

PRE BID QUERIES

**Construction of Residential Complex (Ph -II) for AIIMS, Raipur (CG) and their Maintenance during DLP on comprehensive, design, engineering, procurement and construction (EPC) Basis.
HSCC/AIIMS/Raipur/Phase-II/Housing/2020 dated 25.04.2020**

Tender No.

Amendment No. II

Date: 20.05.2020

Sl. No.	Clause/Sub Head/Page No.	Clause Description	Comments/Observations/ Query	Remarks provided(if any)	HSCC Reply
1	1.2(iv)/Spec Page E-7 R0/MV & FLOOR PANELS	Apparatus forming part of the Main/Sub Panels shall have the following minimum clearances. i. Between phases - 32 mm ii. Between phases and neutral - 26 mm iii. Between phases and earth - 26 mm iv. Between neutral and earth - 26 mm	Minimum clearances required as per IEC 61439 shall be min. 14 mm. However you may consider clearances as below:- i. Between Phases: 25mm ii. Between phase and earth: 19 mm iii. Between phase and neutral: 19mm	Kindly consider clearances as below:- i. Between Phases: 25mm ii. Between phase and earth: 19 mm iii. Between phase and neutral: 19mm	shall be as per tender conditions.
2	2.1.6/Spec Page E-12 R0/AIR CIRCUIT BREAKERS	Auxiliary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.	ACB makes approved in tenders offers 4 NO + 4NC auxiliary contacts	Kindly consider 4NO + 4NC	shall be as per tender conditions.
3	2.1.6/Spec Page E-12 R0/AIR CIRCUIT BREAKERS	Shunt release for tripping the breaker remotely and shall be suitable for 240volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.	Wide range of operation from 10% - 130% will increase the Coil VA Burden and power consumption. Kindly consider range of operation as 70% to 130% which is available with all approved makes.	Kindly consider range of operation as 70% to 130% of rated voltage.	shall be as per tender conditions.
4	2.2/Spec Page E-13 R0/MOULDED CASE CIRCUIT BREAKERS	MCCBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects.	Latest standard for MCCB is IS/IEC 60947-2	Kindly amend as IS/IEC 60947-2	Latest IS/IEC will be accepted
5	2.2.1/Spec Page E-13 R0/MOULDED CASE CIRCUIT BREAKERS	Fault identification of O/L, S/C, E/F shall be indicated on panel door.	This is a standard feature for ACB however same is not available for MCCB's as of now. We can give common LED indication on panel door for tripping due to Over load or / and Short circuit faults	Kindly delete the same.	Stands deleted
6	2.2.2/Spec Page E-14 R0/MOULDED CASE CIRCUIT BREAKERS	The MCCBs shall have the following frame sizes subject to meeting the fault level or as per manufacturer's standard practice. a. Upto 100A rating 100A frame. b. Above 100A upto 200A 200A frame. c. Above 200A up to 250A 250A frame. d. Above 250A up to 400A 400A frame. e. Above 400A up to 630A 630A frame. f. Above 630A to 800A 800A frame.	Frame sizes are specific to some manufacturer.	Please accept standard frame sizes of approved makes	standard frame sizes of approved makes may be accepted
7	3.3/Spec Page E-17 R0/Distribution Board	All miniature circuit breakers shall be of minimum 9 KA rated rupturing capacity unless otherwise specified.	All miniature circuit breakers shall be of minimum 10KA rated rupturing capacity unless otherwise specified.	Kindly accept minimum rupturing capacity as 10kA.	Accepted
8	12.05(i)/Spec Page E-66 R0/Capacitors	The capacitor unit shall be Heavy Duty MPP resin filled, copper wound type. The dielectric should be made of polypropylene. Capacitor Impregnation shall be Oil Type. Capacitor should be fitted with safety device for each capacitor units. The capacitor should be low loss type (total losses should not exceed 0.45 W/ KVAR).	Capacitor unit shall be Heavy Duty/ Extra Heavy Duty as per given parameters for Over current & Peak Inrns current .	Kindly include Heavy Duty/Extra Heavy duty as per mentioned parameters.	Heavy Duty/Extra Heavy duty accepted
9	Variable Frequency Drive	L&T make is missing in Variable Frequency Drive	We are a reputed and established make of VFD in industry and have a complete range of VFD from 0.1 kW to 450kW.	Kindly add L&T in make list of VFD.	shall be as per tender conditions.

10	extension of bid submission date		As you are aware that no movement is possible due to complete lockdown in the country in compliance with the appeal of Hon'ble Prime Minister of India to observe the 'Janta Curfew' and various notifications/ orders of Govt of India/ State Government issued from time to time with regard to 'Lockdown' of the country including Madhya Pradesh due to Corona Virus Disease (COVID-19). Our offices were not functional and also not able to visit the project location due to this situation. Banks working is also operational with minimum staff and getting service from the bank for the BG/FDR etc is also taking time. Now some employees of our company are able to join the office and again started working on the tender. We are expecting some more relaxation on person/ vehicle movement by the government after 17 May 2020. As this tender is on EPC basis, need through working to derive items BOQ incorporating site visit reports and other aspects of the project to submit the most competitive rates. Considering the above facts, it is requested to consider an extension of bid submission date for at least 21 days to facilitate preparing competitive rates, eligibility documents/ EMD/DD etc. A request letter is also attached for your kind consideration, please.		As per tender condition
11	reschedule the date for the Pre-Tender Meeting		It is to inform you that due to the lock down imposed all over the country because of Covid-19, it was not possible to attend the Pre-Tender Meeting held on 14-05-2020 at HSCC Office, Noida. There are a lot of queries regarding this tender to be discussed in the meeting. Hence, it is requested to your good self to please reschedule the date for the Pre-Tender Meeting after lock down period.		As per tender condition
12	Soil Investigation Report		Kindly Provide Soil Investigation Report for designing structure parts of buildings		Soil investigation report is attached for information only. The Topographical survey, Geotechnical investigation, Hydraulic survey, other investigation(s) as required/desired shall be in the scope of Contractor. Detailed design and engineering shall be done accordingly.
13	Tender drawings		Also provide Tender drawings in Auto Cad format for easing estimation works.		PDF drawings have already been uploaded with tender
14	Clause 4 & Clause 11.1(b)	Maintenance during Defect Liability Period (DLP)	Sir, kindly define the scope of work of Maintenance during Defect Liability Period.		As per tender condition
15	Clause 11.1 (d)	Soil Investigation report will be provided by HSCC to contractor for reference	There is no Soil Investigation report attached in any of the tender documents, kindly provide it as in EPC contract we need it for structural design.		Soil investigation report is attached for information only. The Topographical survey, Geotechnical investigation, Hydraulic survey, other investigation(s) as required/desired shall be in the scope of Contractor. Detailed design and engineering shall be done accordingly.
16	Clause 11.2	Approvals Required	a) Sir, as per our information, campus already has existing building with people living in it, campus approval happens once and then for addition new building permission is taken. Thus, we understand that we have to get all related approvals for only the new blocks to be constructed as mentioned in this tender. b) Kindly provide the drawings of existing services in the site campus		As per tender condition
17	Clause 24, Page 18	Testing facilities," Contractor/EPC agency shall bear the cost of two (02)Nos. qualified engineer having experience of 3 years on role of HSCC for quality control of works"	Kindly specify the cost of engineer per month that is to be borne by the contractor.		Payment shall be made as per the minimum wages guidelines of labour department
18	OPC 43 Grade Cement (Conforming to IS8112)		Sir, ACC, Jaypee Cement, J K. Cement, Vikram, Shree are not supplying OPC 43 grade cement in Chhattisgarh. Kindly add JK Lakshmi cement, Emami cement to the list, as they have a manufacturing plant in the vicinity of Raipur (CG) & they have stable and regular supply of OPC 43. Also they are approved in various central government departments.		As per tender condition
19	Reinforcement Steel (TMT Bars)		Sir, RINL supply is not available in Chhattisgarh. Sir, kindly add "Panther brand TMT of Jindal Steel & Power Limited (JSPL), as they are a primary producer and have their manufacturing facility in state of Chhattisgarh. Also they are in the approved list of CPWD, AAI, NBCC etc.		As per tender condition
20	WPC Flush Doors, WPC Door frame and Shutters		Sir, only a single manufacturer is mentioned, which would result in monopolising of the product and would result in non-competitive rates. Since, equivalent makes is subjected to price adjustments, thus we request you to kindly add three/four names so that competitive rates & time su. *1 may be available to the contractors.		As per tender condition
21	U-PVC Windows		Sir, only a single manufacturer is mentioned, which would result in monopolising of the product and would result in non-competitive rates. Since, equivalent makes is subjected to price adjustments, thus we request you to kindly add "Duroplast", "NCL Veka", "Rehau", these brands are approved in CPWD etc also		As per tender condition
22	STP,ETP,VVTP System Integrator/FIRE FIGHTING System Integrator /EPBAX , SOLAR System Integrator		Sir, it is requested to kindly keep the specialized jobs free for execution by any agencies of repute. We work with a select few specialized agencies of repute, which ensures quality work on timely delivery at competitive prices. We feel limiting/specifying names would result in monopolistic prices for the work execution, thus we kindly request you to remove the names from this for healthy & competitive rates & better work control for the tender.		As per approve make list

23	Introduction about Site	Total Area of all the Blocks combined to be constructed is mentioned is 30,440.00 SQM	a) We are considering that the contractors has to build this area only including stilt area, common areas, mumty, balcony, corridors, lift machine room etc. whatso ever. Kindly advise b) Kindly provide the building dimensions for all the blocks to be built in this tender. c) Kindly provide the AutoCad drawing of this project, as it will be helpful for us in working.	(a) The plinth area shall be calculated as per the "Rules for working out plinth area from plans" of CPWD norm(s). The above area is based on the concept drawings which include Free FAR/ FAR/ Non FAR and other components. Stilted portion has also not been considered at ground floor or at other floor as case may be. (b) Any decrease in the area with respect to the prescribed area shall be recovered proportionately. However additional cost on account of increase in area over and above prescribed area upto +2% shall not be payable and deemed to be included in the quoted rate. Any increase in the area with respect to the prescribed area more than +2% shall be paid proportionately. (c) PDF drawings have already been uploaded with tender.
24	External Finishes-Site Plan	2. ALL INTERNAL ROADS WILL BE CONCRETE WITH BRUSH FINISH 3. CONCRETE KERB ON EDGES OF FOOTPATHS, GREEN ISLANDS, ETC. 4. PAVER TILES + SANDSTONE BANDS ON FOOTPATHS 9. PARKING AREA – CAR PARKING @ CONCRETE WITH BRUSH FINISH	Kindly clarify, a) Length & width of Internal Road & cross section of the internal road. b) Length of Footpath & cross section of the same. c) Cross section of Drains to be made along the internal road. d) The demarcated location of Car Parking in the campus and the area (in SQM) of the required car parking.	As per tender condition
25	External Finishes-Site Plan	11. GATE & GUARD ROOM – SAND STONE CLADDING (VENTILATED FACADE) WITH GRC JALI, GRANITE DLADDIN, ZINC CLADDING, ALUMINIUM DOORS & WINDOWS, MS GATE AS PER DESIGN	Kindly clarify, a) Details, concept drawings & elevation of the Gate b) The size (in SQM) and amenities (like bathroom) to be provided for the Guard room.	As per tender condition
26	Finishes Residential Blocks	All Blocks	Kindly clarify, a) Finishes of Staircases (like tread, riser & Railing) b) Staircase tread/riser size . Only type 3 has steps of 300/150mm rest all are 250/157mm. Can this be standardized across all blocks c) Railing / parapet height has been given as – 1000mm, whereas the same is specified as 1200mm as per NBC 2016 d) External Finish-Crushed Stone Dust Paint, none of the paint companies have such a product, please clarify	As per tender condition
27	Landscape Concept, Landscape Sustainability, Guidelines – PDF Page no 18-21.	It is mentioned to make a grand landscape design with woodlands, plazas, squares, courtyards, market place, amphitheatre, reading zones, sports area and other architectural land marks etc.	Kindly provide a) detailed scope of work for the same with Landscape area (in SQM) and locations demarcated in the site plan. b) provide the areas (in SQM), concept drawings of all the structures (like market place, plazas, square, amphitheatre etc) and schedule of finishes for the same.	As per tender condition
28	DBR - Plumbing, Clause 1.5, Clause 6	Garden Hydrant System & Irrigation system for lawns and gardens	Kindly provide the area (in SQM) and location for the Landscape/Garden areas as it is not mentioned anywhere in the tender.	The total plot area and the footprint area of the buildings are already mentioned in the tender.
29	DBR - Plumbing, Clause 9	WTP, STP	Kindly clarify, a) Kindly provide the location for the new STP & WTP in site plan. b) Clause 9, B, 2.5- Water demand Projection mentioned is 170 GUM, is this daily/monthly/yearly?	A) As per Drawing/as Per site condition b) Daily water demand Projection
30	DBR - Plumbing, Clause 9,B,2.6.1	Under Ground/Overhead Water Storage	Kindly Clarify, a) Do we have to make individual UG tank for water supply for each block or can it be centralized as per contractors discretion? a) Do we have to make individual UG tank for Fire Fighting for each block or can it be centralized as per contractors discretion?	A) Centralized UG tank for water supply B) No Fire fighting UG tank as per DBR
31	DBR - Plumbing, Clause 9, C- Design Basis Report of Reverse Osmosis Plant (RO Plant) & Technical Specification- PHE and Fire Fighting Works	Clause 9,C,2:- Portable RO Unit & Technical Specs, Clause 15:- REVERSE OSMOSIS (R.O.) PLANT FOR PROCESS AND DRINKING WATER	Kindly Clarify, a) In DBR it is mentioned Portable RO Units in each buildings while, in Technical specification it is mentioned centralized RO unit for the whole project. Kindly advise.	A) As per DBR Portable RO unit in Each building

32	DBR - Plumbing, Clause 9 (F)- Fire Fighting System & Technical Specification- Fire Fighting Works	Clasue 9(F), 1.0, "Fire Fighting system shall comprise of Wet Riser /Hydrant (Internal & External), Down corner System..." & Technical Specs. Clause 21, Scope of Work:- 21.01(i)- "Fire sprinkler system, as described later in the volume."	Kindly Clarify, Do we have to consider Fire sprinkler system also in addition to scope of work of Fire Fighting as mentioned in DBR in all blocks		No Fire Sprinkler system
33	DBR - Plumbing, Clause 3, Sanitary Works	Clause 3.1, a) WCs - Low volume dual flushing system comprising concealed cistern are proposed as per IS: 2556. b) Lavatory Basins available in all size and shapes including wall hung, over or under counter types etc with infra-red sensor as per IS: 2256 (Part 7) 1995. c) Accessories - Soap dispensers, toilet paper holders, hand drier, etc. shall be of Stainless Steel. d) Chrome Fittings Provision for additional and special hospital fittings where required shall be made as per IS: 781 - 1984.	Kindly clarify, a) It is understood by us that we have to provide flushing system comprising of concealed cistern system in all the bathrooms of all residences, in all hostels, in full amenity block. Kindly Advise. b) Lavatory basin is to be provided with infra-red sensor CP fittings in all the bathrooms of all residences, in all hostels, in full amenity block. Kindly Advise. c) In accessories - kindly provide the exact list as you have mentioned "etc.", and due to this the accessories list will be highly variable and would be difficult to calculate cost of accessories. d) Kindly specify the list of "special hospital fittings where required shall be made".		a)Low volume dual flushing system comprising concealed cistern shall be proposed in Type-4 &6 and amenity block. b)No infra-red sensor in lavatory Basins. c) Requirements as per drawing of Toilet layout(Soap dispenser, toilet paper holder, towel rail, soap tray, coat hook, hand drier). d) No hospital fittings shall be required.
34	DBR - Fire Fighting DBR- HVAC	DBR-Fire Fighting, Clause 2.6, Pressurization System & Compartment System DBR-HVAC, Clause 1.3.1, Type of Air Conditioning System	With study of both clauses we have understood that we have to provide pressurization system in all the Staircases & all Lift Lobby & all Lift-well of all the building blocks to be constructed in this tender. Kindly advise.		A) No compartment system is required. B) Pressurisation Required as per NBC/Local bylaws for lift lobby/lift well of high rise buildings only not all buildings
35	DBR-Electrical Clause 11.8, UPS System	UPS System	Kindly clarify the capacity of UPS and list of equipments for which UPS will provide backup,as list of System LV equipments is very long		UPS for LV equipment CCTV,PA,FDA etc. considered as per design based on DBR and specs.
36	DBR-Electrical, Clause 5 & Clause 6, Electrical Substation	Electrical Substation	Kindly clarify the location for the new Electrical Substation to be made in the site plan.		Pacakege type substation has been consided. Proposed to nearest existing Substation.
37	PHE & Fire Fighting Works, Clause 18	HYDROPNEUMATIC SYSTEM	Kindly Clarify, a) Sir, this is not mentioned in Designing Basis report, do we have to provide it?		Hyopneumatic system is to be provided
38	PHE & Fire Fighting Works, Pg no 69 to 75	TERRACE WATERPROOFING AND INSULATION, WATERPROOFING OF WATER TANKS & STP, TOILET WATERPROOFING.	Sir multiple specification is given for the same work, kindly clarify which specification to follow.		As per technical Specification
39	Tender Drawings		Are the dimensions mentioned (lift well, corridor, room size etc.) in the drawings fixed or can be hanged a bit keeping inline with NBC 2016 code.		Detailed architectural planning, design and engineering shall be in the scope of contractor as per relevant clause(s) of tender provison(s) and approval of competent

All other terms & conditions of tender shall remain unchanged.

Prospective bidders are advised to regularly scan through HSCC e-tender portal <http://www.tenderwizard.com/HSCC> as corrigendum/amendments etc, if any, will be notified on this e- tender portal only and separate advertisement separate advertisement will not be made for this.

Thanking You.

General Manager(Projects)



**REPORT
ON
GEOTECHNICAL INVESTIGATION
FOR**

**“GEOTECHNICAL INVESTIGATION FOR PROPOSED
CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS,
RAIPUR (C.G).”**

CARRIED OUT FOR



H.S.C.C (INDIA) LIMITED

(A Government of India Enterprise)

SUBMITTED BY



Becquerel Industries Pvt. Ltd. (BIPL)

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REPORT

Report No. 2262

Report Date. 14.6.2019

CUSTOMER : H.S.C.C (INDIA) LIMITED

ADDRESS : E-6 (A), Sector-1, Noida
(U.P.)-201 301

CUSTOMER REFERENCE No. : HSCC/D&E/AIIMS/Raipur/Residential/Geotech_Survey/2019/06 DT. 20.06.2019

SAMPLED BY : Becquerel Industries Pvt. Ltd.

PROJECT : Geotechnical Investigation for Proposed Construction of Residential Blocks at AIIMS Raipur, (CG)

MATERIAL IDENTIFICATION : SPT & Soil from 5 Locations

DATE OF FIELD TEST : 28.06.2019 to 15.07.2019

TEST PERFORMED : SPT & Lab Test on Soil samples.

DATE OF LAB TEST : From 19.07.2019 onwards

METHOD OF TEST : As Per Indian Standard

SUB SOIL EXPLORATION & ANALYSIS REPORT

1.0 OBJECT

Conducting detailed Subsoil Investigation for proposed “**Geotechnical Investigation for Proposed Construction of Residential Blocks at AIIMS, Raipur, (CG).**” for “**H.S.C.C (INDIA) LIMITED**” The present report consists of detailed engineering services carried out at the above mention site location.

2.0 INTRODUCTION

2.1 PROJECT DESCRIPTION

Exploratory drilling and other geotechnical investigations work is carried out for M/s. “**H.S.C.C (INDIA) LIMITED**”, for the Project of “**Geotechnical Investigation for Proposed Construction of Residential Blocks at AIIMS, Raipur (CG).**”

Investigation was intended to evaluate bearing capacity of available soil/rock stratum and other physical parameters necessary for the design of suitable foundation for proposed construction of new recreation and residential Buildings. The scope of work includes in this project is explain briefly below. The main text of the report includes description of field explorations, laboratory testing, subsurface conditions, conclusions and recommendations based upon review of existing data, engineering studies and analysis. M/s. **Becquerel Industries Pvt. Ltd.** has been appointed by **H.S.C.C (INDIA) LIMITED** for carrying out geotechnical investigation at the project site.

3.0 SCOPE OF WORK

The overall scope of work was to investigate the stratigraphy at the site and to develop preliminary geotechnical recommendations for the initial planning to accomplished these purposes, the work is being conducted in the following phases.

- 1) Drilling 13 boreholes to specified depth in order to evaluate the stratigraphy at the site, and to collect soil samples for laboratory testing's.
- 2) Testing selected soil and groundwater samples in the laboratory to determine pertinent index and engineering properties; and
- 3) Analyzing all the field and laboratory data to develop geotechnical recommendations for foundation design and construction.

