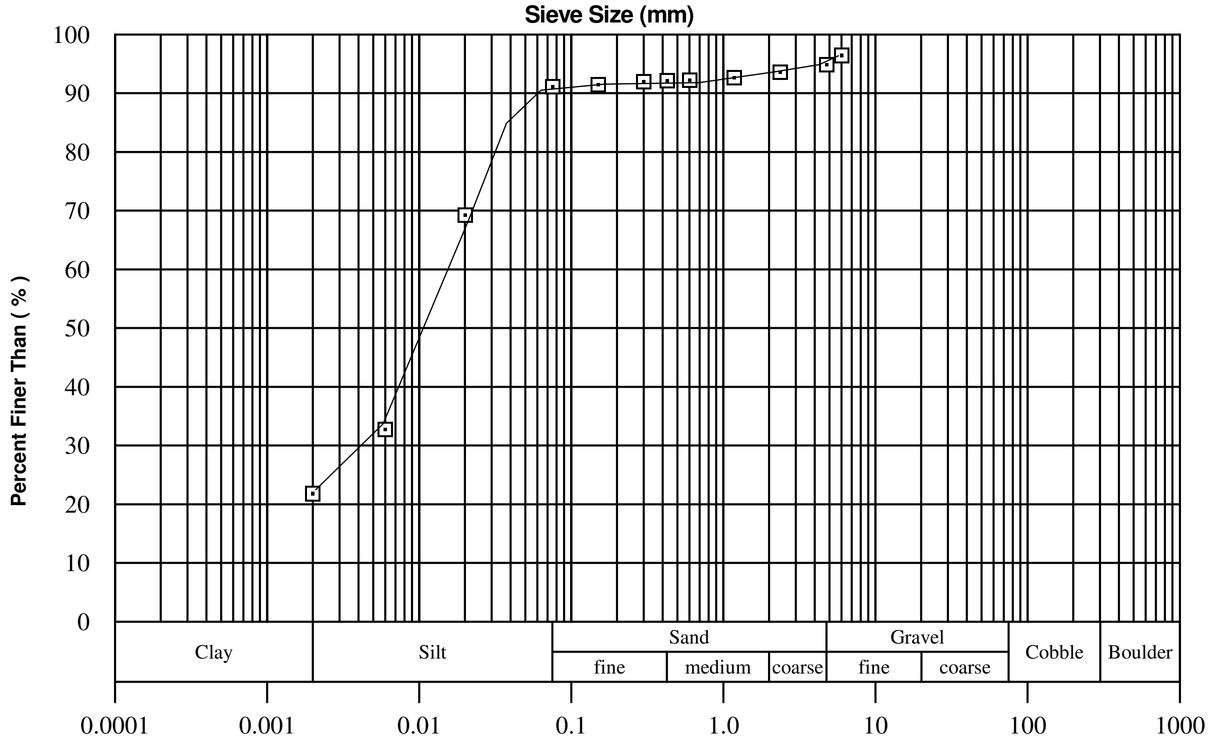


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	05	100457	3.50-3.95		4.50	61.12	34.38

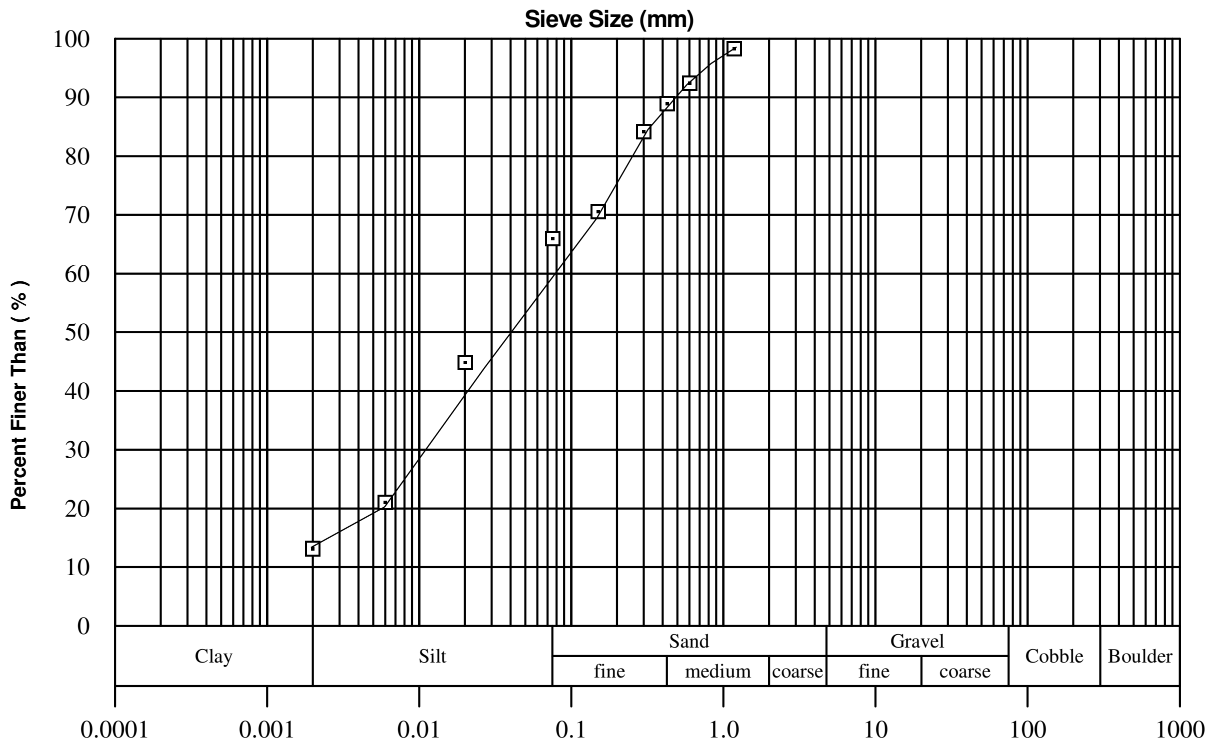


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	05	100459	4.50-4.95		37.27	47.67	15.05

PARTICLE SIZE DISTRIBUTION CURVES

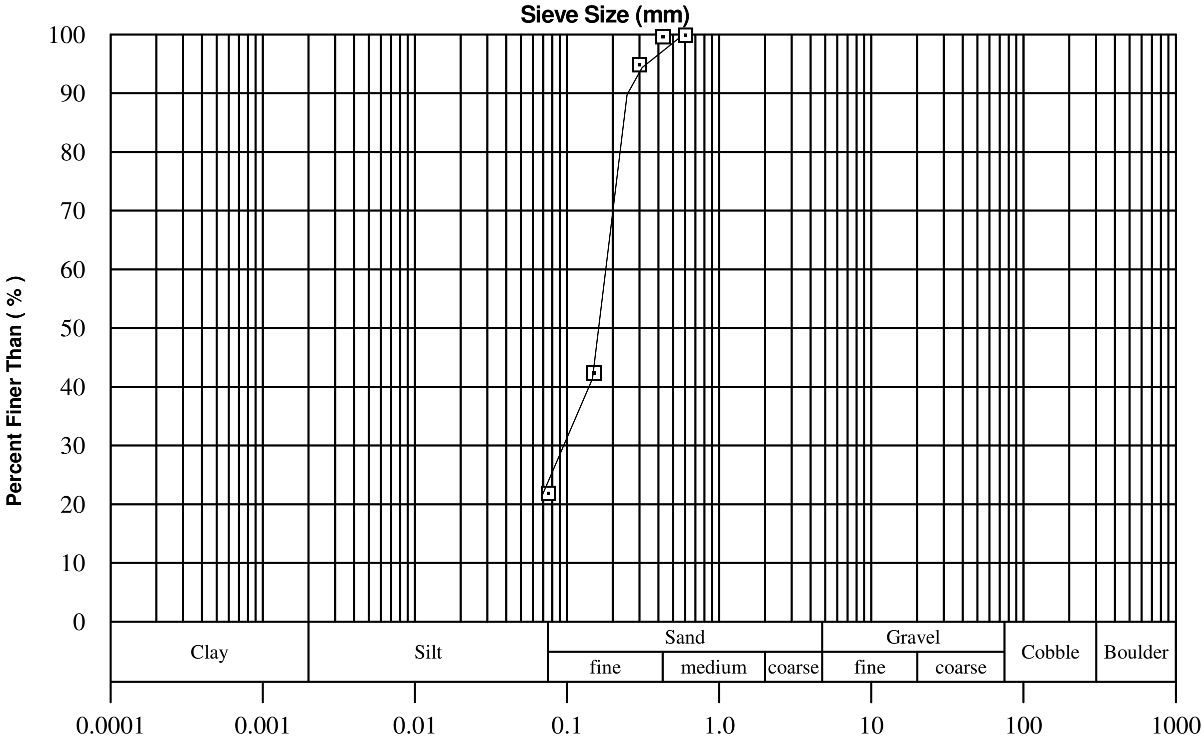


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	06	105112	1.00-1.45	5.10	3.70	69.31	21.89

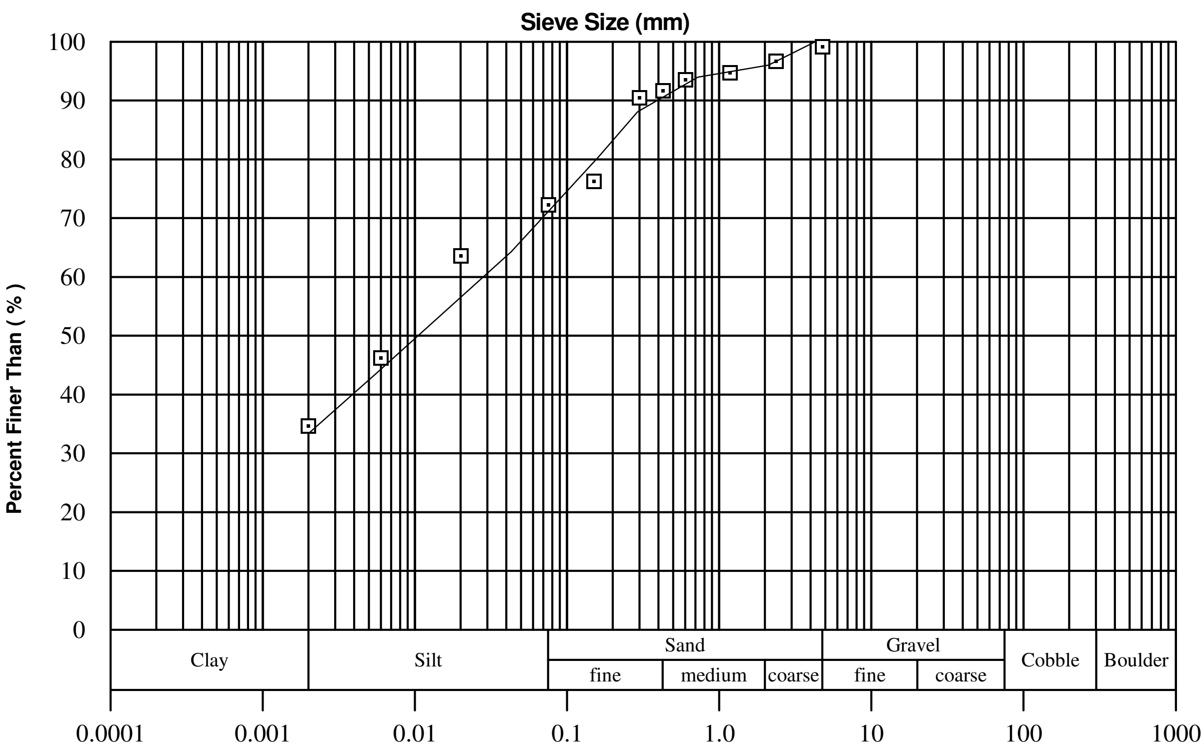


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	06	105116	3.00-3.45		34.00	52.80	13.20

PARTICLE SIZE DISTRIBUTION CURVES

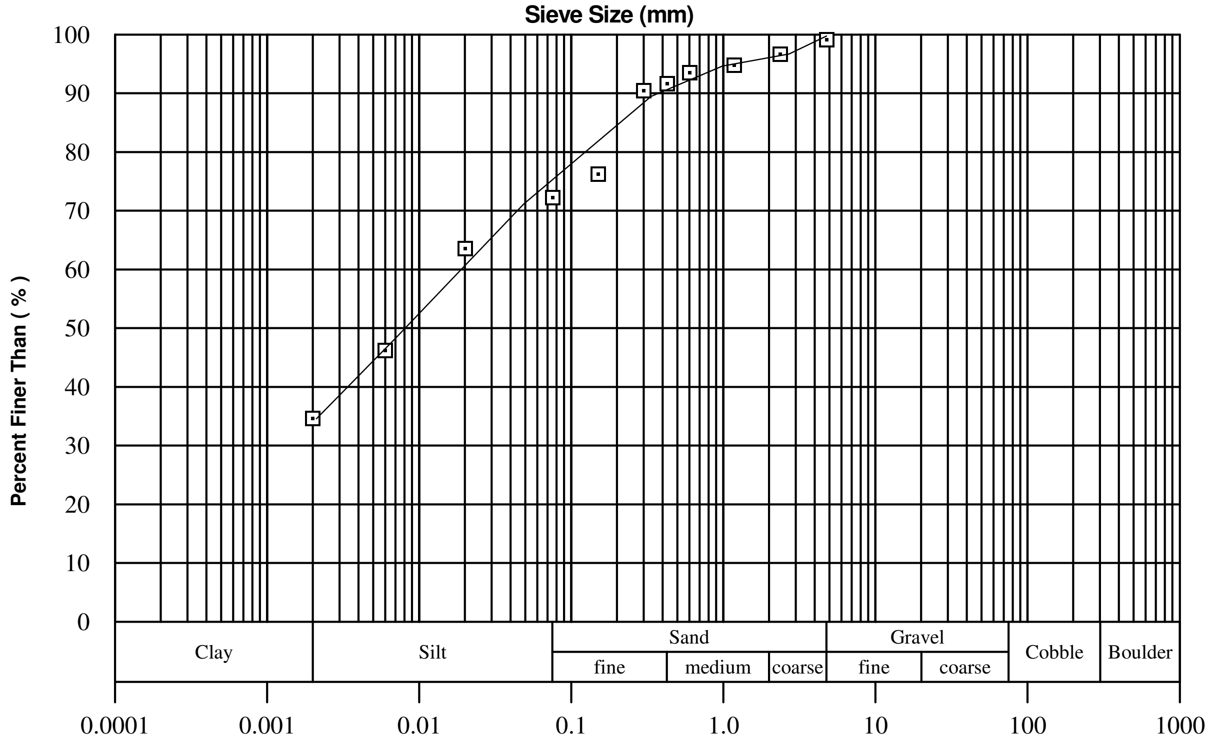


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	06	105118	5.00		78.10	21.90	

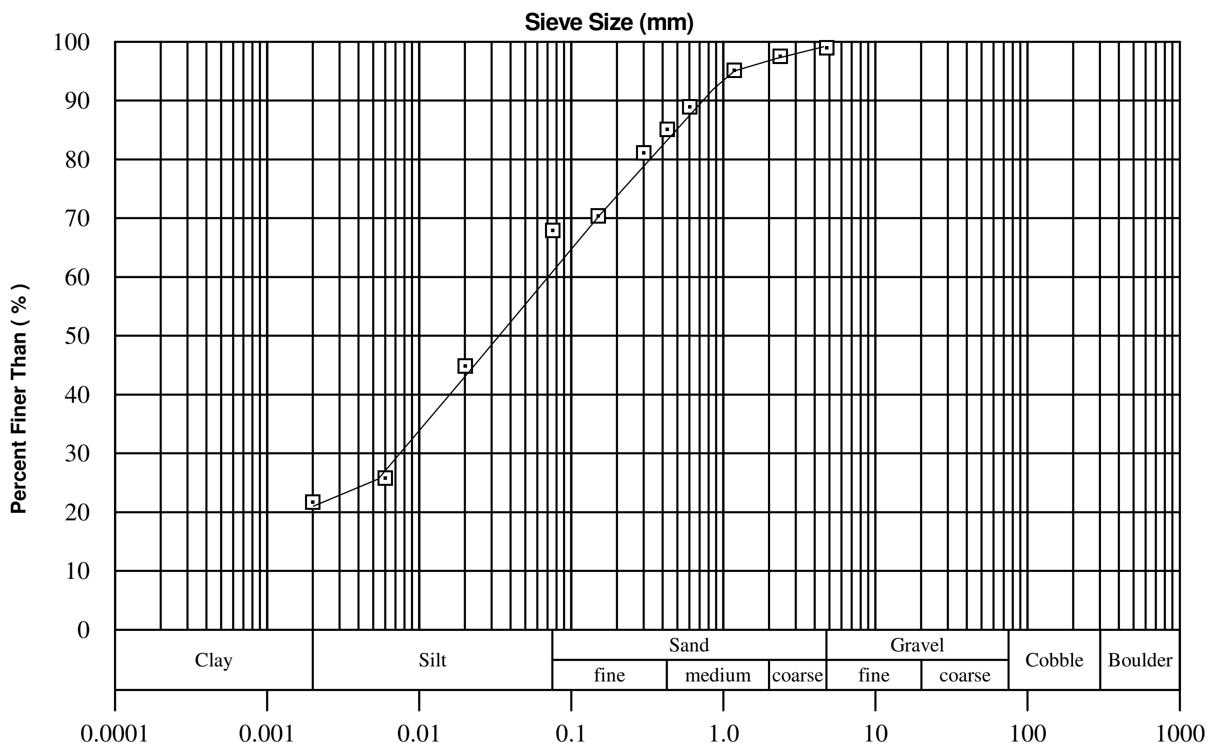


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	07	105102	1.00-1.45	0.80	26.90	37.60	34.70

PARTICLE SIZE DISTRIBUTION CURVES

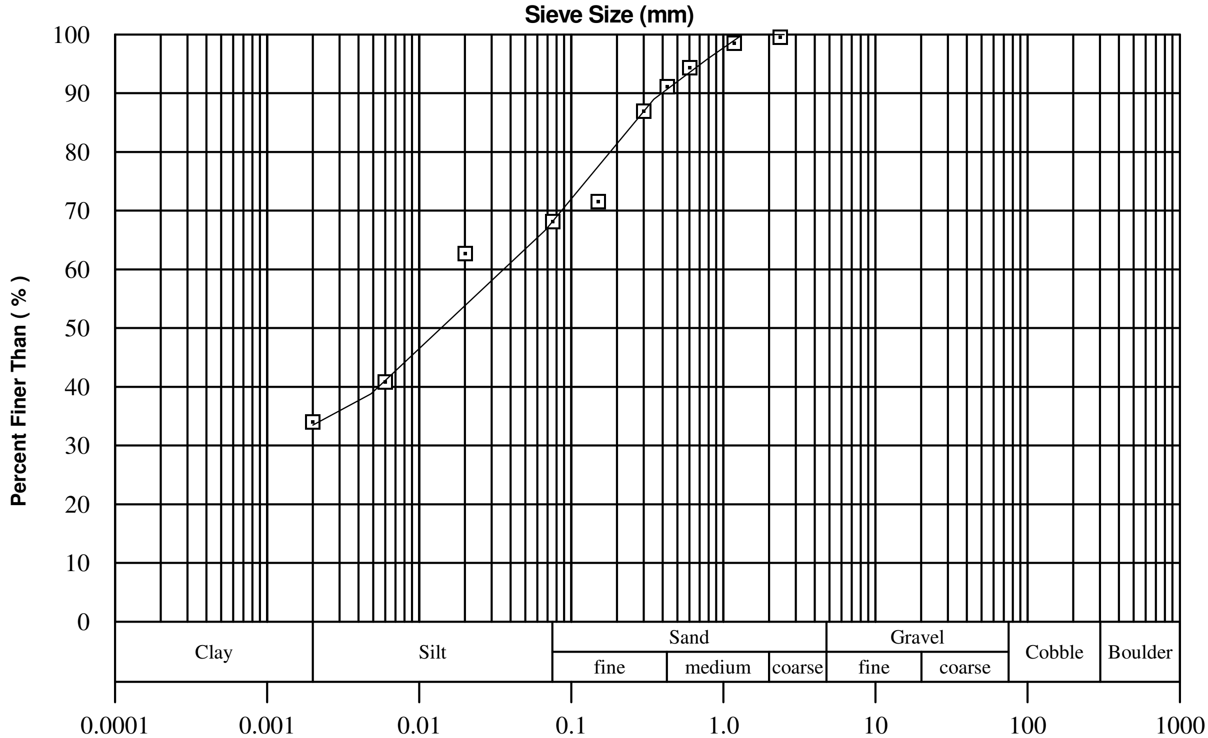


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	07	105102	1.00-1.45	0.80	26.90	37.60	34.70

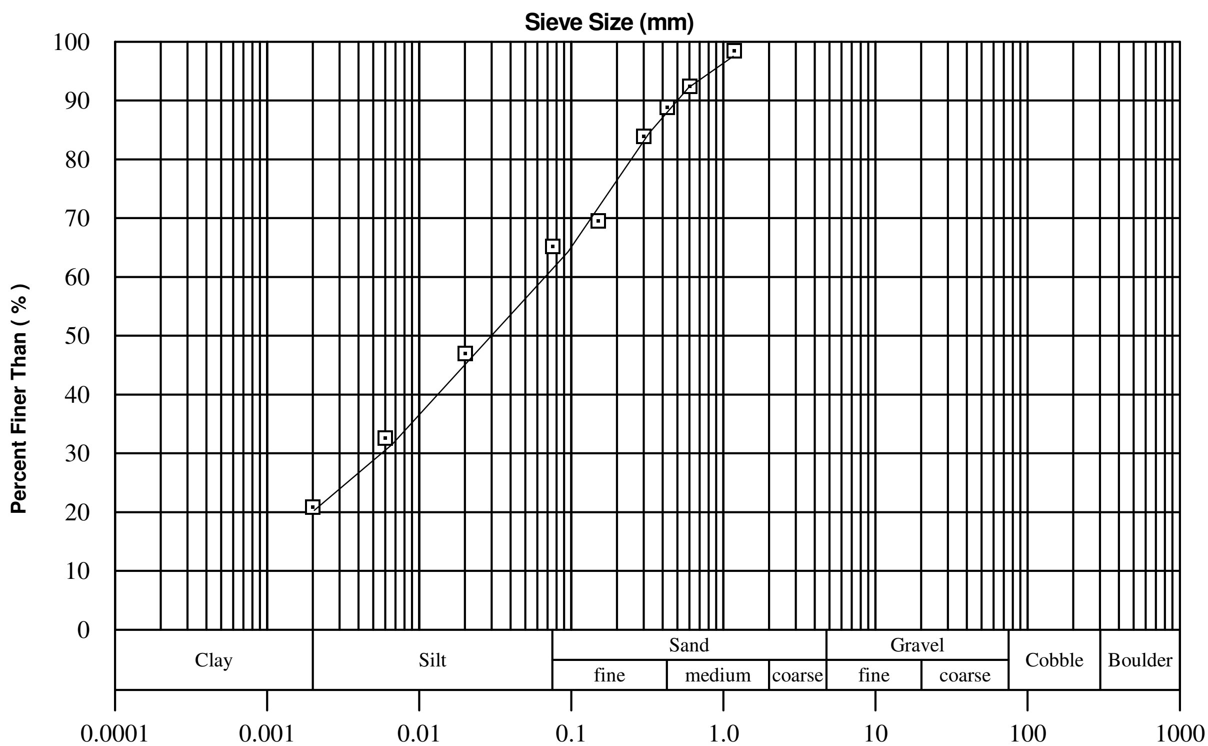


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	07	105104	2.00-2.45	1.00	31.00	46.24	21.76

PARTICLE SIZE DISTRIBUTION CURVES

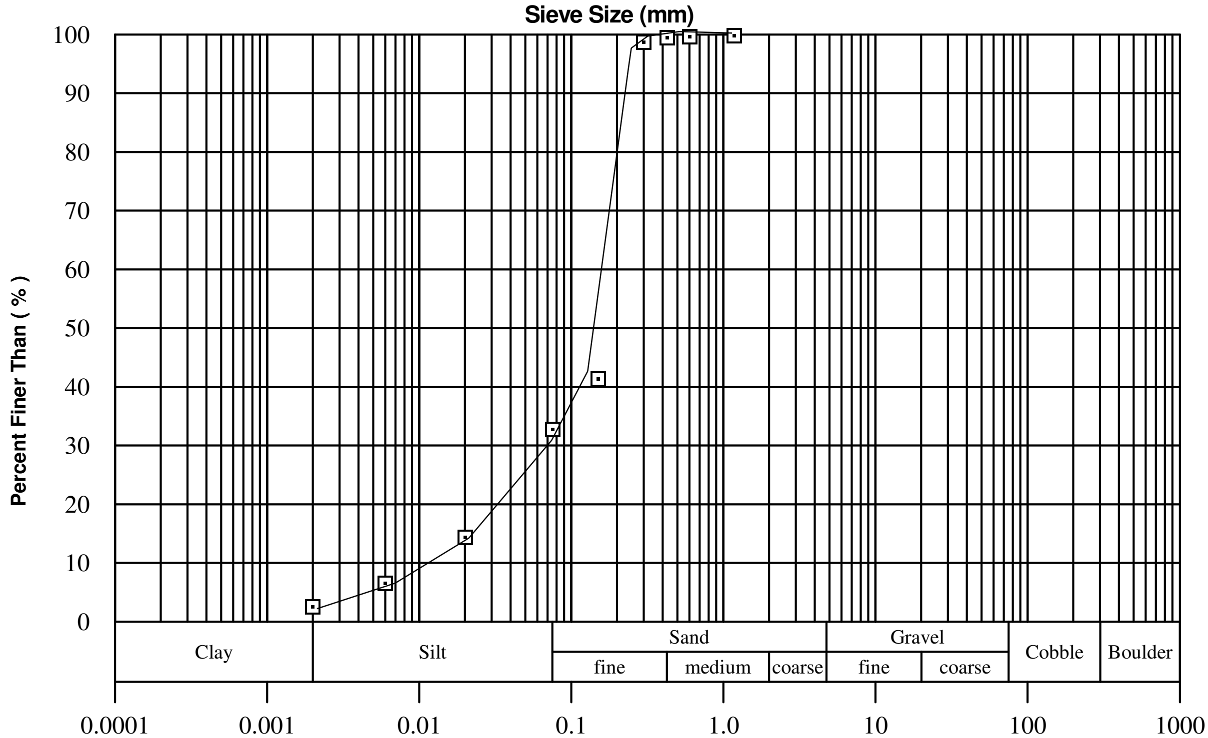


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	08	100968	1.00-1.45		31.80	34.10	34.10

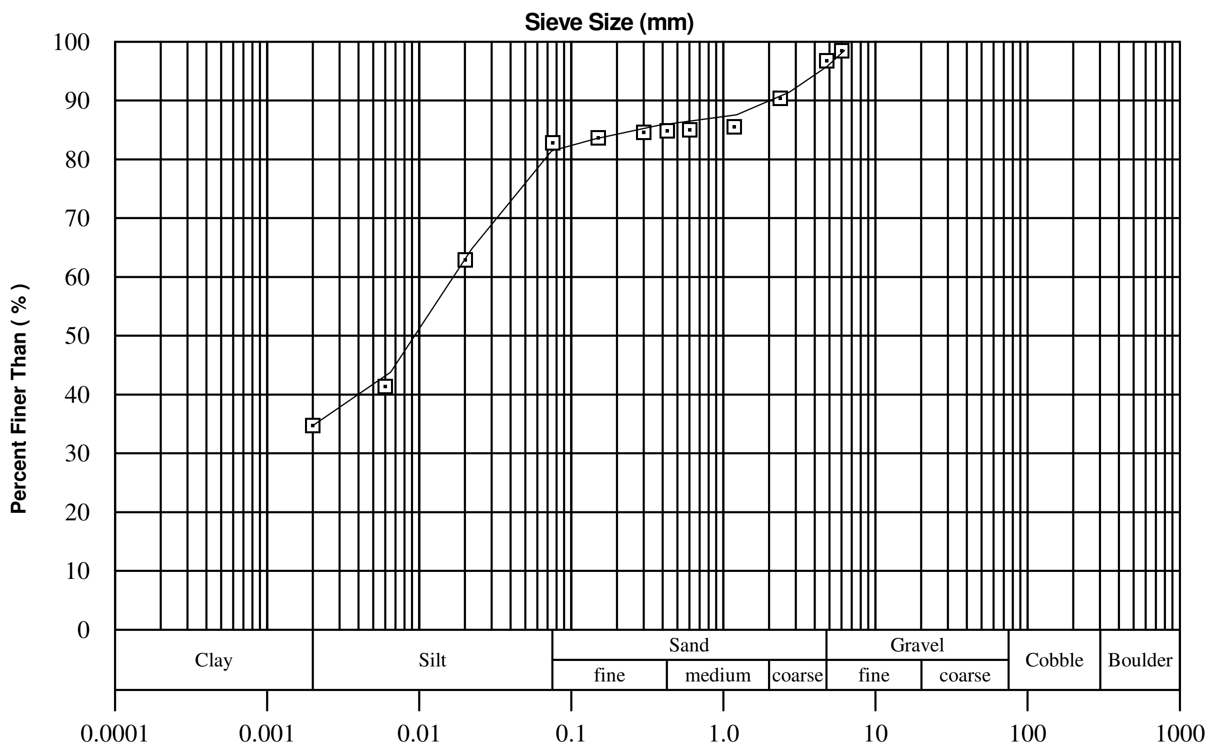


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	08	100972	3.00-3.45		34.70	44.40	20.90

PARTICLE SIZE DISTRIBUTION CURVES

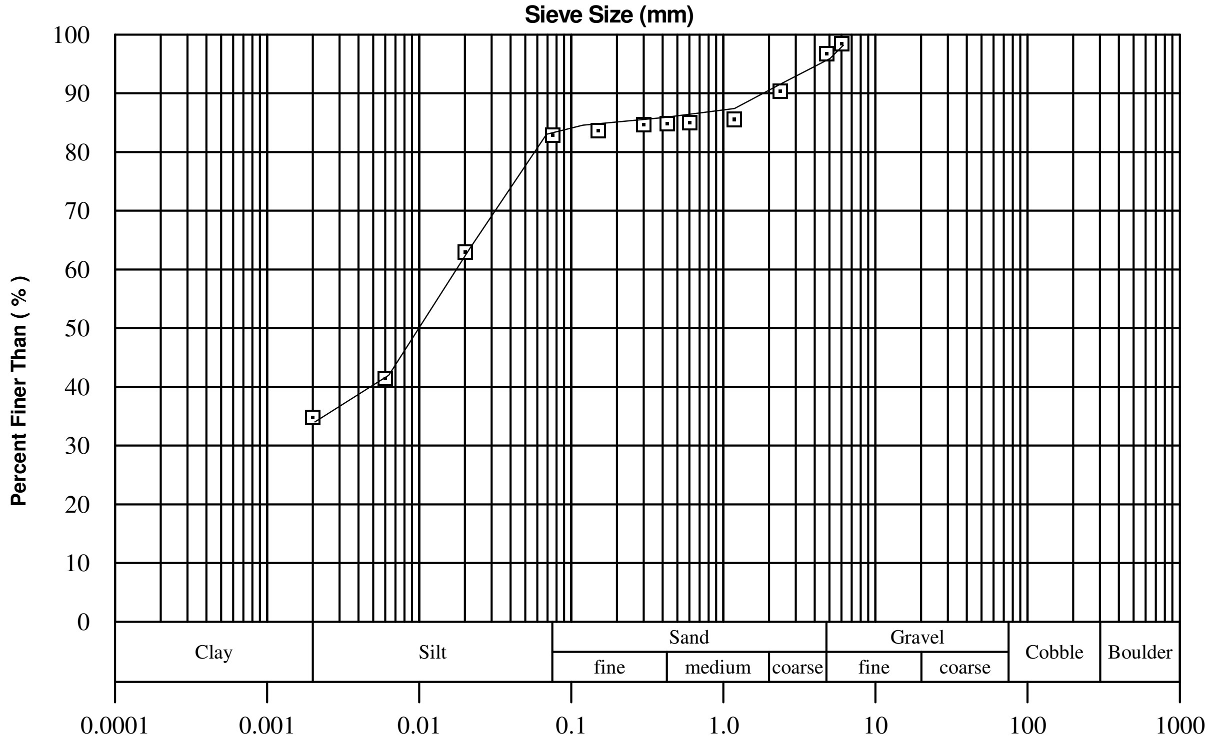


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	08	100976	7.50-7.95		67.23	30.15	2.62

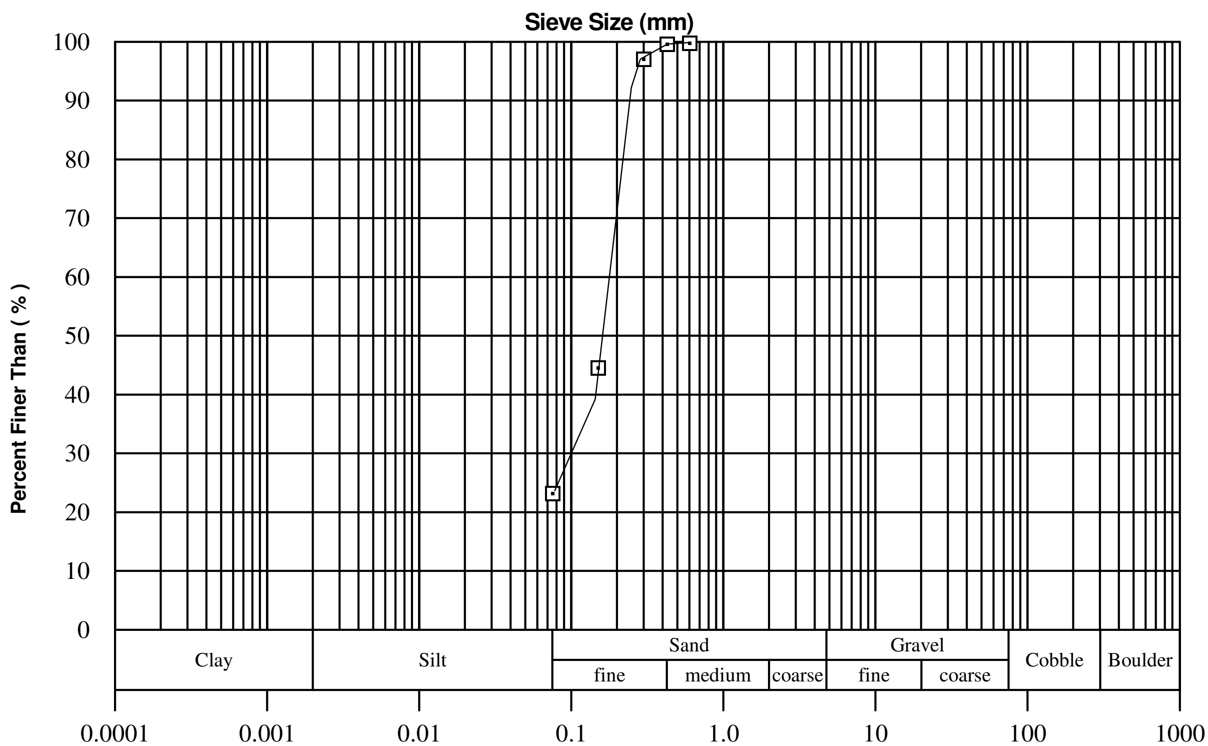


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	09	100878	2.00-2.45	3.20	13.90	48.08	34.82

PARTICLE SIZE DISTRIBUTION CURVES

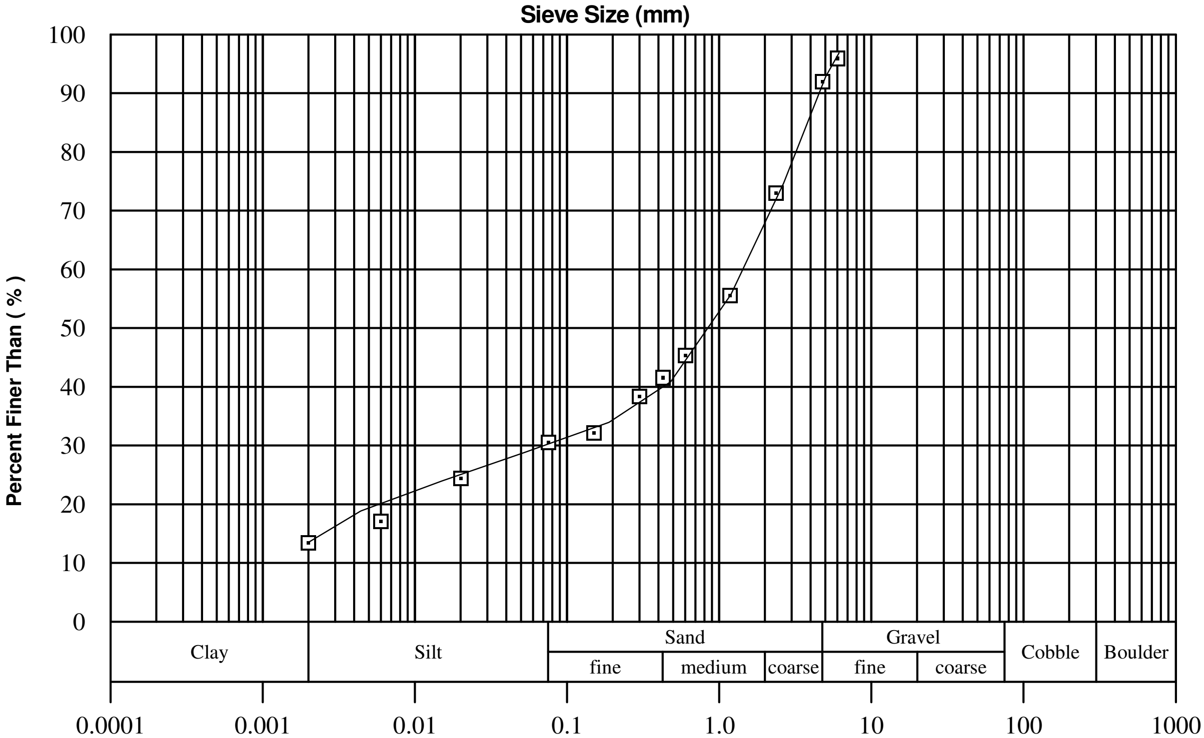


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	09	100878	2.00-2.45	3.20	13.90	48.08	34.82

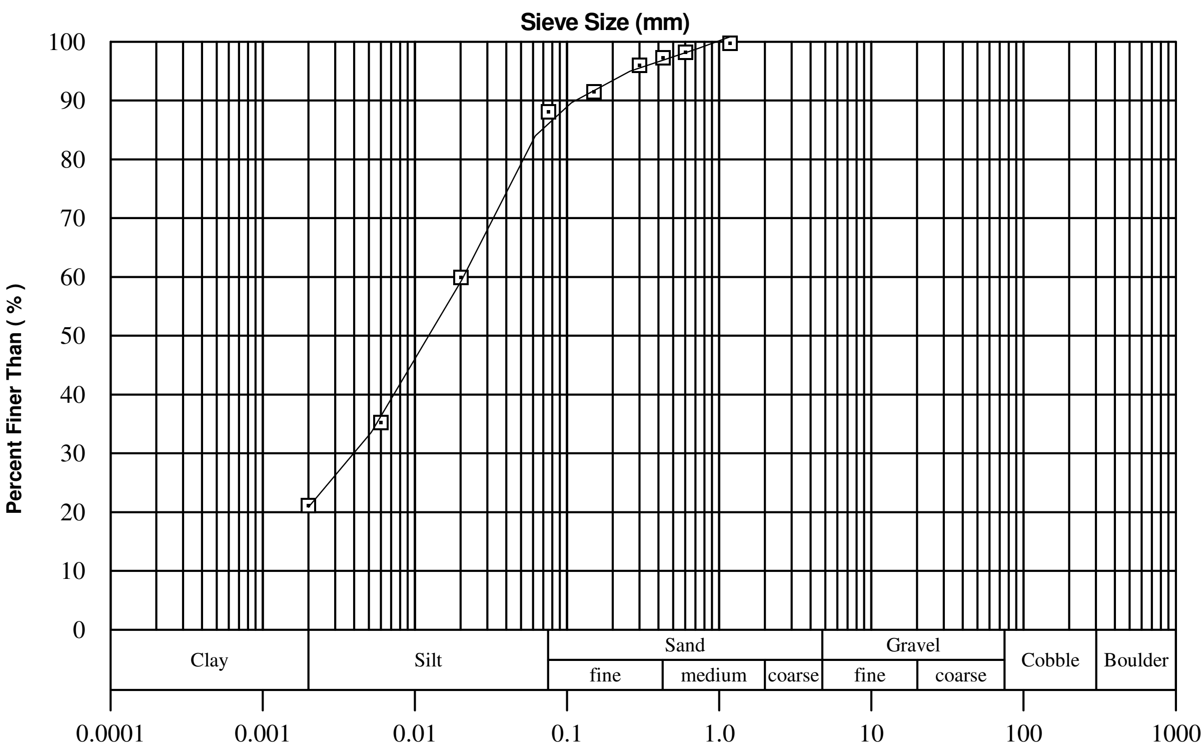


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	09	100884	7.50-7.95		76.80	23.20	

PARTICLE SIZE DISTRIBUTION CURVES

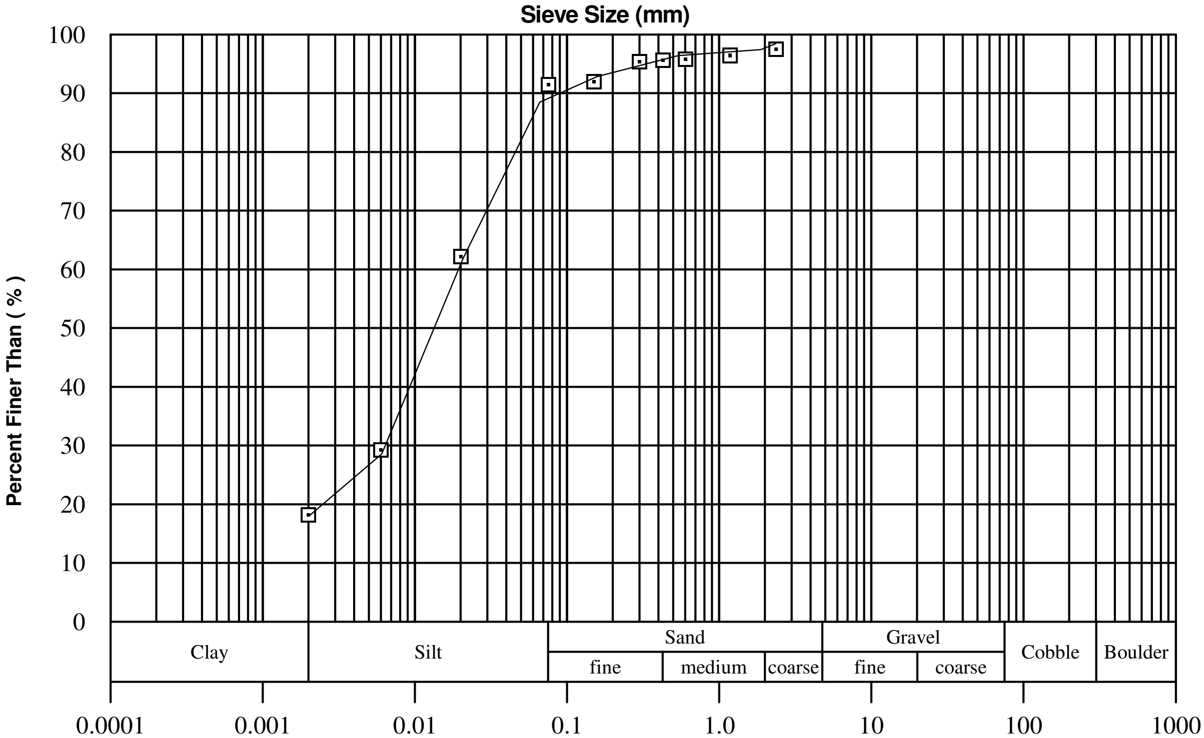


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	10	100472	1.00-1.45	8.00	61.40	17.14	13.46

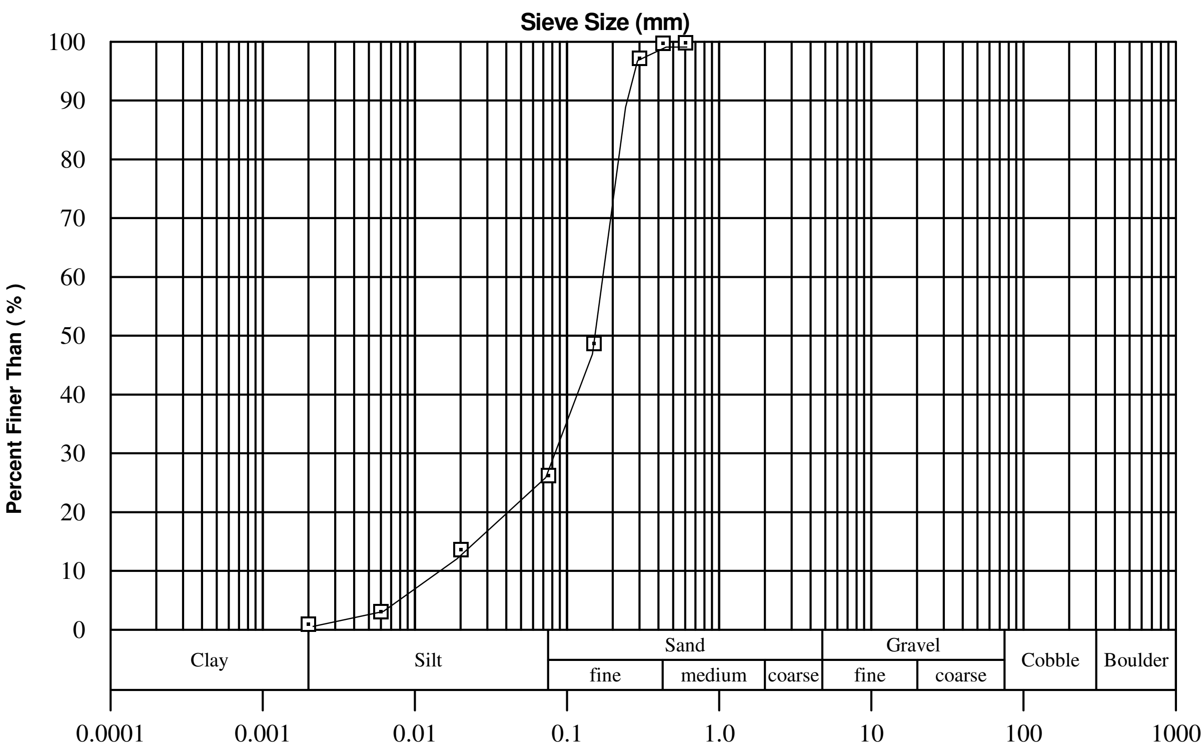


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	10	100476	3.00-3.45		11.83	67.01	21.16

PARTICLE SIZE DISTRIBUTION CURVES

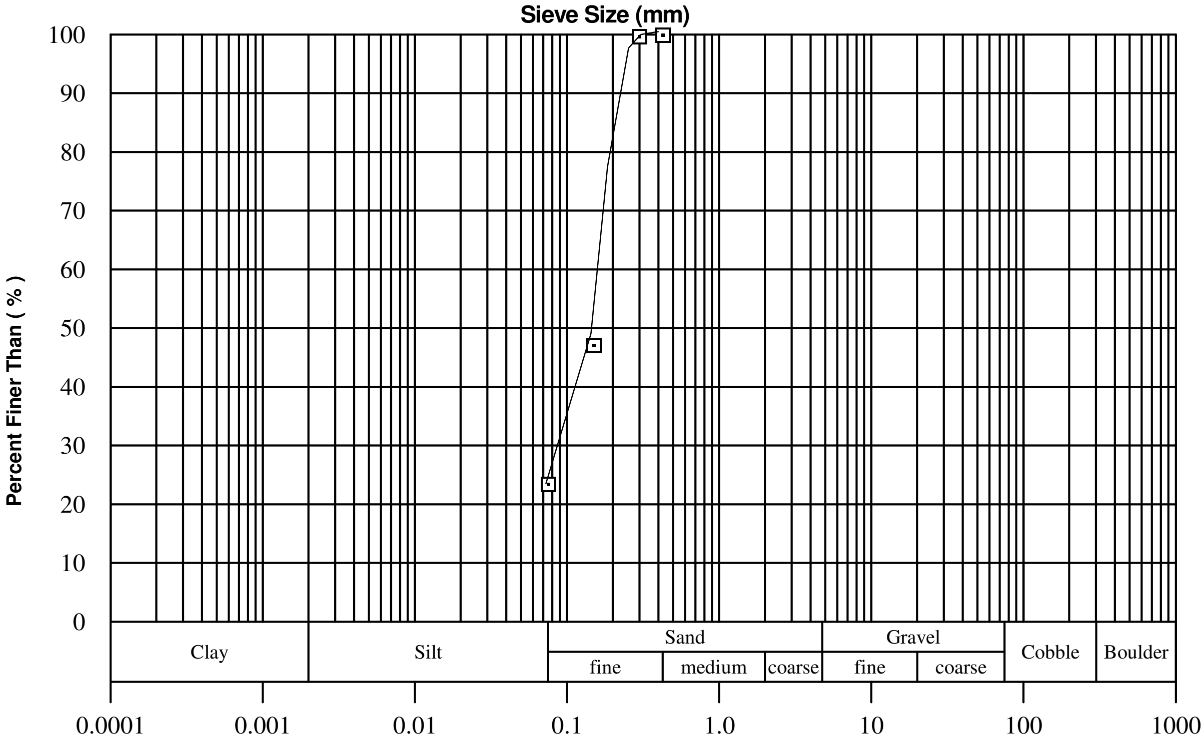


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	11	100852	1.00-1.45		8.50	73.20	18.30

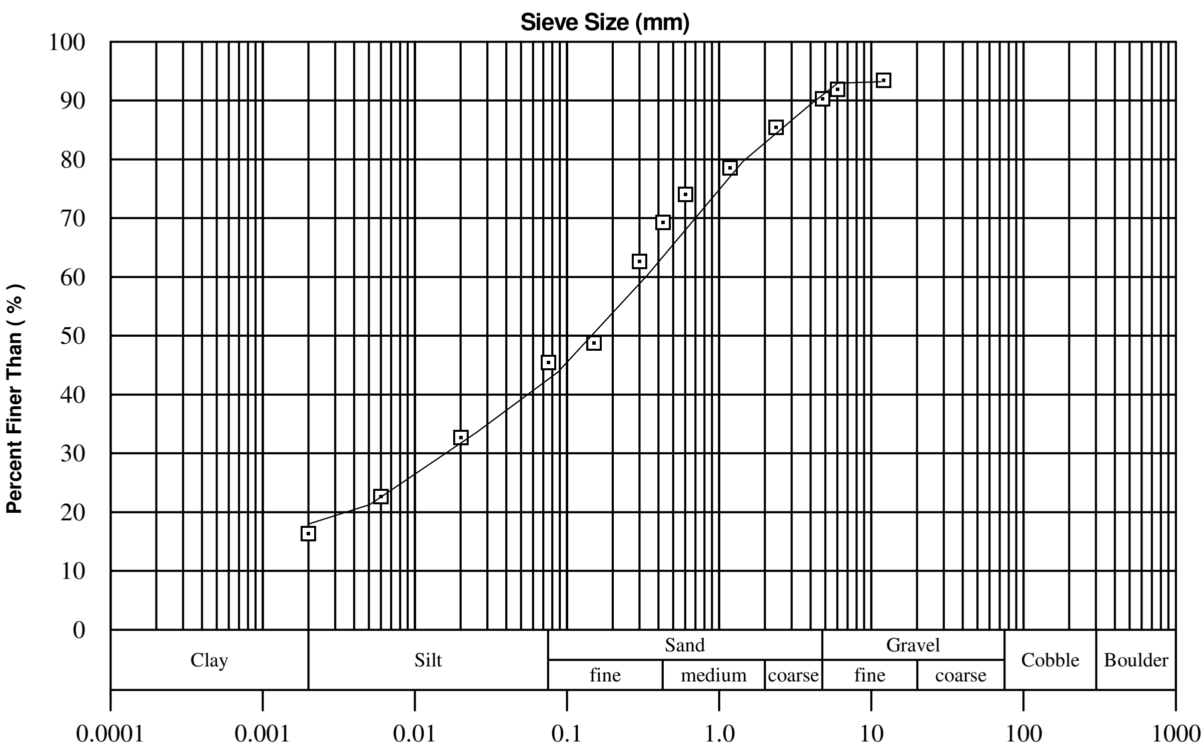


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	11	100860	5.00-5.45		73.70	25.25	1.05

PARTICLE SIZE DISTRIBUTION CURVES

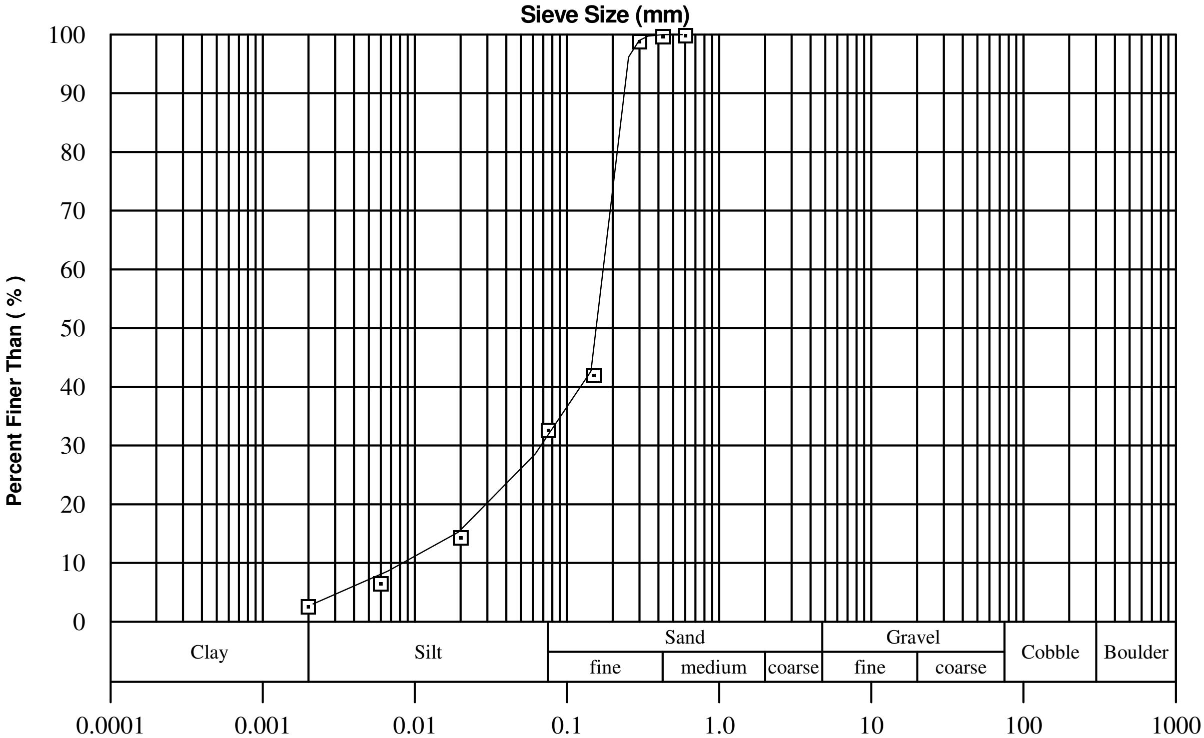


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	11	100872	8.50-8.95		76.60	23.40	

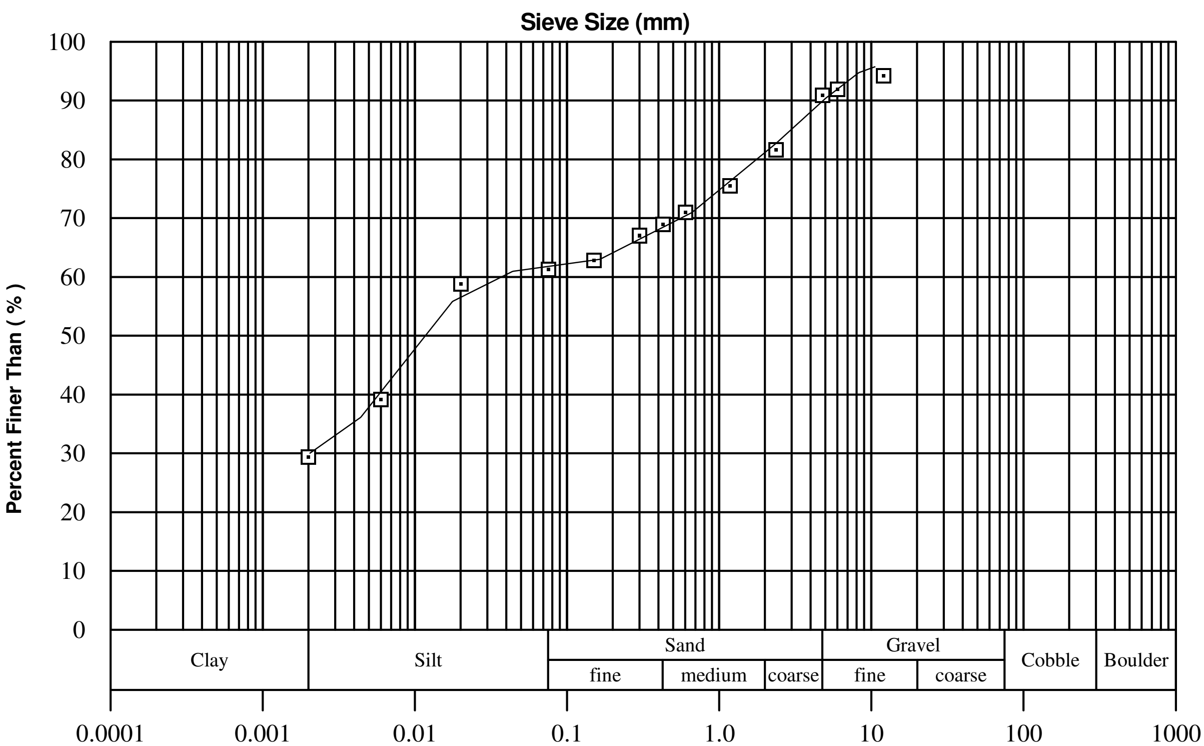


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	12	100982	3.00-3.45	9.67	44.83	29.12	16.38

PARTICLE SIZE DISTRIBUTION CURVES

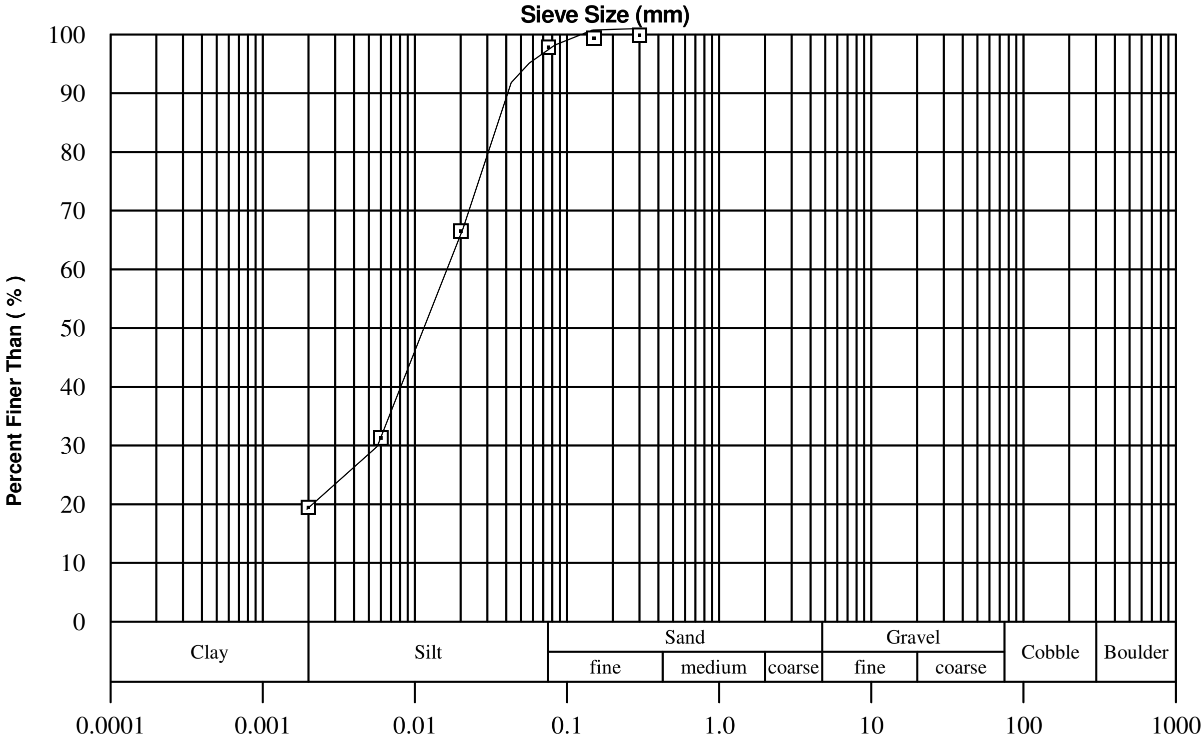


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	12	100985	5.00-5.25		67.33	30.05	2.61

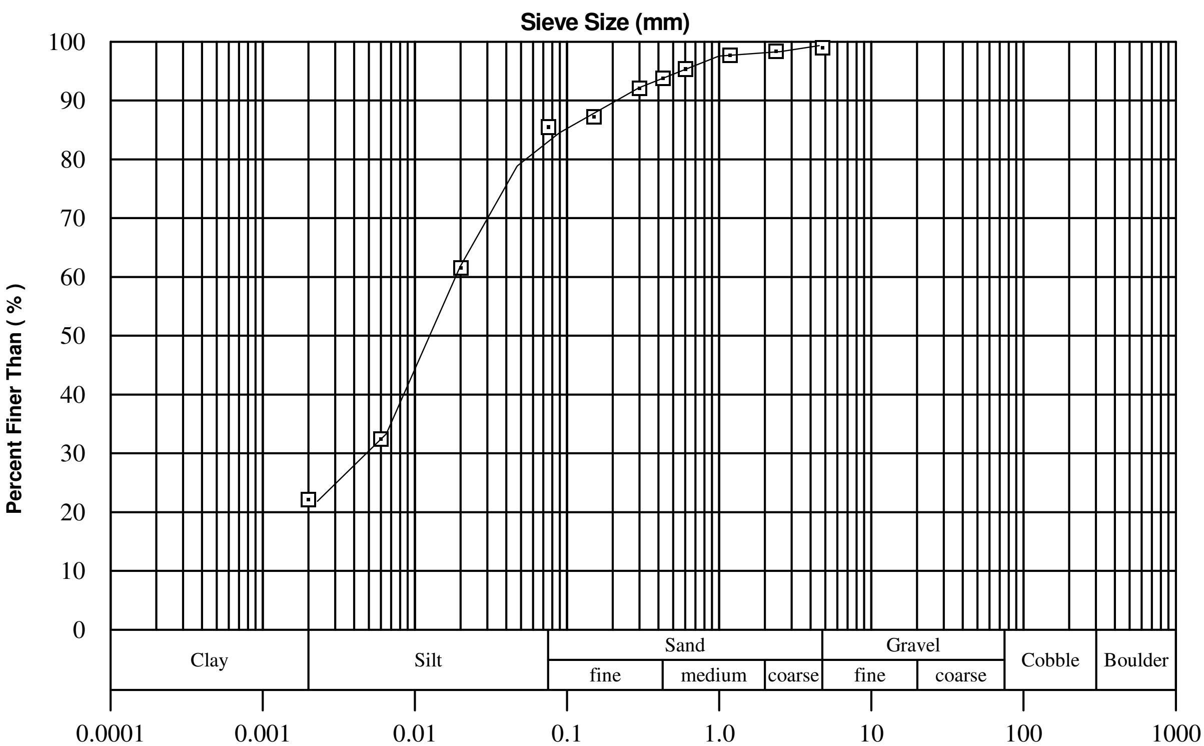


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	13	100485	2.00-2.45	9.10	29.60	31.88	29.42

PARTICLE SIZE DISTRIBUTION CURVES

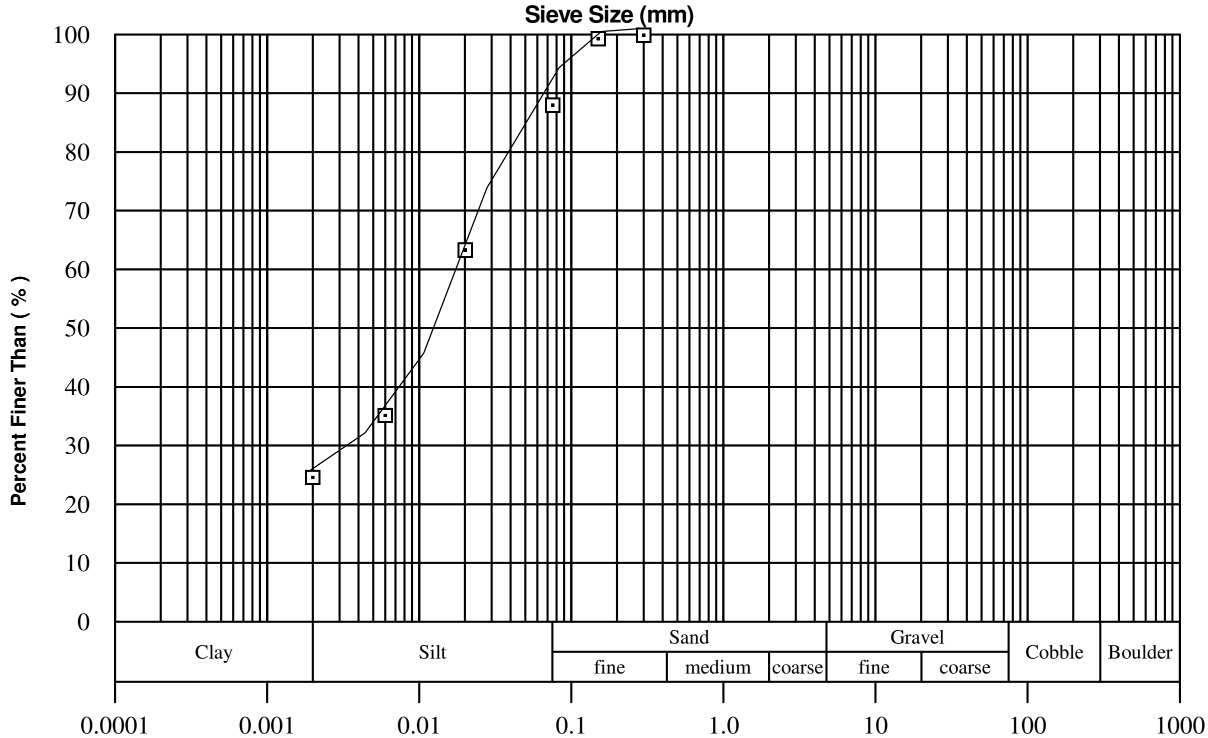


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	13	100489	4.0-4.45		2.10	78.32	19.58

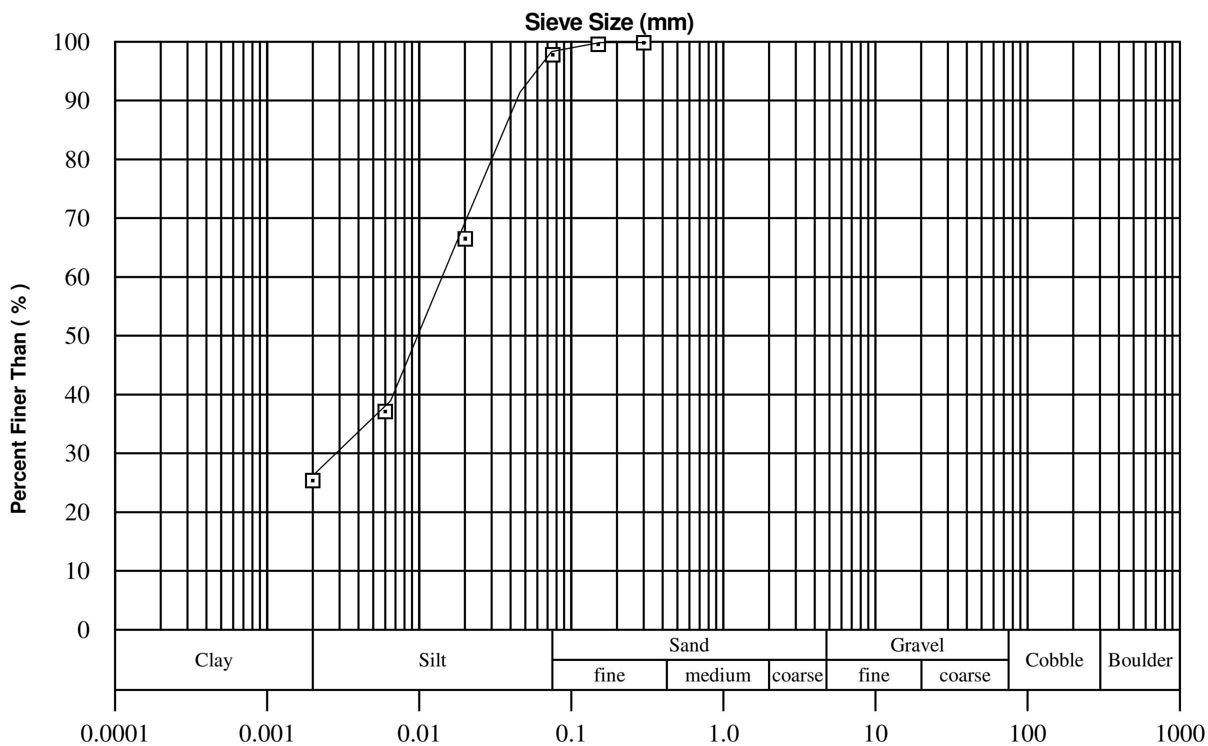


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	14	100554	2.00-2.45	1.00	13.43	63.32	22.25