3.1 Exploratory Boreholes

SR. No	STRUCTURE/LOCATION/ CHAINAGE	B.H No	CO-ORDINATES		REDUCED LEVEL (M)	DEPTH OF G.W.T (M)	TERMINATION DEPTH (M)
			EASTING X	NORTHING Y			
1	Type -1B Left Side	BH-1	81.5642	21.2317		2.00	10.50
2	Type -1B Front	BH-2	81.5940	21.2621		2.50	10.25
3	Type -1B Front	BH-3	81.5939	21.2624		4.00	13.50
4	Type -1A Front	BH-4	81.5946	21.2322		2.10	10.00
5	Type -1A Front	BH-5	81.5949	21.2625		6.00	10.50
6	Type-3 A Left Side	BH-6	81.5956	21.2334		6.50	10.00
7	Type -3A Left Side	BH-7	81.5987	21.2638		6.00	10.15
8	Type-4 A Left Side	BH-8	81.5948	21.2643		6.20	10.00
9	Type -4A Left Side	BH-9	81.5945	21.2646		7.00	10.50
10	Type -4A Left Side	BH-10	81.5943	21.2345		7.50	10.00
11	Director Bungalow Front side	BH-11	----	-----		7.50	10.00
12	Director Bungalow Left side	BH-12	81.5964	21.2656		6.50	10.30
13	Director Bungalow Left side	BH-13	81.5965	21.2665		6.00	10.20

4.0 GEOLOGICAL INFORMATION OF THE REGION

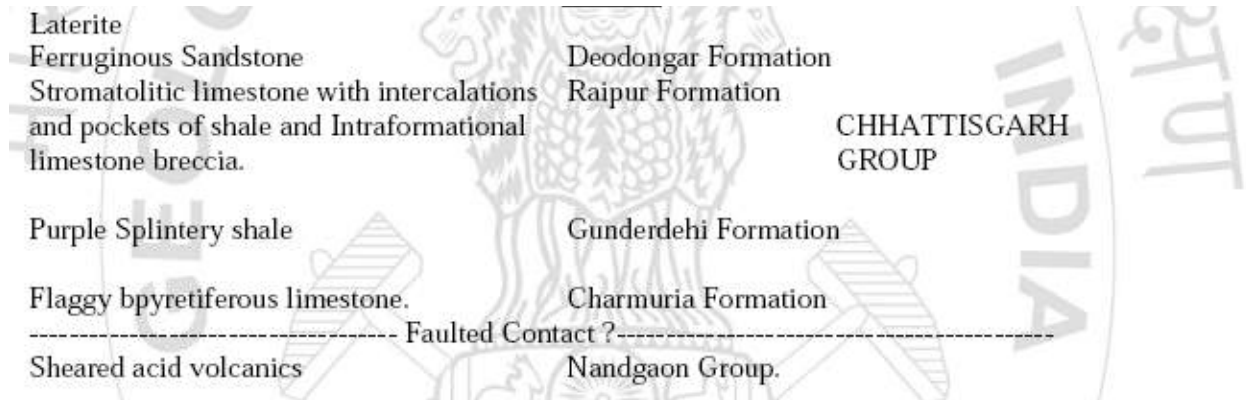
4.1 REGIONAL GEOLOGY

Project "Geotechnical Investigation for Proposed Construction of Residential Blocks at AIIMS, Raipur (CG)." is in the state of Chhattisgarh. The total area is cover in Raipur district.

Raipur district is located in the centre of the Chhattisgarh state and is bounded by East longitudes 81°32'05" & 82°59'05" and by North latitudes 19°46'35" & 21°53'00". Raipur is located near the centre of a large plain, sometimes referred as the "rice bowl of India", where hundreds of varieties of rice are grown. The Mahanadi Riverflows to the east of the city of Raipur, and the

southern side has dense forests. The Maikal Hills rise on the north-west of Raipur; on the north, the land rises and merges with the Chota Nagpur Plateau, which extends north-east across Jharkhand state. On the south of Raipur lies the Deccan Plateau.

Raipur district area is monotonously plain with very scanty exposures. Lithological boundaries are mostly concealed under soil cover. As per geological survey of India, systematic geological mapping was carried out of Raipur district (Toposheets no 64/G3, G8,). On the base of the field observation, tentative stratigraphic succession of durg district area is as followed :



4.2 SITE GEOLOGY

The project site is totally flat.

The soils at the site generally consist of yellowish clayey soil from the ground level to maximum explored depth of about 3.0m. A surficial layer of clayey soil is encountered about 1.5m depth followed by limestone.

As per the exploration work done by Becquerel industries pvt ltd for HSCC (INDIA) LIMITED, at Raipur, during the exploration work following rock was occurred at deferent bore holes locations

LIMESTONE

The rock is grey coloured, Stromatolitic limestone. The rock occurs at comparatively higher elevation than that of the adjacent Raipur Stromatolitic limestone-shale Formation.

4.3 SEISMICITY

The seismic hazard map of India was updated in 2002 by the Bureau of Indian Standards (BIS). The project site lies in Zone II. The maximum intensity expected in these areas would be around MSK VI. The area under study and its surroundings are seismically active falls in Seismic Zone – II and the tectonic elements of the area are considered capable of generating an earthquake of moderate intensity. In seismic design Zone factor, Z of 0.10 is recommended for Zone II.



5.0 METHODOLOGY OF FIELD INVESTIGATION

The investigation was planned to obtain the subsurface stratification in the proposed project site and collect soil samples for laboratory testing to determine the engineering properties such as shear strength, along with basic engineering classification of the subsurface stratum to arrive at the foundation design parameters.

5.1 BOREHOLES

For Geotechnical investigation work, drilling rig was installed at the specified borehole location. The boreholes were progressed using Rotary Drilling machines. Boring was advanced at selected / specified borehole locations. This rig is coupled with diesel engine and has tripod and all drilling accessories. Drilling rig deployed is suitable for and has arrangement for driving as well as extracting casing, boring drilling by mud circulation method, conducting Standard Penetration Test (SPT) collection of Undisturbed Soil Sample (UDS) and Disturbed or wash Soil Sample (DS). Fig.1 illustrates a standard rotary drilling rig

The following precautions were taken;

1) Diameter of Borehole was 150mm in soil and NX size in rock, all field work was supervised by well trained / experienced persons.

- 2) Borehole was properly cleaned before taking any sample in soil.
- 3) Casing was used as per the prevailing soil conditions / rock, to stabilize the borehole.
- 4) Required field tests i. e, Standard Penetration Tests and collection of undisturbed / disturbed samples was conducted as per requirements and specified depths / levels, the same has been discussed in detail in sampling and tests in a borehole clause.
- 5) Rock core drilling was advanced using double tube core barrels with diamond bits

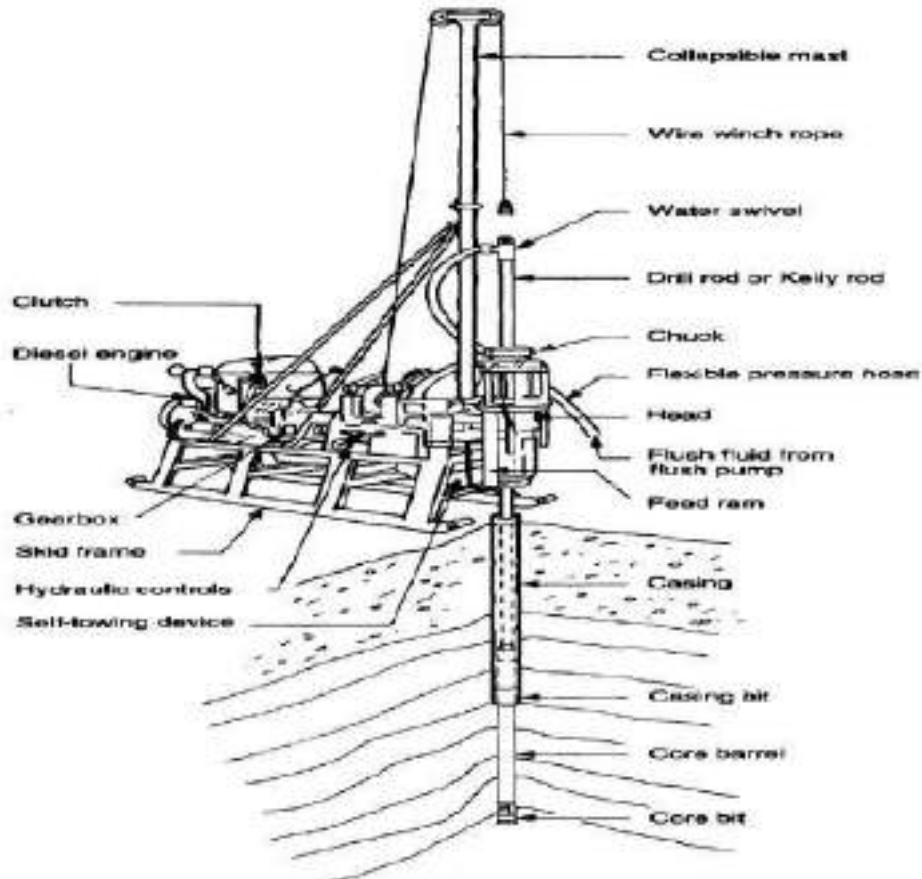


Figure 1: Layout for a Small Rotary Drilling Rig

5.2 STANDARD PENETRATION TESTS (SPT)

Standard Penetration Tests (SPT) was conducted as per IS specifications. SPT split spoon sampler of standard dimensions was driven into the soil from the borehole bottom using 63.5 kg Hammer falling from 75 cm height. The SPT weight was mechanically lifted to the specified height and allowed to fall freely on the anvil with the use of cat-head winch with one to one and half turn of the drum. Blow counts for the penetration of every 15 cm were recorded and the N is reported as the blow counts for 30 cm penetration of the sampler leaving the first 15 cm penetration as seating drive.

When the number of blows exceeded 50 to penetrate the first or second 15 cms length of the sampler, the SPT N is regarded as more than 100. The test is terminated in such case and a record of penetration of the sampler under 50 blows or more is made. SPT refusal is recorded when there is no penetration of the sampler at any stage and also when a rebound of the sounding system is recorded. SPT 'N' values are correlated with relative density of non-cohesive stratum and with consistency of cohesive stratum. SPTs were taken at 1.50 m interval. Fig.2 Illustrates general arrangement for SPT.

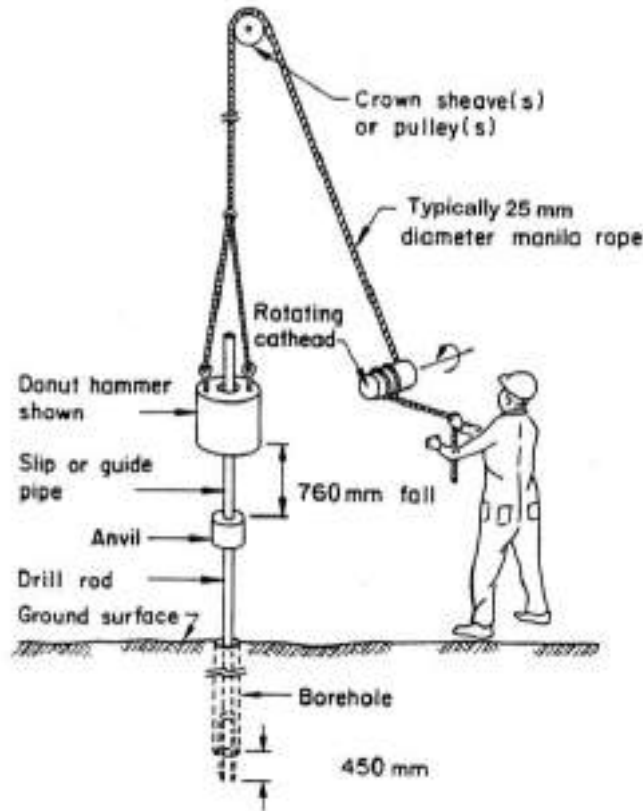


Figure 2: General arrangement for Standard Penetration Test

Correlation for Clayey/ Plastic Silt		Correlation for Sand / Non-Plastic Silt	
Consistency	Penetration Value	Relative Density	Penetration Value
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	3 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	5 to 8 Blows	Medium	11 to 30 Blows
Stiff	9 to 16 Blows	Dense	31 to 50 Blows
Very Stiff	17 to 32 Blows	Very Dense	Above 50
Hard	Above 32		

5.3 DISTURBED SAMPLING (SOIL) IN BOREHOLES

Disturbed soil collected in the SPT sampler was preserved in polythene covers and transported to the laboratory. One more polythene cover was provided to prevent the loss of moisture during the transit period.

5.4 UNDISTURBED SAMPLING (SOIL) IN BOREHOLES

Undisturbed samples were collected using 100 mm dia and 450 mm long MS tubes with Area ratio as specified in BIS provided with sampler head with ball check arrangement, before taking any sample tubes were properly greased. Immediately after taking an undisturbed sample in a tube, the adopter head was removed along with the disturbed material. The visible ends of the sample shall each be trimmed off any wet disturbed soil. The ends will then be coated alternately with four layers of just molten wax. More molten wax will then be added to give a total thickness of not less than 25 mm.

Undisturbed samples were collected by light hammering, all precautions were taken to prevent disturbance in transport also. If in laboratory, density is not found in order in comparison of N values, that sample was treated as disturbed sample, and tests were conducted on remolded samples and recorded in laboratory data sheet as UDS/DS-S. Collection of undisturbed samples in very hard cohesive soils / dense granular soils / gravels / cobbles / pebbles / boulders, refusal strata is practically not possible and such collected samples will not truly represent the undisturbed conditions.

5.5 ROCK CORE SAMPLES

Drilling was advanced by rotary core drilling method using double tube core barrels as per the guidelines of IS: 6926-1996. A core barrel and NX sized bits are used for drilling and recovering rock cores. Recovered rock cores were numbered serially and preserved in good quality sturdy core boxes as specified in IS: 4078-1980 as shown in fig. 3. Rock core recovery and Rock Quality Designation (RQD) were computed for every run length drilled as shown in fig. 4

Rock classification in terms of weathering and state of fractures and strength is carried out in the following manner. Tabulations given in below explain it briefly.

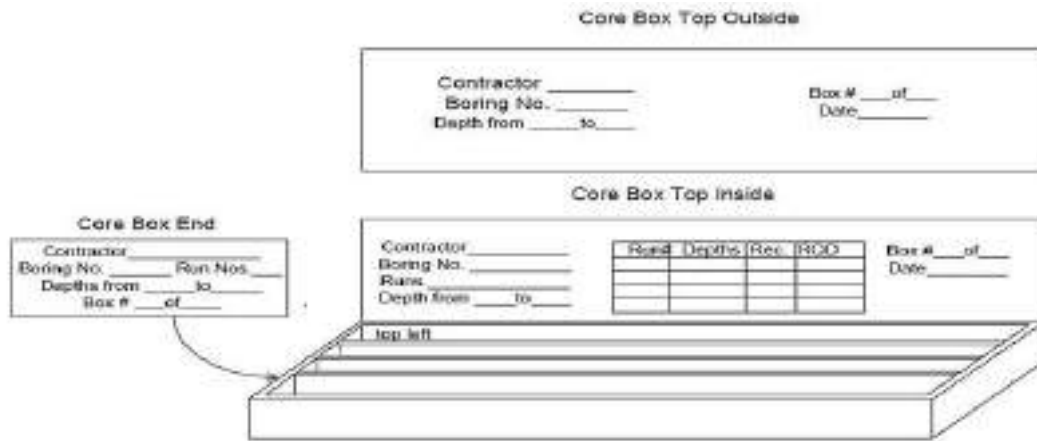


Figure 3: Figure 4: Core Box Captioning

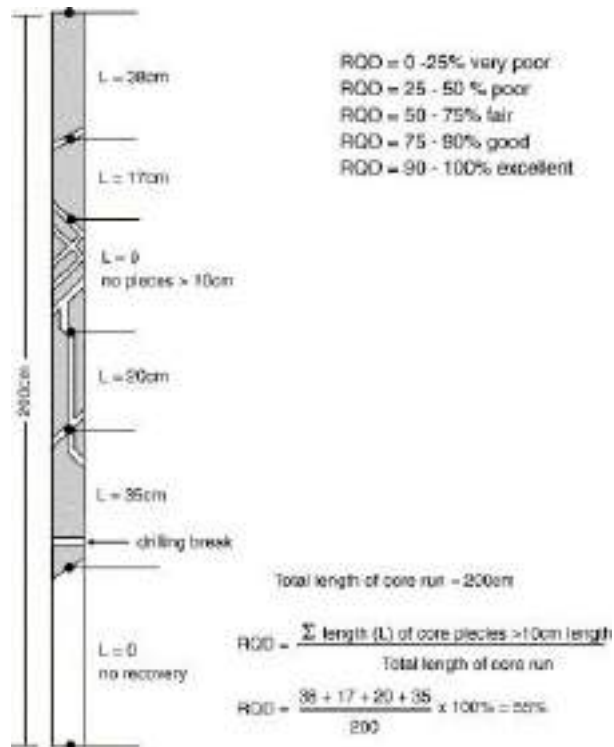


Figure 4: Percentage Core Recovery and Rock Quality Designation

SCALE OF WEATHERING GRADES OF ROCK MASS

Item	Description	Grade	Geologist Interpretation
Fresh	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces	I	CR > 90%
Slightly Weathered	Discolouration indicates weathering of rock material & discontinuity surfaces. All the rock material may be discoloured by weathering & may be somewhat weaker externally than in its fresh condition.	II	CR in between 70% to 90%

Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as core stones.	III	CR in between 50% to 70%
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as core stone.	IV	CR in between 10% to 50%
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V	CR in between Zero to 10%
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI	No Core Recovery But N > 50 (Refusal)

As per IS 4464 It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

CLASSIFICATION OF ROCK WRT COMPRESSIVE STRENGTH

Rock is also classified by strength of intact rock cores collected during drilling. Rock Unconfined Compressive strength (UCS) is used to define strength of rock. Classification of rocks given in cIs 8, Table 2 of Appendix-2 of IRC: 78-2014 is reproduced below;

Rock Type	Description	Unconfined Compressive Strength (UCS) in MPa
Extremely Strong	Cannot be scratched with knife or sharp pick. Breaking of specimen could be done by sledge hammer only.	> 200
Very Strong	Cannot be scratched with knife or sharp pick. Breaking of specimens requires several hard blows of geologists pick.	100 to 200
Strong	Can be scratched with knife or pick with difficulty. Hard blow of hammer required to detach hand specimen.	50 to 100
Moderately Strong	Can be scratched with knife or pick, 6 mm deep gouges or grooves can be made by hand blow of geologists pick. Hand specimen can be detached by moderate blow.	12.5 to 50
Moderately Weak	Can be grooved or gouged 1.5 mm deep by firm pressure on knife or pick point. Can be broken into pieces or chips of about 2.5 mm	5 to 12.5

	maximum size by hard blows of the points of geologists pick.	
Weak	Can be grooved or gouged easily with knife or pick point. Can be break down in chips to pieces several cm's in size by moderate blows of pick point. Small thin pieces can be broken by finger pressure.	1.25 to 5
Very Weak	Can be carved with knife. Can be broken easily with point of pick. Pieces 25 mm or more in thickness can be broken by finger pressure. Can be scratched easily by finger nail.	< 1.25

5.6 GROUND WATER

Ground water table was observed after waiting for time gap of 24 hours after completion of borehole. The measured Ground water levels are recorded on the individual soil profiles.

5.7 CHEMICAL ATTACK

Results of chemical test on ground water and selected soil samples are presented in Annexure. The results indicate that ground water contains about 41.98 – 62.98 mg/l sulphates, 41.98 – 62.98 mg/l chlorides, whereas Soil sample contains about 0.030-0.054% by mass of sulphates, 0.011 – 0.041% by mass of chlorides. The ph value of soil sample is about 7.72-8.45 and that of ground water is 6.5-8.10 indicating nearly neutral condition.

IS:456-2000 recommends that precautions should be taken against chemical degradation of concrete if

- the sulphates contain of soil exceed 0.2 percent or,
- Ground water contains more than 300 mg/l of sulphates (SO₃).

Comparing the test results with these specified limits, the sulphates content of the groundwater exceed the limit whereas that for soil is within the limits. Reviewing the test results the strata at site may be treated in Class 1 category (as per table 4, IS 456-2000)

6.0 GEOTECHNICAL LABORATORY TESTING.

The laboratory testing on collected soil and rock samples had been carried out in our NABL accredited laboratory as per relevant IS codes to determine their physical and engineering properties.

6.1 SOIL SAMPLES

Sr. No.	Tests		IS Codes
1	Bulk Density		By calculations
2	Natural Moisture Content		IS:2720 Part 2-1973, RA-2010
3	Specific Gravity		IS:2720 Part 3-1980, RA-2007
4	Grain Size Analysis		IS:2720 Part 4-1985, RA-2010
5	Liquid Limit(LL), Plastic Limit (PL), Plasticity Index (PI)		IS:2720 Part 5-1985, RA-2010
6	Free Swell Index (FSI)		IS:2720 Part 40-1977
7	Direct Shear Test (DST)		IS :2720 Part 13- 1986
8	Consolidation Test Results		IS:2720 Part 15-1986, RA-2007
9	Chemical Analysis of Water	pH value	IS:3025 Part 11-1983, RA-2006
10		Sulphates	IS:3025 Part 24-1986, RA-2009
11		Chlorides	IS:3025 Part 32-1988, RA-2009
12	Chemical Analysis of Soil	pH value	IS:3025 Part 11-1988, RA-2006
13		Sulphates	IS:3025 Part 24-1986, RA-2009
14		Chlorides	IS:3025 Part 32-1988, RA-2009

6.2 ROCK CORE SAMPLES

Sr. No.	Tests	IS Codes
1	Preparation of Rock Specimen	IS : 9179
2	Point Load Strength tests	IS : 8764
3	Uniaxial Compressive Strength	IS : 9143
4	Density, Water Absorption, Porosity, Sp. Gravity	IS : 13030 / IS : 1124

7.0 ENGINEERING ANALYSIS OF FOUNDATION SUPPORT

A suitable foundation for any structure should have an adequate factor of safety against exceeding the bearing capacity of the supporting soil. also the vertical movements due to compression of the soils should be within tolerable limits for the structure. we consider that

foundation designed in accordance with the recommendations given herein will satisfy these criteria.