PARTICLE SIZE DISTRIBUTION CURVES

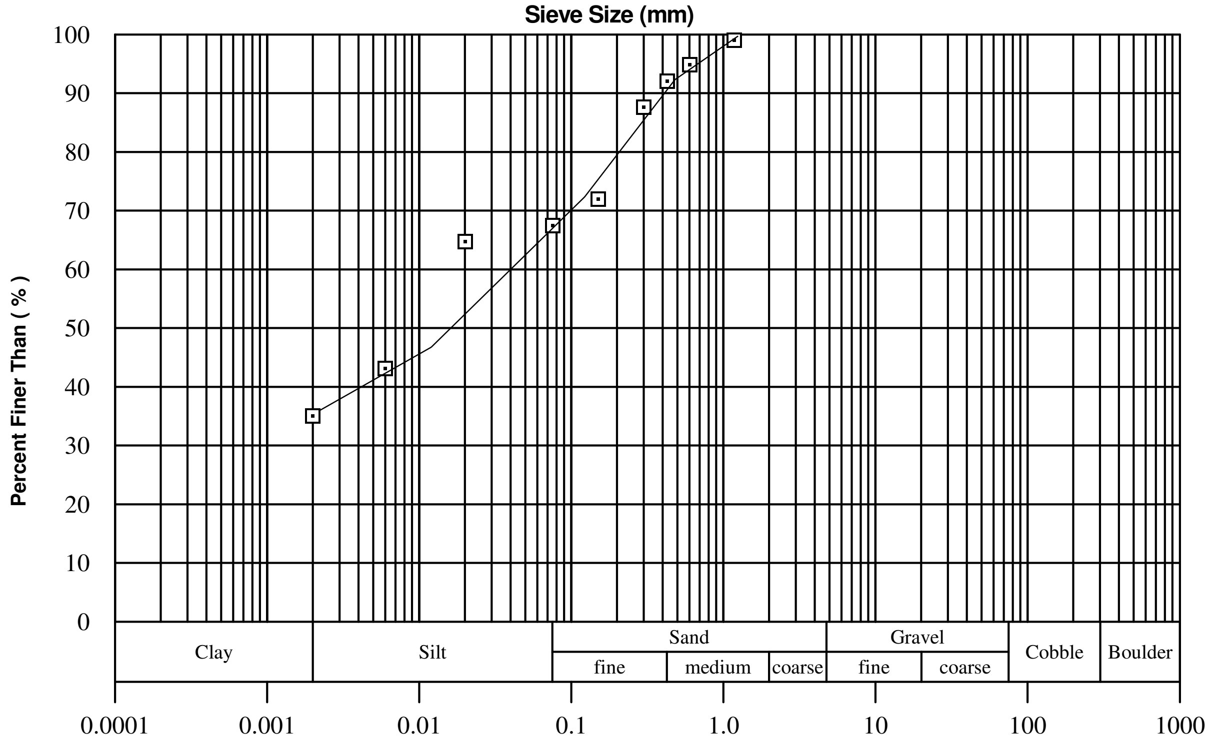


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	14	100556	3.00-3.45		12.00	63.36	24.64

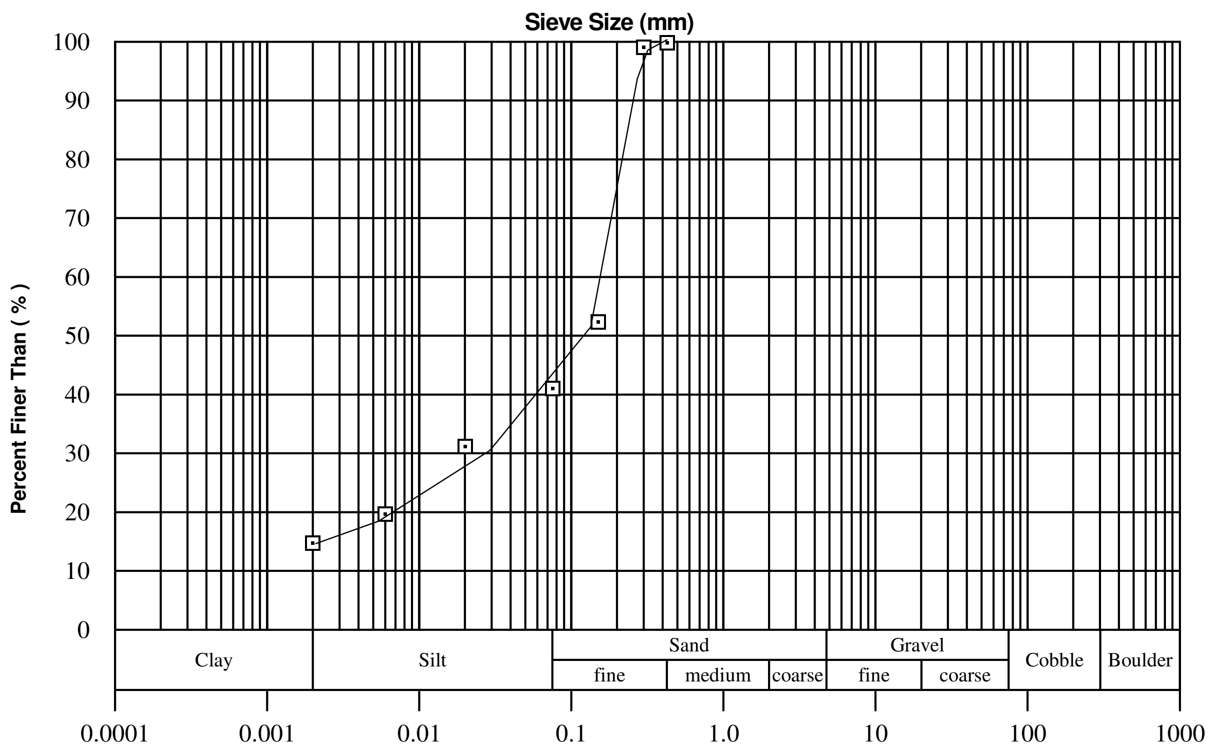


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	15	100465	1.00-1.45		2.10	72.45	25.45

PARTICLE SIZE DISTRIBUTION CURVES

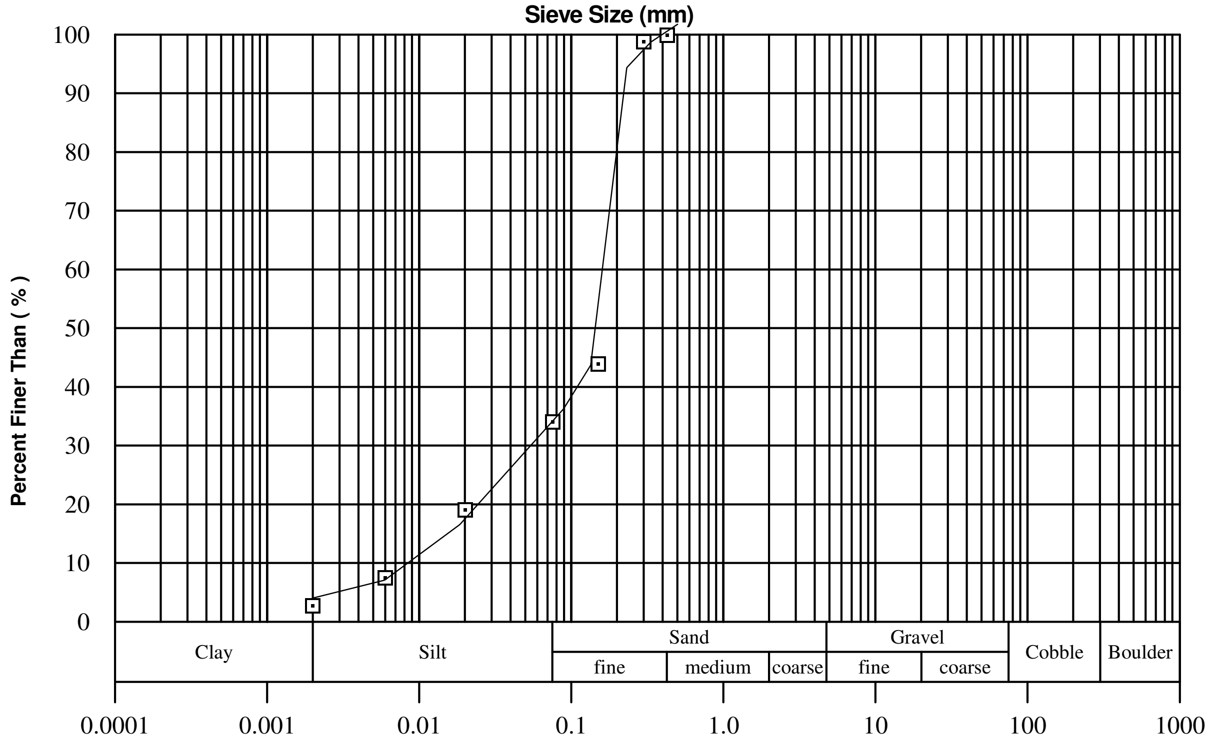


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	16	100954	2.00-2.45		32.50	32.40	35.10

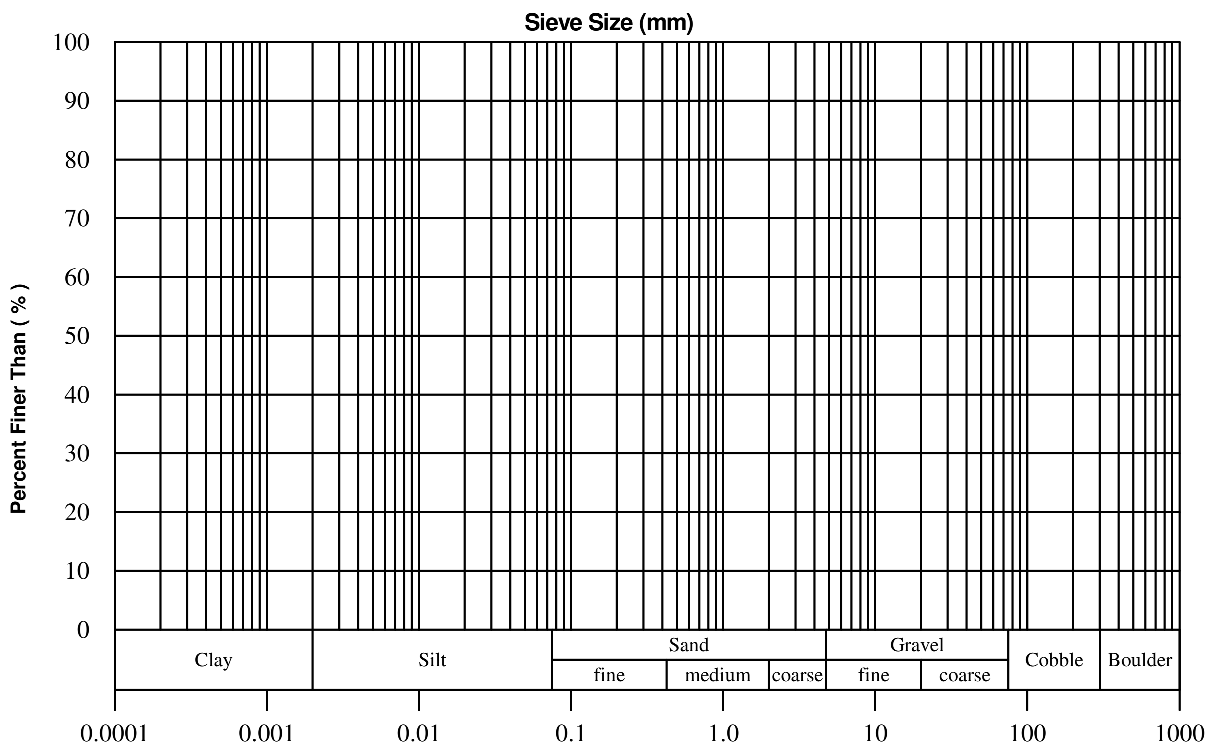


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	16	100958	5.00-5.45		58.90	26.30	14.80

PARTICLE SIZE DISTRIBUTION CURVES

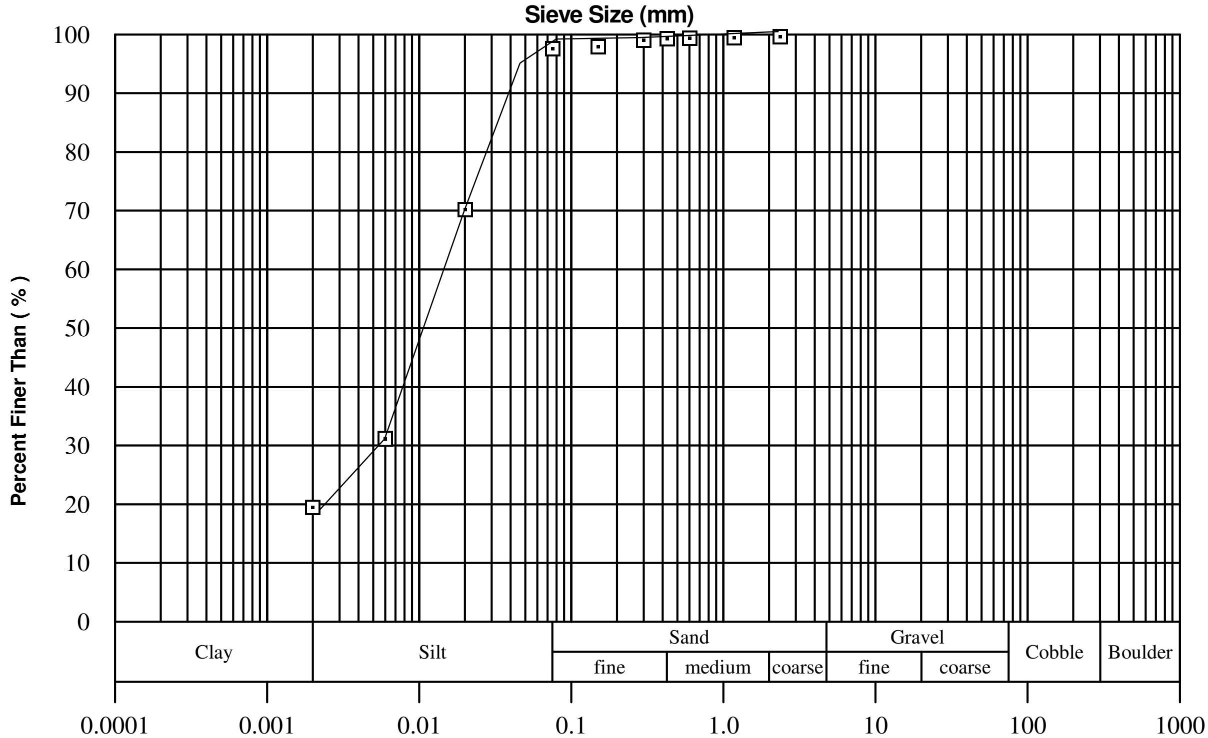


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	16	100962	7.00-7.95		65.90	31.37	2.73

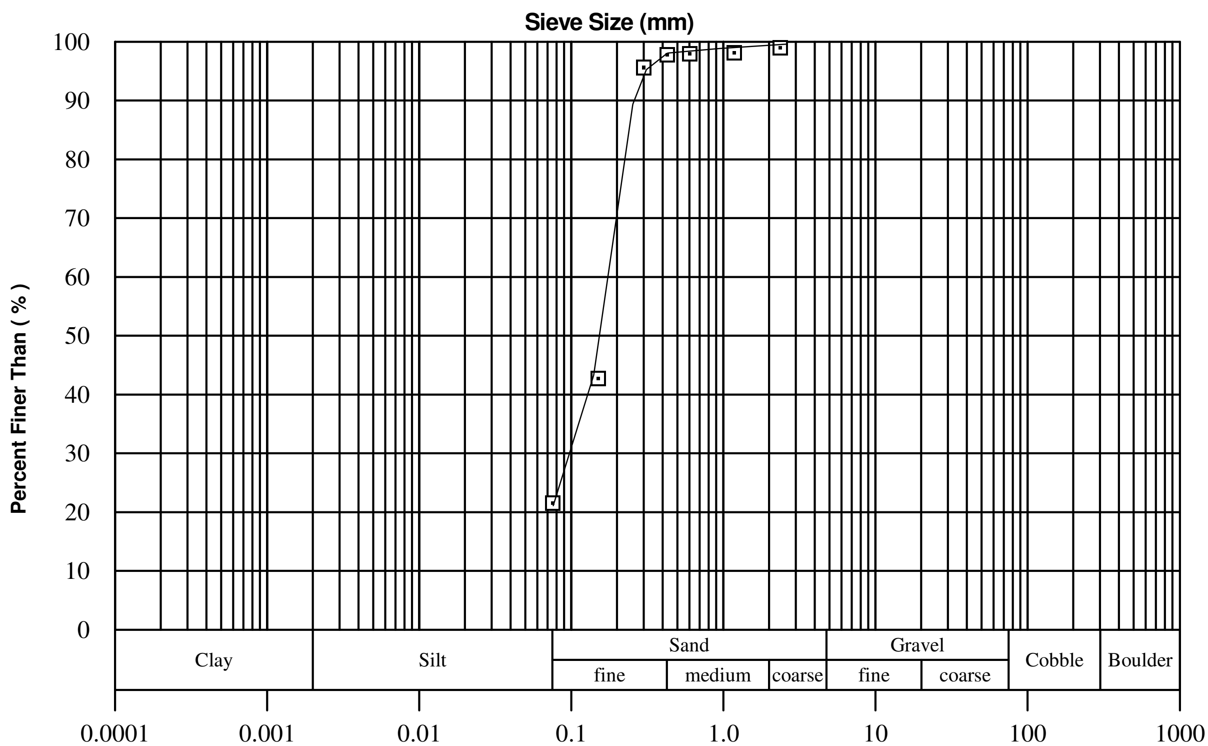


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay

PARTICLE SIZE DISTRIBUTION CURVES

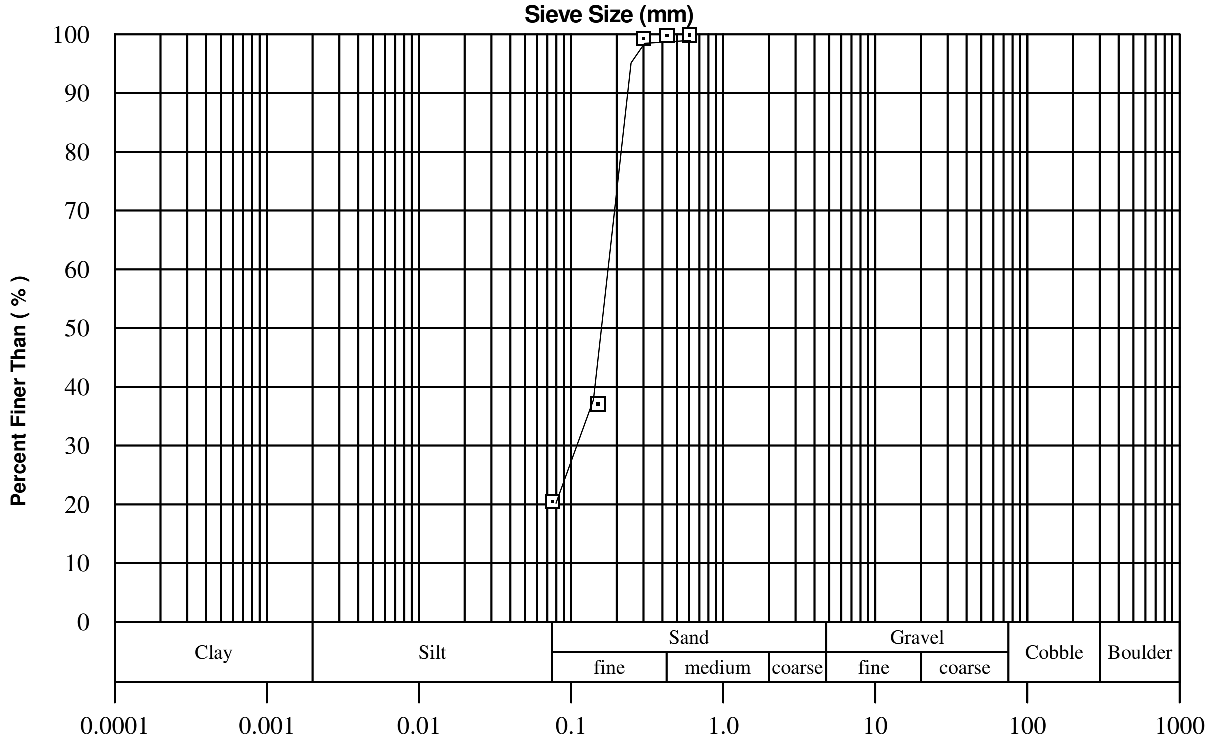


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	17	100521	4.00-4.45		2.40	78.08	19.52

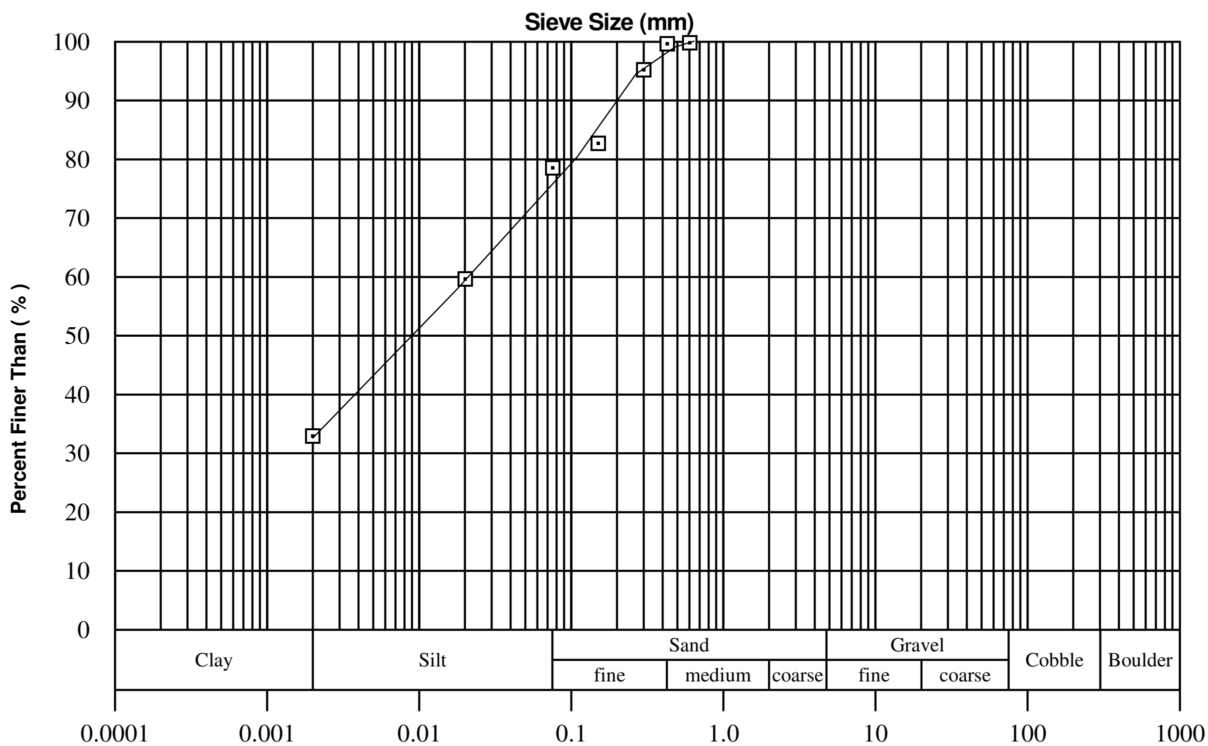


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	17	100524	7.50-7.95		78.40	21.60	

PARTICLE SIZE DISTRIBUTION CURVES

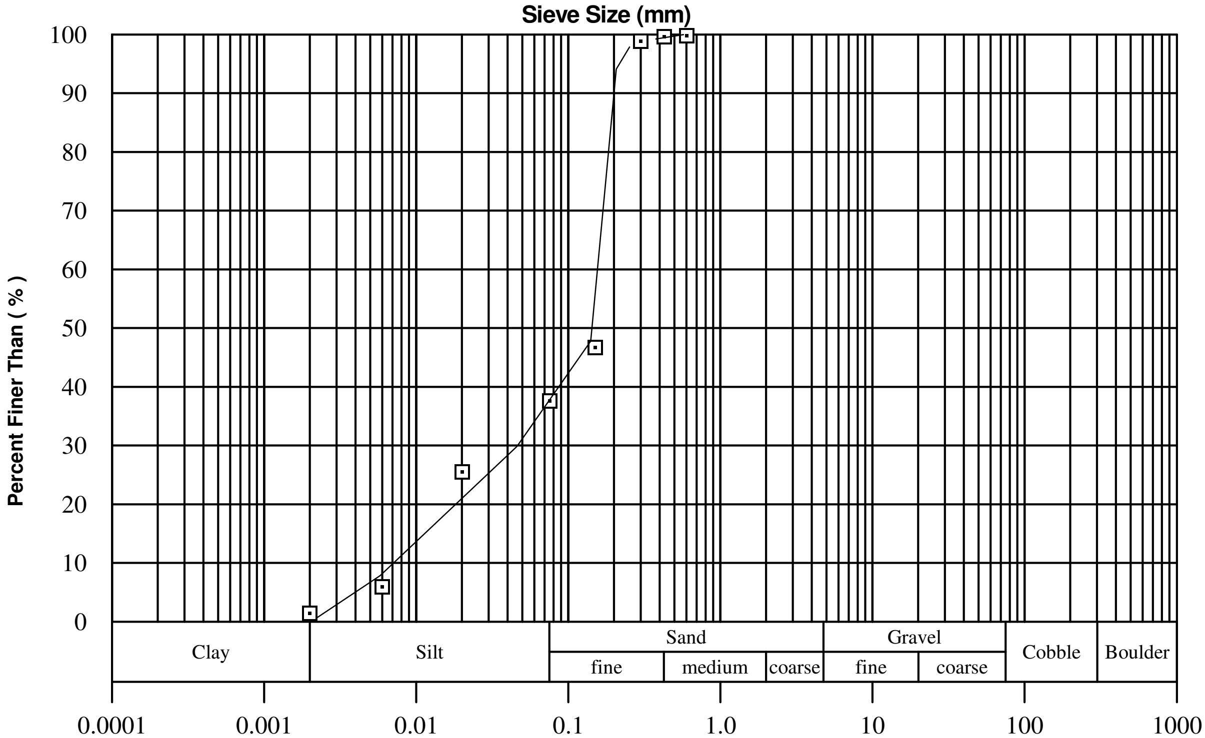


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	17	100527	10.50-10.95		79.40	20.60	

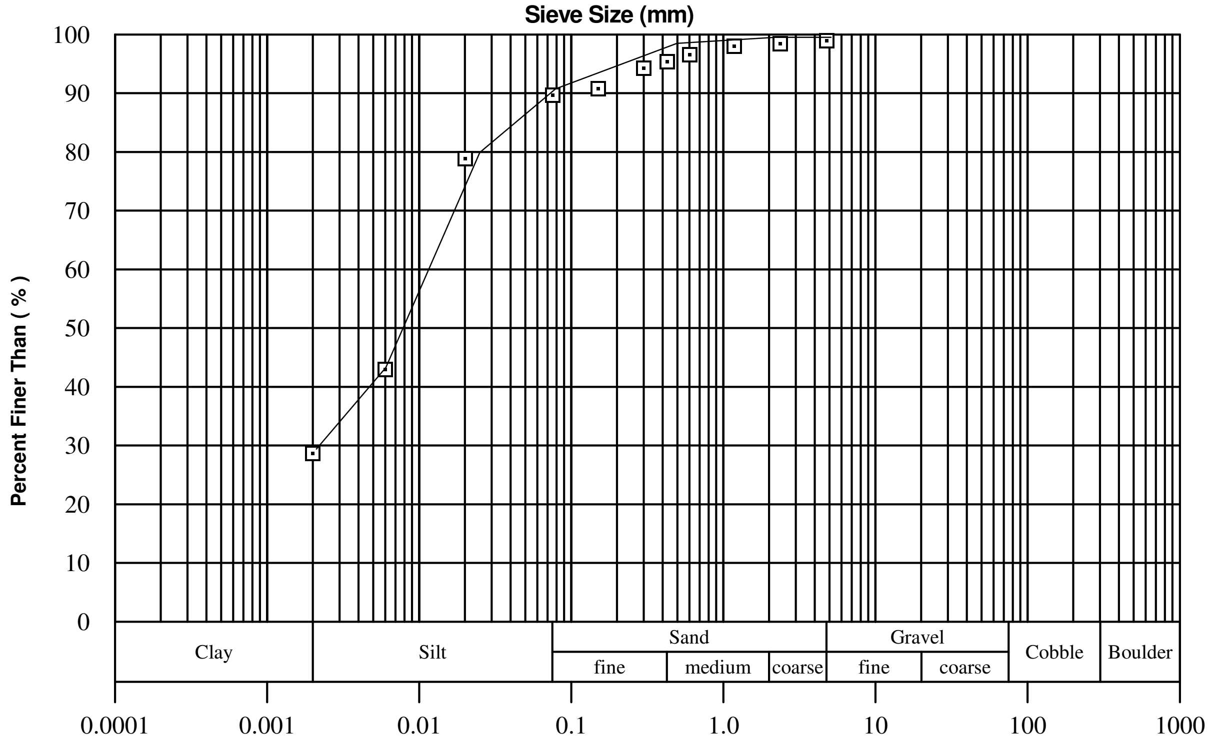


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	18	100531	1.00-1.45		21.40	45.59	33.01

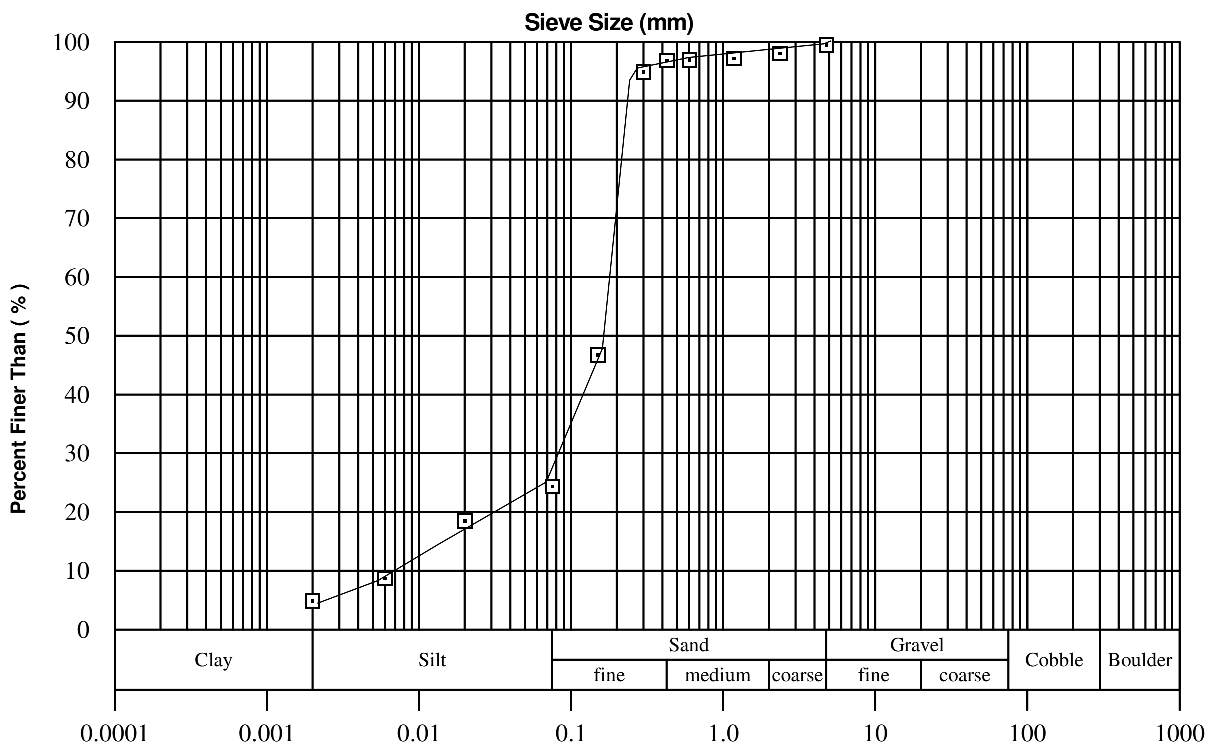
PARTICLE SIZE DISTRIBUTION CURVES



Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	18	100539	5.50-5.95		62.40	36.10	1.50

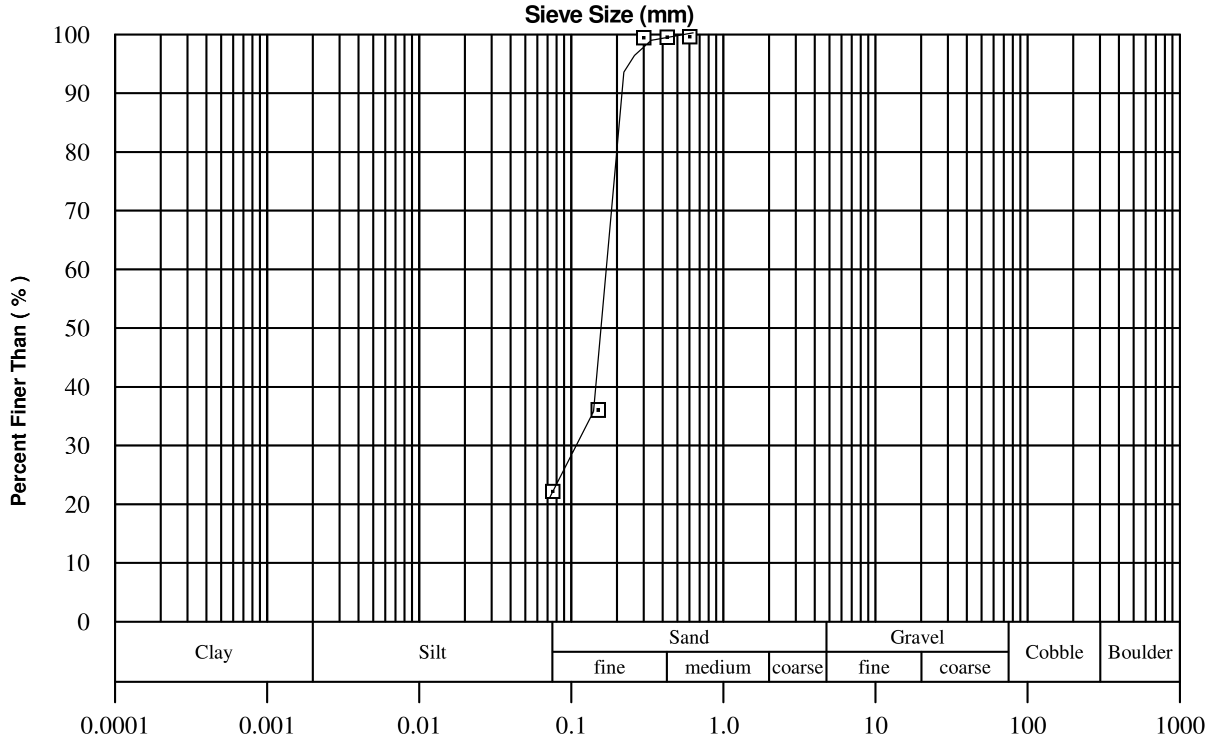


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	19	100503	2.00-2.45	1.00	9.30	61.00	28.70

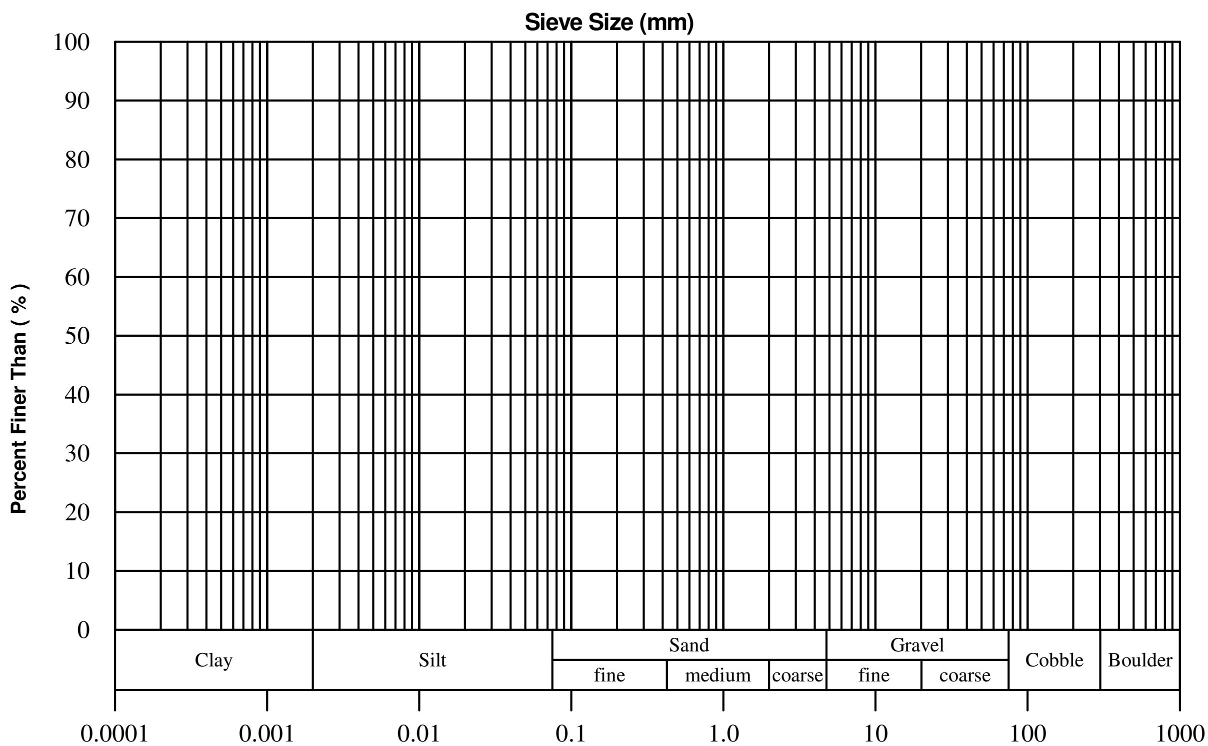


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	19	100507	4.00-4.45	0.50	75.10	19.52	4.88

PARTICLE SIZE DISTRIBUTION CURVES



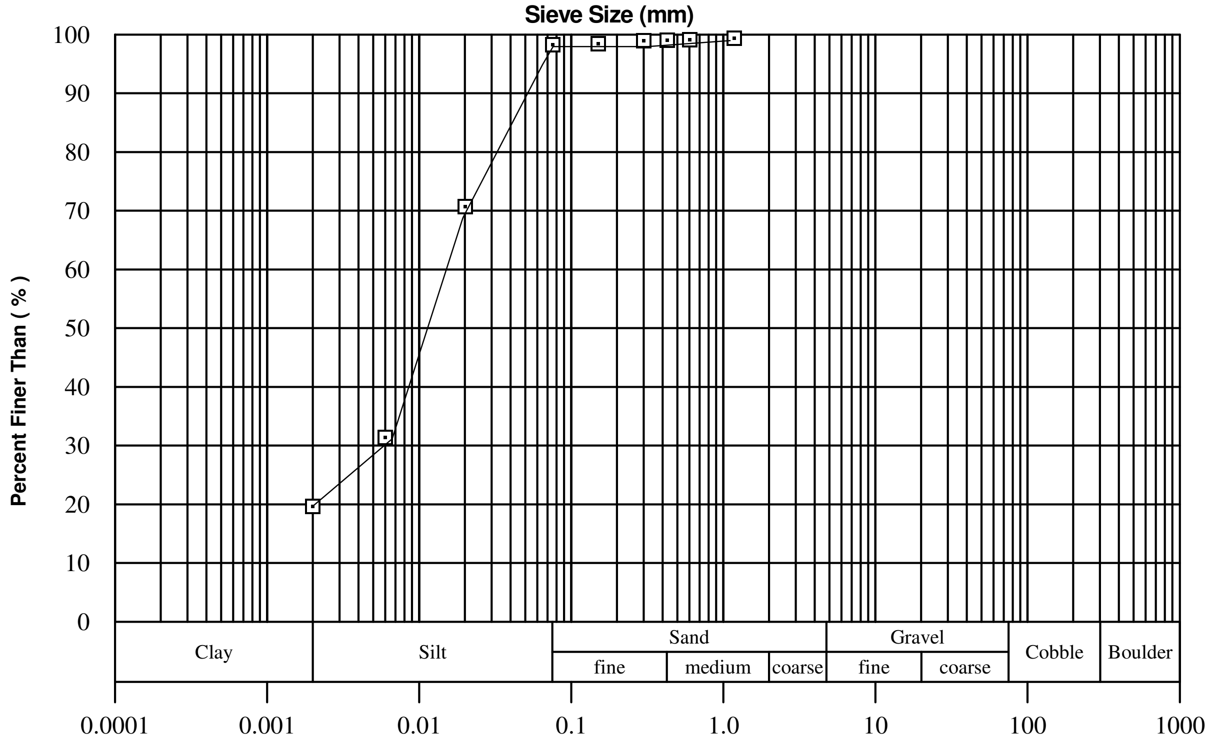
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	19	100511	7.50-7.95		77.70	22.30	



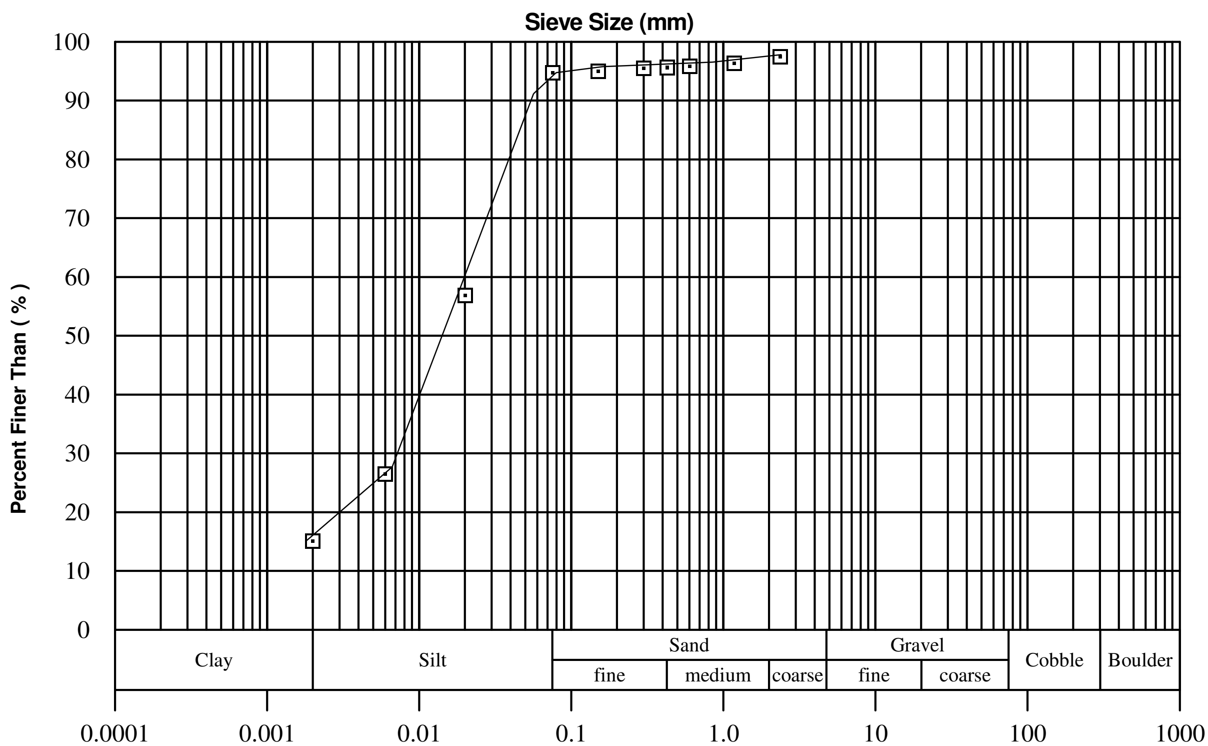
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay

PARTICLE SIZE DISTRIBUTION CURVES

Job No :30796

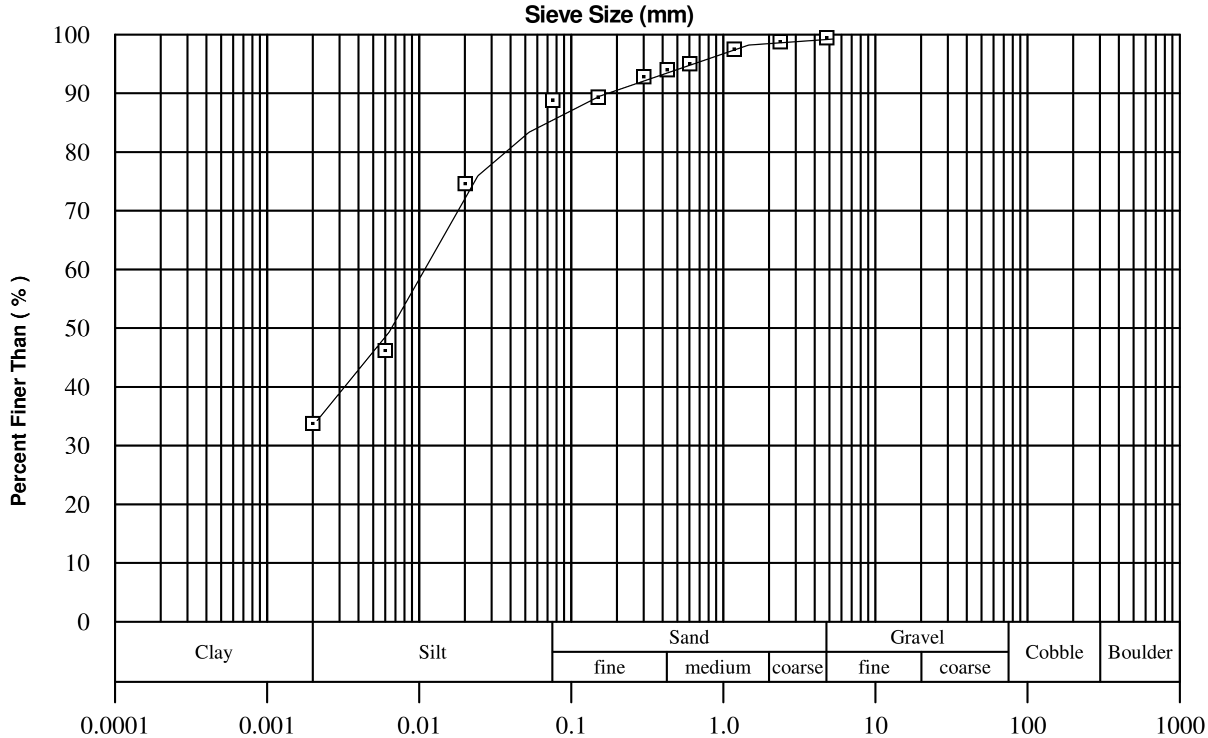


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	20	120103	2.00-2.45		1.70	78.64	19.66

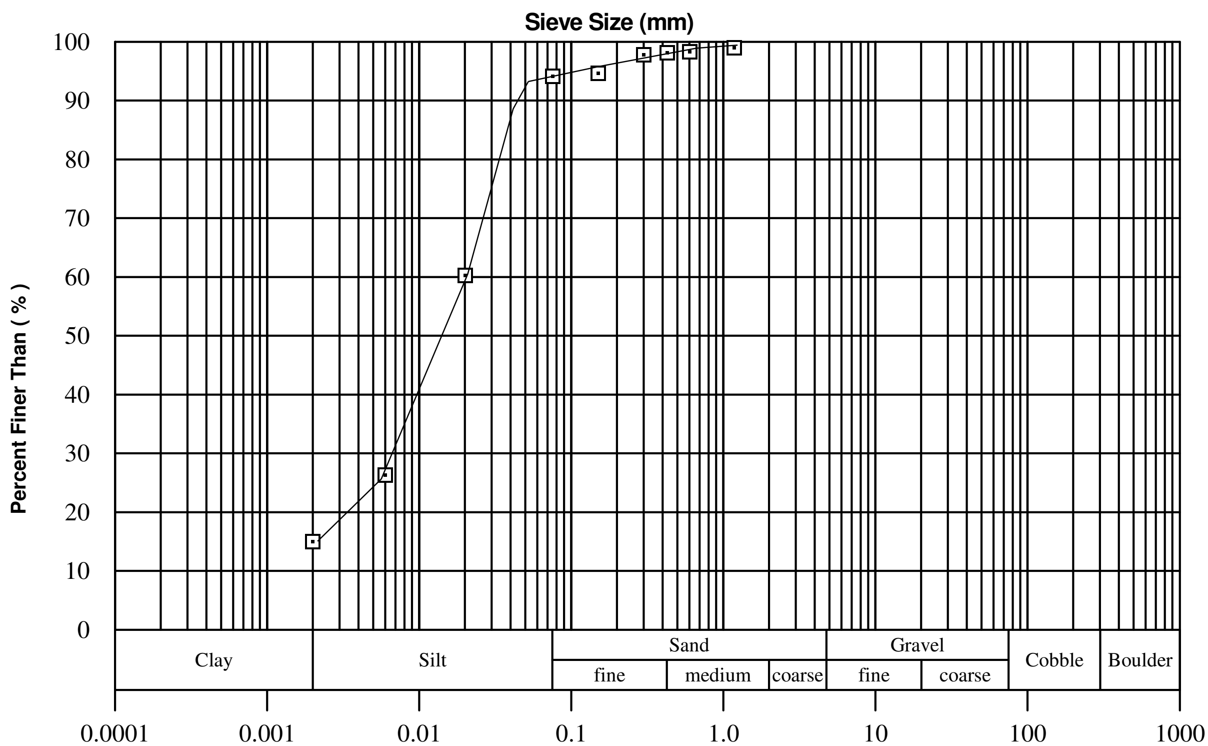


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	20	120106	4.50-4.95		5.20	79.63	15.17

PARTICLE SIZE DISTRIBUTION CURVES

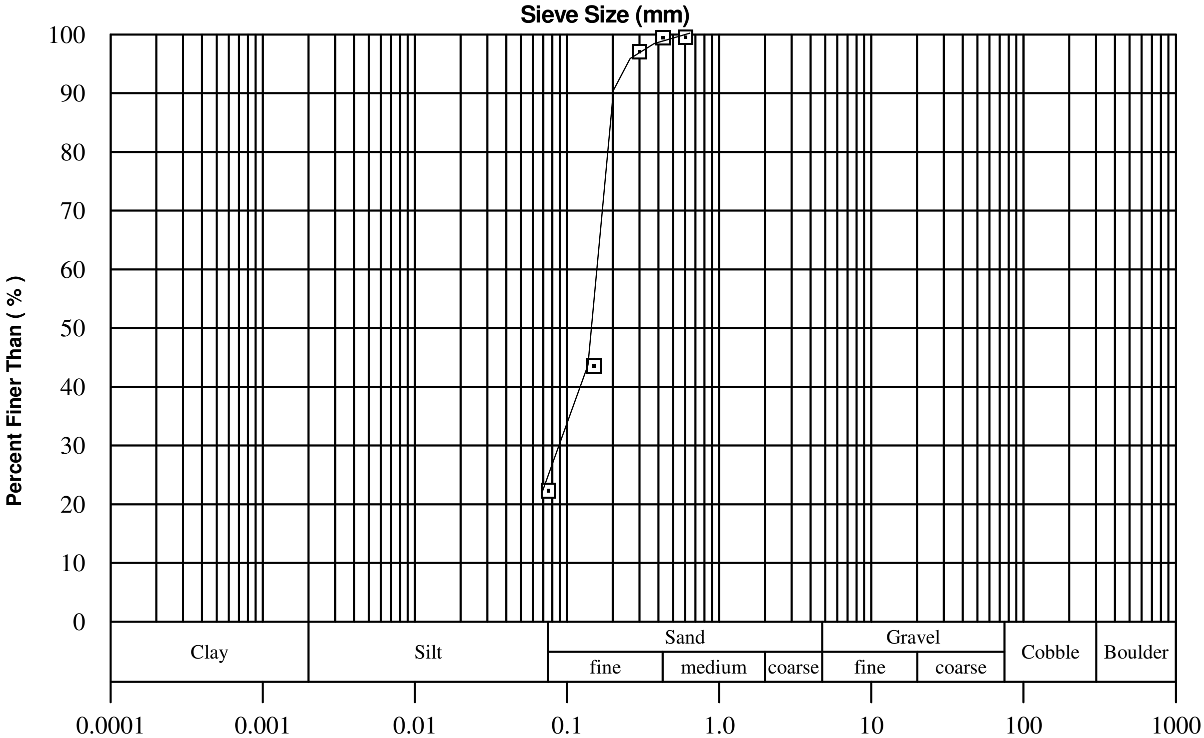


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	21	120111	1.00-1.45	0.50	10.60	55.12	33.78

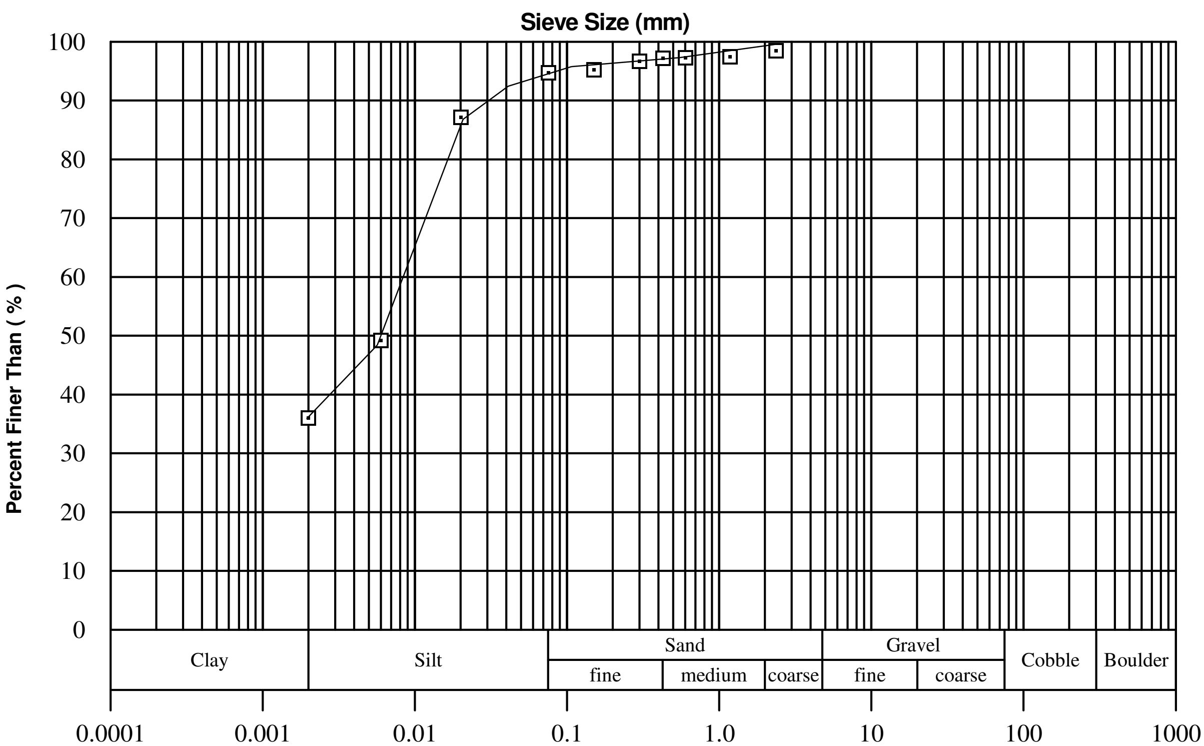


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	21	120117	4.50-4.95		5.80	79.13	15.07

PARTICLE SIZE DISTRIBUTION CURVES

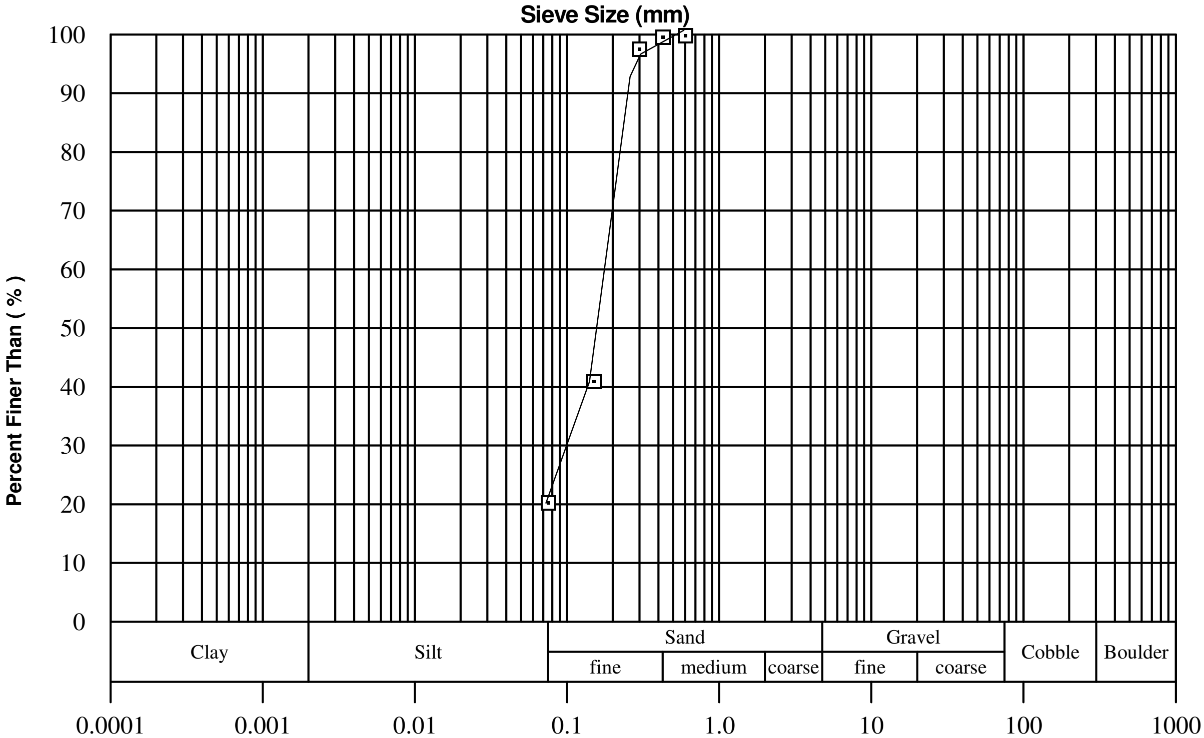


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	21	120119	7.50-7.95		77.60	22.40	

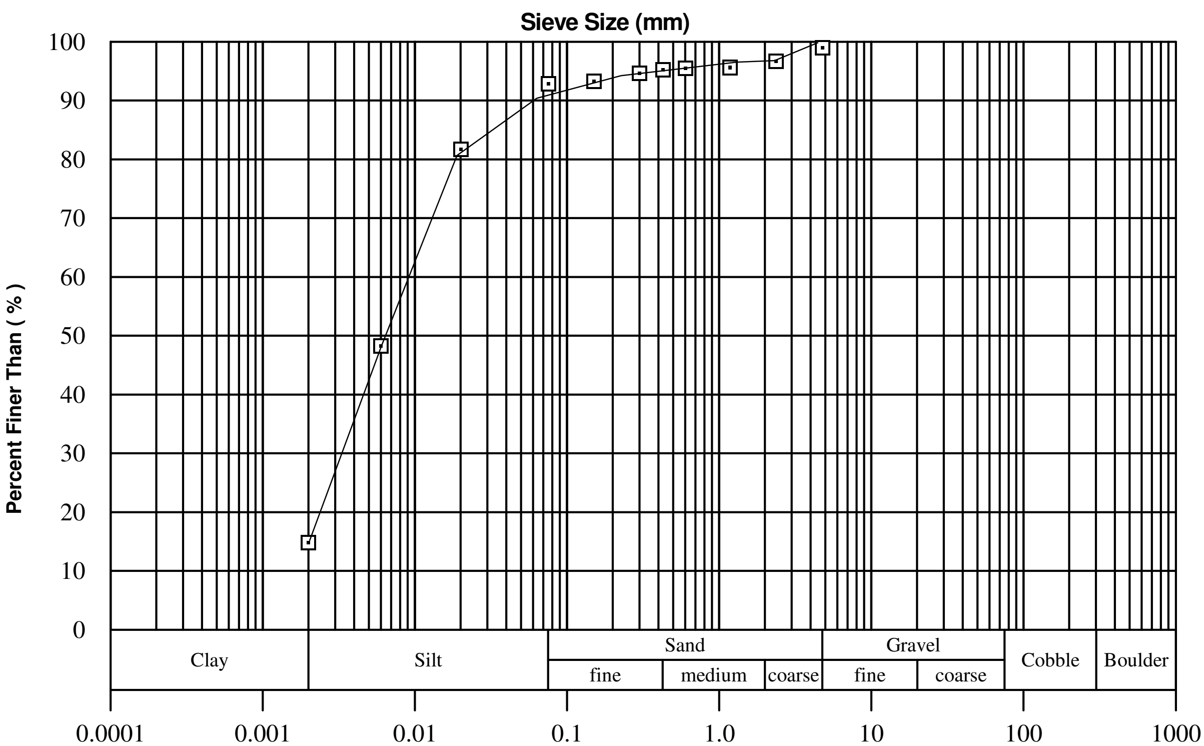


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	22	165101	1.00-1.45		5.20	58.78	36.02

PARTICLE SIZE DISTRIBUTION CURVES

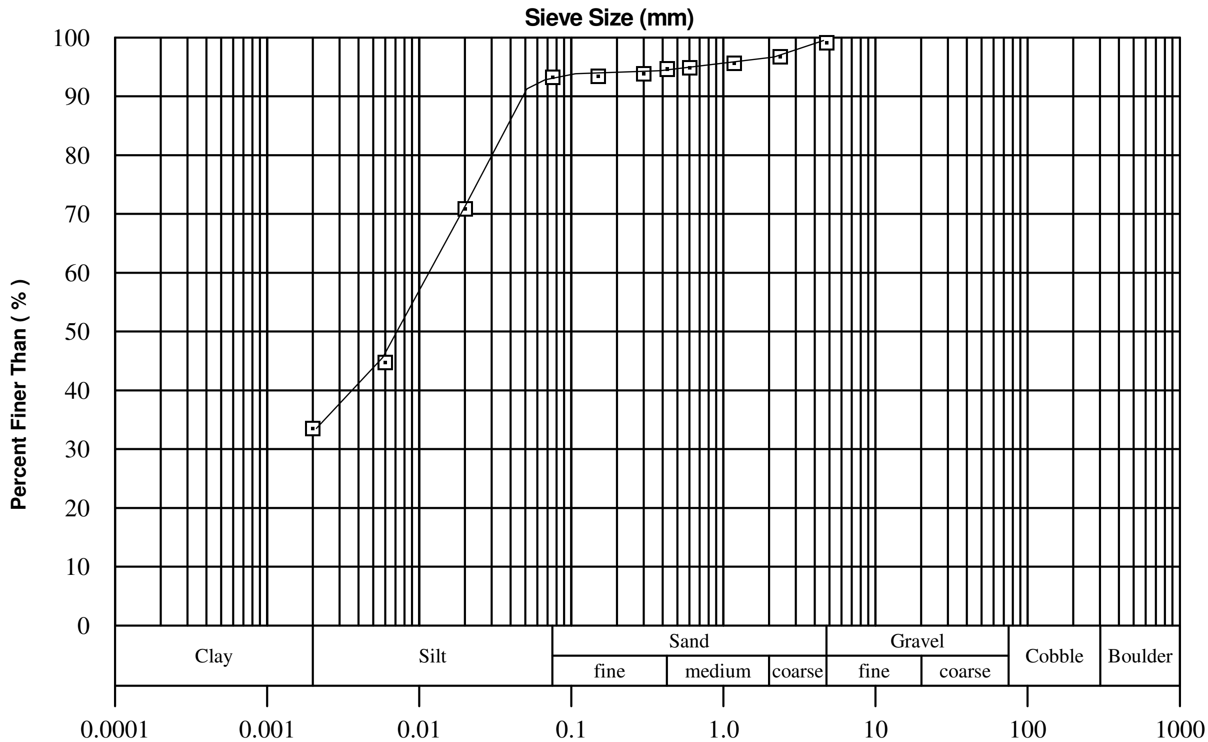


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	22	165109	7.50-7.95		79.70	20.30	

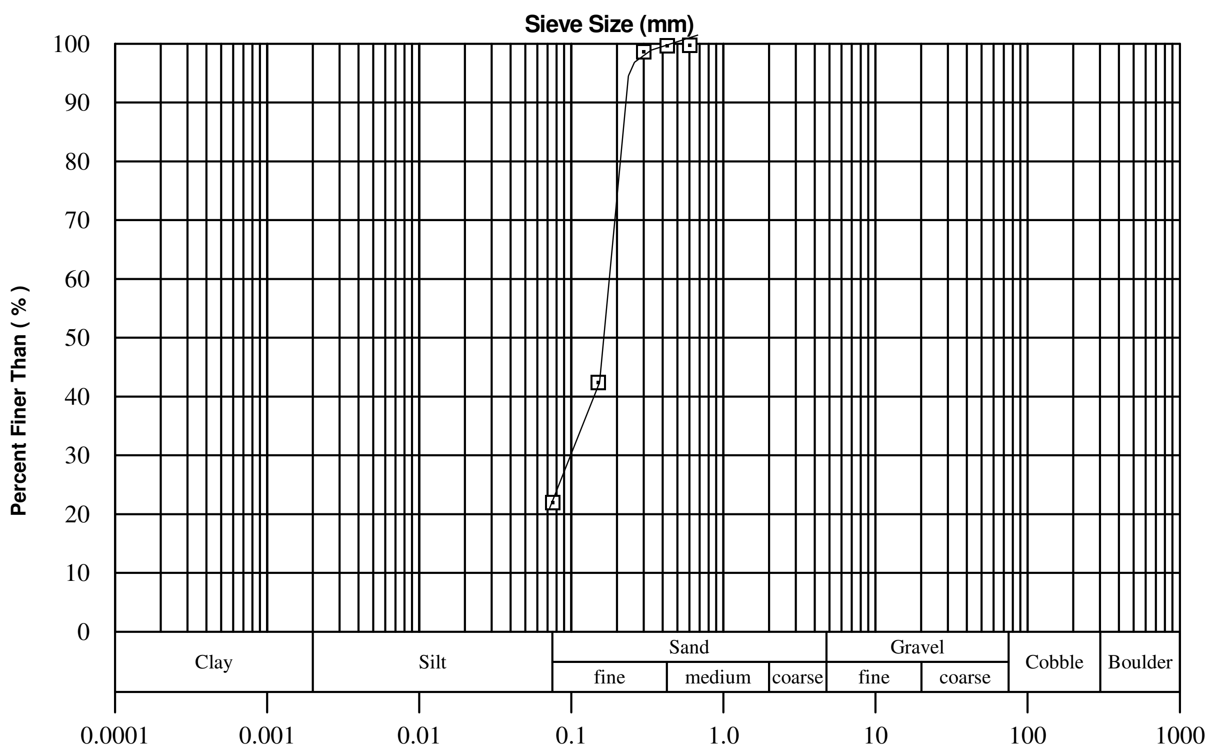


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	25	170020	1.00-1.45	1.00	6.10	78.04	14.86

PARTICLE SIZE DISTRIBUTION CURVES

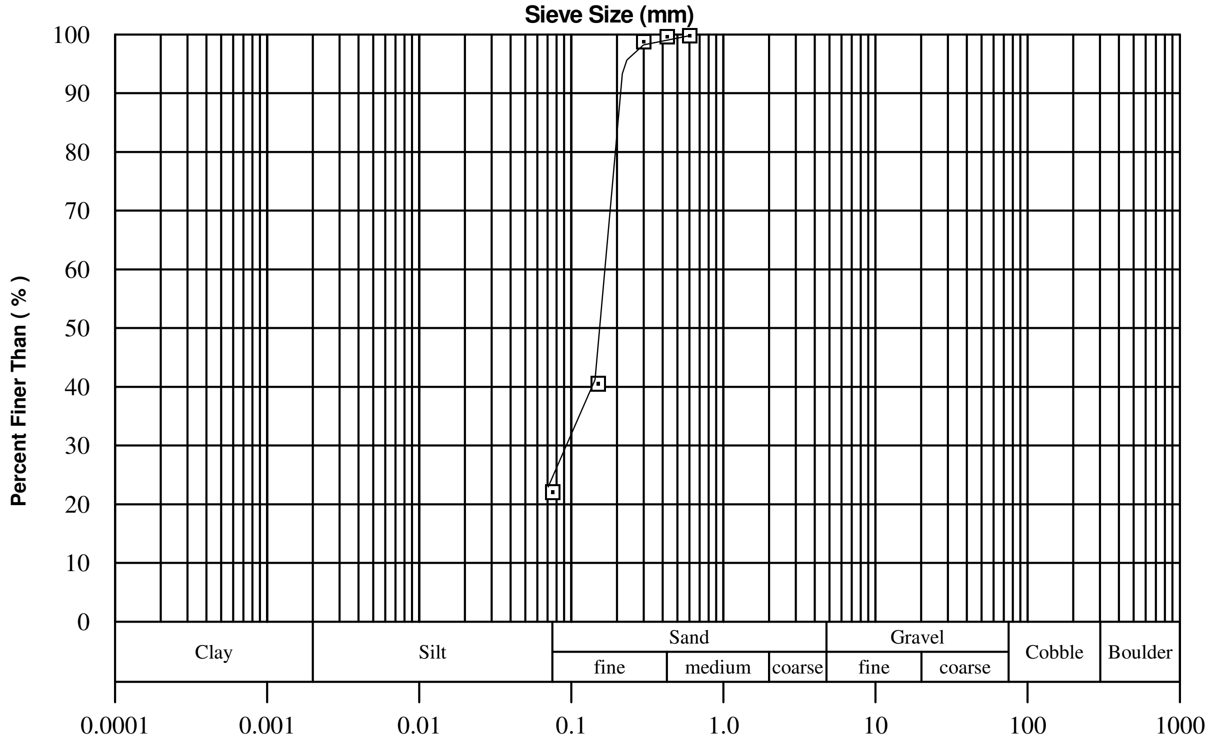


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	23	100251	1.00-1.45	0.80	5.90	59.71	33.59