Considering the nature of sub-surface strata, type of proposed structures, expected scour and loads on foundations, Open foundation is recommended;

For satisfactory performance of a foundation, the following criteria must be satisfied;

- (i) The foundation must not fail in shear.
- (ii) The foundation must not settle by an amount more than the permissible settlement.

The smaller of the bearing pressure values obtained according to (i) and (ii) above, is adopted as the allowable bearing capacity.

Design Considerations for Open Foundations

Permissible settlement in soil (Non Plastic / Plastic)	50 mm / 75 mm
Permissible settlement in rock	12 mm
Water Table correction factor	0.50
Average Design Parameters	as per clause 5.2 to 5.6.

Depth of Open Foundation in Soil

A foundation must have an adequate depth from considerations of adverse environmental influences. It must also be economically feasible in terms of overall structure.

Depth of foundations in soil shall be decided as per clause 7 of IS: 1904 for special cases like; where volume change is expected / scour is expected / foundations on sloping ground / foundation on made or filled up ground / frost action is expected etc. All foundations shall extend to a depth of at least 0.5 m below natural ground level. Where filled up materials are encountered, foundations should rest either on natural ground or engineered fill. Where filled material is exposed at the founding level, excavation should be carried out up to the level of natural soils. Backfill of granular materials should be placed in layers and compacted thoroughly. In case of small bridges / culverts, top of bottom slab shall extend 0.3 m depth below bed level as per IRC: SP-13.

Depth of Open Foundation in Rock

The founding levels should fix considering an embedment of at least 0.60 m into the sound rock and 1.50 m in to the disintegrated / weathered soft rock.

As per clause 705.2.2 (a) of IRC: 78; for moderately strong to extremely strong rock with an ultimate crushing strength of 125 kg/cm² or above or where it is not possible to take core to get the UCS but

extrapolated SPT N value is more than 500 the depth of foundation shall be 0.60 m. below rock surface.

However, depth of foundation is 1.50 m. in moderately weak rocks having with an ultimate crushing strength between 125 kg/cm² to 25 kg/cm² or where it is not possible to take core to get the UCS but extrapolated SPT N value is more than 100 but less than 500. In other cases the embedment of the foundations shall be decided keeping in view the overall characteristics like fissures, bedding planes, cavities, ultimate crushing strength, proposed treatment of foundation strata etc.

8.0 BEARING CAPACITY

8.1 Bearing Capacity for Open Foundations in Soil

Bearing capacity for shallow foundations in soil has been analyzed in accordance with IS: 6403-1981, which is based on, modified Terzaghi's classical approach. The weighted average of shear parameters for various strata up to a significant influence zone of 1.5 B (B = width of the foundation) below the foundation level is used in the analysis. Considering the fluctuation of ground water, it is assumed that water table will be at existing ground level and accordingly the water table correction is applied. A factor of safety of 2.5 is selected based on clause 706.3.1.1.1 of IRC 78-2014 to estimate the net safe bearing capacity from ultimate net bearing capacity.

Standard Penetration Test (SPT) results are also used to determine the safe bearing capacity of shallow foundation in accordance with IS: 6403-1981 for non-cohesive soil, hard clay. While using this approach, the N value was corrected, wherever applicable, below the footing base to at least 1.5B below the base to account for the effects of energy ratio, adopted boring procedure, dilation for submerged Silty fine sands /fine sands as well as that due to the overburden pressure (Reference: IS: 2131-1981, "Foundation Analysis and Design" by J. E. Bowles).

8.1.1 Bearing Capacity as per I.S 6403-1981 R.A.2002 from shear failure consideration

❖ For local shear failure:

$$Q'd = 2/3 * C * N' * C * s_c * d_c * i_c + q * (N'q - 1) * s_q * d_q * i_q + 0.5 * B * \gamma * N'r * s_r * d_r * i_r * W'$$

❖ For general shear failure:

$$Q_d = C * N_c * s_c * d_c * i_c + q * (N_q - 1) * s_q * d_q * i_q + 0.5 * B * \gamma * N_r * s_r * d_r * i_r * W'$$

Where, Q'd = Net ultimate Bearing Capacity based on local shear failure

Qd = Net ultimate Bearing Capacity based on local shear failure

C=Cohesion.

ϕ =Angle of Internal Friction.

N_c, N_q, N_γ =Bearing Capacity Factors Based on ϕ .

S_c, S_q, S_γ =Shape Factors

d_c, d_q, d_γ =Shape Factors

i_c, i_q, i_γ =Shape Factors

q= Overburden Stress at the Bottom of the Foundation.

γ = Unit weight of subsoil

B= Width of foundation

W'= Correction factor for water table location

Where factors are calculated as follows

❖ Shape Factor

Shape of Base	S_c	S_q	S_γ
Continuous strip	1	1	1
Rectangle	$1 + 0.2B/L$	$1 + 0.2B/L$	$1 - 0.4B/L$
Square	1.3	1.2	0.8
Circle	1.3	1.2	0.6

❖ Depth factor

$d_c =$	$1 + 0.2(D_f/B)(N\phi)^{1/2}$
$d_q = d_\gamma =$	1 for $\phi < 10^\circ$
$d_q = d_\gamma =$	$1 + 0.1(D_f/B)(N\phi)^{1/2}$ for $\phi > 10^\circ$

❖ Inclination factor

Inclination Factor	
$i_c = i_q =$	$(1 - \alpha/90)^2$
$i_\gamma =$	$(1 - \alpha/\phi)^2$

Appropriate values have been substituted into the above mention bearing capacity equation to compute the net ultimate bearing capacity. A factor of safety of 2.5 is selected based on clause 706.3.1.1.1 of IRC 78-2014 to estimate the net safe bearing capacity from ultimate net bearing capacity. the values have been checked to determine the settlement of the foundation under the safe bearing pressure. The allowable bearing pressure has been checked as the lower of the two

values computed from the bearing capacity shear failure criteria as well as that computed from the tolerable settlement criteria.

8.1.2 Bearing Capacity as per I.S 6403-1981 R.A.2002 for Cohesionless Soil (When C = 0)

As per clause 5.2.2 of IS:6403-1981 (*Determination of bearing capacity of shallow foundations*), for cohesionless soil the net ultimate bearing capacity is given based on Standard Penetration Resistance Value as follows

$$Q_d = q \cdot (N_q - 1) \cdot s_q \cdot d_q \cdot i_q + 0.5 \cdot B \cdot \gamma \cdot N_r \cdot s_r \cdot d_r \cdot i_r \cdot W'$$

Where ϕ may be read from Fig. 1, page no 11 in I.S 6403-1981 R.A.2002, N_q , N_r may be read from Table 1, S_q , d_q , i_q , S_r , d_r , i_r and W' may be obtained as in clause 5.1 I.S 6403-1981 R.A.2002

8.1.3 Bearing Capacity as per I.S 6403-1981 R.A.2002 for Cohesive Soil (When $\phi = 0$)

❖ Homogeneous Layer

As per clause 5.3.1 of IS:6403-1981 (*Determination of bearing capacity of shallow foundations*), for fairly homogeneous soil the net ultimate bearing capacity is given as;

$$Q_d = C \cdot N_c \cdot s_c \cdot d_c \cdot i_c$$

where $N_c = 5.14$

Settlement for Open Foundations

The magnitude of settlement, when foundation loads are applied, depends upon the compressibility of the underlying strata and rigidity of the substructure. In cohesive deposition, the post construction settlement is caused by dissipation of pore pressures and hence is time dependent so that consolidation settlement is computed for such soils using Terzaghi's one-dimensional consolidation theory.

The immediate settlements in clays are estimated using the elastic theory considering the effect of a rigid stratum underlying the foundation soils (Reference: "Foundation Analysis and Design" by J.E.Bowles). The immediate settlements in cohesion-less soil are estimated using elastic theory as mentioned above or using SPT value as per IS: 8009 (Part 1).

Settlement analysis has been performed based on S.P.T values in accordance with Clause 9. 1. 4 of I.S 8009 (Part-1) – 1976 RA Fig.9.

If clay is not recompressed

$$S_c = \frac{Ht}{(1 + e_0)} C_c \log_{10} \left(\frac{p_0 + \Delta p}{p_0} \right)$$

where

S_c = consolidation settlement

e_0 = Initial void ratio

C_c = Compression Index

P_0 = initial effective pressure

Δp = Pressure increment.

8.2 Bearing Capacity of Open Foundations on Rock

Analysis for allowable bearing capacity on rock has been done by the following method.

8.2.1 Safe Bearing Pressure from the RMR System:

Analysis has been carried out using the RMR also known as Geo-mechanics classification by considering various parameters such as uni-axial compressive strength, RQD, spacing and condition of discontinuities and ground water condition. The correlation between the RMR value and allowable pressure has been given in Table –3 IS: 12070. This will ensure settlement of raft foundation to be less than 12 mm. *IS 12070* does not mention width or size and shape of foundation for calculating net safe bearing capacity. Also in the referred IS code there is no mention of immediate settlement.

Net Safe Bearing Pressures Based on RMR:

Classification No.	I	II	III	IV	V
Description of Rock	Very Good	Good	Fair	Poor	Very Poor
RMR	100-81	80-61	60-41	40-21	20-0
qns (t/m ²)	600-448	448-288	280-141	135 - 48	45-30

The RMR for use in Table should be the average within a depth below foundation level equal to the width of foundation, provided the RMR is fairly uniform within the depth. If the upper part of the rock, within a depth of about one fourth of the width of foundation, is of lower quality the value of this part should be used or the inferior rock should be removed. Since these values are based on limiting the settlement, they should not be increased if the foundation is embedded into the rock.

IS 13365 (part I) "Quantitative classification system of rock mass": This code defines various parameters for obtaining RMR values based on rock core logging sheet and laboratory test of rock cores.

The rock mass rating should be determined as an algebraic sum of ratings for all the parameters given in Table 2 after adjustments for orientation of discontinuities given. The sum of Items 1 to 5 is called Rock Condition Rating (RCR), which discounts the effect of compressive strength of intact rock material and orientation of joints. This is also called as the modified RMR

PARAMETER		Range of values // RATINGS							
1	Strength of intact rock material	Point-load strength index	> 10 MPa	4 - 10 MPa	2 - 4 MPa	1 - 2 MPa	For this low range uniaxial compr. strength is preferred		
		Uniaxial compressive strength	> 250 MPa	100 - 250 MPa	50 - 100 MPa	25 - 50 MPa	5 - 25 MPa	1 - 5 MPa	< 1 MPa
	RATING	15	12	7	4	2	1	0	
2	Drill core quality RQD	90 - 100%	75 - 90%	50 - 75%	25 - 50%	< 25%			
	RATING	20	17	13	8	5			
3	Spacing of discontinuities	> 2 m	0.6 - 2 m	200 - 600 mm	60 - 200 mm	< 60 mm			
	RATING	20	15	10	8	5			
4	Condition of discontinuities	Length, persistence	< 1 m	1 - 3 m	3 - 10 m	10 - 20 m	> 20 m		
		Rating	6	4	2	1	0		
	Separation	none	< 0.1 mm	0.1 - 1 mm	1 - 5 mm	> 5 mm			
	Rating	6	5	4	1	0			
	Roughness	very rough	rough	slightly rough	smooth	slickensided			
	Rating	6	6	3	1	0			
	Infilling (gouge)	none	Hard filling		Soft filling				
Rating	6	4	2	2	0				
5	Ground water	Weathering	unweathered	slightly w.	moderately w.	highly w.	decomposed		
		Rating	6	5	3	1	0		
Inflow per 10 m tunnel length		none	< 10 litres/min	10 - 25 litres/min	25 - 125 litres/min	> 125 litres /min			
		p_w / σ_1	0	0 - 0.1	0.1 - 0.2	0.2 - 0.5	> 0.5		
		General conditions	completely dry	damp	wet	dripping	flowing		
		RATING	15	10	7	4	0		

p_w = joint water pressure; σ_1 = major principal stress

RATING ADJUSTMENT FOR DISCONTINUITY ORIENTATIONS

		Very favourable	Favourable	Fair	Unfavourable	Very unfavourable
RATINGS	Tunnels	0	-2	-5	-10	-12
	Foundations	0	-2	-7	-15	-25
	Slopes	0	-5	-25	-50	-60

ROCK MASS CLASSES DETERMINED FROM TOTAL RATINGS

Rating	100 - 81	80 - 61	60 - 41	40 - 21	< 20
Class No.	I	II	III	IV	V
Description	VERY GOOD	GOOD	FAIR	POOR	VERY POOR

9.0 GENERALISED CONSIDERATION FOR CONSTRUCTION OF FOUNDATION

Excavation:

It is advisable to provide suitable slope protection method to keep sides of deep excavation from sloughing.

Side slopes will depend on actual site condition & extent of ingress of water.

Safe Slopes for excavated surfaces as below:-

Slightly weathered to Fresh Rock	- 0.25 H to 1.0 V
Highly to moderately weathered Rock	- 0.50 H to 1.0 V
Completely disintegrated Rock as Murrum	- 1.00 H to 1.0 V
Silty Clay / sandy clayey silt	- 1.50 H to 1.0 V

Following General values may be adopted for Lateral pressure

$$K_a = 0.3$$

$$K_p = 3.3$$

Backfill:

The material used for backfilling shall be non-expansive, size of particles shall be <20 mm and preferably conforming to soil groups of SC/GC/SM of IS soil classifications. The material shall be spread and levelled in layers of not exceeding 225 mm. Each layer shall be compacted by vibratory roller of around 10-12 tonnes to 95% of the modified Proctor density.

Special Precautions

It is essential to ensure that trees and other landscaped area will be about 3 m away from the building boundary. Area around the building shall have proper slope so that the water is drained away from the building boundary.

For foundations placed on Weathered Rock / Murrum, excavation up to required depth shall be carried out by Backhoe / hydraulic excavator and the seat of 30 cm desired for the footing in founding strata may be developed manually. This will avoid loosening of founding strata layer by sharp edge teeth of hydraulic excavator.

In case the footing are rested to be rock the excavation may be continued up to that depth by Excavator bucket and a seat of 30 cm for the individual footing in the founding strata may be provided either manual means or by the hydraulic excavator.

10.0 CONCLUSION / RECOMMENDATIONS

10.1.Open Foundation

SR.NO	LOCATION	BORE HOLE	TYPE OF FOOTING	DIMENSIONS (m ²)	DEPTH (m)	ALLOWABLE BEARING CAPACITY (T/m ²)
1	Type -1B Left Side	BH-01	ISOLATED	2mx2m	1.50 m	10
					3.0 m	12
				3mx3m	1.50 m	9
					3.0 m	11
				4mx4m	1.50 m	8
					3.0 m	11
RAFT	10mx5m	1.50 m	11			
		3.0 m	12			
2	Type -1B Front	BH-02	ISOLATED	2mx2m	1.50 m	10
					3.0 m	12
				3mx3m	1.50 m	9
					3.0 m	11
				4mx4m	1.50 m	8
					3.0 m	12
RAFT	10mx5m	1.50 m	12			
		3.0m	13			
3	Type -1B Front	BH-03	ISOLATED	2mx2m	1.50 m	10
					3.0 m	12
				3mx3m	1.50 m	9
					3.0 m	12
				4mx4m	1.50 m	8
					3.0 m	11
RAFT	10mx5m	1.50 m	12			
		3.0m	13			

4	Type 1 A Front	BH-04	ISOLATED	2mx2m	1.50 m	11
					3.0 m	14
				3mx3m	1.50 m	10
					3.0 m	12
				4mx4m	1.50 m	9
					3.0 m	12
RAFT	10mx5m	1.50 m	8			
		3.0m	10			
5	Type 1 A Front	BH-05	ISOLATED	2mx2m	1.50 m	13
					3.0 m	14
				3mx3m	1.50 m	10
					3.0 m	13
				4mx4m	1.50 m	9
					3.0 m	13
RAFT	10mx5m	1.50 m	9			
		3.0m	11			
6	Type 3 A Left Side	BH-06	ISOLATED	2mx2m	1.50 m	10
					3.0 m	36
				3mx3m	1.50 m	11
					3.0 m	34
				4mx4m	1.50 m	10
					3.0 m	34
RAFT	10mx5m	1.50 m	10			
7	Type 3 A Left Side	BH-07	ISOLATED	2mx2m	1.50 m	10
					3.0 m	12
				3mx3m	1.50 m	9
					3.0 m	11
				4mx4m	1.50 m	8
					3.0 m	10
RAFT	10mx5m	1.50 m	8			
		3.0 m	9			
8	Type 4 A Left Side	BH-08	ISOLATED	2mx2m	1.50 m	10
					3.0 m	40
				3mx3m	1.50 m	8
					3.0 m	35
				4mx4m	1.50 m	8
					3.0 m	45
RAFT	10mx5m	1.50 m	7			
9	Type 4 A Left Side	BH-09	ISOLATED	2mx2m	1.50 m	11
					3.0 m	48
				3mx3m	1.50 m	9
					3.0 m	48
				4mx4m	1.50 m	8

					3.0 m	48
10	Type 4 A Left Side	BH-10	ISOLATED	2mx2m	1.50 m	10
					3.0 m	38
				3mx3m	1.50 m	9
					3.0 m	38
				4mx4m	1.50 m	9
					3.0 m	38
RAFT	10mx5m	1.50 m	8			
11	Director Bungalow Front Side	BH-11	ISOLATED	2mx2m	1.50 m	12
					3.0 m	40
				3mx3m	1.50 m	10
					3.0 m	45
				4mx4m	1.50 m	9
					3.0 m	47
RAFT	10mx5m	1.50 m	8			
12	Director Bungalow Left Side	BH-12	ISOLATED	2mx2m	1.50 m	9
					3.0 m	40
				3mx3m	1.50 m	9
					3.0 m	45
				4mx4m	1.50 m	9
					3.0 m	47
RAFT	10mx5m	1.50 m	8			
13	Director Bungalow Left Side	BH-13	ISOLATED	2mx2m	1.50 m	10
					3.0 m	40
				3mx3m	1.50 m	9
					3.0 m	40
				4mx4m	1.50 m	9
					3.0 m	45
RAFT	10mx5m	1.50 m	8			
					3.0 m	45

For **Becquerel Industries Pvt. Ltd.**

Mr Manish Bawankule

(B.E Civil, M-Tech Geotech)

Mr. P. S. Chauhan

(Quality Head) Geotech & Geology

❖ This report is issued based on the subsoil condition revealed at the location of boreholes and laboratory tests performed on recovered samples. If during construction of foundations it is observed that sub soil conditions vary from those revealed during investigation it is essential that Becquerel Industries Pvt. Ltd. Nagpur shall be contacted so that on confirmation supplementary report shall be issued.

❖ Structural designer should ensure overlap between adjacent foundations is minimum. To minimize overlap minimum clear distance between two adjacent foundations shall not be less than minimum width of the two.

11.0 REFERENCES

Sr. No.	IS Codes No	Title
1	IS : 1892-1979	Code of Practice for subsurface investigation for foundations.
2	IS : 1498-1970	Classification and Identification of soils for general Engineering Purpose.
3	IS : 2131-1981	Method for Standard Penetration Test (SPT) for Soils.
4	IS : 2132-1986	Code of Practice for Thin - Walled tube sampling of Soils.
5	IS : 4464-1985	Code of Practice for presentation of drilling information and core description in foundation investigation.
6	IS : 5313-1980	Guide for core drilling observations.
7	IS : 4078-1980	Code of Practice for indexing and storage of drill cores
8	IS : 6926-1996	Diamond core drilling – Site investigation for river valley projects - code of Practice.
9	IS : 6935-1973	Method of determination of water level in a bore hole
10	IS : 6065(part-1) -1985	Recommendations for the preparation of Geological and Geotechnical maps for river valley projects
Sr. No.	BOOK	Title
1	N. V. Nayak	Foundation Design Manual
2	Joseph E. Bowles	Foundation Analysis and Design

ANNEXURE

1.0 SAMPLE CALCULATIONS

SBC CALCULATION FOR BH-1 Depth- 1.50m

Name of project	"Geotechnical Investigation for Proposed Construction of Residential Blocks AIIMS Raipur , (Chhattisgarh)."
Location	Type 1 B Left Side
Design as per	IS :6403-1981 CLAUSE NO 5.3 Cohesive Soil (when $\phi=0$)

The net ultimate bearing capacity immediately after construction on fairly saturated homogeneous cohesive soils shall be calculated from following formula

In Case for Cohesive Soil	$Q_d = c \cdot N_c \cdot s_c \cdot d_c \cdot i_c$
---------------------------	---------------------------------------------------

$Q_d =$	ULTIMATE BEARING CAPACITY IN (t/ m²)	
$c =$	Assuming cohesion in t/m ² =	4.50
$D_f =$	Depth of foundation in (m)	1.5
$B =$	Width/diameter of footing in (m)	2
$L =$	Length of footing in (m)	2
$N_c =$	Bearing capacity factors due to cohesion, surcharge and weight of subsoil	5.14
$s_c =$	Shape factor for square footing = $1 + 0.2(B/L)$	1.20

DEPTH FACTORS CALCULATION

$d_c =$	$(1 + (0.2) \cdot (D_f/B) \cdot (\sqrt{N_c}))$		1.15
$i_c =$	$i_q =$	$(1 - \alpha/90)^2$	1
$Q_d = c \cdot N_c \cdot s_c \cdot d_c \cdot i_c$			31.92

considering factor of safety (FOS)	3
SAFE BEARING CAPACITY IN (t/ m²) =	10.64

Therefore Safe Bearing Capacity say, **11 t/m²**

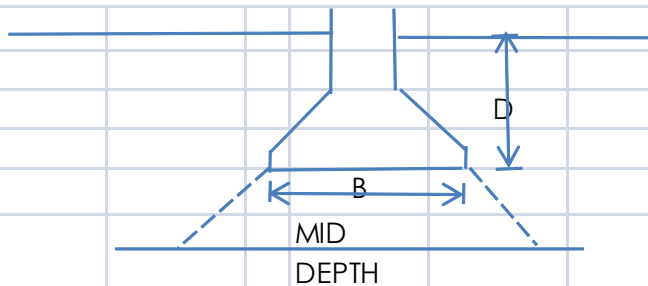
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+91 9689 909 304 E-mail: spectro@biplndt.com, Web Site: www.biplndt.in

SAFE BEARING CAPACITY CALCULATION AS PER SETTLEMENT CRITERIA

AS PER IS 8009-1 CLAUSE No. 9.0

BORE HOLE NO. :	BH-1
1) TYPE OF FOOTING	ISOLATED
2) LENGTH OF FOOTING = L (m)	2.00
3) WIDTH OF FOOTING = B (m)	2.00
4) DEPTH OF FOOTING BELOW GROUND LEVEL = D (m)	1.50
c) DENSITY OF SOIL AT FOUNDATION γ (t/m ³)	1.89
6) $q = \gamma * D =$ OVER BURDEN SURCHARGE (t/m ²)	2.84
SAY $Q_{safe} =$ (t/m²)	10.00

CHECK FOR SETTLEMENT CRITERIA



DATA

1) CONSTANT OF COMPRESSIBILITY = $C_c =$	0.147
2) INITIAL VOID RATIO = $e_o =$	0.67
3) DENSITY OF SOIL = γ (t/m ³)	1.82
2) NET LOAD AT BASE = $(q_{SAFE} - q)$ (t/m ²)	7.17
3) ORIGINAL OVERBURDEN PRESSURE BELOW G.L. AT MID DEPTH (m)	3.50
$S_o, P_o =$ (t/m ²)	6.62
4) AREA AT BASE (m ²)	4.00
5) AREA AT MID DEPTH (m ²)	16.00
6) INCREASE OF PRESSURE AT MID DEPTH = Δp (t/m ²)	1.79

Where, $\Delta p =$ Net load*Area at Base/Area at mid depth

CALCULATION :

$S = (H/1+e_o)*C_c*\log_{10} [(P_o+\Delta p)/P_o]$	
where, H = Depth of compressible layer below foundation in cm	300.00
$S_o, S =$ cm	2.95
$S =$ mm	29.47

CORRECTION OF RIGIDITY FACTOR AND DEPTH FACTOR =

Rigidity factor	0.80
Depth factor	0.97

FINAL SETTLEMENT = $S_f =$

$S_f = S * \text{Rigidity factor} * \text{Depth factor}$	22.87
22.87 mm which is less than 25mm hence, ok	

RECOMMENDED SAFE BEARING CAPACITY BASED ON SETTLEMENT CRITERIA IS= t/m² **10.00**

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SBC CALCULATION FOR BH-6 Depth- 3.0m

Name of project	"Geotechnical Investigation for Proposed Construction of Residential Blocks AIIMS Raipur , (Chhattisgarh)."
Location	Type 3 A Left Side
Design as per	IS :6403-1981 CLAUSE NO 5.2

VOID RATIO:- Void ratio of a soil mass is defined as the ratio of volume of voids to the volume of solids.

As per Fig.1 of IS: 6403-1981, the ϕ value for $N > 50$ is $41^\circ 00'$, As per classification, adapting ϕ as $27^\circ 00'$.

In Case for SPT Sample	$Q_d = q \cdot (N_q - 1) \cdot s_q \cdot d_q \cdot i_q + 0.5 \cdot B \cdot Y \cdot N_r \cdot s_r \cdot d_r \cdot i_r \cdot W'$		
$Q_d =$	ULTIMATE BEARING CAPACITY IN (t / m²)		
$\phi =$	Angle of internal friction of soil in (degree)		27.00
$D_f =$	Depth of foundation in (m)		3
$Y =$	Unit Weight of subsoil in submerged condition in (t/m ³)		0.8
$q =$	Effective Surcharge = ($Y \cdot d_f$) in absence of external surcharge. d_f refers to depth of footing in (t/m ²) where Y		5.4
$B =$	Width/diameter of footing in (m)		2
$L =$	Length of footing in (m)		2
$N_q =$	Bearing capacity factors due to cohesion, surcharge and weight of subsoil		13.76
$N_r =$	Bearing capacity factors due to cohesion, surcharge and weight of subsoil		15.49
$s_q =$	Shape factor for square footing =		1.2
$s_r =$	Shape factor for square footing =		0.60

DEPTH FACTORS CALCULATION

$\sqrt{N_q} =$	$\sqrt{\tan^2(\pi/4 + \phi/2)} =$	$\tan(45 + \phi/2) =$	$\tan(45 + \phi/2) =$	1.6319
$d_c =$	$(1 + (0.2) \cdot (D_f/B) \cdot (\sqrt{N_q}))$			1.4896
$d_q =$	$d_r =$	1	FOR $\phi < 10^\circ$	1
$d_q =$	$d_r =$	$1 + (0.1 \cdot D_f/B) \cdot \sqrt{N_q}$	FOR $\phi > 10^\circ$	1.2448
$i_c =$	$i_q =$	$(1 - \alpha/90)^\circ$		1
$i_r =$		$(1 - \alpha/\phi)^\circ$		1
$W' =$	Water table effect			0.5
	$q'd = q \cdot (N_q - 1) \cdot s_q \cdot d_q \cdot i_q + 0.5 \cdot B \cdot Y \cdot N_r \cdot s_r \cdot d_r \cdot i_r \cdot W'$			107.55

considering factor of safety (FOS)

3

SAFE BEARING CAPACITY IN (t / m²) =

35.85

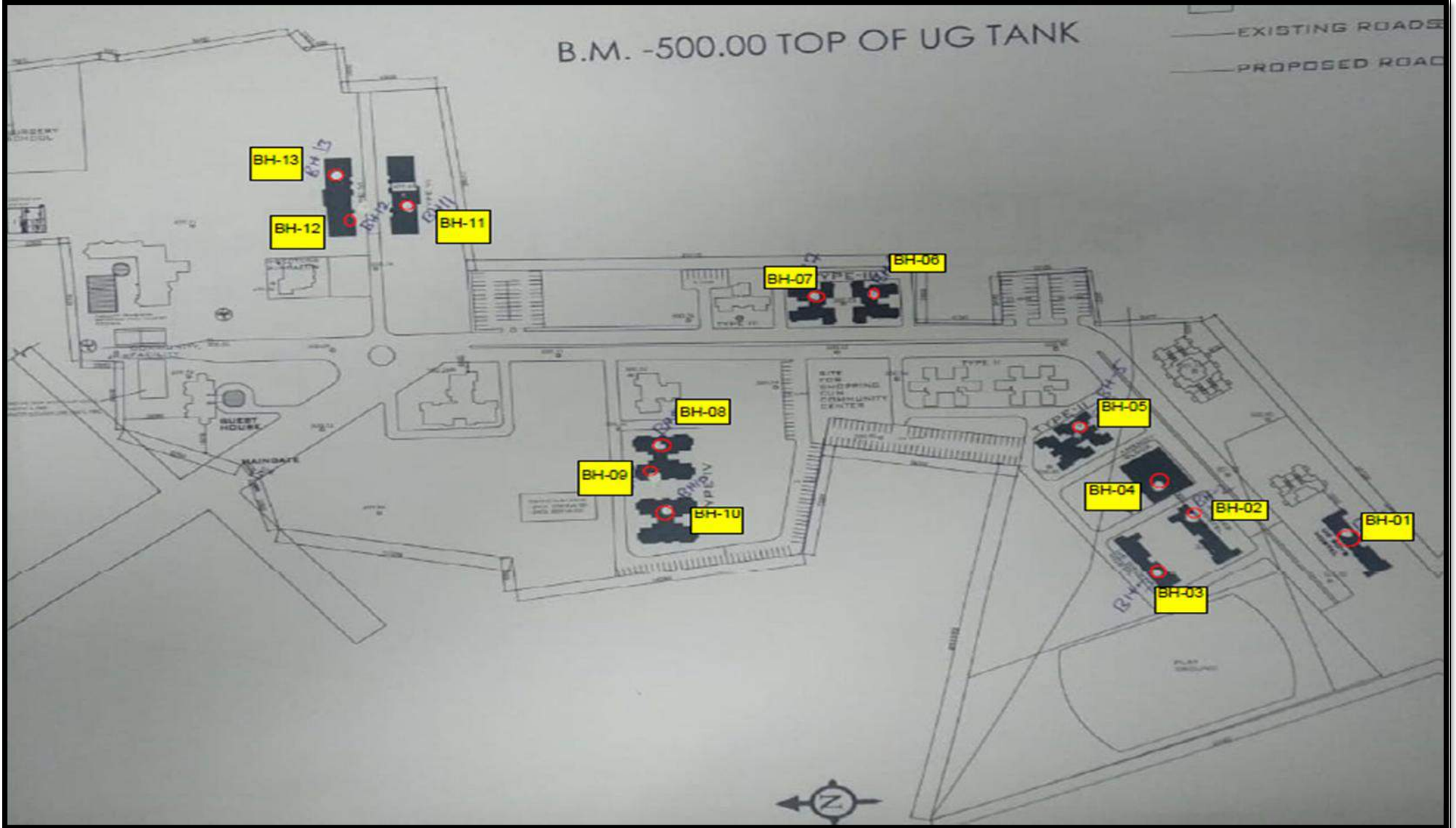
Therefore Safe Bearing Capacity say, **36 t/m²**

Note: As per IS-1904-1986, The permissible Settlement for Isolated Footing resting on sand and hard clay is 50mm, Fig 9 of IS 8009-Part I (checking for 25mm settlement), Considering above N Value and width of the footing 2.00 m and depth factor 0.82 and water table effect, the foundation settlement per unit pressure i.e. 10 T/m² is 5.5 mm. So for 36t/m² bearing pressure, settlement would be about 19.02 mm (which is less than maximum permissible settlement 25mm)

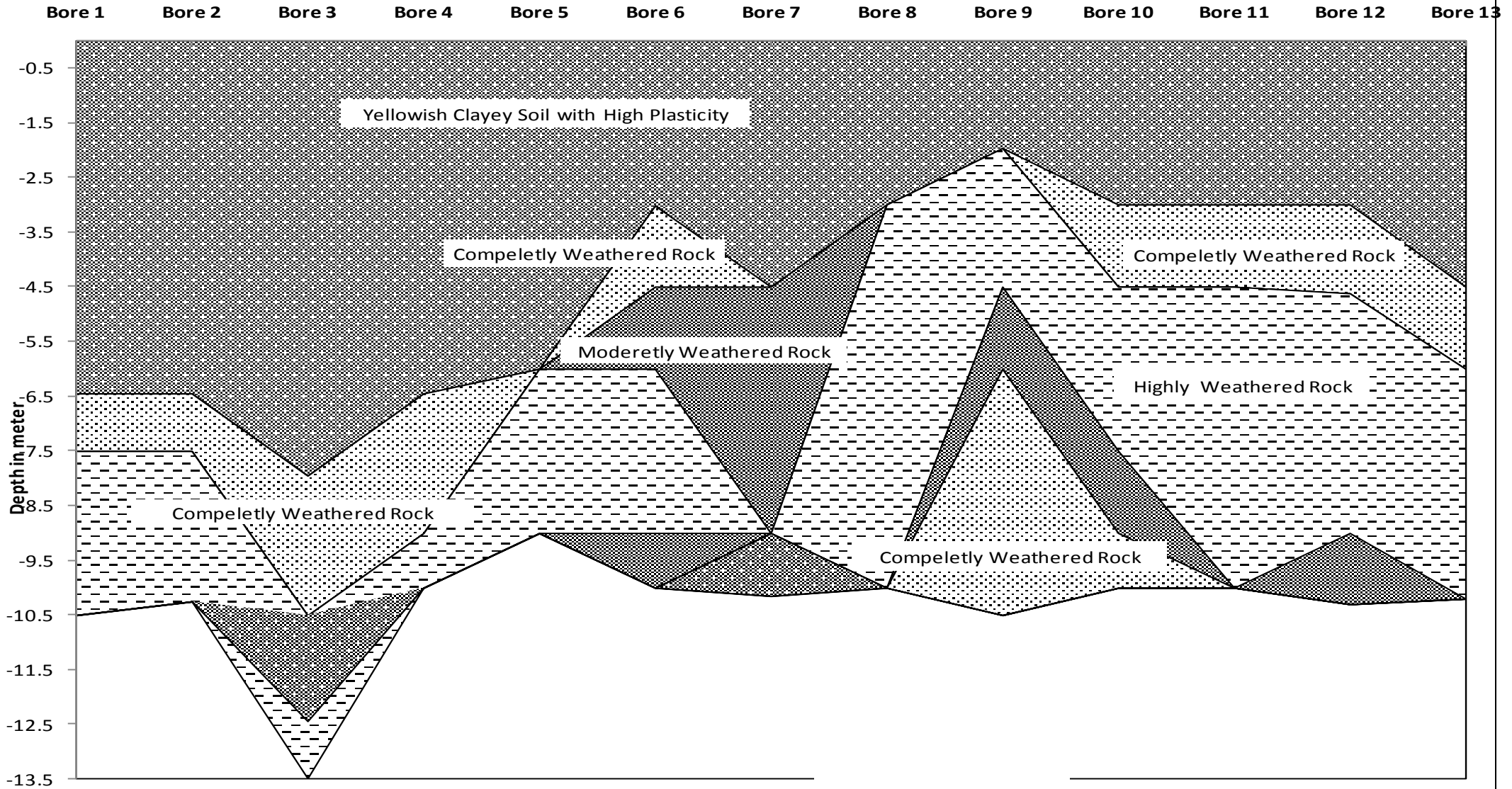
RMR Table

Bore No.	Depth below GL In meter	Individual Rating						Total Rating RMR	RMR Class No.	Rock Description	Net Safe Bearing Pressure qns tons/m ²
		I Strength	II RQD	III Spacing of Discontinuities	IV Condition of Discontinuities	V Ground Water Condition	VI Fracture Orientation Rating				
BH-1	6.45-7.5	12	3	8	0	0	-7	16	V	Very poor	42
	7.5-9.0	12	3	8	10	0	-7	26	IV	Poor	71
	9.0-10.5	12	3	8	10	0	-7	26	IV	Poor	71
BH-2	7.5-9.0	12	3	8	10	0	-7	26	IV	Poor	71
	9.0-10.25	1	3	8	0	0	-7	5	V	Very poor	34
BH-4	7.5-9.0	12	3	8	0	0	-7	16	V	Very poor	42
	9.0-10.00	1	3	8	10	0	-7	15	V	Very poor	41
BH-5	7.5-9.0	12	3	8	0	0	-7	16	V	Very poor	42
	9.0-10.5	12	3	8	10	0	-7	26	IV	Poor	71
BH-6	4.5-6	4	8	9	10	0	-7	18	V	Very poor	44
	6.00-7.5	4	3	8	10	0	-7	18	V	Very poor	44
	7.5-9.0	4	3	8	10	0	-7	18	V	Very poor	44
	9.0-10.0	2	13	8	20	0	-7	36	IV	Poor	117
BH-7	4.5-6.0	7	8	8	20	0	-7	36	IV	Poor	117
	6.0-7.5	7	13	8	20	0	-7	41	IV	Poor	141
	7.5-9.0	4	8	8	20	0	-7	33	IV	Poor	103
BH-8	3.0-4.5	7	3	8	0	0	-7	11	V	Very poor	38
	4.5-6.0	4	8	8	10	0	-7	23	IV	Poor	57
	6.0-7.5	12	3	8	10	0	-7	26	IV	Poor	71
	7.5-9.0	4	8	8	10	0	-7	23	IV	Poor	57
	9.0-10.0	7	3	8	10	0	-7	21	V	Very poor	48
BH-9	1.97-3.0	7	3	8	10	0	-7	21	V	Very poor	48
	3.0-4.5	7	3	8	10	0	-7	21	V	Very poor	48
	4.5-6.0	7	13	8	20	0	-7	41	IV	Poor	141
	6.0-7.5	4	13	8	10	0	-7	28	IV	Poor	80
	7.5-9.0	12	3	8	10	0	-7	26	IV	Poor	71
	9.0-10.5	4	3	8	10	0	-7	18	V	Very poor	44
BH-10	3.45-4.5	7	3	8	0	0	-7	11	V	Very poor	38
	4.5-6.0	7	3	8	0	0	-7	11	V	Very poor	38
	6.0-7.5	7	8	8	10	0	-7	26	IV	Poor	71
	7.5-9.0	7	8	8	10	0	-7	26	IV	Poor	71
	9.0-10.5	7	3	8	10	0	-7	21	V	Very poor	48
BH-11	4.5-6.0	12	3	8	10	0	-7	26	IV	Poor	71
	6.0-7.5	7	8	8	10	0	-7	26	IV	Poor	71
	7.5-9.0	7	8	8	10	0	-7	26	IV	Poor	71
	9.0-10.5	4	3	8	10	0	-7	18	V	Very poor	44
BH-12	4.62-6.0	4	3	8	0	0	-7	8	V	Very poor	36
	6.0-7.5	7	3	8	10	0	-7	21	V	Very poor	48
	7.5-9.0	12	3	8	10	0	-7	26	IV	Poor	71
	9.0-10.30	4	13	8	20	0	-7	38	IV	Poor	126
BH-13	6.0-7.5	12	3	8	10	0	-7	26	IV	Poor	71
	7.5-9.0	12	8	8	10	0	-7	31	IV	Poor	94
	9.0-10.20	7	3	8	0	0	-7	11	V	Very poor	38

2.0 PLAN OF WORK /LOCATION



3.0 GEOLOGICAL PROFILE



4.0 BORE LOGES

BORE HOLE NO # BH-1

Project No. 2262

Client : HSCC (INDIA) LIMITED

Date : 19.07.2019

Project : GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR C.G

Co-ordinates : N-21.26172 E-81.594292

Location : TYPE 1B LEFT SIDE Date Hole Started : 04.07.2019

Elevation : 0

Water Level : 3 M

Drilling Method: - Nx core drilling

Finished : 05.07.2019

Depth (m)	Run	Water Level	Sample no.	Symbols	LITHOLOGIC DESCRIPTION	Type	Elevation	SPT - N	SPT Graph	Core Recovery %	RQD%	CR %	RCD %	LABORATORY TESTING																								
														Gravel	Sand	M+C	Liquid limit	Plastic Limit %	Plasticity ,PI	FSI%	Classification	C (Kg/cm2)	Phi	UCS (Kg/cm2)														
1			DS		Very Stiff to Hard Yellowish CLAY of High Plasticity	SS																																
2			UDS-1			SS													9.4	13.4	77.2	59.7	19.3	40.4	41.6	CH	.22	10										
3		▼	SPT-1			SS			27	↑ 27									1.8	17.2	81	57.7	19.6	38.1		CH												
4						SS																																
5			UDS-2			SS													0.9	19.8	79.4	55	20	35	41.6	CH												
6			SPT-2			SS		-6.45	34	↑ 34									0.4	10.6	88.9	54	19.5	34.5		CH												
7			1-8		Very week to week, greyish, fine grained, completely weathered LIMESTONE.	RR	6.45			10	-																									0		
8			9-23		Very week to week, greyish, fine grained, highly weathered LIMESTONE.	RR	-7.50			37	-																									0		
9							7.50																															
10			24-29			RR				53	22																									0		
11					End of Borehole		-10.50																															
12							10.50																															
13																																						
14																																						
15																																						



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BORE HOLE NO # BH-4

Project No. 2262

Client : HSCC(INDIA) LIMITED

Date : 19.07.2019

Project : GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR C.G

Co-ordinates : E-21.26221,N-81.5946

Location : TYPE 1A-FRONT

Date Hole Started : 02.07.2019

Elevation : 0

Water Level : 2.10 M

Drilling Method: - Nx core drilling

Finished : 03.07.2019

Depth (m)	Run	Water Level	Sample no.	Symbols	LITHOLOGIC DESCRIPTION	Type	Elevation	SPT - N	LABORATORY TESTING												
									Gravel	Sand	M+C	Liquid limit	Plastic Limit %	Plasticity ,PI	FSI%	Classification	C (Kg/cm2)	Phi	UCS (Kg/cm2)		
1			DS		Stiff to very stiff Yellowish CLAY of High Plasticity	SS															
2		▼	UDS-1			SS					4.0	9.7	86.4	54.7	19.5	35.2	40	CH	.5	10	
3			SPT-1			SS		13													
4						SS															
5			UDS-2			SS					6.3	12.5	81.3	52.7	26.9	25.8	40	CH	.48	10	
6			SPT-2			SS	-6.45	18													
7			-		Very week to week, greyish, fine grained, completely weathered LIMESTONE	RR	6.45														
8			01-2			RR				10											
9			3-8		Very week to week, greyish, fine grained, highly weathered LIMESTONE	RR	-9.00			32											
10					End of Borehole		9.00														
11							-10.00														
12							10.00														
13																					
14																					
15																					