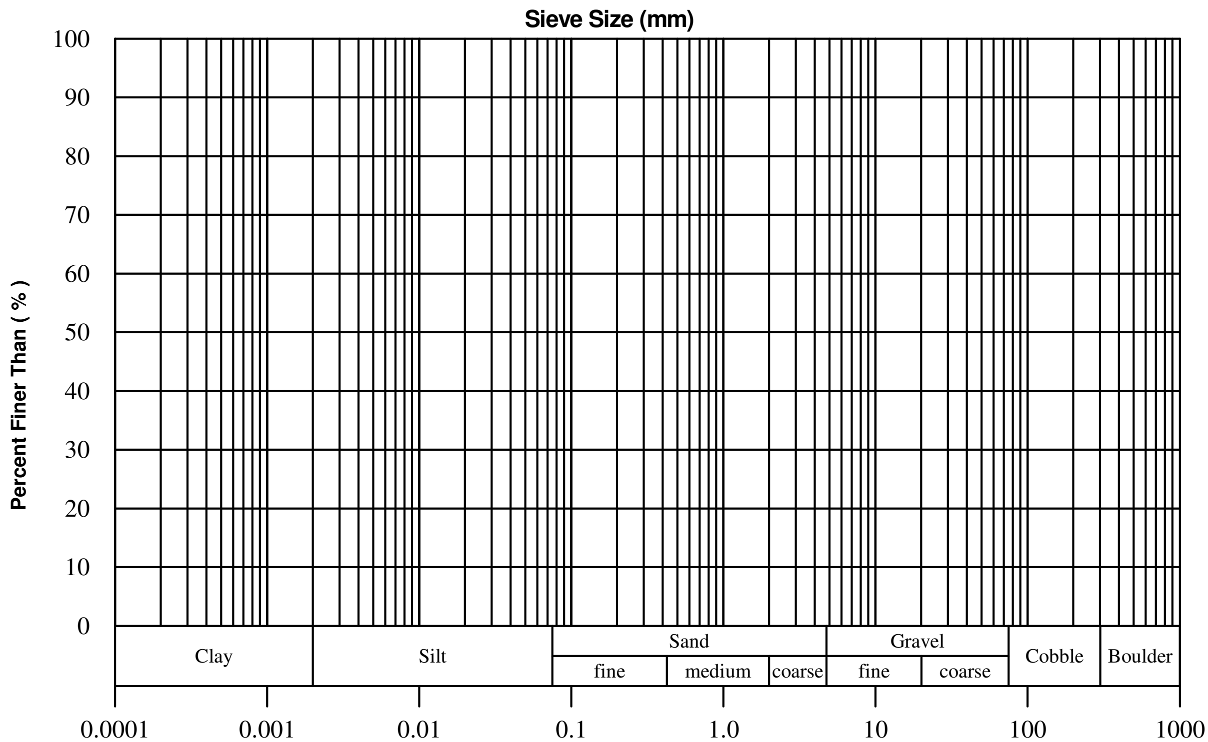


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	23	100258	6.00-6.45		78.00	22.00	

PARTICLE SIZE DISTRIBUTION CURVES

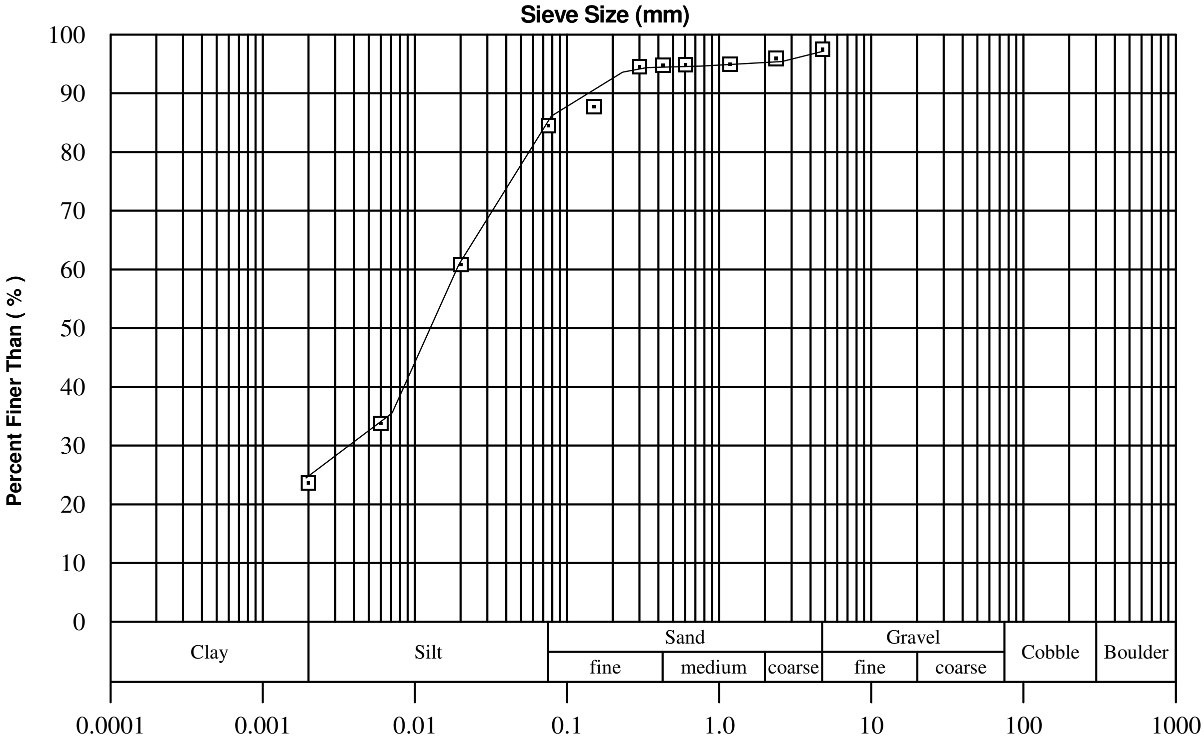


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	23	100260	8.5-8.75		77.90	22.10	

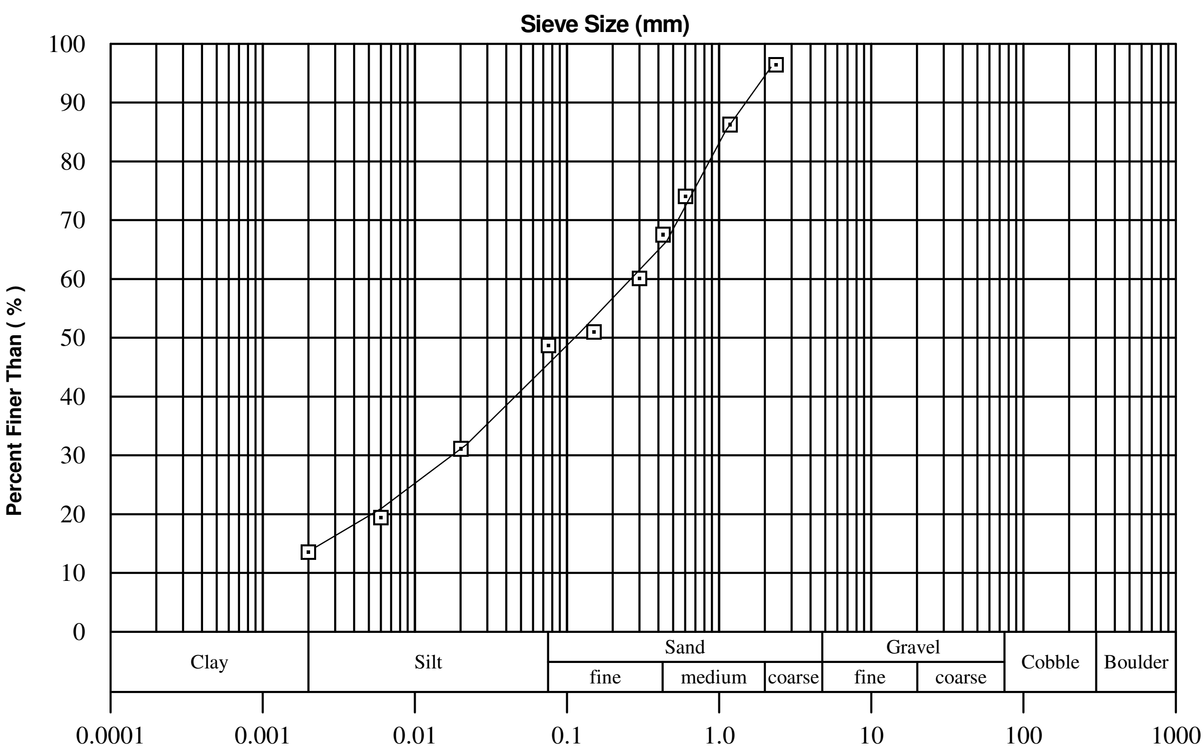


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay

PARTICLE SIZE DISTRIBUTION CURVES

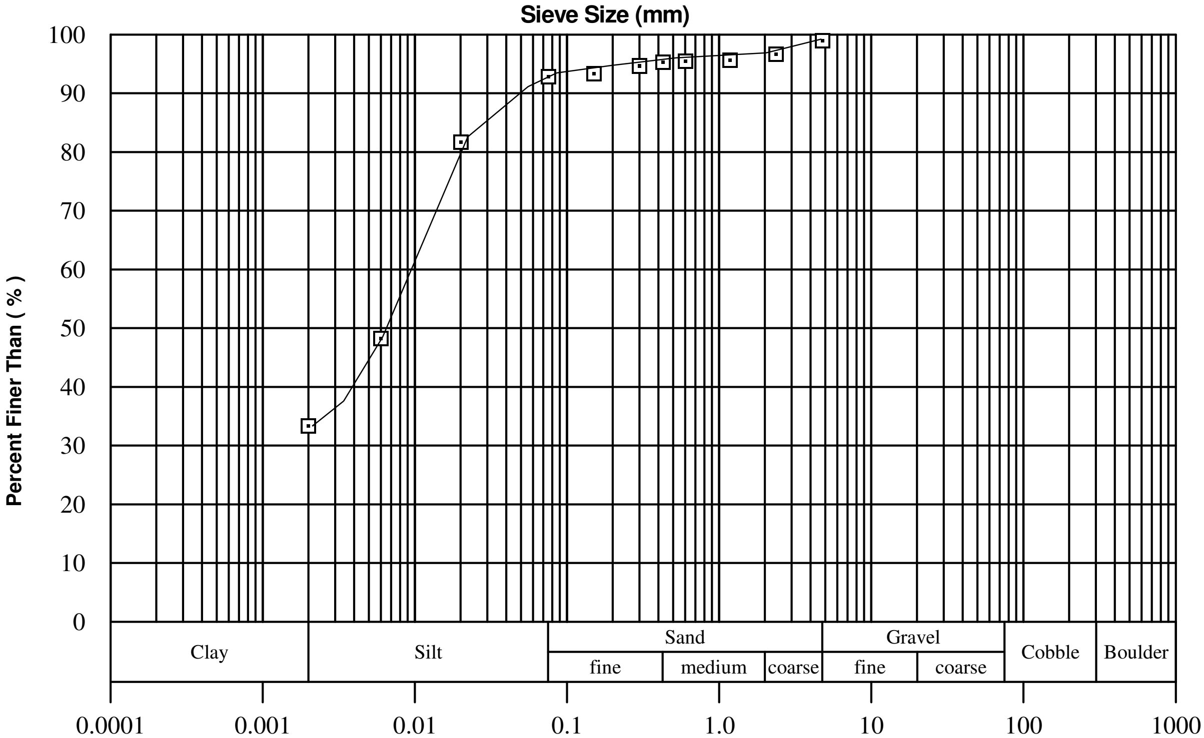


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	24	100102	1.00-1.45	2.50	12.90	60.91	23.69

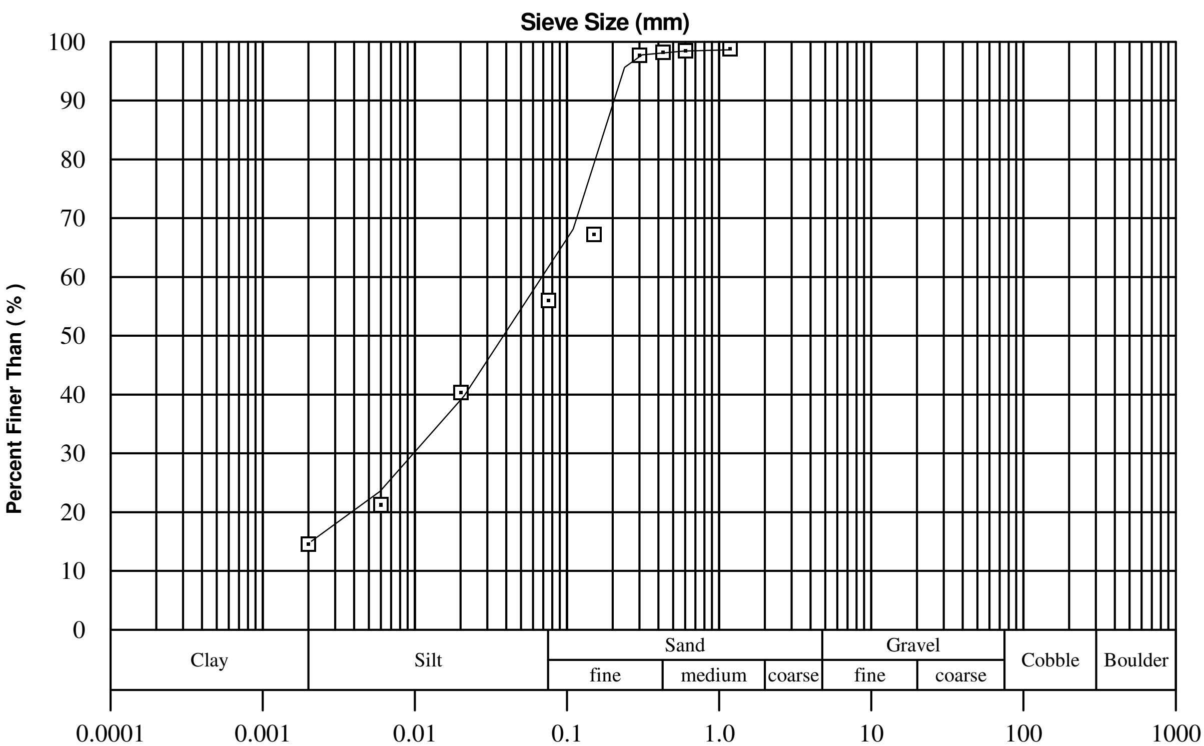


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	24	100109	5.00		51.30	35.06	13.64

PARTICLE SIZE DISTRIBUTION CURVES



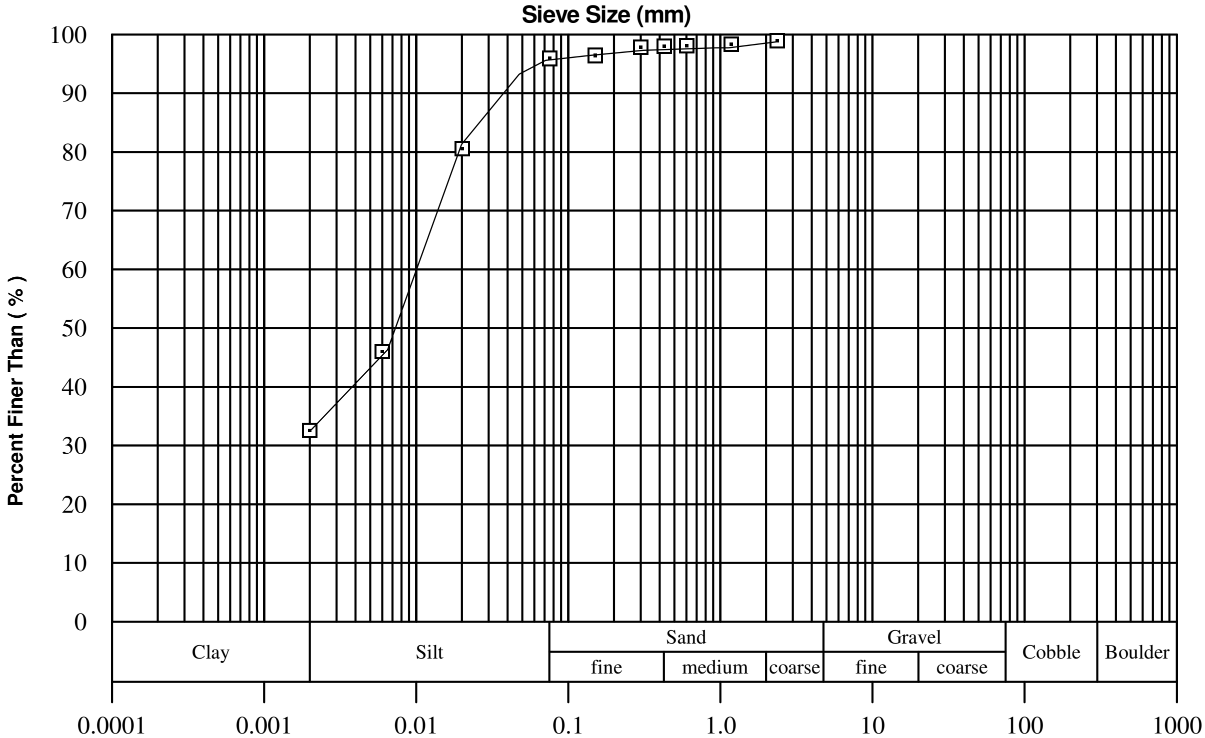
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	25	170020	1.00-1.45	1.00	6.10	59.46	33.44



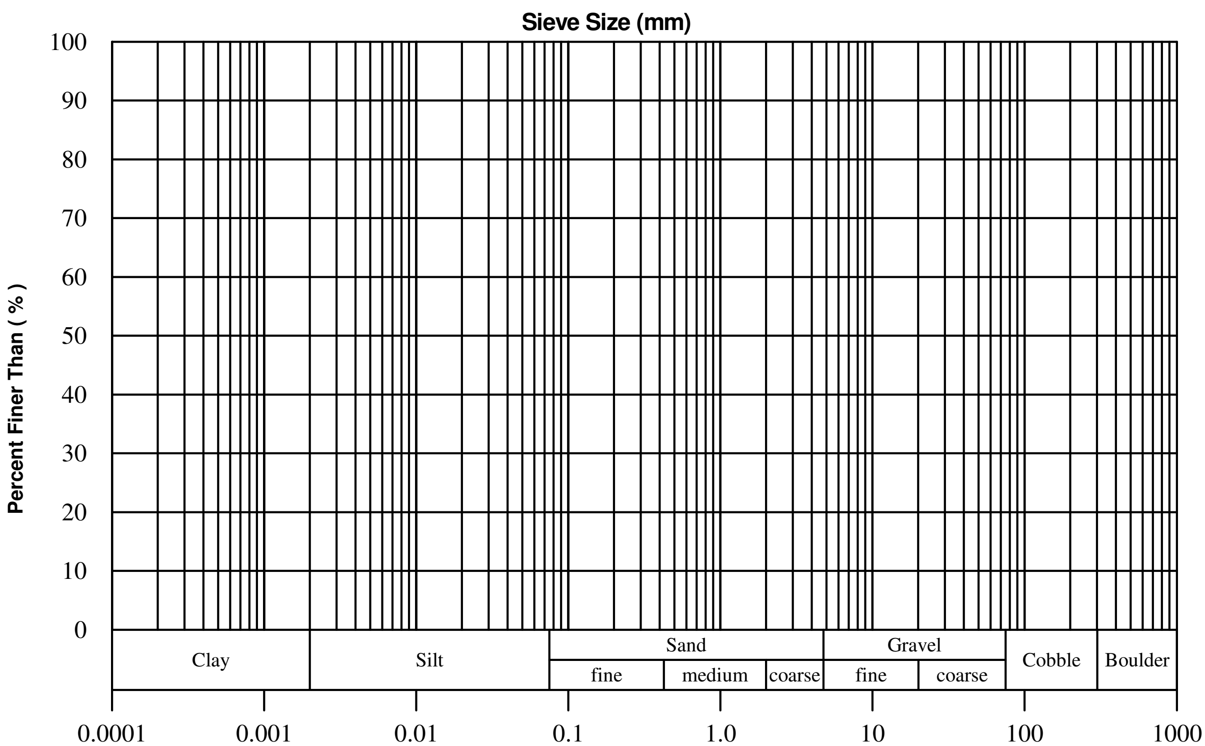
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	25	170027	6.00-6.45		43.90	41.51	14.59

PARTICLE SIZE DISTRIBUTION CURVES

Job No :30796

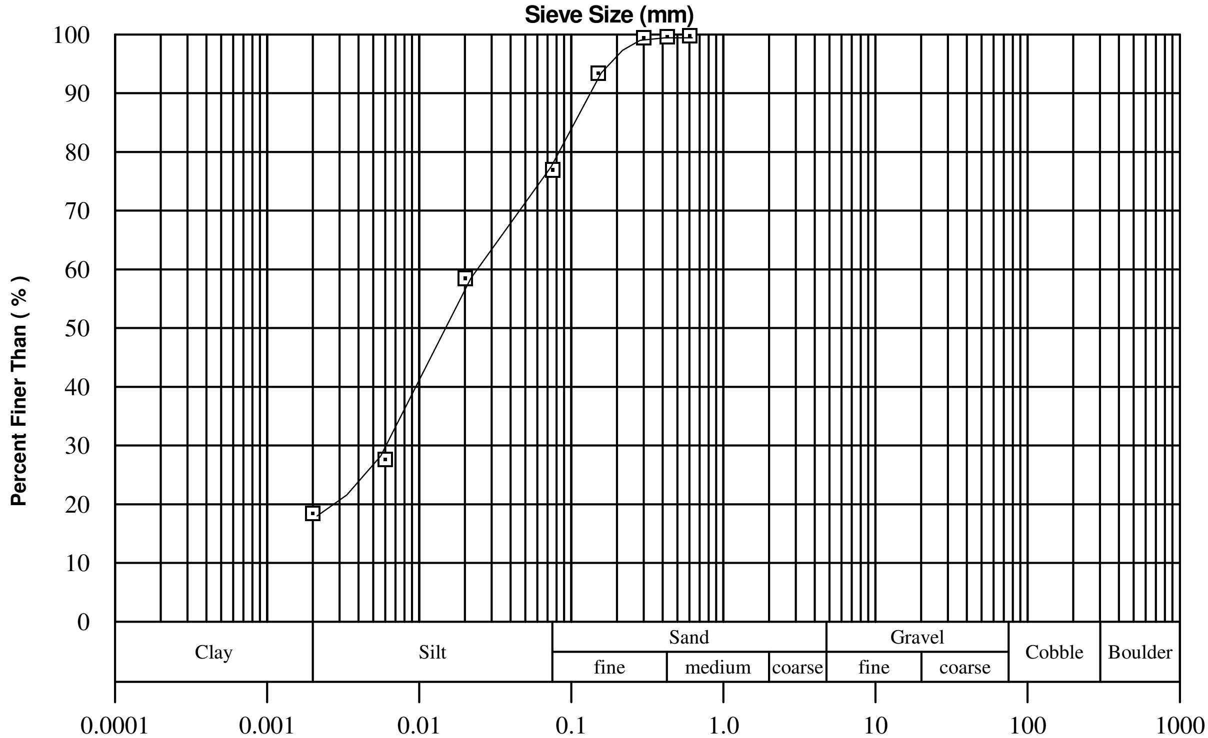


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	26	182156	1.00-1.45		4.00	63.36	32.64

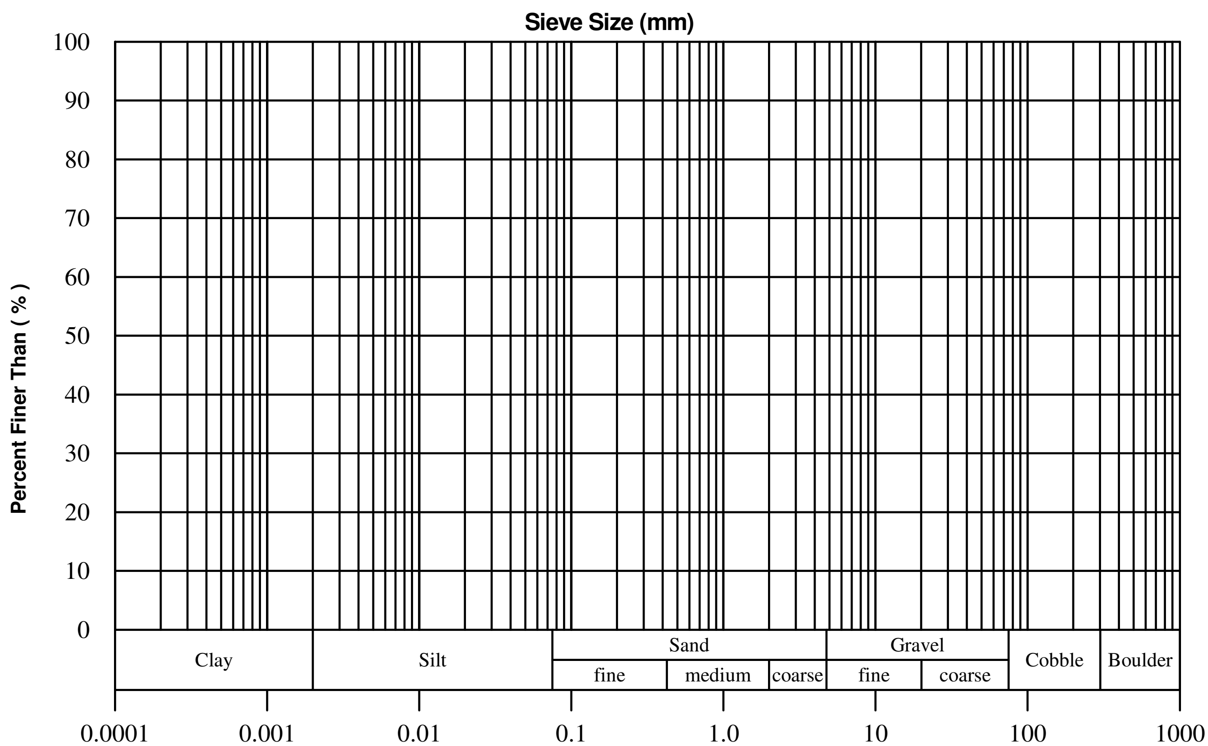


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay

PARTICLE SIZE DISTRIBUTION CURVES

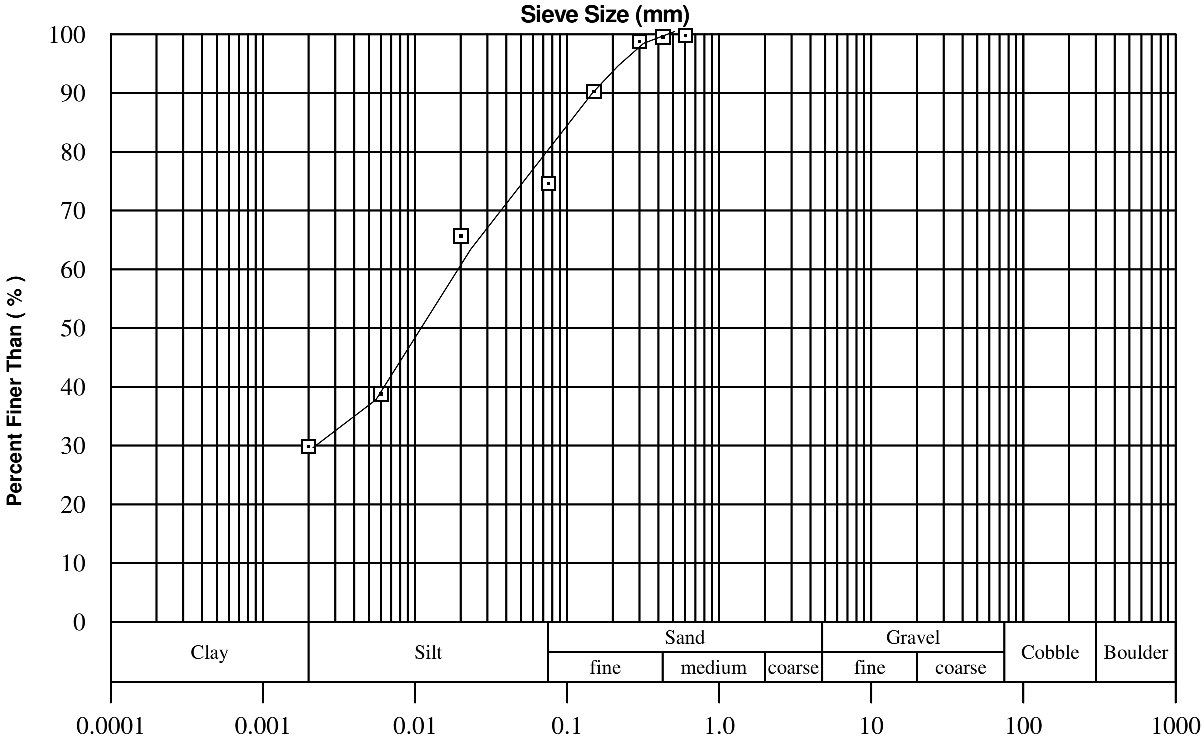


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	27	170667	4.50-4.95		23.00	58.52	18.48

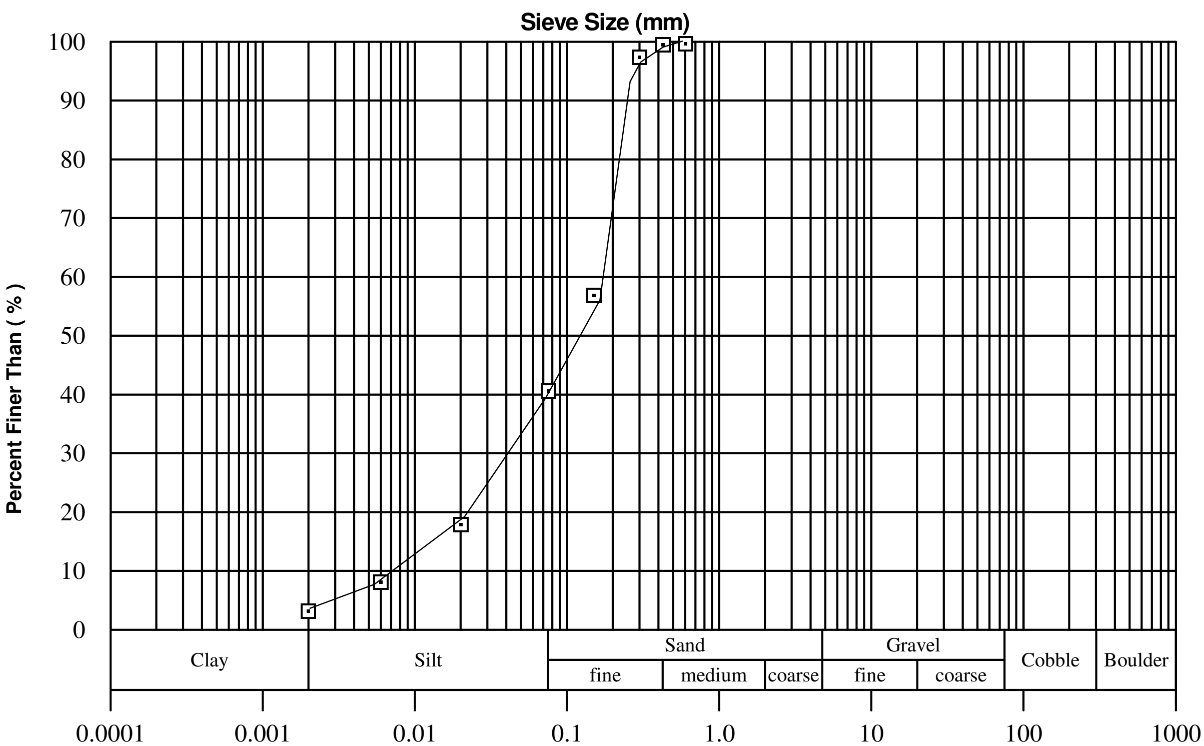


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay

PARTICLE SIZE DISTRIBUTION CURVES



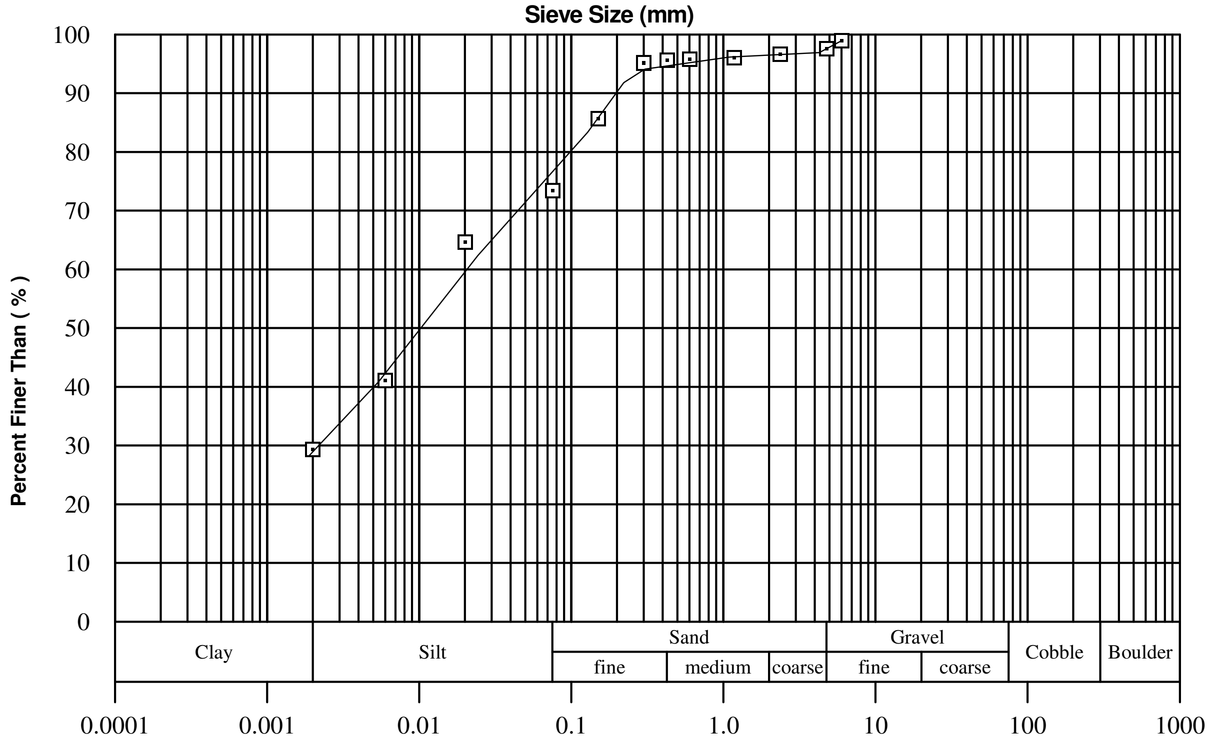
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	28	160771	1.00-1.45		25.30	44.82	29.88