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BORE HOLE NO # BH-5

Project No. 2262

Client : HSCC (INDIA) LIMITED

Date : 19.07.2019

Project : GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR C.G

Co-ordinates : N-21.26250 E-81.59491

Location : TYPE A1-FRONT

Date Hole Started : 28.06.2019

Elevation : 0

Water Level : 6.0M

Drilling Method: - Nx core drilling

Finished : 29.06.2019

Depth (m)	Run	Water Level	Sample no.	Symbols	LITHOLOGIC DESCRIPTION	Type	Elevation	SPT - N	SPT Graph	Core Recovery %	RQD%	LABORATORY TESTING																
												CR %	RCD %	Gravel	Sand	M+C	Liquid limit	Plastic Limit %	Plasticity ,PI	FSI%	Classification	C (Kg/cm2)	Phi	UCS (Kg/cm2)				
1			DS		Stiff to hard, Yellowish CLAY, high plasticity	SS																						
2			UDS-1			SS												3.8	10.4	85.9	54.1	20.3	33.7	41	CH	.56	7.6	
3			SPT-1			SS			15																			
4						SS																						
5			UDS-2			SS													0.6	12.1	87.3	53.9	21.4	32.5	40	CH	.53	8.3
6			SPT-2		SS			>100																				
7					Very week to week, greyish, fine grained, moderately weathered LIMESTONE	SS	-6.45																					
						SS	6.45																					
8			1-2		Very week to week, greyish, fine grained, highly weathered LIMESTONE	RR	-7.50				09	-																
9						RR	7.50																					
10			3-7			RR					23	17																
11					End of Borehole		-10.50																					
12							10.50																					
13																												
14																												
15																												



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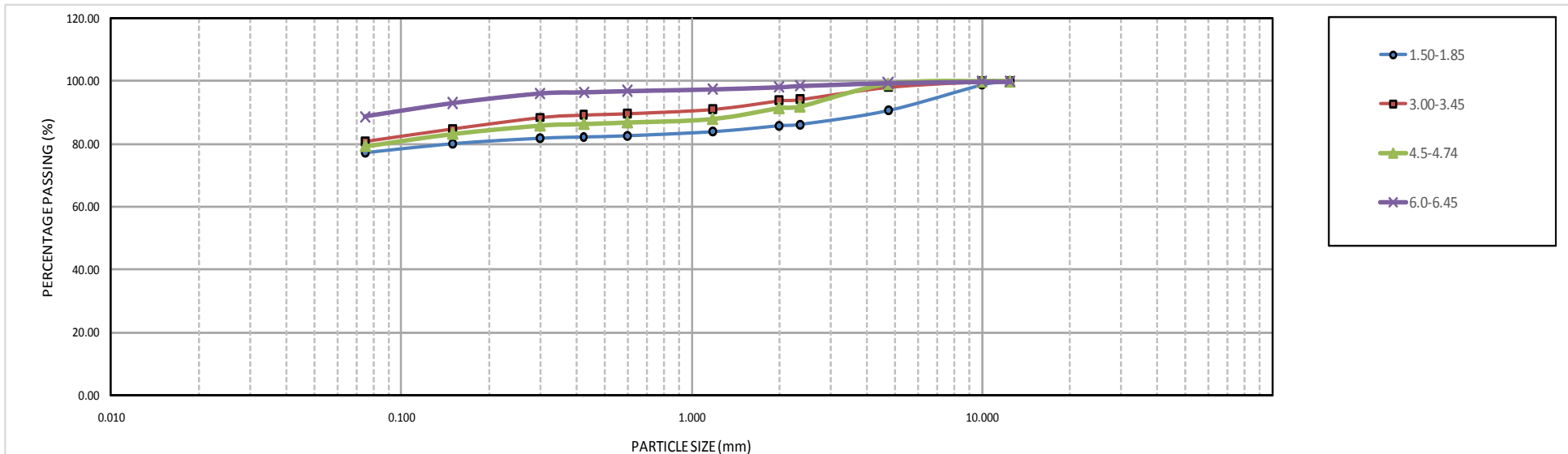
Sheet: 1 of 1

5.0 TEST RESULTS

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED													Report No. 2262						
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR													Report Date: 27.07.2019						
				IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	Bulk	Dry	Moisture	Liquid	Plastic	Plasticity	Grain Size Analysis			Free Swell	Specific	Cohesion	Angle of Internal	Compression	Intial Void	IS
				Density gm/cm ³	Density gm/cm ³	Content %	Limit %	Limit %	Index %	Gravel %	Sand %	Silt/Clay %	Index %	Gravity -	kg/cm ²	Friction degree	Index (Cc) -	Ratio -	Classification -
1	2262	UDS	1.50-1.85	1.899	1.567	21.12	59.7	19.3	40.4	9.4	13.4	77.2	41.66	2.620	0.45	10.05	0.15	0.67	CH
1	2262	SPT	3.00-3.45	-	-	-	57.7	19.6	38.1	1.8	17.2	81.0	-	-	-	-	-	-	CH
1	2262	UDS	4.5-4.74	1.88	1.569	19.79	55.0	20.0	35.0	0.9	19.8	79.4	41.66	2.605	0.43	10.80	-	-	CH
1	2262	SPT	6.0-6.45	-	-	-	54.0	19.5	34.5	0.4	10.6	88.9	-	-	-	-	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

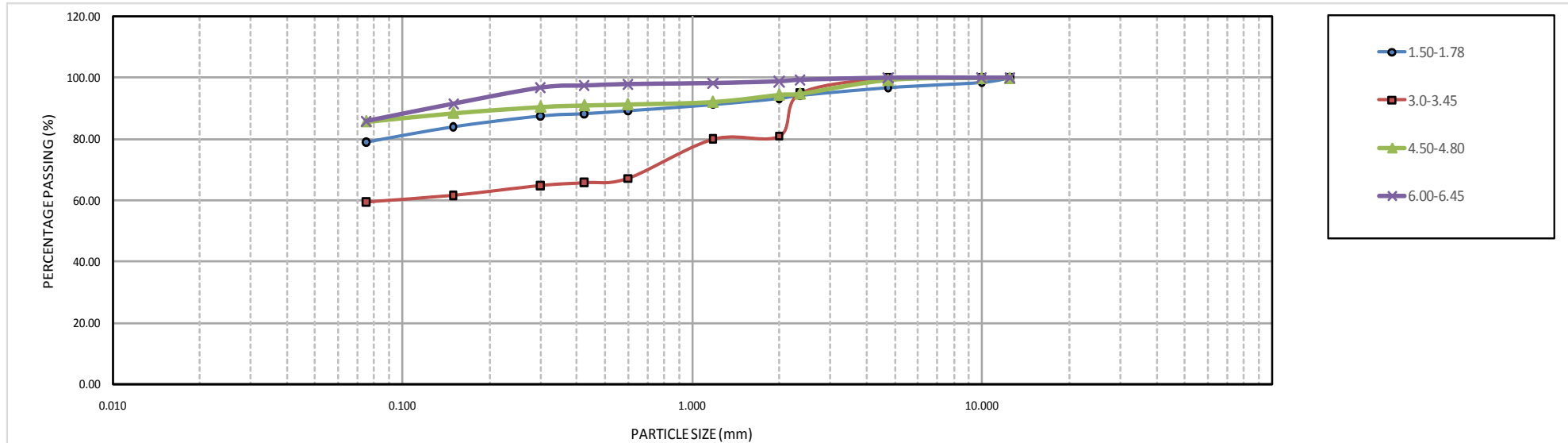
CLIENT: HSCC (INDIA) LIMITED		Report No.	SRAF No - 2262									
SITE: RAIPUR		Report Date:	15.07.2019									
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
<i>Test Methods:</i>												
<i>IS:13030</i>												
<i>IS:1122</i>												
<i>IS:9143</i>												
<i>IS:8764</i>												
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Strength	Strength Index
1	16	7.50-9.00	Core	2262	Soaked	2.425	2.427	0.08	0.19	2.430	0.00	1798.84
1	25	9.00-10.50	Core	2262	Soaked	2.630	2.636	0.24	0.64	2.646	0.00	1569.27

For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED		Report No.: 2262																	
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR		Report Date: 27.07.2019																	
				IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	Bulk	Dry	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Grain Size Analysis			Free Swell Index %	Specific Gravity	Cohesion kg/cm ²	Angle of Internal Friction degree	Compression Index (Cc)	Initial Void Ratio	IS Classification
				Density gm/cm ³	Density gm/cm ³					Gravel %	Sand %	Silt/Clay %							
2	2262	UDS	1.50-1.78	1.82	1.512	20.33	61.3	19.8	41.5	3.2	17.7	79.1	40.00	2.621	0.46	10.74	-	-	CH
2	2262	SPT	3.0-3.45				51.7	19.9	31.8	0.0	40.5	59.5	-	-	-	-	-	-	CH
2	2262	UDS	4.50-4.80	1.792	1.515	18.23	51.2	19.9	31.4	0.7	13.6	85.8	41.66	2.629	0.44	11.07	-	-	CH
2	2262	SPT	6.00-6.45	-	-	-	59.8	20.5	39.4	0.0	14.1	85.9	-	-	-	-	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

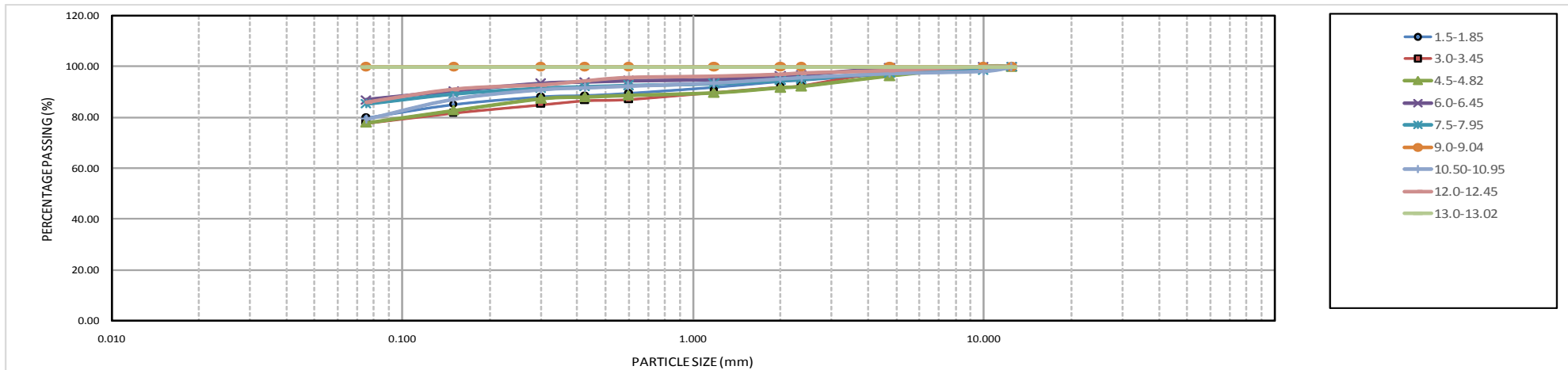
CLIENT:	HSCC (INDIA) LIMITED								Report No.	SRAF No - 2262		
SITE:	RAIPUR								Report Date:	27.07.2019		
PROJECT:	GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)											
				<i>Test Methods:</i>		<i>IS:13030</i>				<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Kg/cm ²	Kg/cm ²
2	1	7.5-9.00	Core	2262	Soaked	2.629	2.638	0.32	0.83	2.651	0.00	1509.82
2	2	9.00-10.25	Core	2262	Soaked	2.630	2.643	0.51	1.34	2.665	0.00	1664.14

For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED													Report No.: 2262						
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR													Report Date: 27.07.2019						
				IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	Bulk	Dry	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Grain Size Analysis			Free Swell Index %	Specific Gravity	Cohesion kg/cm ²	Angle of Internal Friction degree	Compression Index (Cc)	Initial Void Ratio	IS Classification
				Density gm/cm ³	Density gm/cm ³					Gravel %	Sand %	Silt/Clay %							
3	2262	UDS	1.5-1.85	1.699	1.414	20.12	56.9	20.4	36.5	2.9	17.2	80.0	40.00	2.596	0.42	10.63	-	-	CH
3	2262	SPT	3.0-3.45	-	-	-	52.1	20.6	31.5	1.8	20.4	77.9	-	-	-	-	-	-	CH
3	2262	UDS	4.5-4.82	1.604	1.37	17.03	54.5	20.8	33.8	3.7	18.4	78.0	40.00	2.617	0.44	10.27	-	-	CH
3	2262	SPT	6.0-6.45	-	-	-	57.8	20.9	36.9	0.5	12.5	87.0	-	-	-	-	-	-	CH
3	2262	SPT	7.5-7.95	-	-	-	53.6	19.4	34.2	2.4	12.2	85.4	-	-	-	-	-	-	CH
3	2262	SPT	9.0-9.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2262	SPT	10.50-10.95	-	-	-	53.7	19.4	34.3	2.6	18.0	79.5	-	-	-	-	-	-	CH
3	2262	SPT	12.0-12.45	-	-	-	55.1	20.9	34.2	1.5	12.5	86.1	-	-	-	-	-	-	CH
3	2262	SPT	13.0-13.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PARTICLE SIZE DISTRIBUTION CURVE



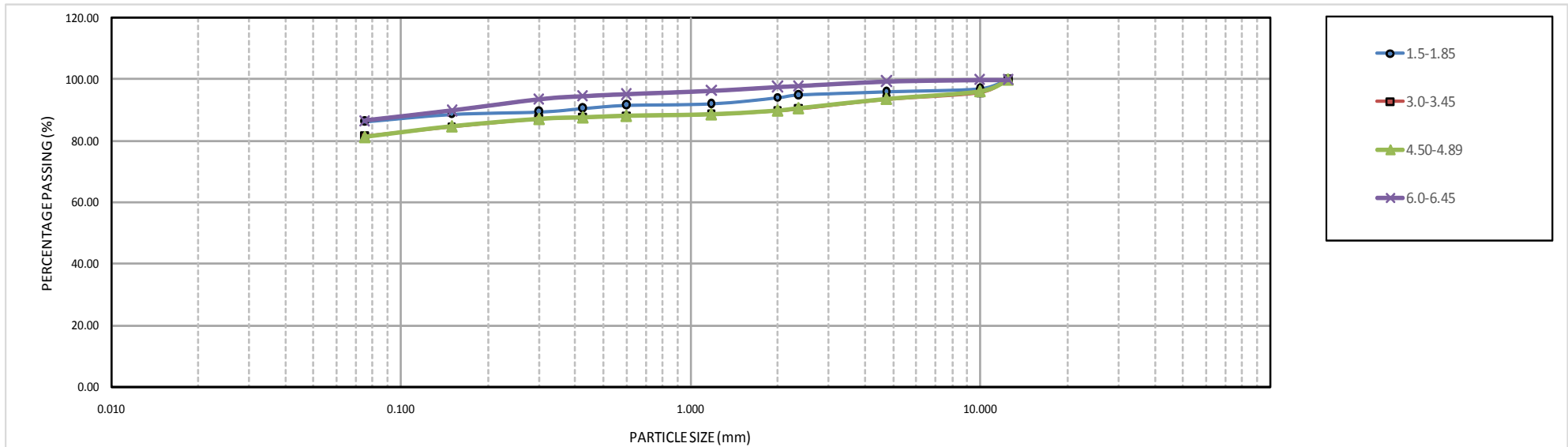
For BIPL Nagpur

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED	Report No.: 2262
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR	Report Date: 27.07.2019

BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
				Bulk	Dry	Moisture	Liquid	Plastic	Plasticity	Grain Size Analysis			Free Swell	Specific	Cohesion	Angle of Internal	Compression	Initial Void	IS
				Density	Density	Content	Limit	Limit	Index	Gravel	Sand	Silt/Clay	Index	Gravity	kg/cm ²	Friction	Index (Cc)	Ratio	Classification
4	2262	UDS	1.5-1.85	1.752	1.476	18.66	54.7	19.5	35.2	4.0	9.7	86.4	40.00	2.622	0.50	10.08	-	-	CH
4	2262	SPT	3.0-3.45	-	-	-	56.1	20.2	36.0	6.5	12.0	81.6	-	-	-	-	-	-	CH
4	2262	UDS	4.50-4.89	1.785	1.517	17.65	52.7	26.9	25.8	6.3	12.5	81.3	40.00	2.617	0.48	10.41	-	-	CH
4	2262	SPT	6.0-6.45	-	-	-	55.1	21.1	34.0	0.5	12.8	86.7	-	-	-	-	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

CLIENT: HSCC (INDIA) LIMITED										Report No.	SRAF No - 2262	
SITE: RAIPUR										Report Date:	27.07.2019	
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
				<i>Test Methods:</i>		<i>IS:13030</i>				<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
										Strength	Strength Index	
						g/cc	g/cc	%	%	-	Kg/cm ²	Kg/cm ²
4	1	7.50-9.00	Core	2262	Soaked	2.575	2.598	0.91	2.35	2.637	0.00	1838.85
4	3	9.00-10.00	Core	0	Soaked	2.478	2.485	0.29	0.73	2.496	34.12	-

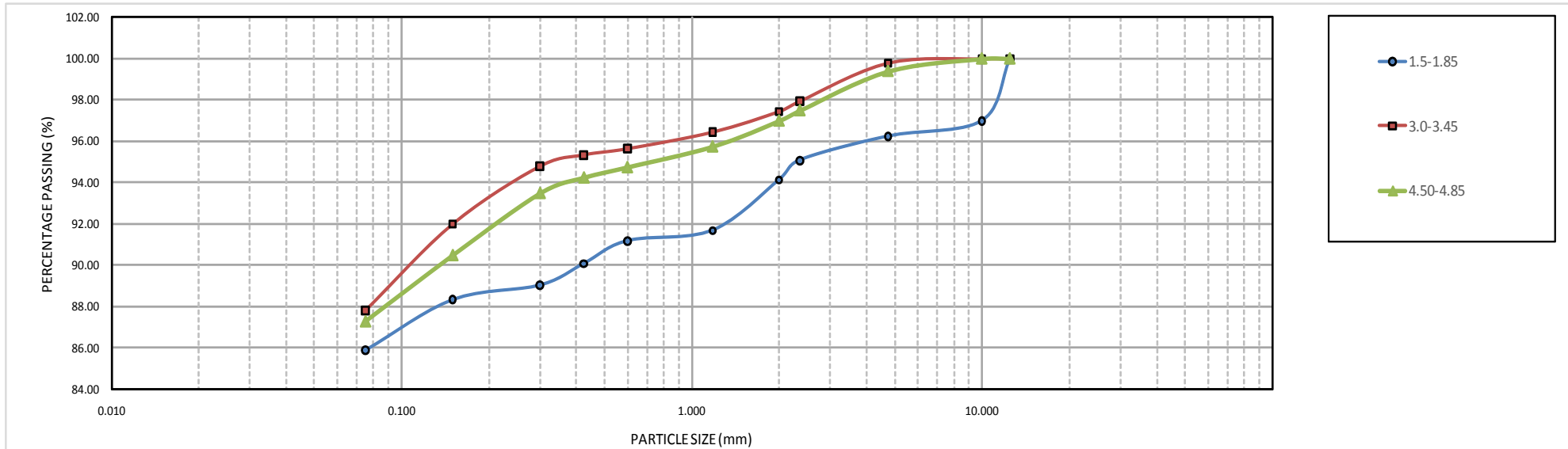
For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED	Report No.: 2262
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR	Report Date: 27.07.2019

BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
				Bulk Density	Dry Density	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Grain Size Analysis			Free Swell Index	Specific Gravity	Cohesion	Angle of Internal Friction	Compression Index (Cc)	Initial Void Ratio	IS Classification
				gm/cm ³	gm/cm ³	%	%	%	%	Gravel	Sand	Silt/Clay	%	-	kg/cm ²	degree	-	-	-
5	2262	UDS	1.5-1.85	1.961	1.598	22.65	54.1	20.3	33.7	3.8	10.4	85.9	41.00	2.618	0.26	7.30	-	-	CH
5	2262	SPT	3.0-3.45	-	-	-	54.0	20.4	33.7	0.2	12.0	87.8	-	-	-	-	-	-	CH
5	2262	UDS	4.50-4.85	1.972	1.638	20.36	53.9	21.4	32.5	0.6	12.1	87.3	40.00	2.622	0.53	8.30	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

CLIENT:	HSCC (INDIA) LIMITED										Report No.	SRAF No - 2262
SITE:	RAIPUR										Report Date:	27.07.2019
PROJECT:	GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)											
				<i>Test Methods:</i>		<i>IS:13030</i>				<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
											Strength	Strength Index
						g/cc	g/cc	%	%	-	Kg/cm ²	Kg/cm ²
5	1	7.50-9.00	Core	2262	Soaked	2.713	2.716	0.10	0.28	2.720	0.00	1835.15
5	3	9.00-10.50	Core	0	Soaked	3.083	3.091	0.25	0.78	3.108	0.00	1627.12

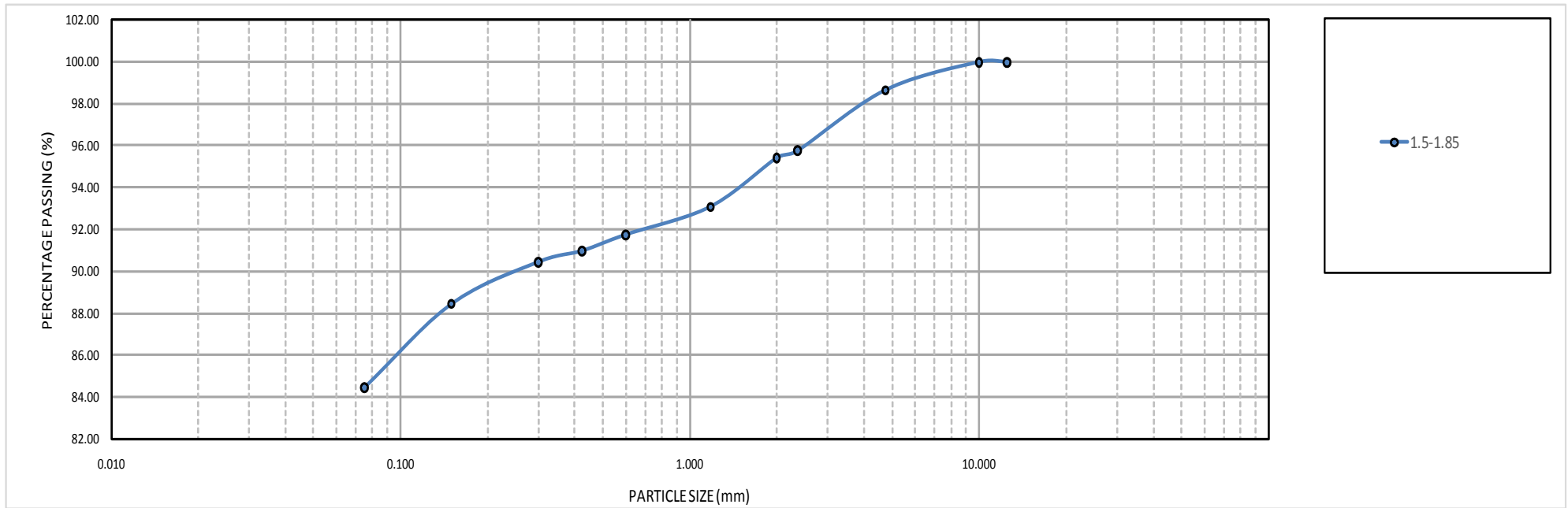
For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED	Report No.: 2262
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR	Report Date: 27.07.2019

BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
				Bulk Density	Dry Density	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Grain Size Analysis			Free Swell Index	Specific Gravity	Cohesion	Angle of Internal Friction	Compression Index (Cc)	Initial Void Ratio	IS Classification
				gm/cm ³	gm/cm ³	%	%	%	%	Gravel	Sand	Silt/Clay	%	-	kg/cm ²	degree	-	-	-
6	2262	UDS	1.5-1.85	1.941	1.582	22.64	51.3	20.5	30.8	1.3	14.2	84.5	40.00	2.608	0.55	7.99	0.13	0.64	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

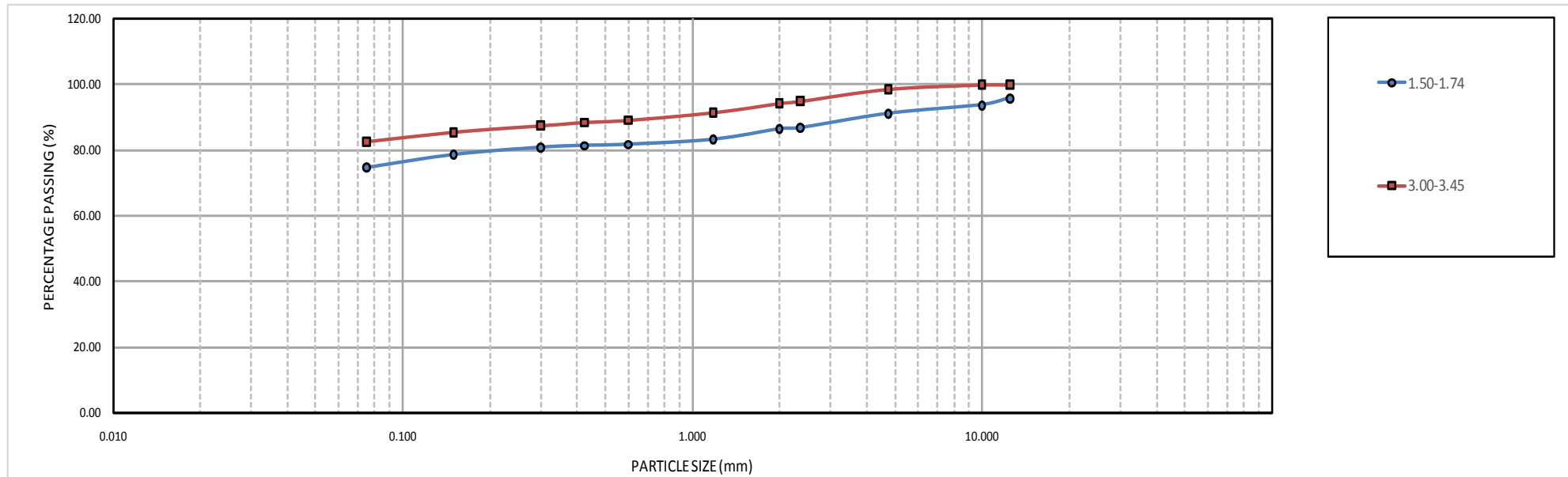
CLIENT: HSCC (INDIA) LIMITED		Report No.	SRAF No - 2262									
SITE: RAIPUR		Report Date:	27.07.2019									
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
		Test Methods:		<i>IS:13030</i>	<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>					
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry Density	Saturated Density	Water Absorption	Porosity	Specific Gravity	Unconfined Compressive Strength	Uniaxial Compressive Strength by Point Load
						g/cc	g/cc	%	%	-	Kg/cm ²	Kg/cm ²
6	9	4.50-6.00	Core	2262	Soaked	2.435	2.439	0.15	0.36	2.444	261.17	-
6	14	6.00-7.50	Core	2262	Soaked	2.633	2.637	0.14	0.37	2.643	296.88	-
6	26	7.50-9.00	Core	2262	Soaked	2.629	2.632	0.13	0.35	2.638	281.47	-
6	34	9.00-10.00	Core	2262	Soaked	2.628	2.631	0.13	0.35	2.637	260.21	-

For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED										Report No. 2262									
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR										Report Date: 27.07.2019									
				IS:2720(P29)		IS:2720(P2)		IS:2720(P5)		IS:2720(P4)		IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498	
BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	Bulk	Dry	Moisture	Liquid	Plastic	Plasticity	Grain Size Analysis			Free Swell	Specific	Cohesion	Angle of Internal	Compression	Intial Void	IS
				Density gm/cm ³	Density gm/cm ³	Content %	Limit %	Limit %	Index %	Gravel %	Sand %	Silt/Clay %	Index %	Gravity -	kg/cm ²	Friction degree	Index (Cc) -	Ratio -	Classification -
7	2262	UDS	1.50-1.74	1.741	1.403	24.02	54.1	21.2	32.9	8.8	16.6	74.7	33.33	2.648	0.42	10.74	-	-	CH
7	2262	SPT	3.00-3.45	-	-	-	54.8	21.0	33.8	1.3	16.0	82.7	-	-	-	-	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

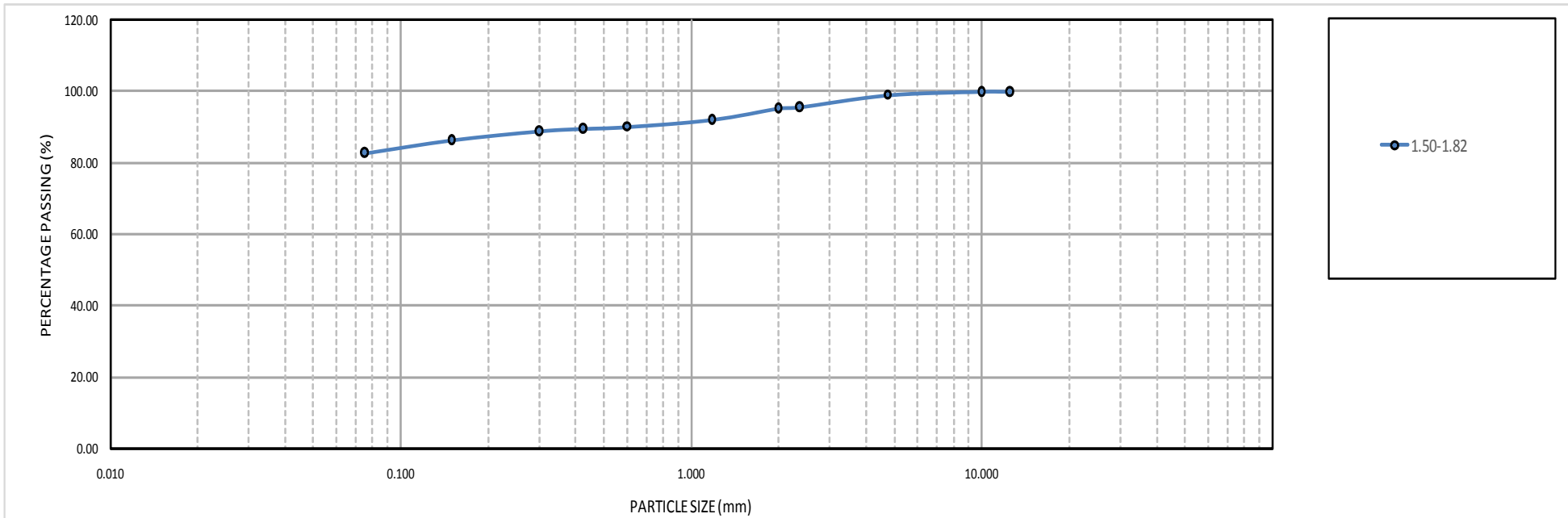
CLIENT: HSCC (INDIA) LIMITED		Report No.	SRAF No - 2262									
SITE: RAIPUR		Report Date:	27.07.2019									
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
			Test Methods:		<i>IS:13030</i>	<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>				
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Kg/cm ²	Kg/cm ²
7	13	4.50-6.00	Core	2262	Soaked	2.664	2.666	0.11	0.29	2.671	517.00	-
7	20	6.00-7.50	Core	0	Soaked	2.627	2.633	0.23	0.60	2.643	553.04	-
7	27	7.50-9.00	core	0	soaked	2.633	2.639	0.23	0.60	2.649	495.92	-

For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED											Report No. 2262								
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR											Report Date: 27.07.2019								
				IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	Bulk		Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Grain Size Analysis			Free Swell Index	Specific Gravity	Cohesion	Angle of Internal Friction	Compression Index (Cc)	Initial Void Ratio	IS Classification
				Density	Density					Gravel	Sand	Silt/Clay							
				gm/cm ³	gm/cm ³	%	%	%	%				%	%	-	kg/cm ²	degree	-	-
8	2262	UDS	1.50-1.82	1.682	1.4	20.12	52.0	21.3	30.7	1.0	16.2	82.8	33.33	2.581	0.52	8.40	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

CLIENT: HSCC (INDIA) LIMITED						Report No.		SRAF No - 2262				
SITE: RAIPUR						Report Date:		27.07.2019				
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
				<i>Test Methods:</i>		<i>IS:13030</i>		<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>		
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Strength	Strength Index
8	6	3.02-4.50	Core	2262	Soaked	2.621	2.624	0.12	0.32	2.629	549.15	0.00
8	11	4.50-6.00	Core	2262	Soaked	2.671	2.674	0.11	0.28	2.679	454.88	0.00
8	15	6.00-7.50	Core	2262	Soaked	2.629	2.631	0.09	0.23	2.635	0.00	1983.38
8	23	7.50-9.00	Core	2262	Soaked	2.711	2.714	0.13	0.35	2.720	387.80	0.00
8	27	9.00-10.00	Core	2262	Soaked	2.413	2.429	0.68	1.65	2.453	0.00	775.63

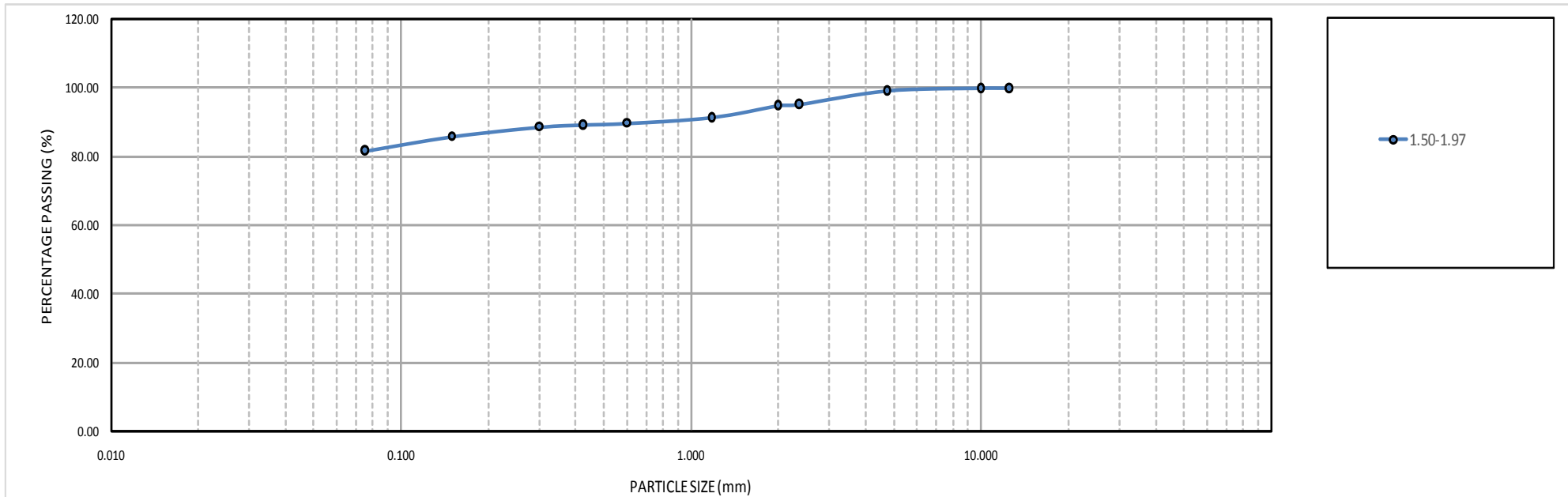
For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED	Report No.: 2262
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR	Report Date: 27.07.2019

BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
				Bulk Density	Dry Density	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Grain Size Analysis			Free Swell Index	Specific Gravity	Cohesion	Angle of Internal Friction	Compression Index (Cc)	Initial Void Ratio	IS Classification
				gm/cm ³	gm/cm ³	%	%	%	%	Gravel %	Sand %	Silt/Clay %	%	-	kg/cm ²	degree	-	-	-
9	2262	UDS	1.50-1.97	1.665	1.397	19.14	51.8	21.2	30.6	0.8	17.5	81.8	33.33	2.580	0.45	10.63	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

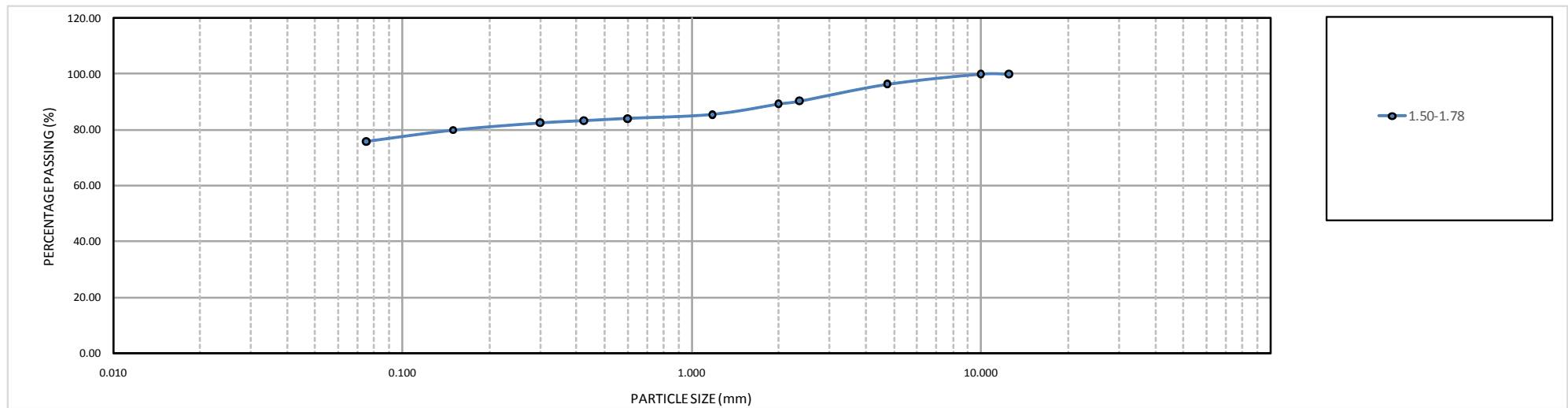
CLIENT: HSCC (INDIA) LIMITED		Report No.	SRAF No - 2262									
SITE: RAIPUR		Report Date:	27.07.2019									
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
			<i>Test Methods:</i>		<i>IS:13030</i>		<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>			
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Kg/cm ²	Strength Index
9	4	1.97-3.00	Core	2262	Soaked	2.698	2.702	0.16	0.43	2.710	595.63	0.00
9	13	3.00-4.50	Core	2262	Soaked	2.701	2.706	0.19	0.51	2.715	542.01	0.00
9	18	4.50-6.00	Core	2262	Soaked	2.705	2.709	0.18	0.48	2.717	627.88	0.00
9	24	6.00-7.50	Core	2262	Soaked	2.692	2.695	0.13	0.35	2.701	467.57	0.00
9	27	7.50-9.00	Core	2262	Soaked	3.001	3.002	0.03	0.09	3.004	0.00	1739.13
9	40	9.00-10.50	Core	2262	Soaked	2.640	2.645	0.22	0.58	2.655	433.12	0.00

For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED										Report No. 2262									
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR										Report Date: 27.07.2019									
				IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	Bulk	Dry	Moisture	Liquid	Plastic	Plasticity	Grain Size Analysis			Free Swell	Specific	Cohesion	Angle of Internal	Compression	Initial Void	IS
				Density gm/cm ³	Density gm/cm ³	Content %	Limit %	Limit %	Index %	Gravel %	Sand %	Silt/Clay %	Index %	Gravity -	kg/cm ²	Friction degree	Index (Cc) -	Ratio -	Classification -
10	2262	UDS	1.50-1.78	1.792	1.481	21.01	52.8	20.9	31.9	3.7	20.5	75.8	33.33	2.633	0.42	11.79	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

CLIENT: HSCC (INDIA) LIMITED

Report No.

SRAF No - 2152

SITE: RAIPUR

Report Date:

15.07.2019

PROJECT: Geotechnical Investigation of AIIMS RESIDENTIAL COMPLEX PHASE 2nd KABIR NAGAR RAIPUR C.G.