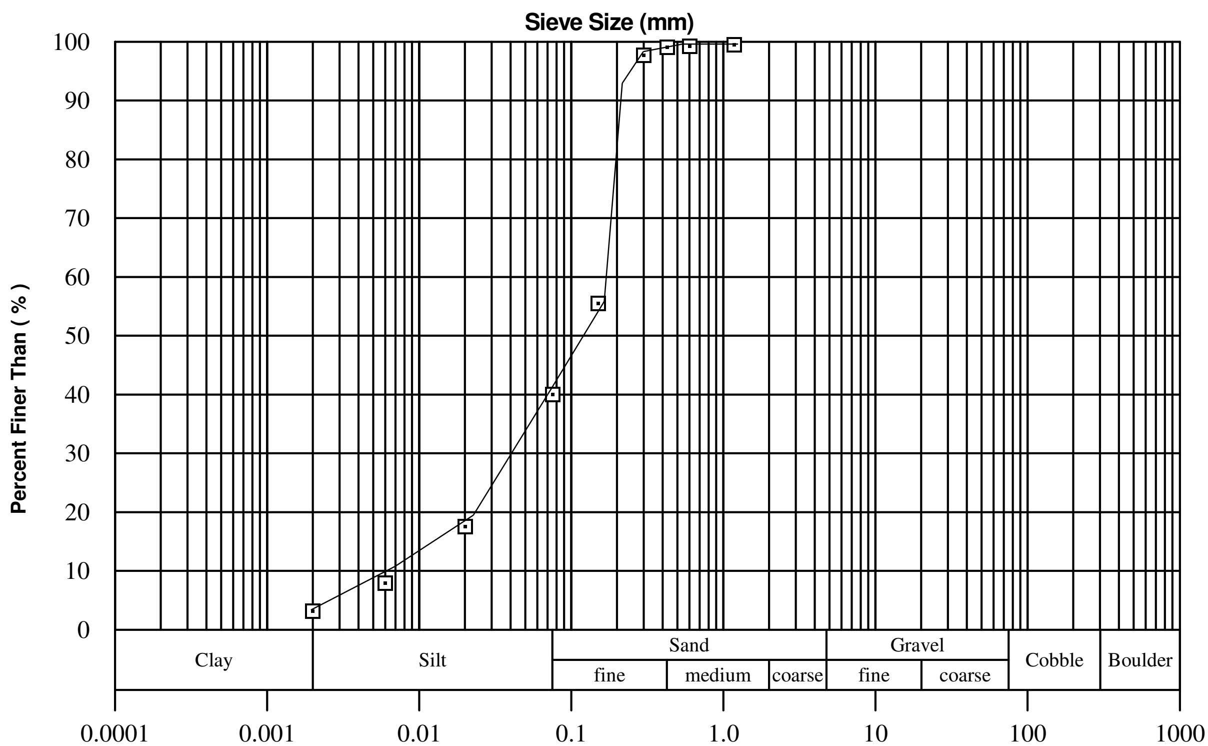
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	28	160778	6.00-6.45		59.30	37.44	3.26

PARTICLE SIZE DISTRIBUTION CURVES

Job No :30796

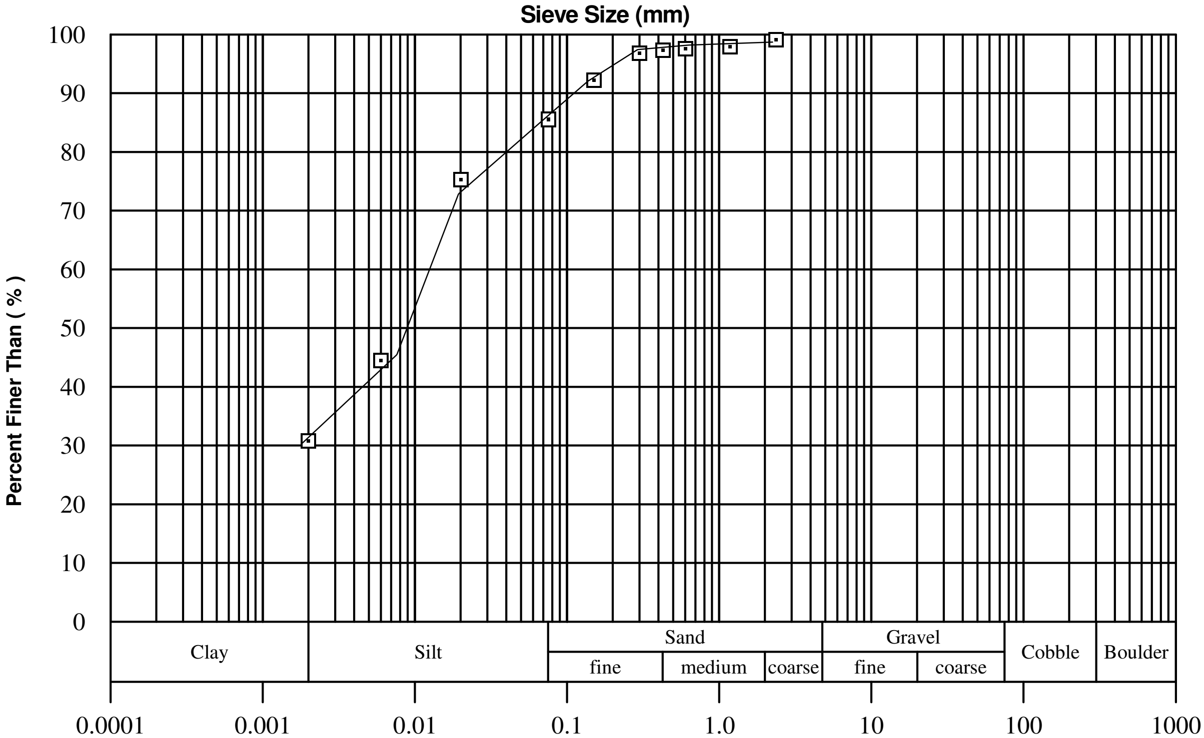


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	29	130154	2.00-2.45	2.40	24.10	44.10	29.40

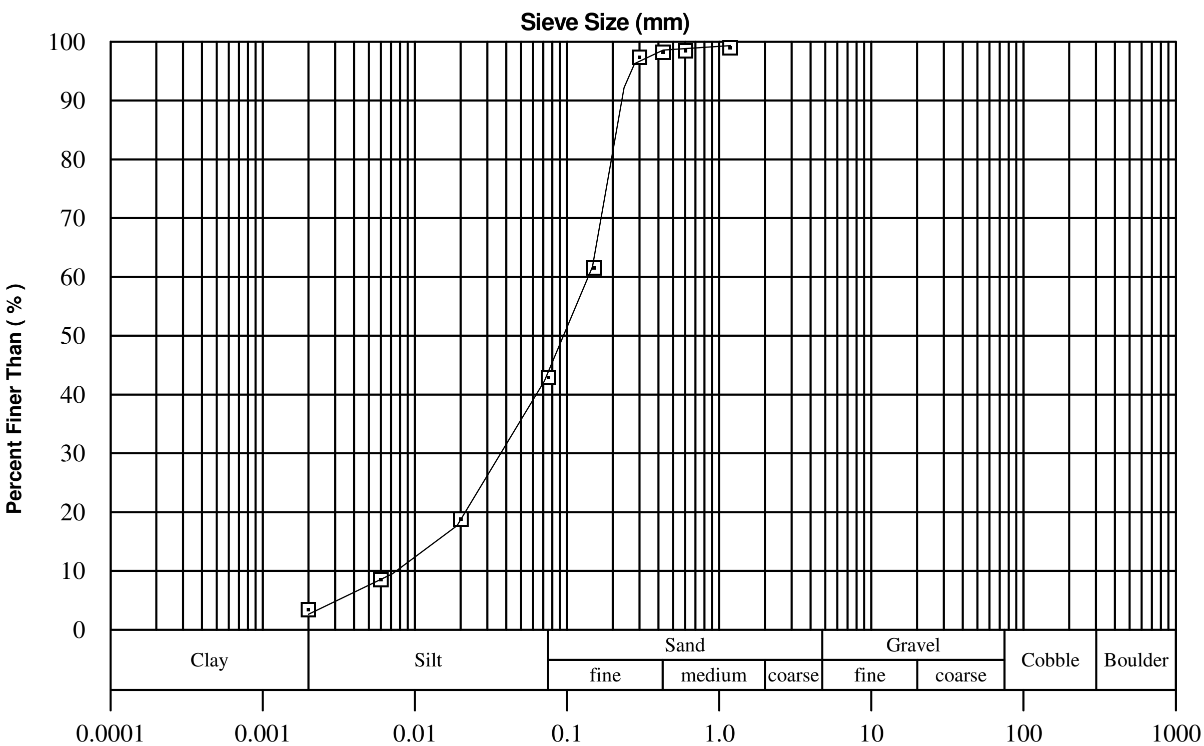


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	29	130160	7.50-7.95		59.90	36.89	3.21

PARTICLE SIZE DISTRIBUTION CURVES

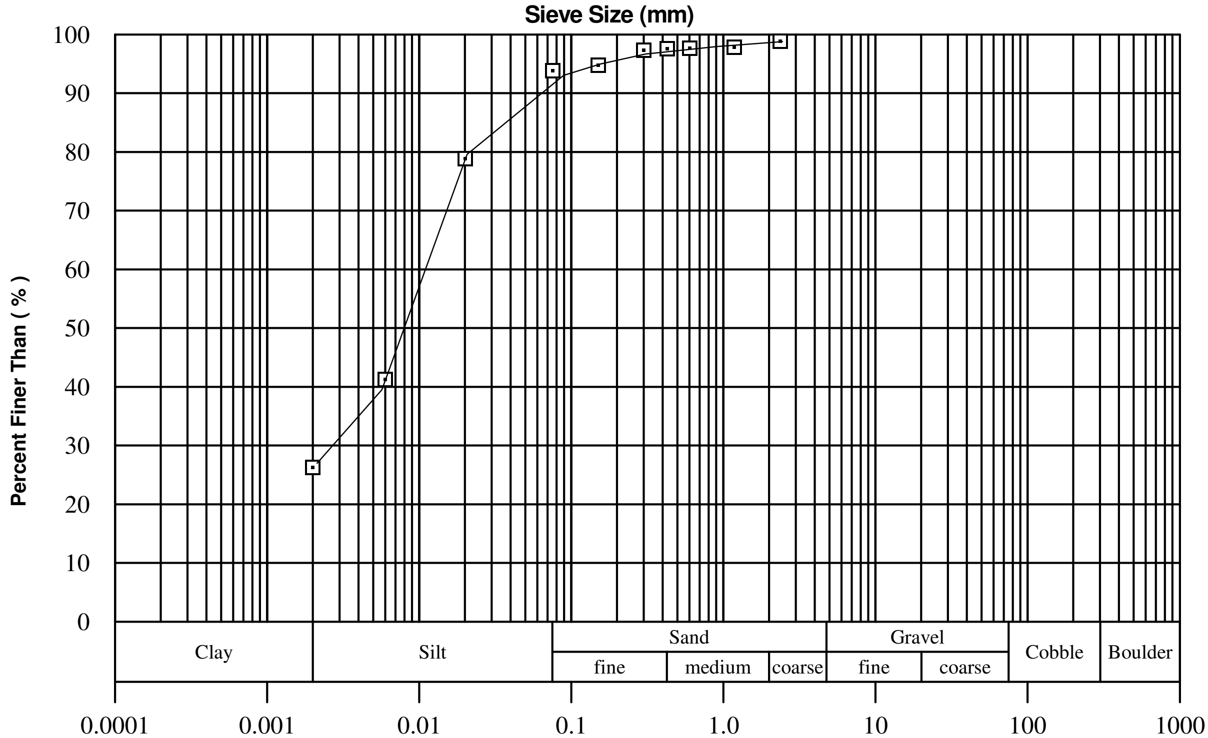


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	30	186111	1.00-1.45		14.40	54.78	30.82

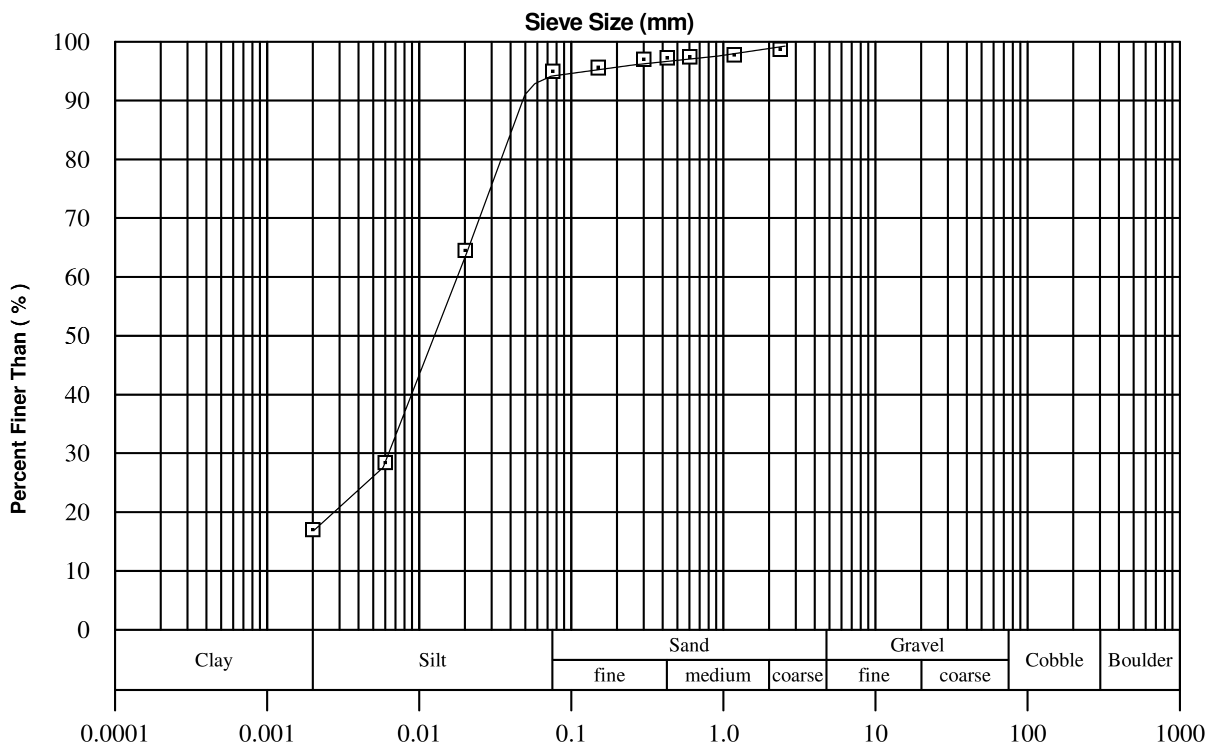


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	30	180118	6.00-6.45		57.00	39.56	3.44

PARTICLE SIZE DISTRIBUTION CURVES



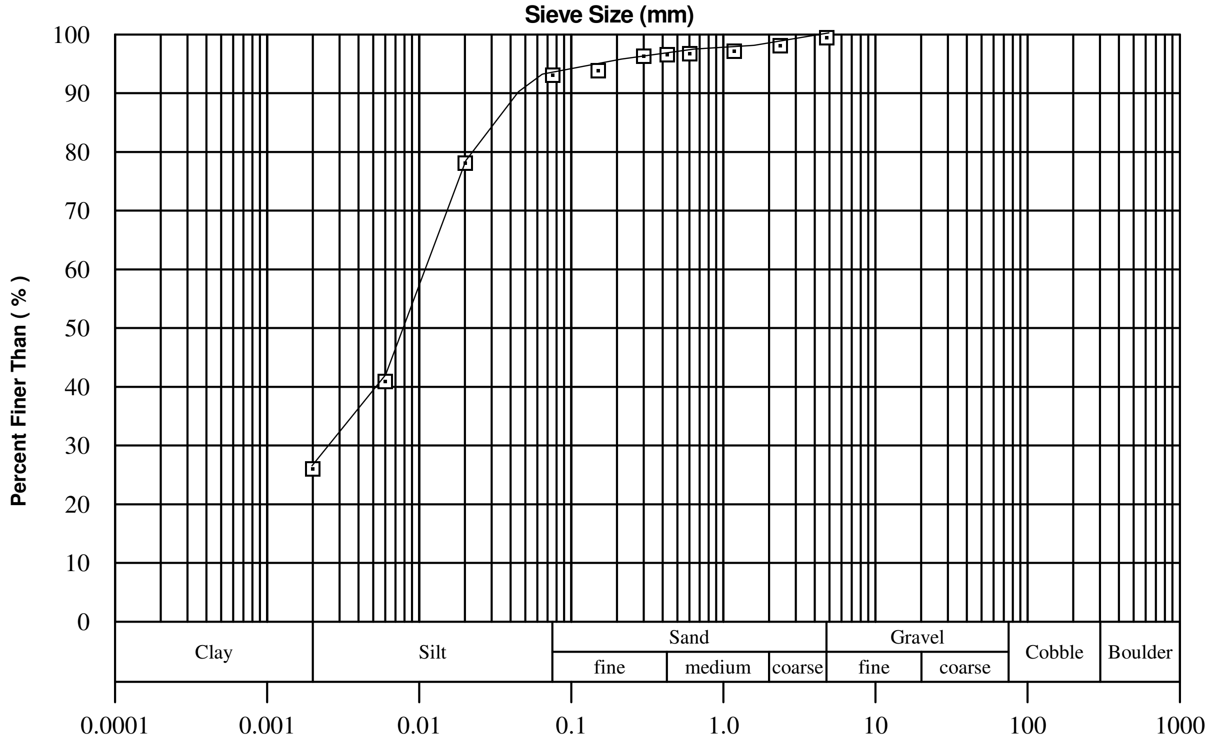
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-1	-	2.00		6.10	67.61	26.29



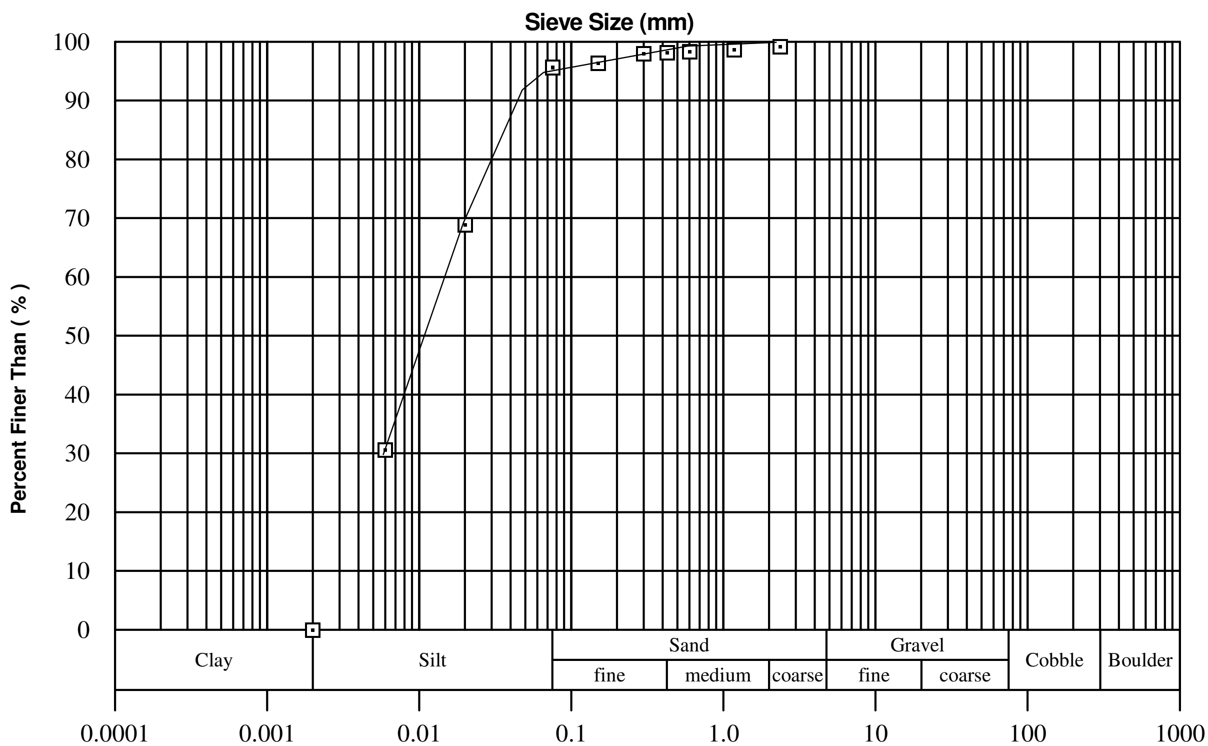
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-1	--	4.00		5.00	77.90	17.10

PARTICLE SIZE DISTRIBUTION CURVES

Job No :30796

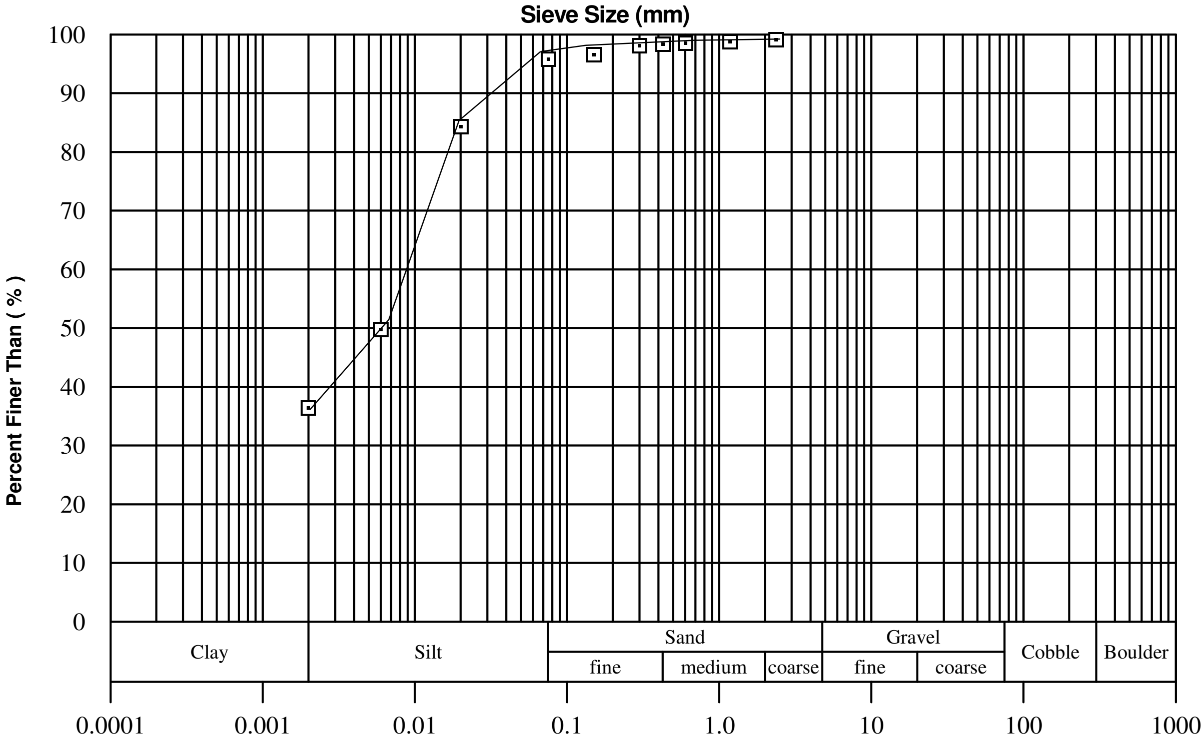


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-2	-	2.00	0.50	6.40	67.03	26.07

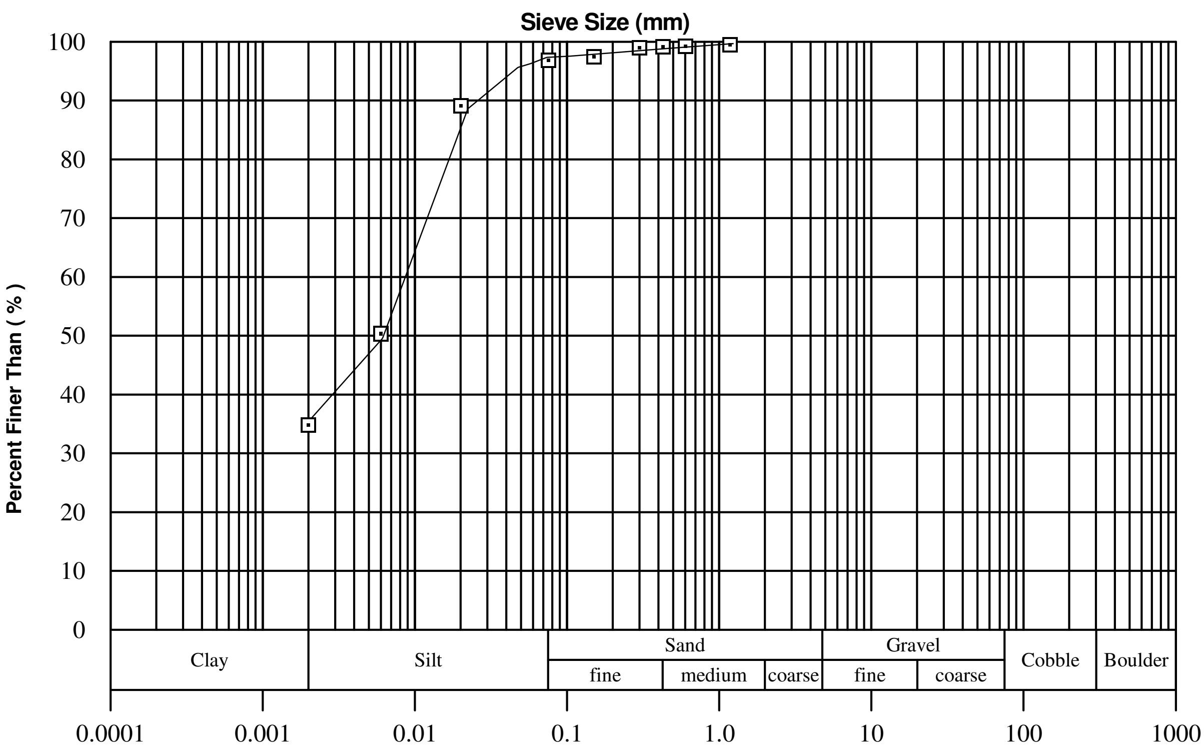


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-2	--	4.00		4.30	95.70	

PARTICLE SIZE DISTRIBUTION CURVES



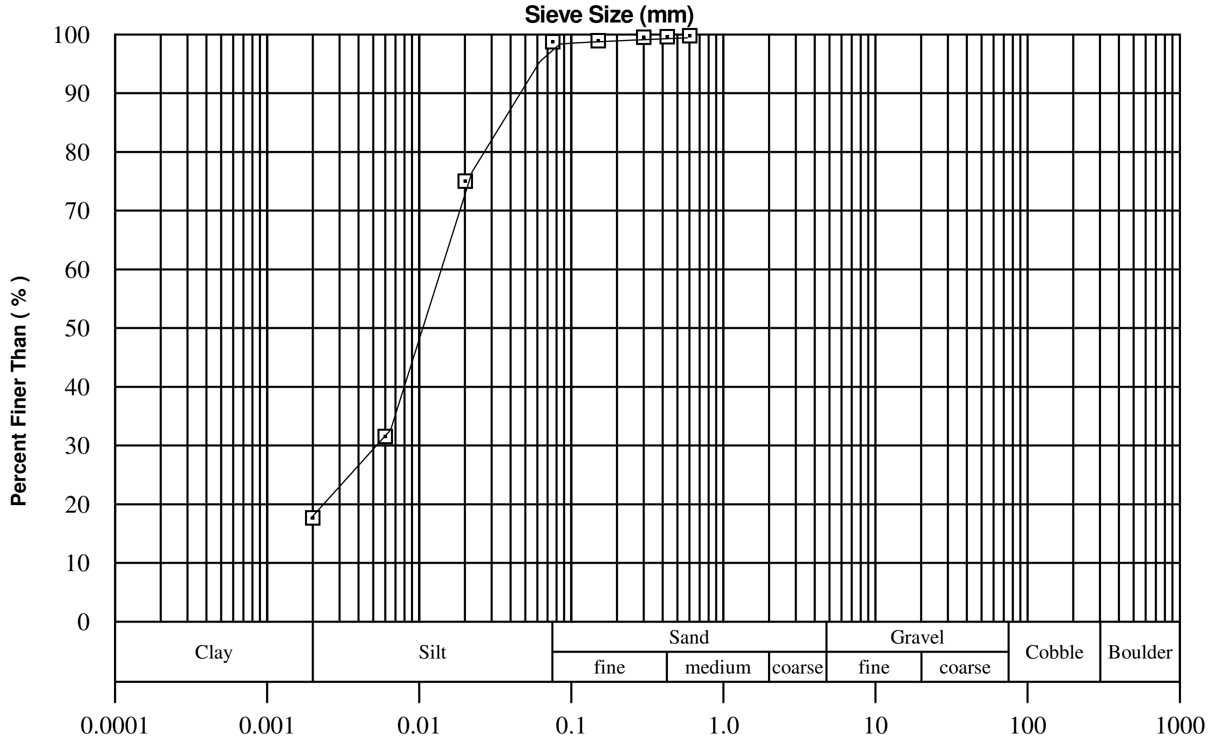
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-3	-	2.00		4.10	59.46	36.44



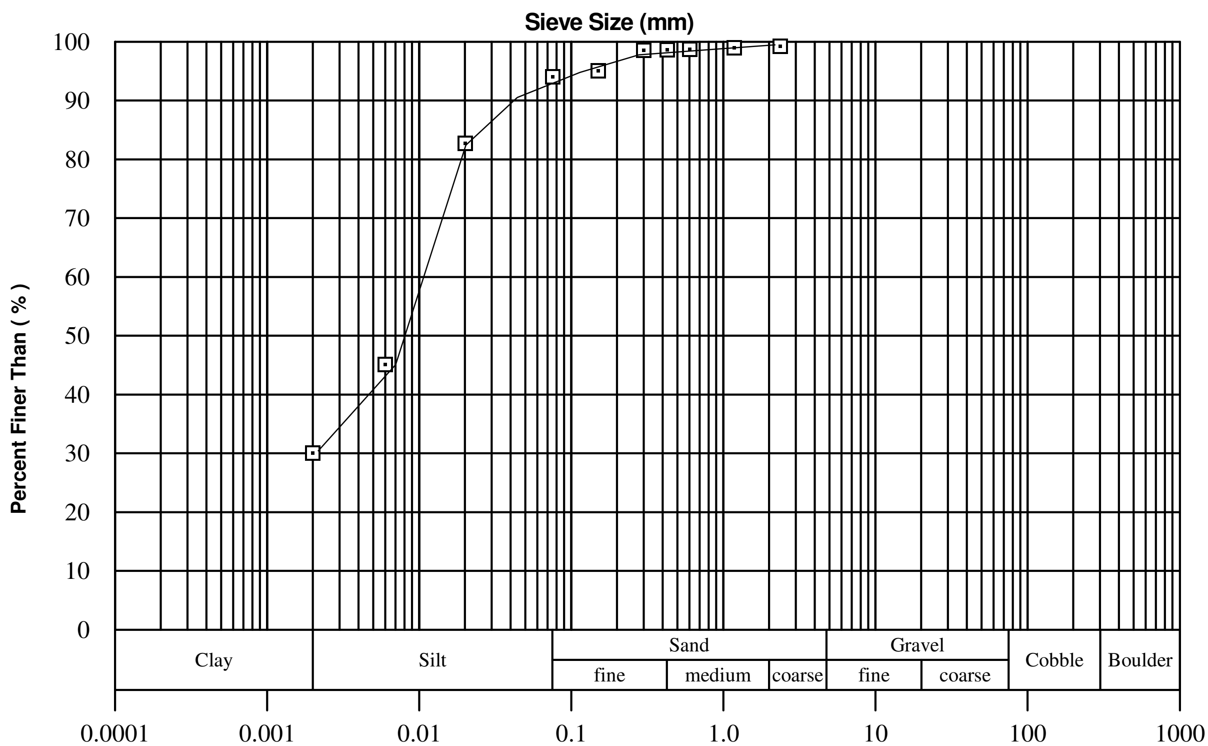
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-3	--	100.00		3.10	62.02	34.88