BH No.	Piece No.	Depth (m)	Sample Type	Test Methods:		IS:13030				IS:1122	IS:9143	IS:8764
				LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Kg/cm ²	Strength Index
10	4	4.50-6.00	Core	2262	Soaked	2.896	2.899	0.10	0.28	2.904	513.20	0.00
10	7	6.00-7.50	Core	2262	Soaked	2.675	2.676	0.05	0.13	2.678	571.37	0.00
10	8	7.50-9.0	Core	2262	Soaked	2.794	2.798	0.12	0.33	2.804	590.89	0.00
10	12	9.00-10.00	Core	2262	Soaked	2.616	2.619	0.13	0.34	2.625	637.77	0.00

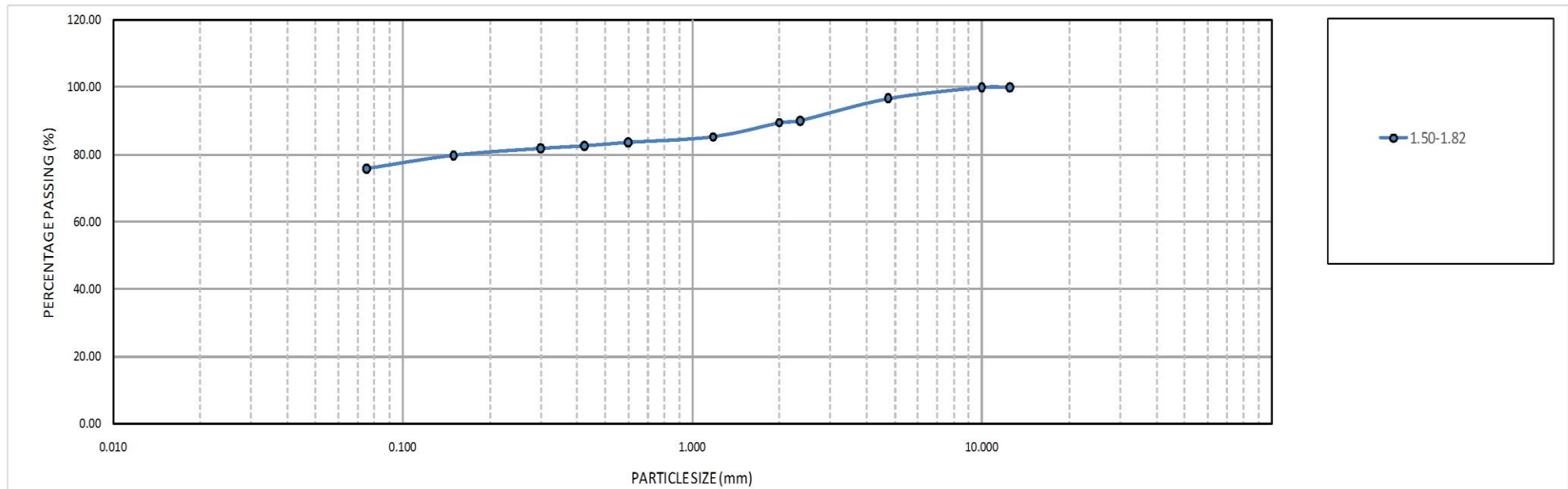
For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED	Report No.: 2262
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR	Report Date: 27.07.2019

BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
				Bulk	Dry	Moisture	Liquid	Plastic	Plasticity	Grain Size Analysis			Free Swell	Specific	Cohesion	Angle of Internal	Compression	Initial Void	IS
				Density gm/cm ³	Density gm/cm ³	Content %	Limit %	Limit %	Index %	Gravel %	Sand %	Silt/Clay %	Index %	Gravity -	kg/cm ²	Friction degree	Index (Cc) -	Ratio -	Classification -
11	2262	UDS	1.50-1.82	1.78	1.507	18.10	52.9	21.7	31.1	3.3	20.8	75.9	40.00	2.640	0.55	7.20	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

CLIENT: HSCC (INDIA) LIMITED						Report No.		SRAF No - 2262				
SITE: RAIPUR						Report Date:		27.07.2019				
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
				<i>Test Methods:</i>		<i>IS:13030</i>		<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>		
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Strength	Strength Index
11	6	4.50-6.00	Core	2262	Soaked	2.198	2.203	0.21	0.46	2.208	0.00	1092.02
11	10	6.00-7.50	Core	2262	Soaked	2.704	2.706	0.05	0.13	2.708	531.23	0.00
11	13	7.50-9.00	Core	2262	Soaked	2.630	2.631	0.05	0.14	2.633	511.65	0.00
11	17	9.00-10.00	Core	2262	Soaked	2.702	2.705	0.10	0.27	2.709	509.93	0.00

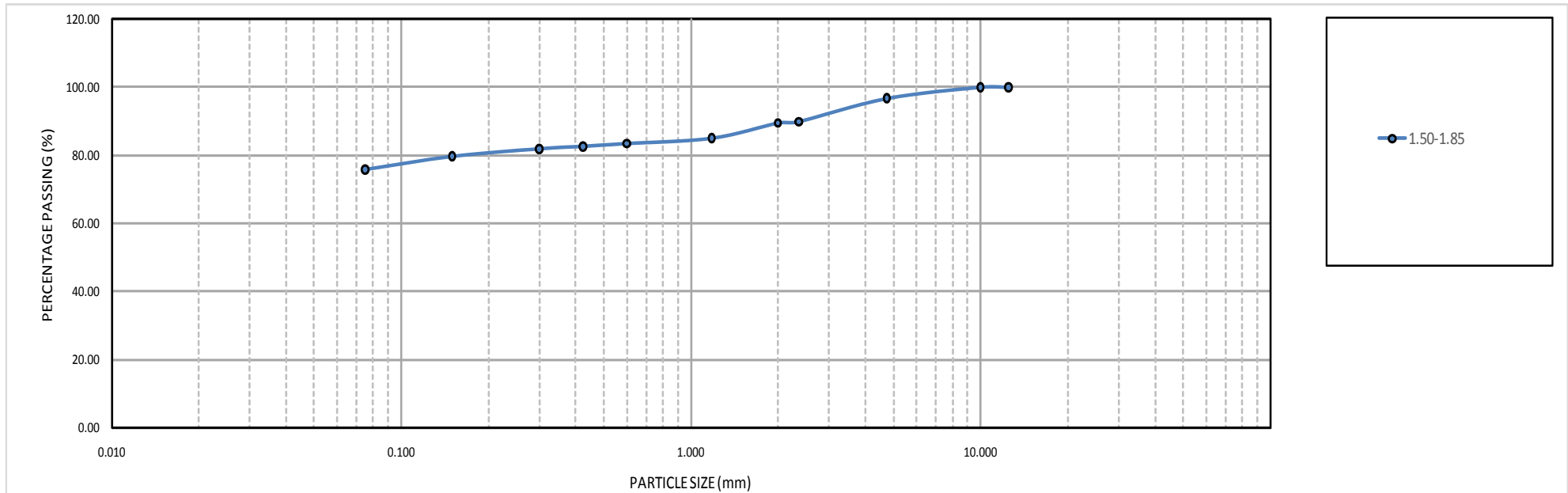
For BIPL

Summary of Soil Test Results

Client: HSCC (INDIA) LIMITED	Report No.: 2262
Project: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR	Report Date: 27.07.2019

BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
				Bulk Density	Dry Density	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Grain Size Analysis			Free Swell Index	Specific Gravity	Cohesion	Angle of Internal Friction	Compression Index (Cc)	Initial Void Ratio	IS Classification
				gm/cm ³	gm/cm ³	%	%	%	%	Gravel	Sand	Silt/Clay	%	-	kg/cm ²	degree	-	-	-
12	2262	UDS	1.50-1.85	1.886	1.556	21.14	51.0	20.3	30.6	3.3	21.0	75.7	40.00	2.584	0.39	11.00	0.13	0.66	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

CLIENT: HSCC (INDIA) LIMITED										Report No.	SRAF No - 2262	
SITE: RAIPUR										Report Date:	27.07.2019	
PROJECT: GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)												
			<i>Test Methods:</i>			<i>IS:13030</i>				<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
											Strength	Strength Index
						g/cc	g/cc	%	%	-	Kg/cm ²	Kg/cm ²
12	5	4.62-6.00	Core	2262	Soaked	2.629	2.633	0.16	0.43	2.640	476.41	0.00
12	10	6.00-7.50	Core	2262	Soaked	2.836	2.844	0.29	0.83	2.860	570.64	0.00
12	19	7.50-9.00	Core	2262	Soaked	2.557	2.566	0.34	0.87	2.579	0.00	1181.49
12	22	9.00-10.30	Core	2262	Soaked	2.693	2.695	0.08	0.22	2.699	352.10	0.00

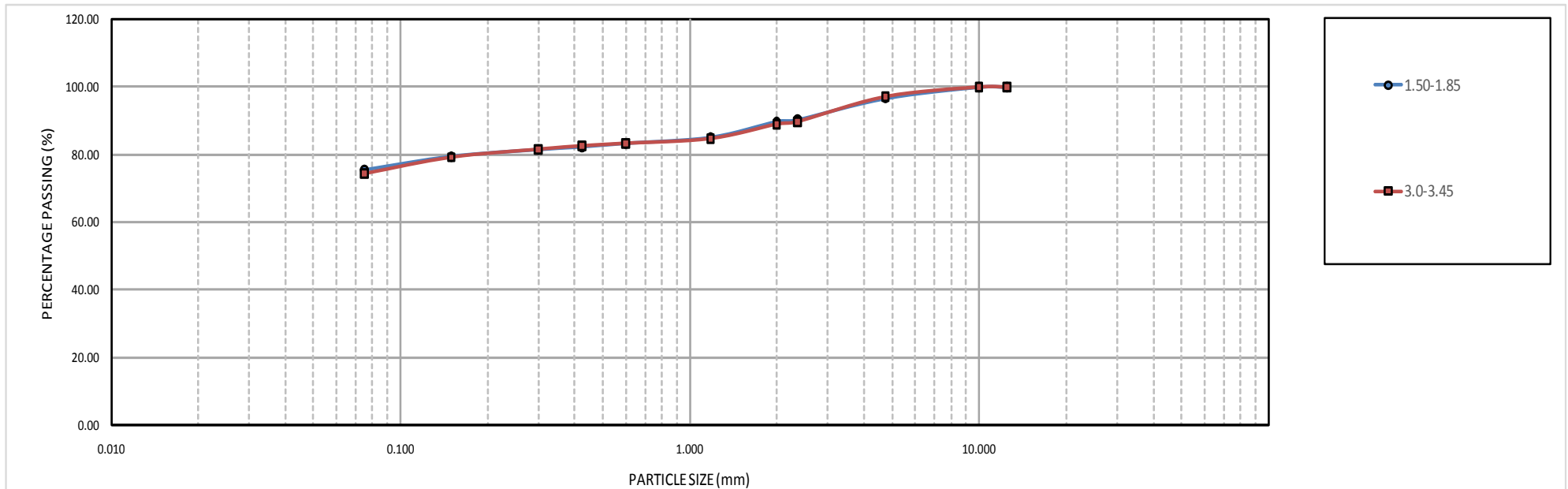
For BIPL

Summary of Soil Test Results

Client:	HSCC (INDIA) LIMITED	Report No.	2262
Project:	GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR	Report Date:	27.07.2019

BH No.	Sample ID (Given in Lab)	Sample Type	Depth (m)	IS:2720(P29)		IS:2720(P2)	IS:2720(P5)			IS:2720(P4)			IS:2720(P40)	IS:2720(P3)	IS:2720(P13)		IS:2720(P15)		IS:1498
				Bulk Density	Dry Density	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	Grain Size Analysis			Free Swell Index	Specific Gravity	Cohesion	Angle of Internal Friction	Compression Index (Cc)	Intial Void Ratio	IS Classification
				gm/cm ³	gm/cm ³	%	%	%	%	Gravel	Sand	Silt/Clay	%	-	kg/cm ²	degree	-	-	-
13	2262	UDS	1.50-1.85	1.781	1.495	19.10	51.7	21.2	30.5	3.3	21.0	75.6	33.33	2.635	0.42	11.95	-	-	CH
13	27.07.2019	spt	3.0-3.45	-	-	-	51.1	21.0	30.1	2.8	22.6	74.6	-	-	-	-	-	-	CH

PARTICLE SIZE DISTRIBUTION CURVE



For BIPL Nagpur

SUMMARY OF ROCK TEST RESULTS

CLIENT:	HSCC (INDIA) LIMITED										Report No.	SRAF No - 2262
SITE:	RAIPUR										Report Date:	27.07.2019
PROJECT:	GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL BLOCKS AT AIIMS RAIPUR (C.G.)											
				<i>Test Methods:</i>		<i>IS:13030</i>				<i>IS:1122</i>	<i>IS:9143</i>	<i>IS:8764</i>
BH No.	Piece No.	Depth (m)	Sample Type	LAB no.	Condition	Dry	Saturated	Water	Porosity	Specific	Unconfined	Uniaxial Compressive
						Density	Density	Absorption		Gravity	Compressive	Strength by Point Load
						g/cc	g/cc	%	%	-	Strength	Strength Index
13	17	6.00-7.50	Core	2262	Soaked	2.696	2.710	0.49	1.31	2.732	0.00	1503.65
13	30	7.50-9.00	Core	2262	Soaked	2.734	2.736	0.08	0.21	2.740	1042.92	0.00
13	33	9.00-10.20	Core	2262	Soaked	2.627	2.633	0.23	0.62	2.643	892.44	0.00

For BIPL

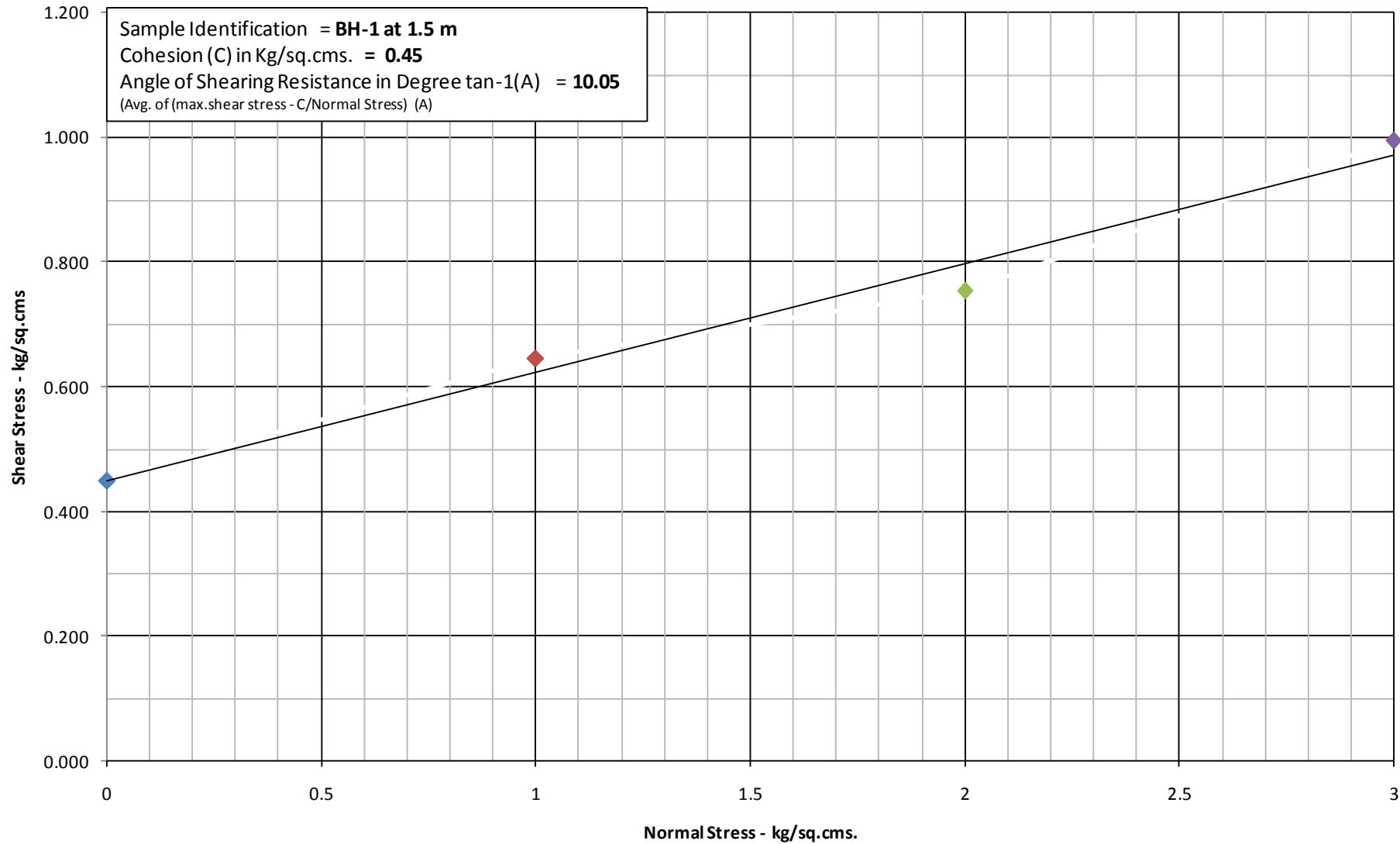
6.0 CHEMICAL TEST RESULTS

CHEMICAL TEST OF WATER SAMPLE														
Parameters	Test Results & Sample Identification													Requirements As Per IS : 456 - 2000
	BH-1	BH-2	BH-3	BH-4	BH-5	BH-6	BH-7	BH-8	BH-9	BH-10	BH -11	BH-12	BH-13	
pH Value	7.61	7.60	7.45	7.90	7.85	7.20	7.75	8.10	7.21	7.72	7.62	7.79	6.50	Min. 6
Sulphate – mg/lit.	78.89	76.83	67.23	72.03	74.09	80.95	82.32	96.04	71.34	85.75	62.42	59.68	58.31	Max. 400
Chlorides – mg/lit.	64.98	59.98	52.98	60.98	54.98	64.98	64.98	66.98	64.98	62.98	41.98	44.98	42.98	max. 500 for RCC

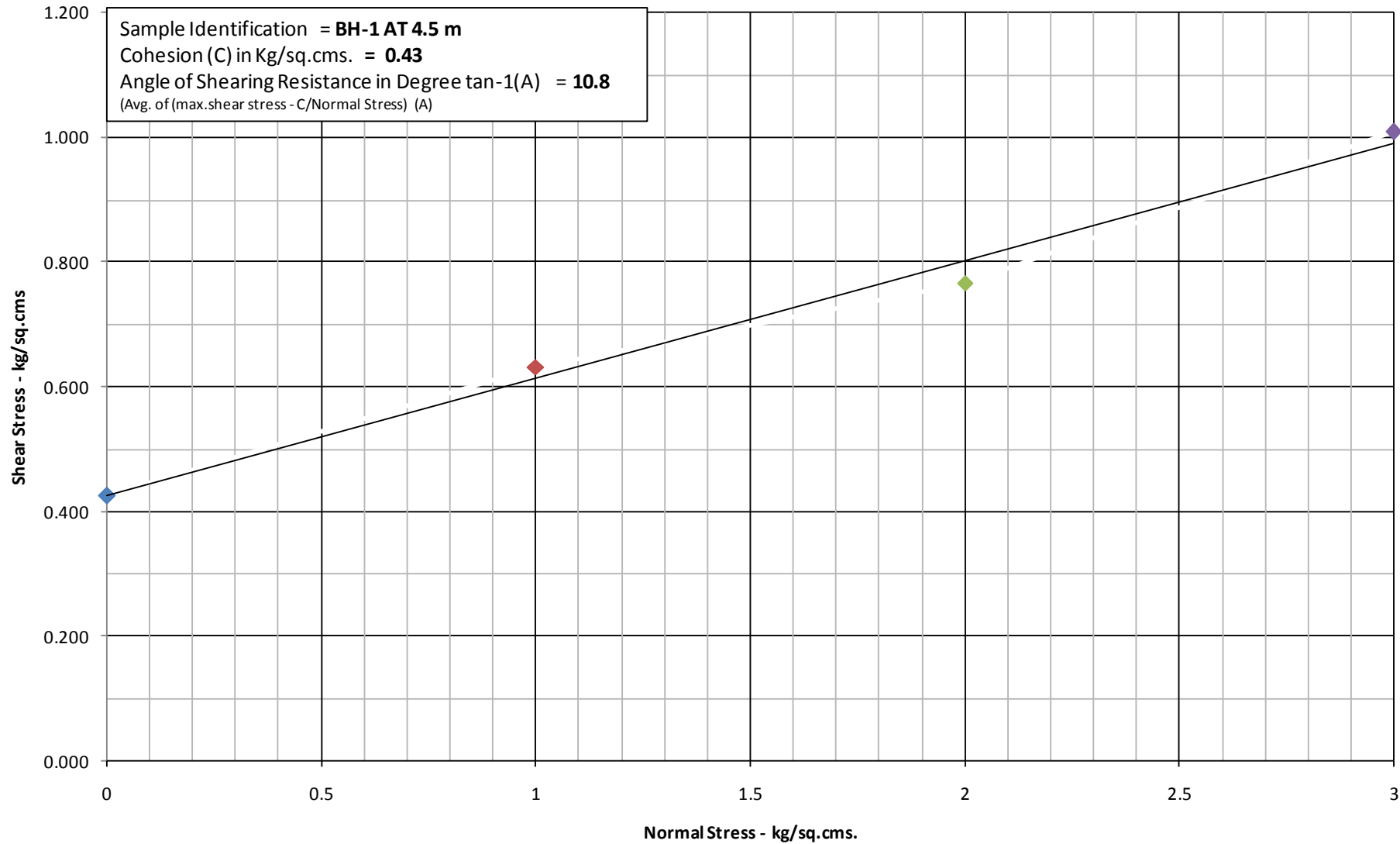
CHEMICAL TEST OF SOIL SAMPLE														
Parameters	Test Results & Sample Identification													
	BH-1	BH-2	BH-3	BH-4	BH-5	BH-6	BH-7	BH-8	BH-9	BH-10	BH -11	BH-12	BH-13	
pH Value	8.16	7.85	8.32	8.36	7.68	8.10	8.06	8.30	7.82	8.75	7.72	8.45	7.93	
Sulphate (SO ₃) % by mass	0.054	0.036	0.041	0.044	0.030	0.032	0.037	0.049	0.030	0.046	0.044	0.053	0.041	
Chlorides – % by mass	0.022	0.103	0.022	0.103	0.039	0.008	0.030	0.103	0.015	0.103	0.103	0.103	0.103	