PARTICLE SIZE DISTRIBUTION CURVES

Job No :30796

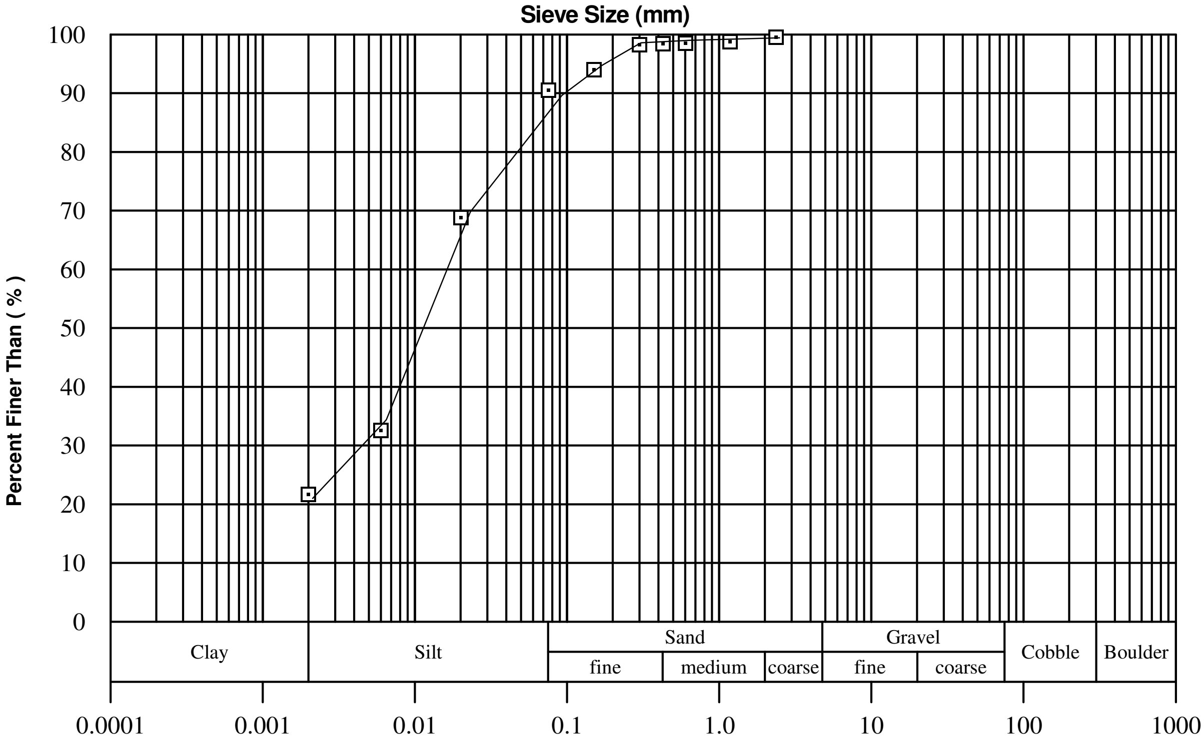


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-4	-	2.00		1.20	81.02	17.78

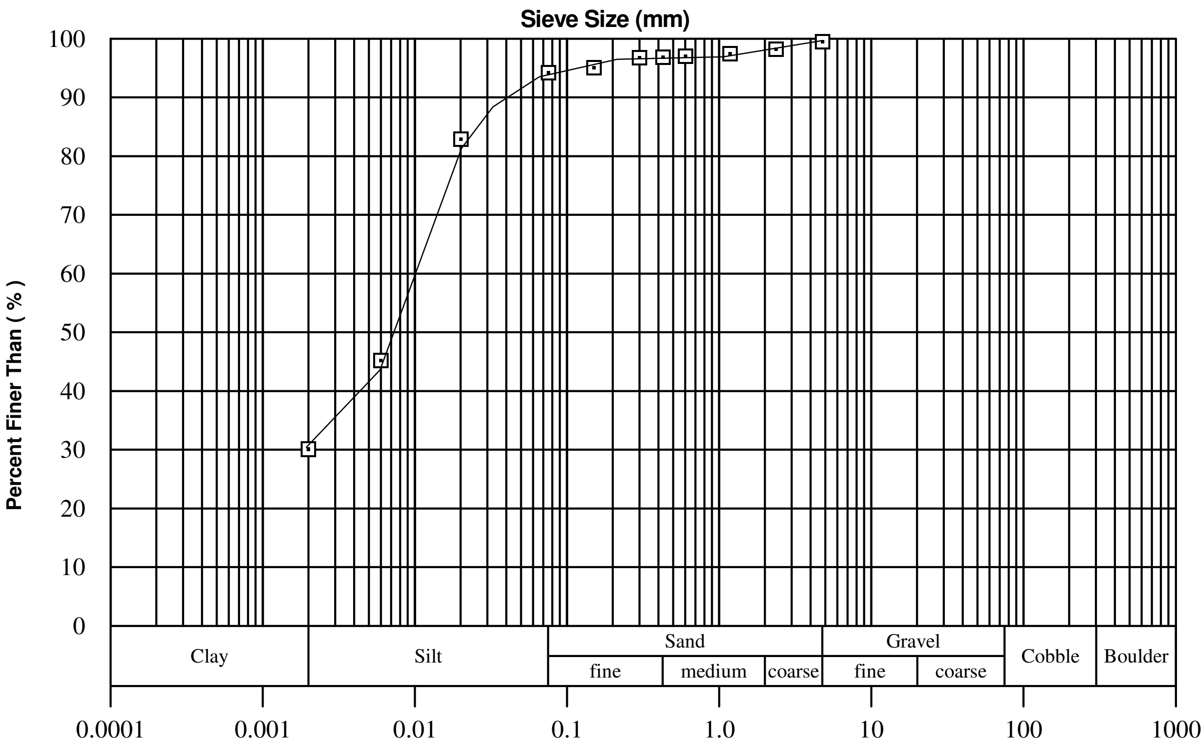


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-5	-	1.00		5.90	63.99	30.11

PARTICLE SIZE DISTRIBUTION CURVES

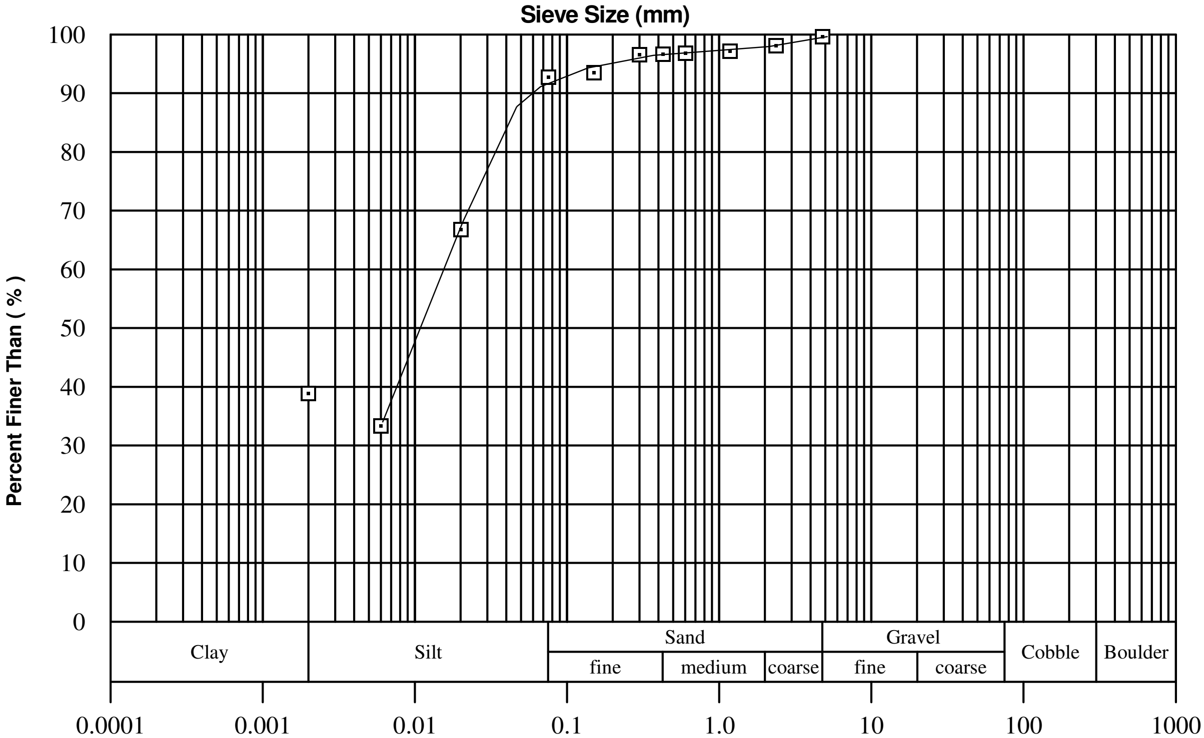


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-5	--	3.00		9.40	68.86	21.74

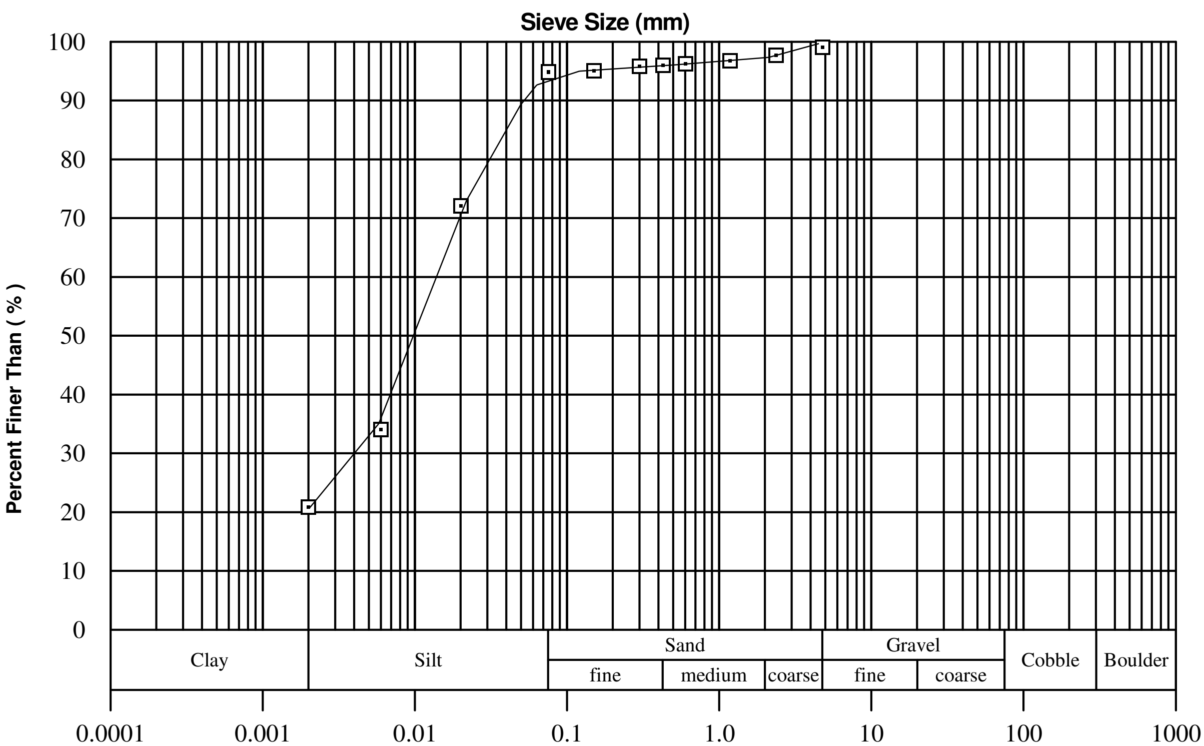


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-6	-	1.00	0.50	5.20	64.12	30.18

PARTICLE SIZE DISTRIBUTION CURVES

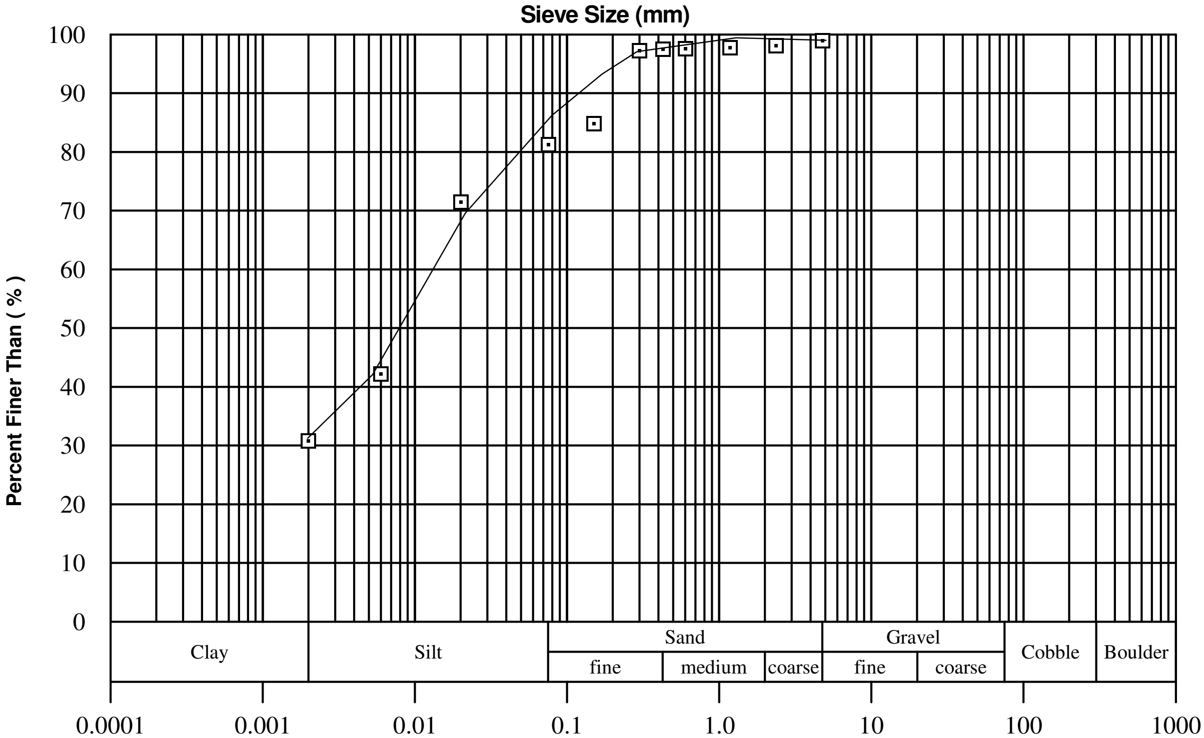


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-6	--	3.00	0.30	6.90	53.82	38.98

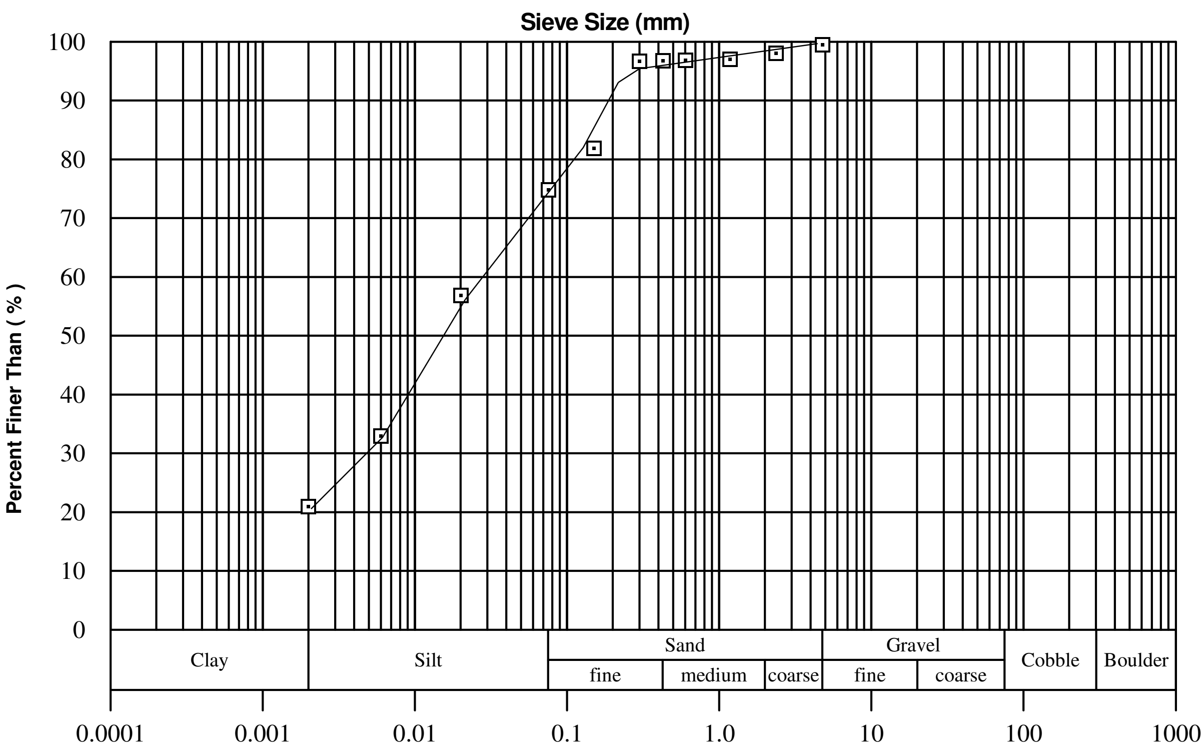


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-7	-	2.00	0.90	4.20	74.02	20.88

PARTICLE SIZE DISTRIBUTION CURVES

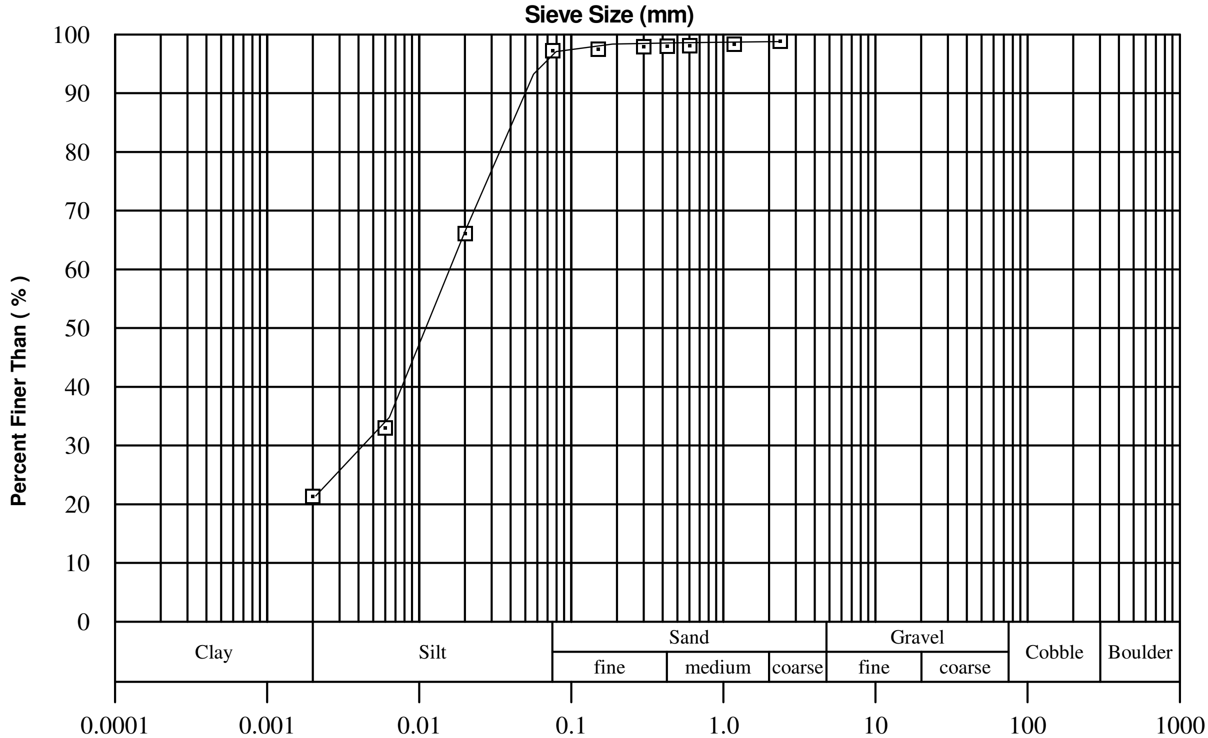


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-8	-	2.00	1.00	17.70	50.41	30.89

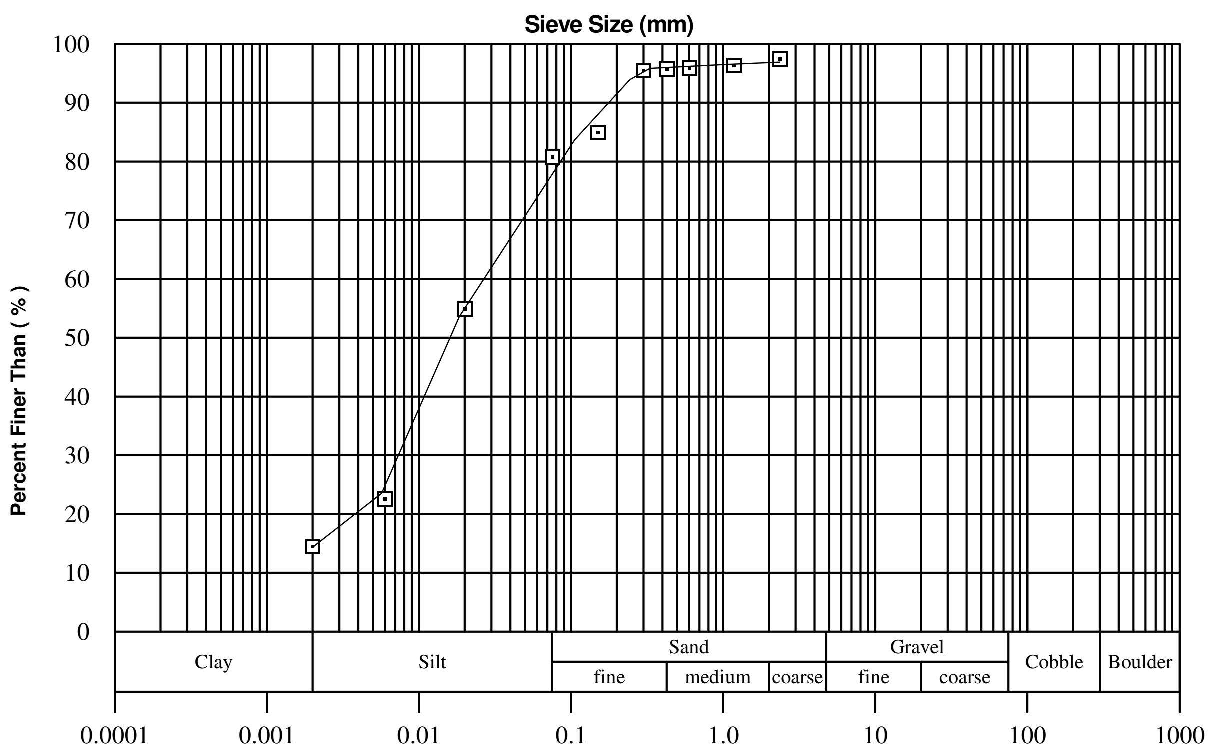


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-8	--	3.00	0.50	24.60	53.93	20.97

PARTICLE SIZE DISTRIBUTION CURVES

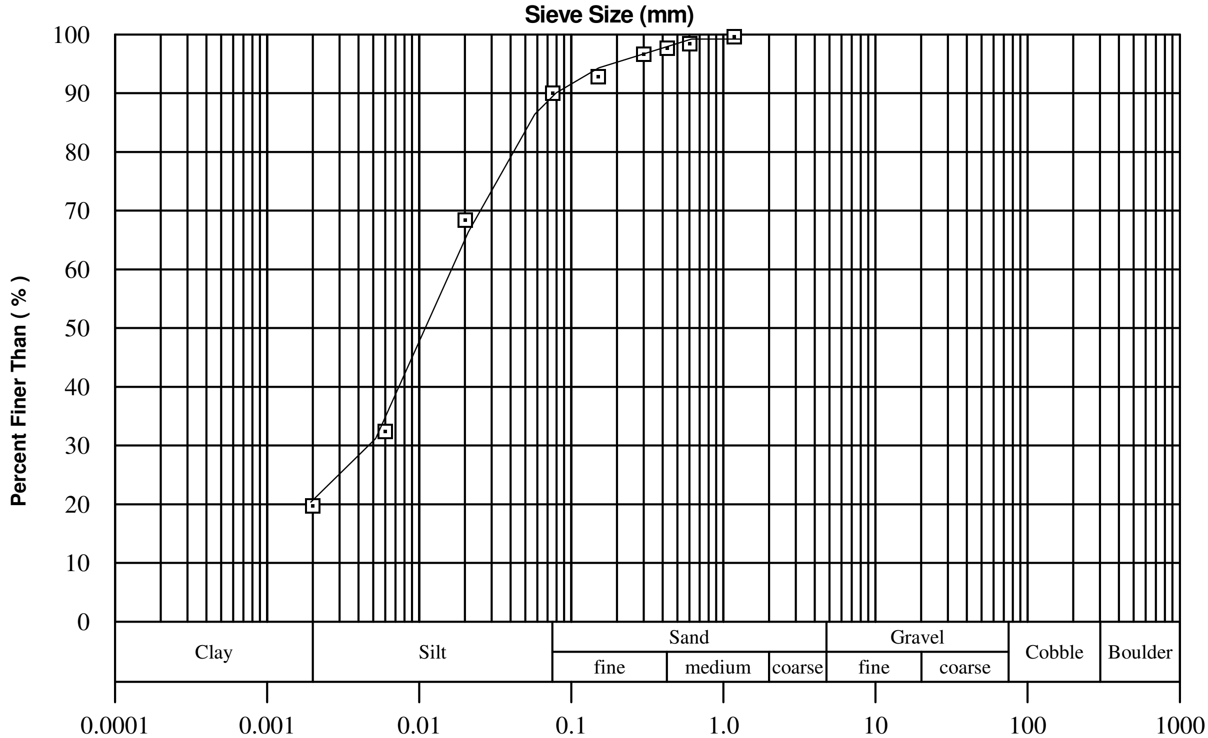


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-9	-	1.00		2.70	75.89	21.41

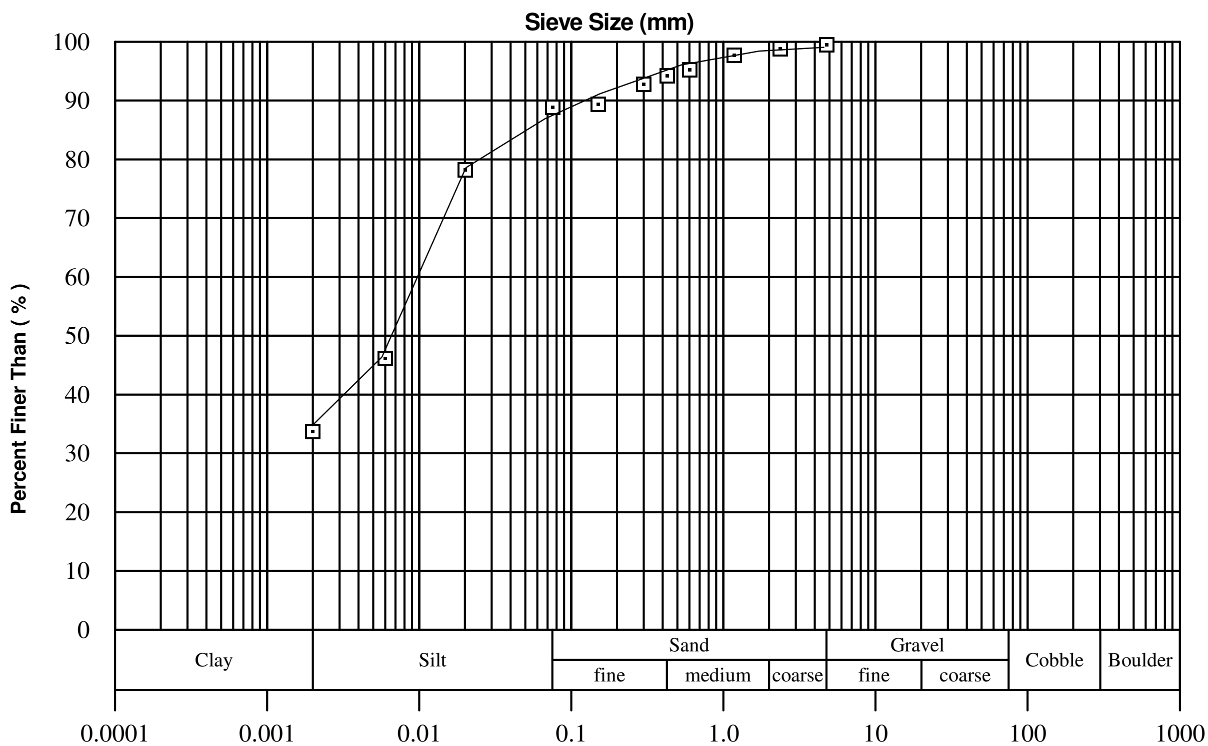


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-9	--	3.00		19.20	66.26	14.54

PARTICLE SIZE DISTRIBUTION CURVES

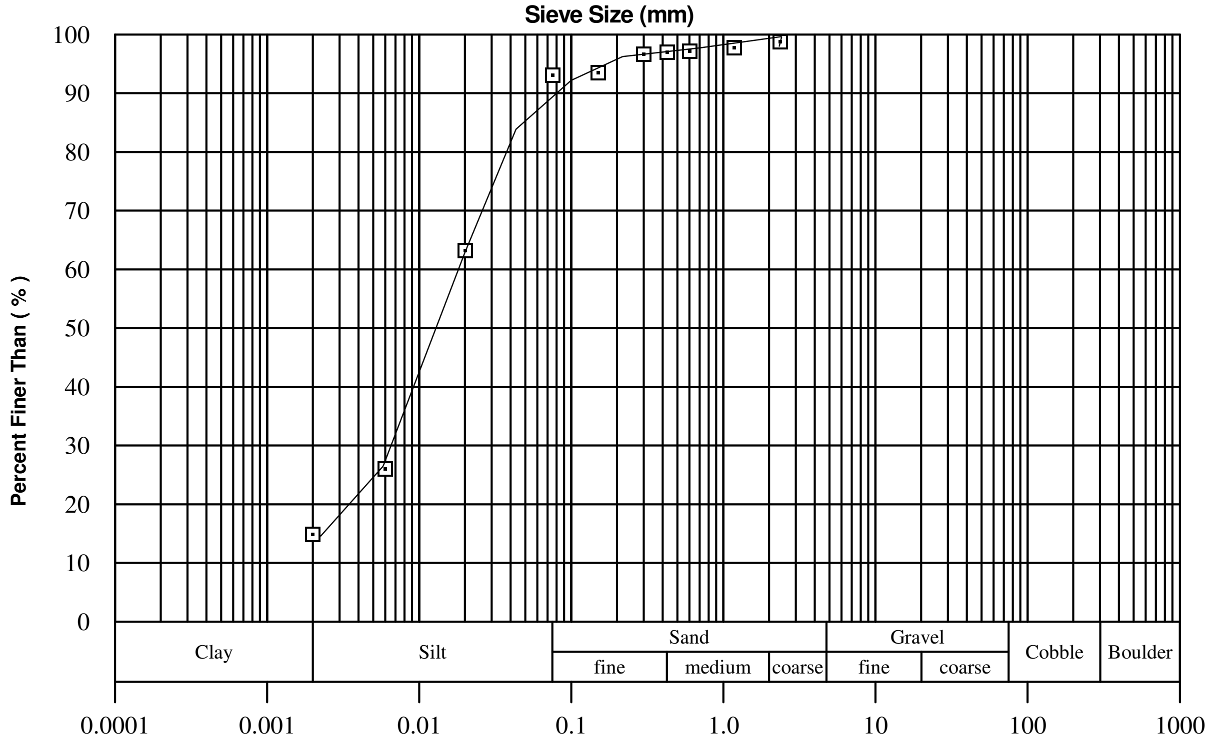


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-10	-	3.00		9.90	70.28	19.82

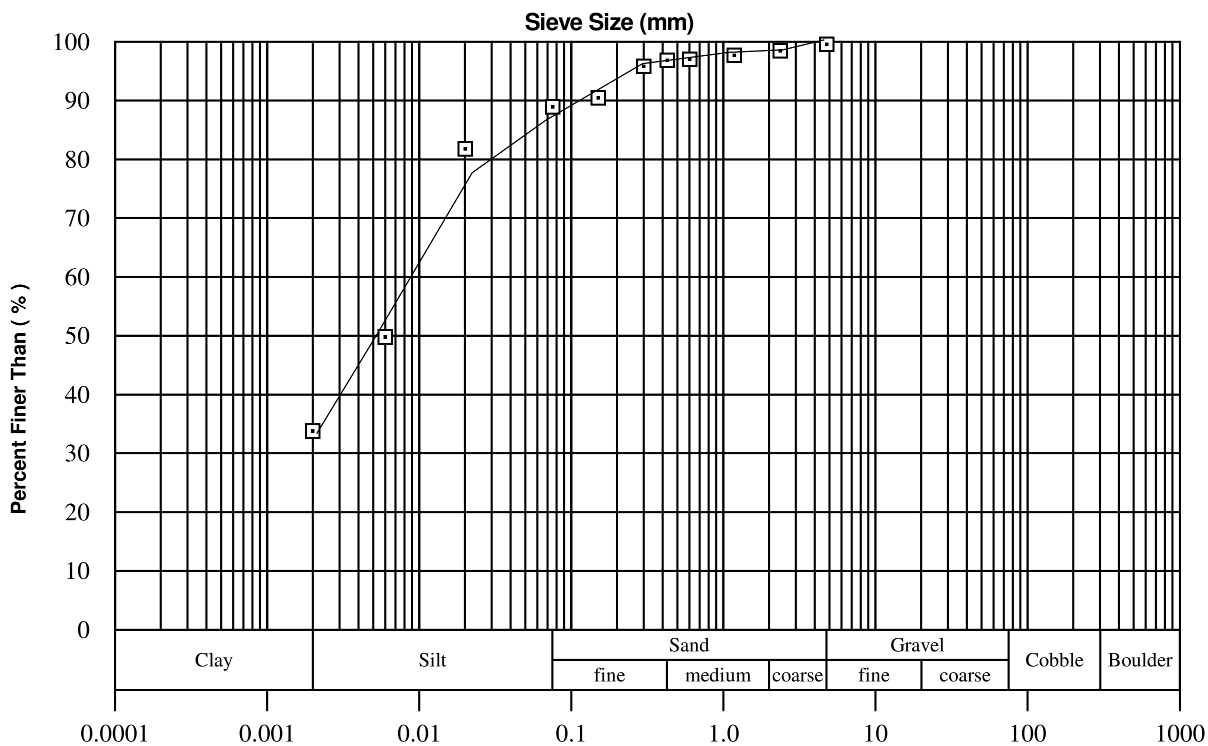


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-11	--	1.00	0.50	10.60	55.12	33.78

PARTICLE SIZE DISTRIBUTION CURVES



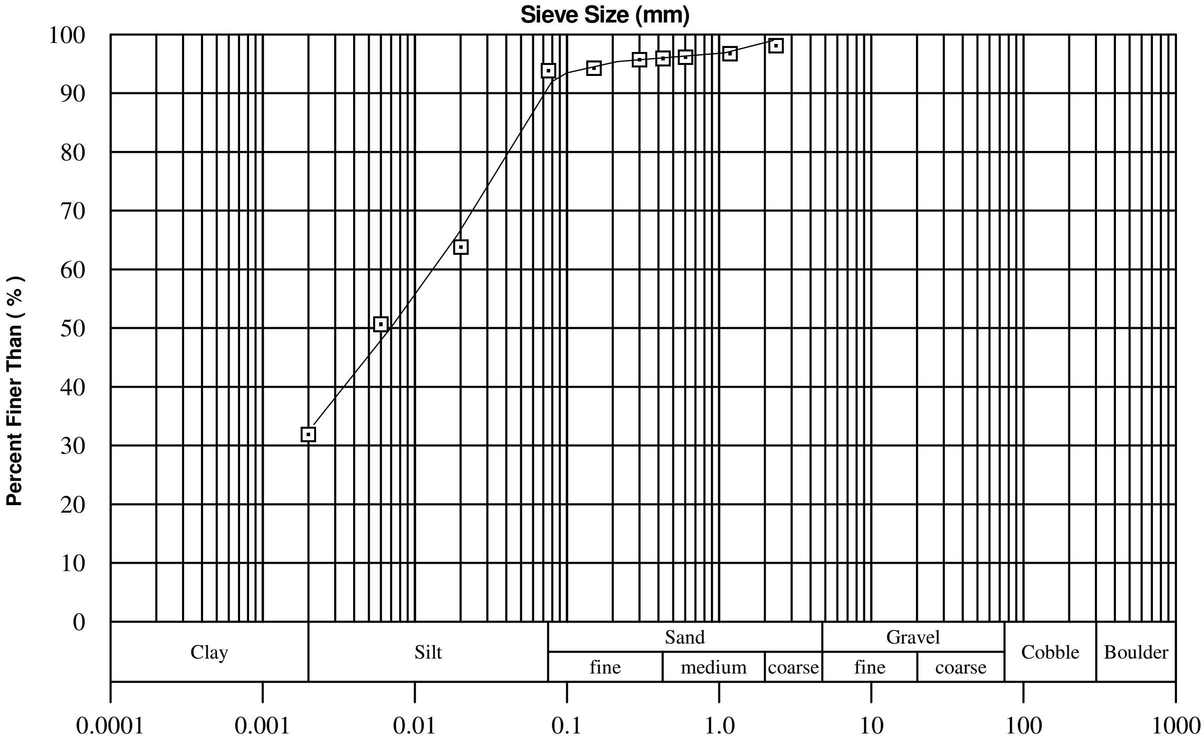
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-11	---	3.00		6.90	78.20	14.90



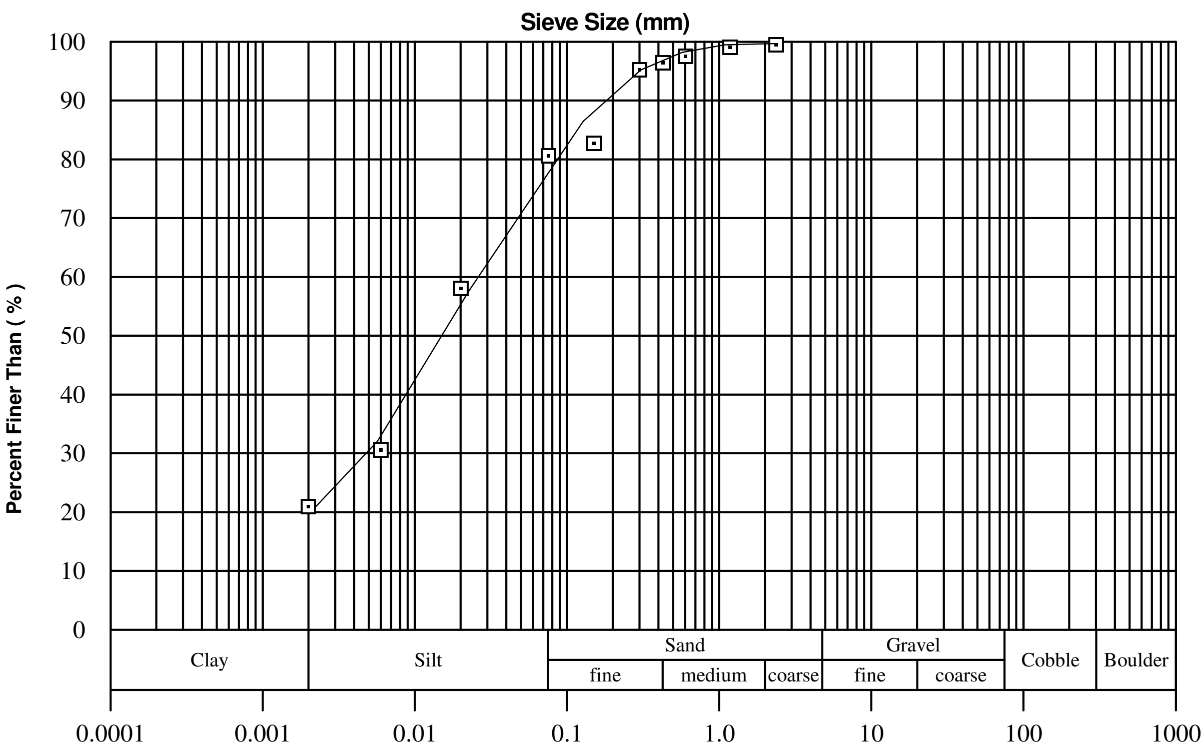
Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-12	-	1.00	0.40	10.60	55.18	33.82

PARTICLE SIZE DISTRIBUTION CURVES

Job No :30796

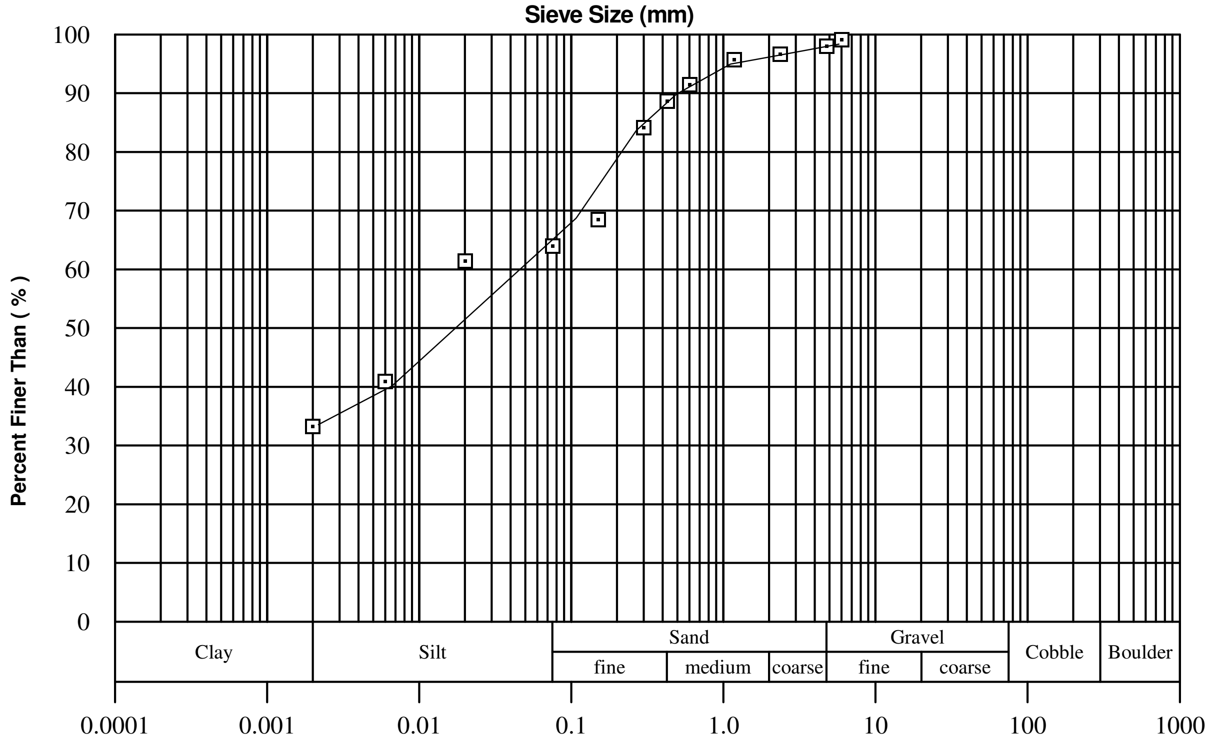


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-12	--	3.00		6.10	61.97	31.93

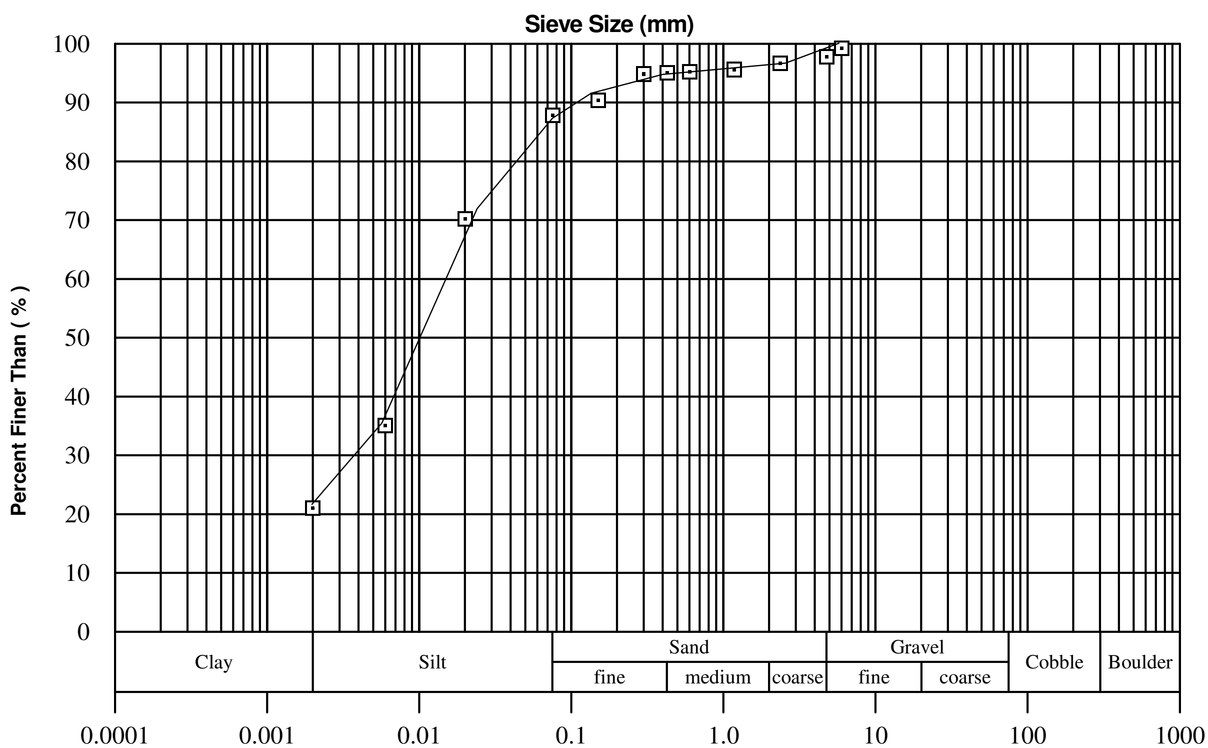


Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-14	-	2.00		19.30	59.72	20.98

PARTICLE SIZE DISTRIBUTION CURVES



Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-15	--	1.00	1.90	34.10	30.72	33.28



Legend	BoreHole Number	Sample Number	Depth (m)	Grain Size Analysis (%)			
				Gravel	Sand	Silt	Clay
⊡	TP-15	---	3.00	2.10	10.00	66.80	21.10

PARTICLE SIZE DISTRIBUTION CURVES

CALCULATION FOR BEARING CAPACITY AND SETTLEMENT OF SHALLOW FOUNDATIONS: (BH-01)

Stratum	Thickness (m)	Bulk Density (KN/m³)	Shear Strength (c/φ)(kPa/degree)	$m_v(m^2/KN) \times 10^{-4}$			Young's Modulus(E) (kPa)	Poisson's Ratio(μ)
				25-50 (kPa)	50-100 (kPa)	100-200 (kPa)		
I	6.00	18.60	C = 57 kPa	1.51	1.57	1.46	28500	0.50
	3.00	19.00	C = 91 kPa	1.09	1.20	1.14	45500	0.50
II	3.00	19.00	Φ = 33*	-			30000	0.35
IVA	>5.06	21.00	Φ = 37*	-			70000	0.30

WIDTH x LENGTH x DEPTH OF FOOTING
Bf = 3.00 m, Lf = 3.00 m, Df = 3.00m

A. CALCULATION FOR BEARING CAPACITY
====================================

Depth considered for bearing capacity parameters is 0.50 x width of foundation = 1.50 m below Foundation

(Considering General Shear Failure Condition)

Weighted Average
Cav.= 57 kPa
Øav.= 0

q_1 ult = $c.N_c.s_c.d_c.i_c + q\,(N_q-1)\,S_q\,d_q\,i_q + 0.5\,\gamma\,B\,N_\gamma\,S_\gamma\,d_\gamma\,i_\gamma\,w'$ [using IS:6403, general shear condition]

$= c.N_c.s_c.d_c.i_c$

= 457.05 kPa

q_{safe} (general) = q ult/F.S. = **152.35 kPa**

where Nc = 5.14, s_c=1.30, d_c=1+0.2(D_f/B). (N_Φ)^0.5 = 1.20, i_c = 1.00

where
i_c, i_q, iγ are the inclination factors
Sc, Sq, Sγ are the shape factors
dγ,dq,dc are the depth factors
Nc,Nq and Nγ are the inclination factors
γ_{av} = weighted bulk density(KN/m³)
B= width of the foundation (m)
C = cohesion value of soil (kPa)
W' = correction factor for water level

B. CALCULATION FOR SETTLEMENT

=========================

Settlement calculated for 152 kPa bearing pressure

Depth considered for settlement calculation 2 x width of foundation = **6.00m below Foundation**

Rigidity Factor (RF) = neglected, Depth Factor (DF) = 0.75 (IS: 8009(pt-1)1976, fig.12,

Lamda factor = 0.90(Stratum-I) Part-A

The thickness of stratum-I below the foundation is = 3.00m

ΔP is calculated at the centre of this stratum considering 2:1 dispersion = 3.00/2= 1.50m

Therefore ΔP = 152 x (3.00 x 3.00) / {(3.00+1.50) x (3.00+1.50)} = 152 x 0.44447 = 67.56 kPa

Total Settlement for Stratum-I Part-A

= **Consolidated Settlement + Immediate Settlement**

Part I

Immediate Settlement = p x B x $(1-\mu^2)$ x If / Es

H immd at centre = 4 x p x (B/2) x $(1- \mu^2)$ x If / Es

Which is = **2 x p x B x $(1- \mu^2)$ x If / Es**

= 2 x 152 x 3.00 x $(1-0.5^2)$ x 0.31 /28500

= 7.44 mm

Where p = imposed loading = 152 kPa

Influence Factor If = 0.31 [as per IS: 8009 Part-1, Fig. 11, H = 3.00, for centre H/[B/2] = 2H/B = 2x3.00/3.00 = 2, L/B = 1]

B = width of foundation = 3.00m

μ = poisson's ratio = 0.50

E_{av} = 28500 kPa obtained as [E = 500 x Cu] (Ref Winterkorn & Fang (1975), Foundation Design by NV Nayak 4th Edition pg-111)

Part – II

Consolidated Settlement

$Sc = m_v \times \Delta P \times H = 1.45 \times 10^{-4} \times 67.56 \times 3.00$ = 0.02938m = 29.38mm

Applying correction for lamda factor = 29.38 x 0.90 = 26.442

Total Settlement = Immediate Settlement + Consolidated Settlement

= 7.44 + 26.442

= 33.882 **mm**

Total Settlement for Stratum-I Part-B

Lamda factor considered = 0.65

ΔP is calculated at the centre of this stratum considering 2:1 dispersion = 3.00 + 3.00/2= 4.50m

Therefore ΔP = 152 x (3.00 x 3.00) / {(3.00+4.50) x (3.00+4.50)} = 152 x 0.16 = 24.32 kPa

= **Consolidated Settlement + Immediate Settlement**

Part I

Immediate Settlement = p x B x $(1-\mu^2)$ x If / Es

H immd at centre = 4 x p x (B/2) x $(1- \mu^2)$ x If / Es

Which is = **2 x p x B x (1- μ^2) x If / Es**

= 2 x 152 x 3.00 x $(1-0.5^2)$ x 0.1 /45500

= 1.503 mm

Where p = imposed loading = 152 kPa

Influence Factor If = 0.41 [as per IS: 8009 Part-1, Fig. 11, H = 6.00(from the base of the foundation, for centre H/ [B/2] = 2H/B = 2x6.00/3.00 = 4, L/B = 1]

Therfore Influence factor only for Part B of Stratum – I

If = (0.41 – 0.31) = 0.10

B = width of foundation = 3.00m

μ = poisson's ratio = 0.50

E_{av} = 45500 kPa obtained as [E = 500 x Cu] (Ref Winterkorn & Fang (1975), Foundation Design by NV Nayak 4th Edition pg-111)

Part – II

Consolidated Settlement

Sc = m_v x ΔP x H = 1.20 x 10^{-4} x 24.32 x 3.00 = 0.0087552m = 8.75mm

Applying correction for lamda factor = 8.75 x 0.65 = 5.68mm

Total Settlement = Immediate Settlement + Consolidated Settlement

= 1.503 + 5.68

= 7.183 **mm**

Applying correction for depth factor and rigidity factor over total settlement= (33.882 + 7.183) x 0.75 x 0.80 = **24.639 mm**

Calculations for Foundation resting directly within Stratum-IVB giving a minimum embedment of 0.50m within it using RMR Method.

ROCK MASS SYSTEM (AFTER BIENIAWSKI 1989)

Parameter Type	Value obtained from rock samples	Rating
Strength of intact rock material	3.50 MPa	1
Drilling core Quality, RQD	<25%	3
Spacing of discontinuities	60-200mm	8
Condition of discontinuities	Slicken gauge> 5mm thick or Separation 1-5 mm continuous	5
Ground water	Wet	7
Rating adjustment for discontinuity orientation	Fair	-7
	Total RMR=	17

Based upon the above table as per Table.3 of IS 12070 – 1987 reaffirmed 2010 the RMR of 17 in very poor category. The corresponding Net Safe Bearing Capacity may be considered as

= 30 + {(45-30) / (20-0) x 17}

= 42.75 MT/m^2 the settlement of which is restricted within 12mm as per IS 12070 Clause 5.30

It may also be noted that the net safe bearing capacity of open foundations placed within rocky strata is independent of the size of the foundation.

SAMPLE CALCULATION FOR OPEN FOUNDATION PLACED WITHIN STRATUM-IVB

The Bearing capacity of open foundation can be determined using the design parameters presented in the table showing recommended engineering properties of rock and using the relation given in text book "*Foundation Design Manual for Practicing Engineers and Civil Engineering Students" by N.V. Nayak; (3rd Edition 1985)*, and bearing capacity equation given in IS: 12070-1987.

The net safe bearing capacity of shallow foundations on rock can be written as:

$$q_s = q_c N_j$$

where,

q_c = Average Uni-axial compressive strength of rock cores
= 3.50 MPa.

N_j = Empirical coefficient depending on the spacing of discontinuities.
= 0.25 (for spacing & discontinuities of about 100 – 300m)

For getting the allowable bearing capacity, calculated net safe bearing capacity should be multiplied with the following correction factor (s) according to the geological condition.

1) *Submerged condition under water table:*

Rock with continuous joints with opening 1 to 5 mm wide and filled with clay = ¾ to ½

Slope
a) Fair orientation of continuous joints in the slope = 1 to 1/2

Gross Safe Bearing Capacity = 3500 x 0.25 x 0.75 x 0.75

= 492.187 kPa

PILE CAPACITY CALCULATION FOR 500MM DIAMETER BORED CAST-IN-SITU PILES FOR PILE TIP RESTING WITHIN STRATUM-IVB:

(Refer: *IS 14593: 1998 "Design and Construction of Bored Cast-in-Situ Piles Founded on Rocks-Guidelines*")

Skin friction of pile shaft in rock is given by:

$$f_s = q_{uc}.\ \Pi.D.\ l_s\ .\ \alpha\ .\ \beta$$

Where, f_s = safe skin friction

α = rock socket slide resistance reduction factor = 0.18

β = rock socket correction factor = 0.50

q_{uc} = unconfined compression strength of rock

= 3.50 MPa = 350 T/m^2

Substituting above values : f_s = 31.50T/m^2 in Stratum IVB.

Unit safe skin friction per meter of pile shaft in Strata IVB:

$F_s = \pi\ .\ D\ .\ f_s$

Where D = Pile diameter in mm

Therefore, $F_s = \pi\ .\ D.\ l.\ 31.50$

= 49.48.l T/m

Hence giving a rock socketing of 3.50D times the dia of the pile it comes= (49.48 x 1.75) = 86.59 T

For end bearing in stratum-IVB

$Qs = q_c.N_j.N_d.A_p$ = 350 x 0.10 x 1.50 x 0.1963 = 10.30 T

Where,

q_c = unconfined compression strength of rock = 3.50 MPa = 350 T/m^2

N_d = depth factor = 0.80 + 0.20l_s/D, limited to 2 = 1.50

$A_p = \pi D^2/4$ = 0.1963m^2

N_j = Values as per Fig. 2 of IS: 12070 = 0.10

Total safe carrying capacity in compression = Skin Friction + End Bearing = 86.59 + 10.30 = 96.89 ~ 95 MT

Tension Capacity of Piles:

= 50% of the skin friction

= 86.59/2 ~ 40 MT

Computation for Lateral Capacity of Pile.
(Consider cut off level 1.50m)

Basic Assumptions

1) Reference codes IS 2911 (Part I/Section 2) – 2010, IS 14593: 1996 – 1998 & IS 456 – 2000.
2) Modulus of Subgrade reaction has been taken assuming the sub-soil as soft to medium stiff Clay under submerged condition.
3) Concrete Grade of piles has been assumed as M25.

List of Notations.

I = Moment of Inertia of Pile Section (m^4)
E= Modulus of Elasticity of concrete (MN/m^2)
R= Relative Stiffness Factor.
z_f= Depth to point of Fixity in m
K_1= Modulus of Sub-grade Reaction of Clay (MN/m^3) (Refer IS-2911, Appendix – C)
H= Lateral Load in (KN)
Y= Maximum displacement allowed at Final load = 5mm = 0.005m
e= cantilever length above ground/ bed to the point of load application in m.

Lateral Load for fixed head piles

1) Pile Geometry
Dia = 500mm = 50cm   Moment of Interia
$I = (\prod/64) \times (0.50)^4 = 3.07 \times 10^{-3}\ m^4$

2) Properties of Pile Material- Concrete Grade M25

Modulus of Elasticity (E) = $5000\sqrt{f_{ck}}$ [where f_{ck} = characteristic strength in N/mm^2]
$=5000\ \sqrt{25}$
$= 25 \times 10^3$ MPa
$= 25 \times 10^6$ KPa

Flexural Stiffness $EI = 7.67 \times 10^4\ kN\text{-}m^2$

c. Depth of Fixity for free head condition

Value of z_f/R, from fig 4, of IS – 2911-2010 for (e/R=0), $z_f/R = 1.90$

Computing, value of Relative Stiffness Factor as per relationship given in Clause C-2.3.2 of Appendix C, IS: 2911

$R = \sqrt[4]{(5EI/K_1)}$ [where K_1 has been obtained as 20.52×10^3 from Table-4 IS: 2911 in kN/m^3]

$R = \sqrt[4]{(5 \times 7.67 \times 10^4/20.52 \times 10^3)}$
$= 2.08$ m

Now,
$z_f/R = 1.90$
$z_f = 1.90 \times 2.08$

$\boxed{z_f = 3.95 \text{ m}}$

b) **Lateral Load Capacity for free head condition**

Computation has been based on equation given on cl C-4.2 of IS 2911 as follows.

$Y = \{H(e + z_f)^3/3EI\}$
$H = 3EI.Y/(e + z_f)^3$

Where

$e=0$
$EI = 7.67 \times 10^4$
$z_f = 3.95$ m
$Y = 0.005$ m

$\therefore$ $Q = (3 \times 7.67 \times 10^4 \times 0.005) / (3.95)^3 =$ **19 kN**

c) **Depth of Fixity for fixed head condition**

Value of z_f/R, from fig 4, of IS – 2911 for ($e/R=0$), $z_f/R = 2.20$

$R = 2.08$m

Now,
$z_f/R = 2.20$
$z_f = 2.20 \times 2.08$

$\boxed{z_f = 4.57\text{m}}$

d. **Lateral Load Capacity for fixed head condition**

Computation has been based on equation given on cl C-4.2 of IS 2911 as follows.

$Y = \{H(e + z_f)^3/12EI\}$
$H = 12EI.Y/(e + z_f)^3$

Where

$e=0$
$EI = 7.67 \times 10^4$
$z_f = 4.57$ m
$Y = 0.005$ m

$\therefore$ $Q = (12 \times 7.67 \times 10^4 \times 0.005)/(4.57)^3 =$ **48 kN**

Sample Computation of Vertical Load Carrying Capacity of 500MM Diameter Bored Pile(Considering BH-01)
(Cut-off level-1.50m)

1. PILE GEOMETRY:

Dia (mm)	(Bored) 500mm
Perimeter (π x D) m	3.14 x 0.50= 1.570m

2. SUBSOIL PARAMETERS;

(Refer from general soil profile)

Subsoil Strata	γ (KN/m^3)	Cohesion (kPa)	φ (Deg)	Values of α/K as per IS:2911 (Part1/Sec2)	Embedment Length (m)
I	18.60	57	-	-	6.00
	19.00	91	-	-	3.00
II	19.00	-	33	K = 1.15	3.00
IVA	21.00	-	37	K = 1.50	6.50

2. OVERBURDEN PRESSURES :

Stratum-II	Upto 17.5D	Upto 8.75m = P_{Di} = (6.00 x 8.60) + (2.75 x 9.00) = 76.35 kPa
Stratum-IVA	Upto 20D	Upto 10.0m = P_{Di} = (6.00 x 8.60) + (3.00 x 9.00) + (1.00 x 9.00) = 87.60 kPa

Skin friction = α x C x A_S [(Using formula for Pile in cohesive soil) IS: 2911(Part I/ Sec 2)-2010]

Skin friction = $\sum_{i=1}^{n} K \times P_{Di} \times \tan\delta \times A_{si}$ [(Using formula for Pile in granular soil) IS: 2911(Part I/ Sec 2)-2010]

Here, $\sum_{i=1}^{n}$ = Summation for n layers in which pile is installed

K = Coefficient of earth pressure

P_{Di} = Effective overburden pressure

A_{si} = Surface area of pile stem

For 500mm Dia Pile

Skin friction

a. Skin friction in stratum I(1st part) (F_1) $= \alpha \times C \times A_S$
$= 0.75 \times 57 \times 1.57 \times 4.50$
$= 302.028$ KN

b. Skin friction in stratum I(2nd Part) (F_2) $= \alpha \times C \times A_S$
$= 0.50 \times 91 \times 1.57 \times 3.00$
$= 214.305$ KN

c. Skin friction in stratum II (F_3) $= K \times \tan\delta \times P_{Di} \times A_{si}$
$= 1.15 \times 76.35 \times \tan 33^0 \times 1.57 \times 3.00$
$= 268.56$ KN

d. Skin friction for Stratum – IVA(F_4) $= K \times \tan\delta \times P_{Di} \times A_{si}$
$= 1.50 \times 87.60 \times \tan 37^0 \times 1.57 \times 6.50$
$= 1010.469$ KN

e. End bearing for Stratum-IVA(F_5) $= A_p \times P_{dn} \times N_q$
$N_q = 70$ for $\varphi = 37^0$
$= 0.19625 \times 87.60 \times 70$
$= 1203.405$ KN

Total ultimate load $= F_1 + F_2 + F_3 + F_4 + F_5$
$= (302.071 + 214.31 + 268.56 + 1010.47 + 1203.41)$ KN
$= 3099.46$ KN
Safe vertical capacity in compression $= 2998.821/2.50$
$= 1199.528$ KN ≈ 1150 KN

Safe Uplift capacity of pile $= Q_f = (302.071 + 214.31 + 268.56 + 1010.47) / 3.0$

$= 598.47$ KN ≈ 500 KN

PILE CAPACITY CALCULATION FOR 500MM DIAMETER BORED CAST-IN-SITU PILES FOR PILE TIP RESTING WITHIN STRATUM-IVC:

(Refer: *IS 14593: 1998 "Design and Construction of Bored Cast-in-Situ Piles Founded on Rocks-Guidelines"*)

Skin friction of pile shaft in rock is given by:

$$f_s = q_{uc}.\ \Pi.D.\ l_s\ .\ \alpha\ .\ \beta$$

Where, f_s = safe skin friction

α = rock socket slide resistance reduction factor = 0.14

β = rock socket correction factor = 0.50

q_{uc} = unconfined compression strength of rock

= 6.00 MPa = 600 T/m^2

Substituting above values : f_s = 42 T/m^2 in Stratum IVC.

Unit safe skin friction per meter of pile shaft in Strata IVC.

$F_s = \pi\ .\ D\ .\ f_s$

Where D = Pile diameter in mm

Therefore, $F_s = \pi\ .\ D.\ l.\ 42.00$

= 65.97.l T/m

Hence giving a rock socketing of 2.50D times the dia of the pile it comes= (65.97 x 1.25) = 82.463 T

For end bearing in stratum-IVC

$Qs = q_c.N_j.N_d.A_p$ = 600 x 0.10 x 1.30 x 0.1964 = 15.31 T

Where,

q_c = unconfined compression strength of rock = 6.00 MPa = 600 T/m^2

N_d = depth factor = 0.80 + 0.20l_s/D, limited to 2 = 1.30

$A_p = \pi D^2/4 = 0.1963m^2$

N_j = Values as per Fig. 2 of IS: 12070 = 0.10

Total safe carrying capacity in compression = Skin Friction + End Bearing = 82.463 + 15.31 = 97.773 ~ 95 MT

Tension Capacity of Piles:

= 50% of the skin friction

= 82.463/2 ~ 40 MT

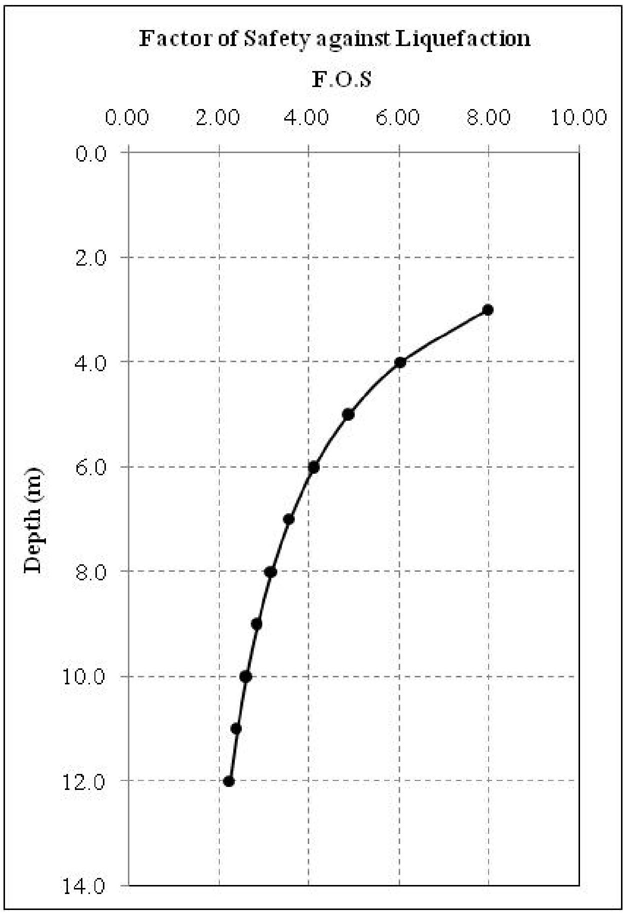
California Bearing Ratio Test

No field CBR/lab CBR have been carried out at this site however on request, based upon our experiences and referring to various standard books providing CBR values for different subsoil conditions. We would like to suggest a CBR value of 6% in soaked condition.

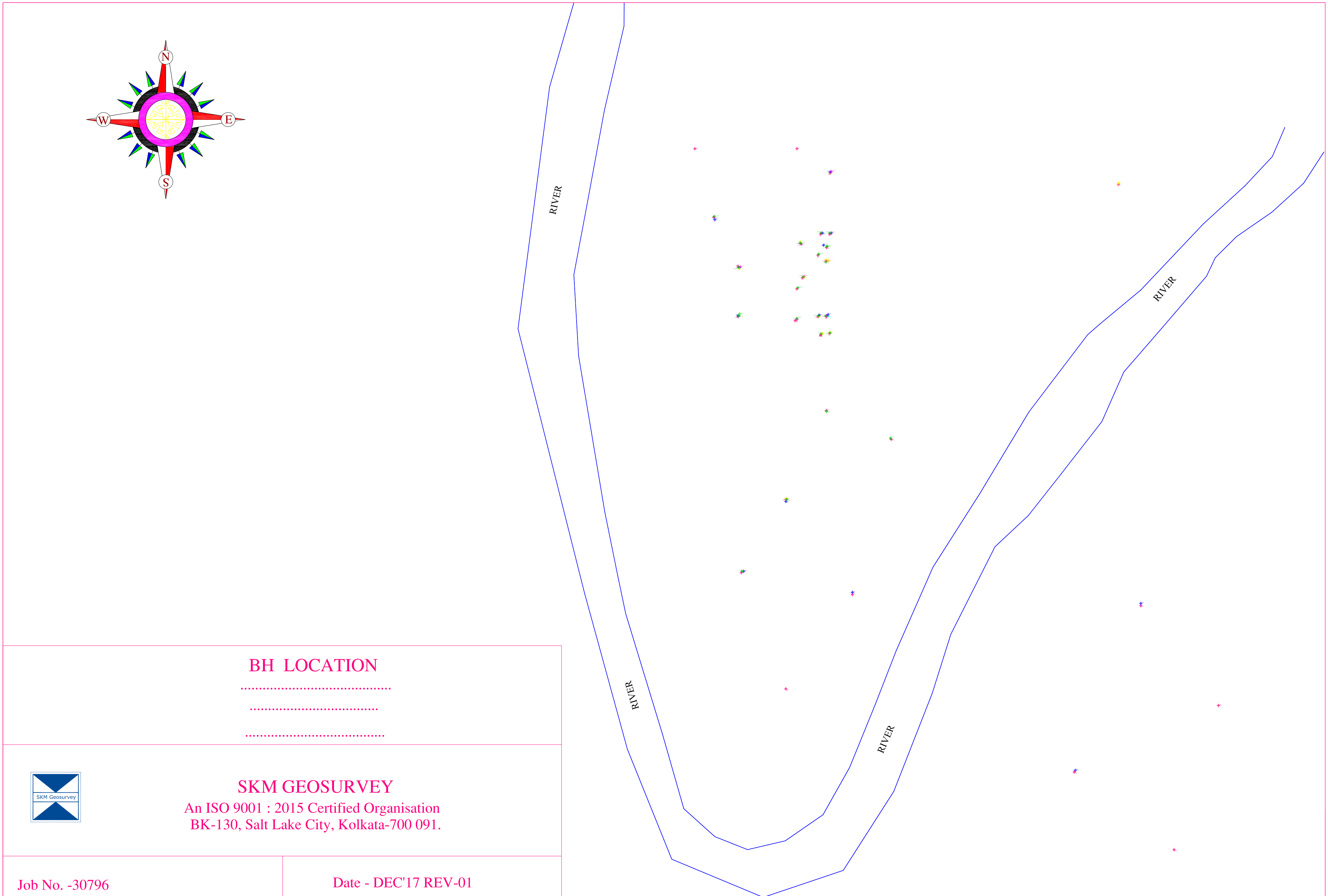
Earthquake magnitude,	M	7.5	
Peak ground acceleration	amax	0.16 g	Bh-03

For Clayey Soil

Strata	Description	Thickness (m)	LP determined for depth, z (m)	Unit weight γ (kN/m^3)	Cohesion (kPa)	Total vertical stress, σ_v	Eff. vertical stress, σ'_v	K_α	MSF	$CRR_{M=7.5}$	Cyclci Stress Ratio induced by Earthquake, CSR	Cyclic Resistance Ratio, CRR	FOS	Check
			1.00	18.60	57.0	18.6	8.6	1.00	1.00	5.28	0.225	5.280	23.49	**Not Liquefiable**
			2.00	18.60	57.0	37.2	17.2	1.00	1.00	2.64	0.223	2.640	11.84	**Not Liquefiable**
			3.00	18.60	57.0	55.8	25.8	1.00	1.00	1.76	0.221	1.760	7.97	**Not Liquefiable**
			4.00	18.60	57.0	74.4	34.4	1.00	1.00	1.32	0.219	1.320	6.04	**Not Liquefiable**
			5.00	18.60	57.0	93.0	43	1.00	1.00	1.06	0.216	1.056	4.89	**Not Liquefiable**
I	Silty clay		6.00	18.60	57.0	111.6	51.6	1.00	1.00	0.88	0.213	0.880	4.12	**Not Liquefiable**
			7.00	18.60	57.0	130.2	60.2	1.00	1.00	0.75	0.211	0.754	3.58	**Not Liquefiable**
			8.00	18.60	57.0	148.8	68.8	1.00	1.00	0.66	0.208	0.660	3.18	**Not Liquefiable**
			9.00	18.60	57.0	167.4	77.4	1.00	1.00	0.59	0.205	0.587	2.87	**Not Liquefiable**
			10.00	18.60	57.0	186.0	86	1.00	1.00	0.53	0.202	0.528	2.62	**Not Liquefiable**
			11.00	18.60	57.0	204.6	94.6	1.00	1.00	0.48	0.198	0.480	2.42	**Not Liquefiable**
		12.0	12.00	18.60	57.0	223.2	103.2	1.00	1.00	0.44	0.195	0.440	2.26	**Not Liquefiable**



SAMPLE CALCULATION FOR LIQUEFACTION



BH LOCATION

....

....

....

SKM GEOSURVEY

An ISO 9001 : 2015 Certified Organisation

BK-130, Salt Lake City, Kolkata-700 091.

Job No. -30796	Date - DEC'17 REV-01