7.0 GRAPHS

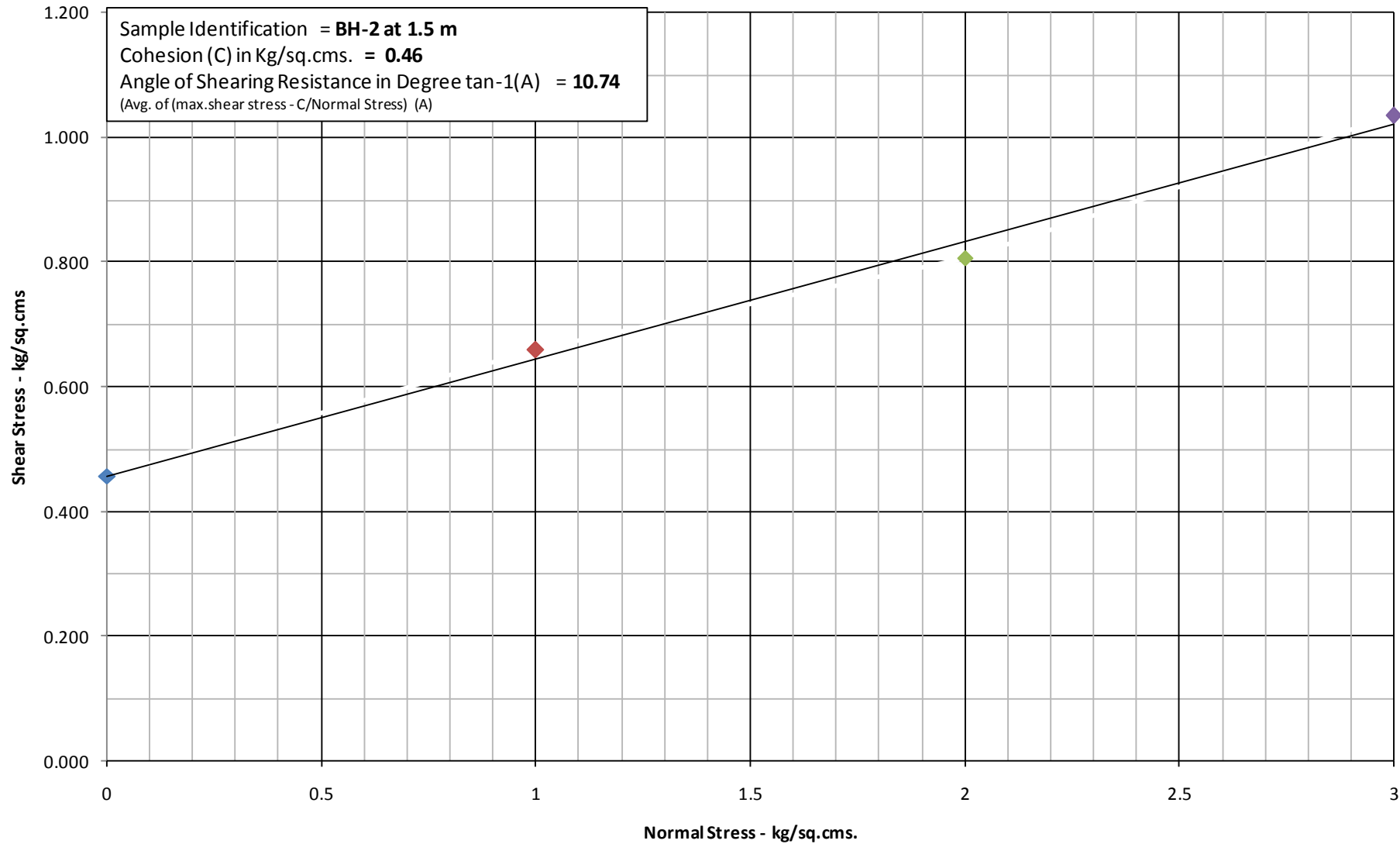
DIRECT SHEAR TEST



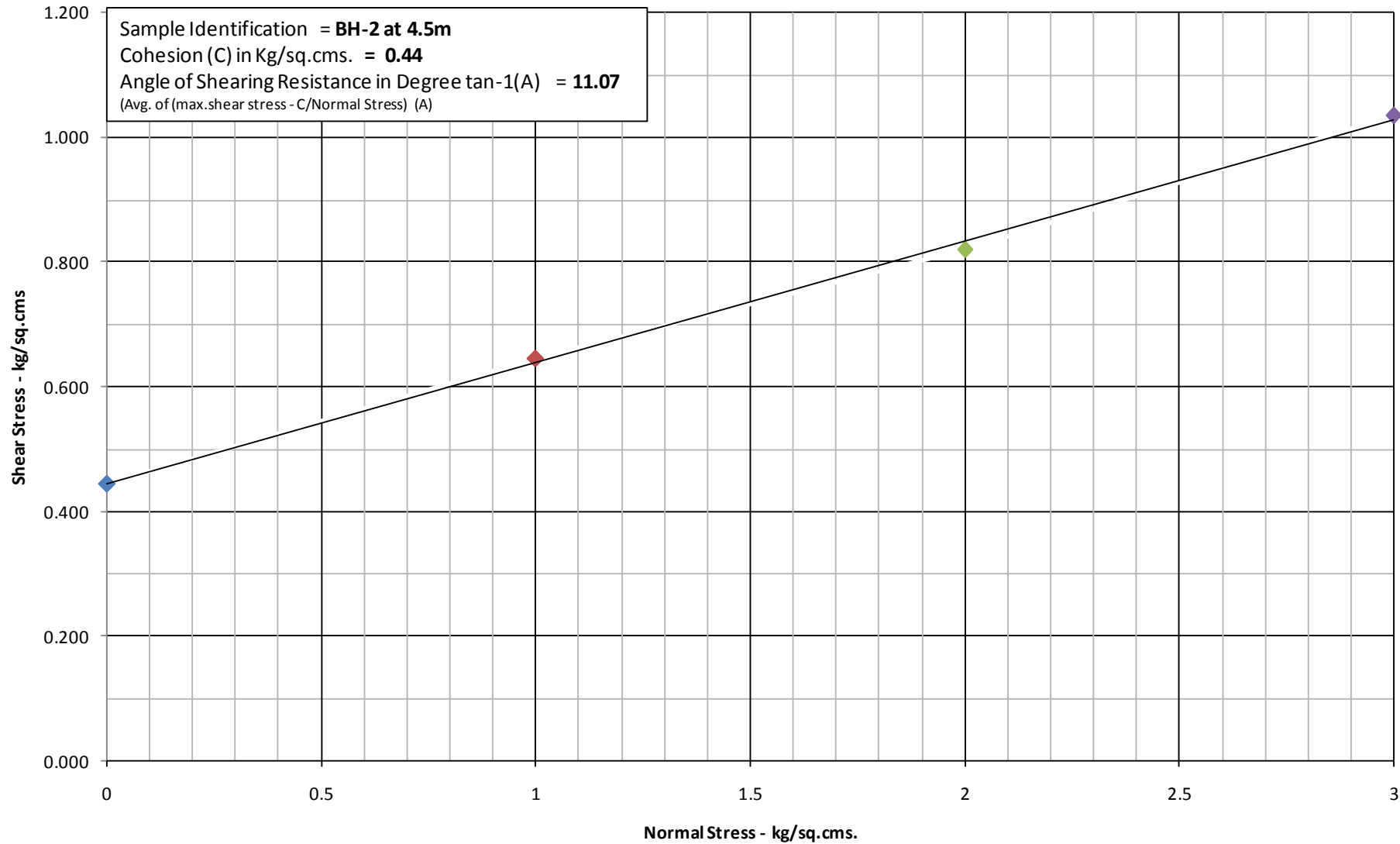
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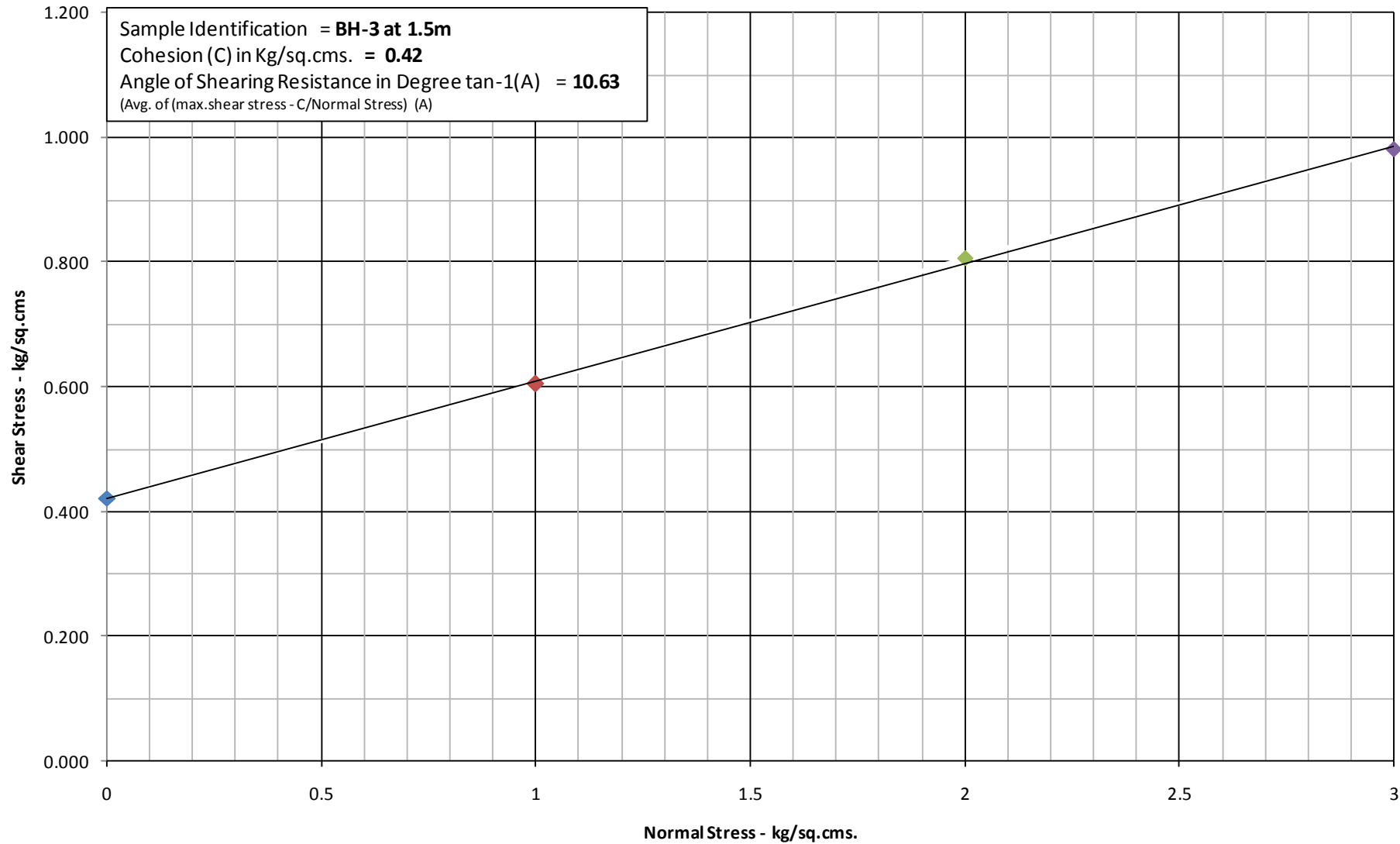
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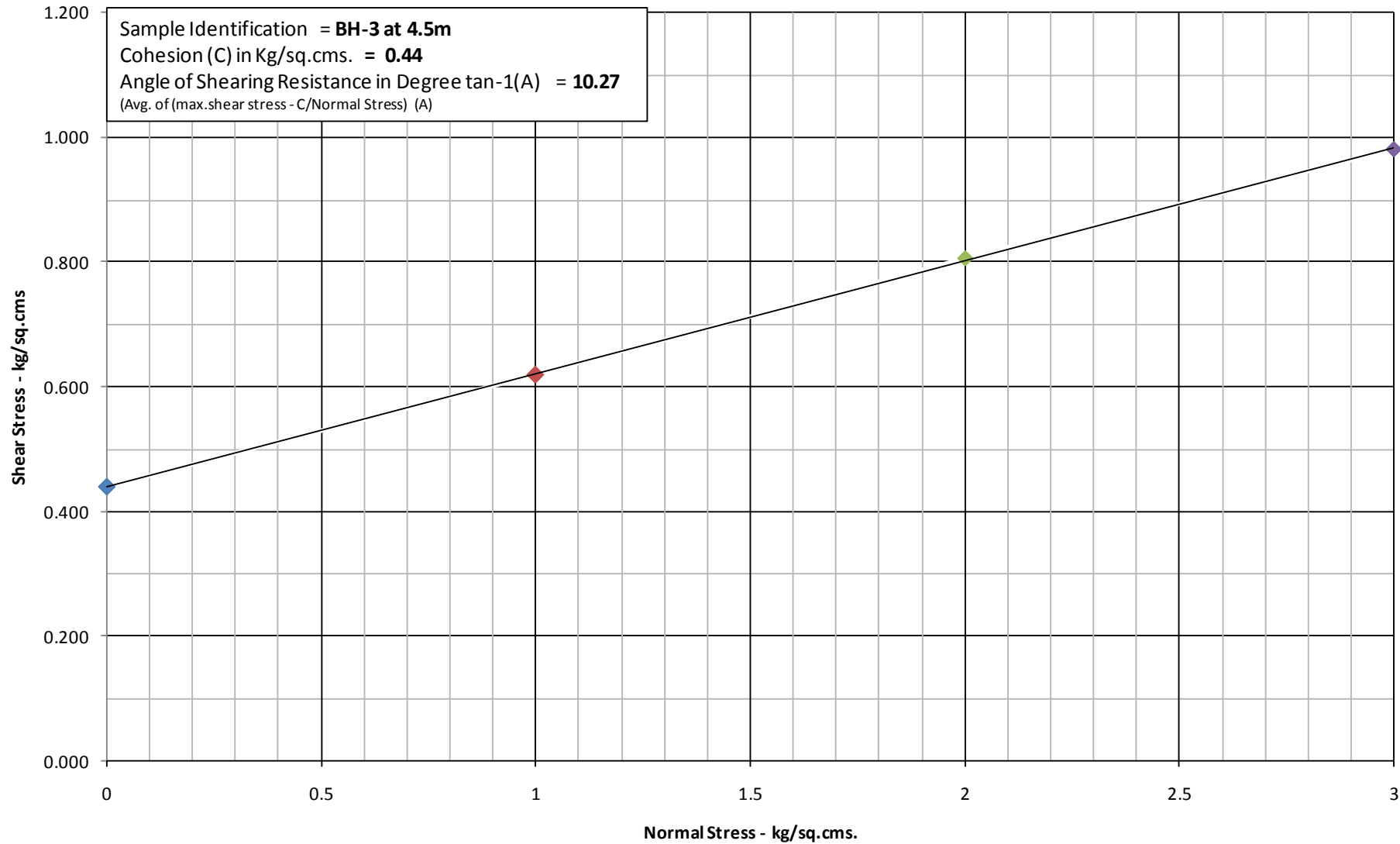
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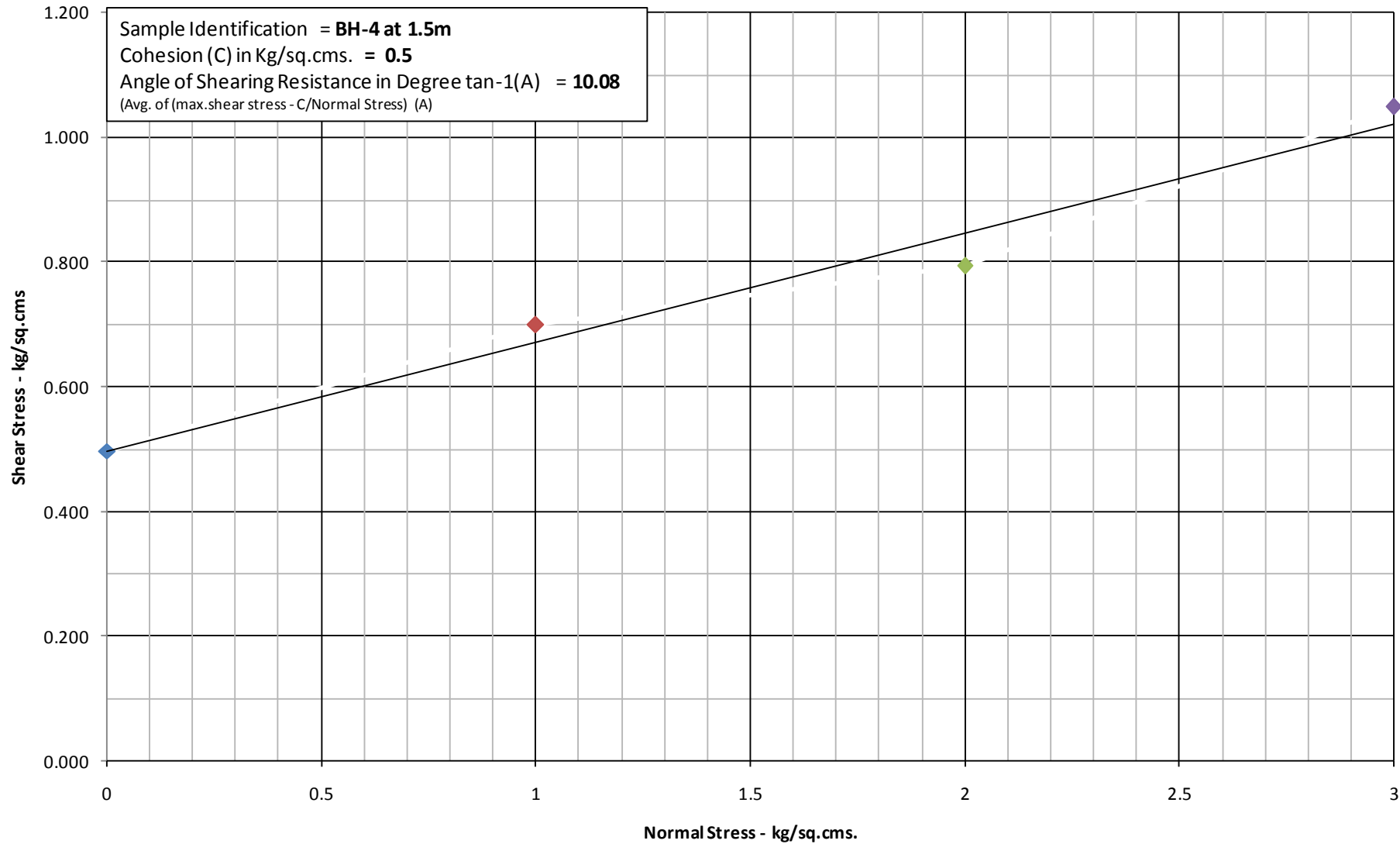
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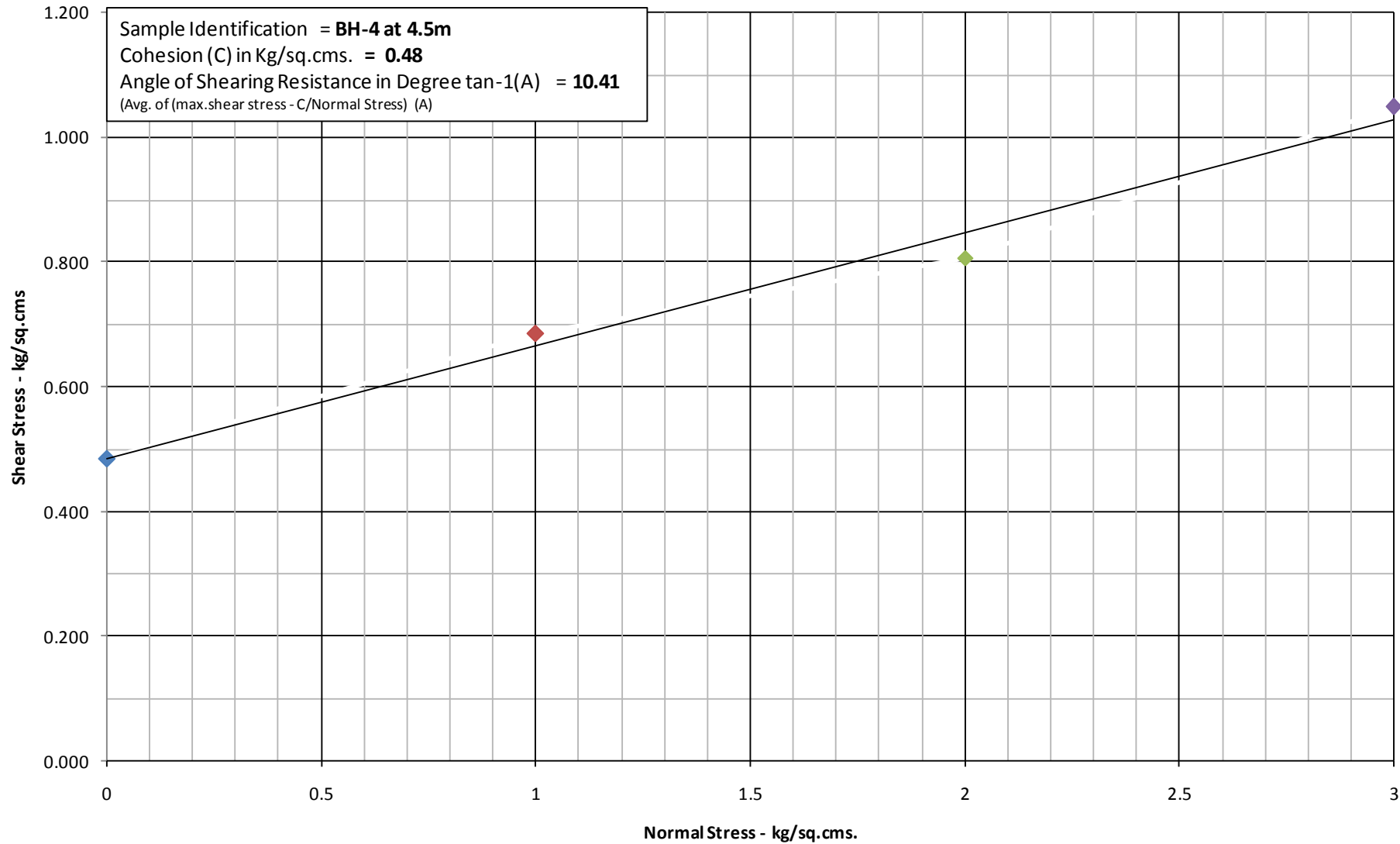
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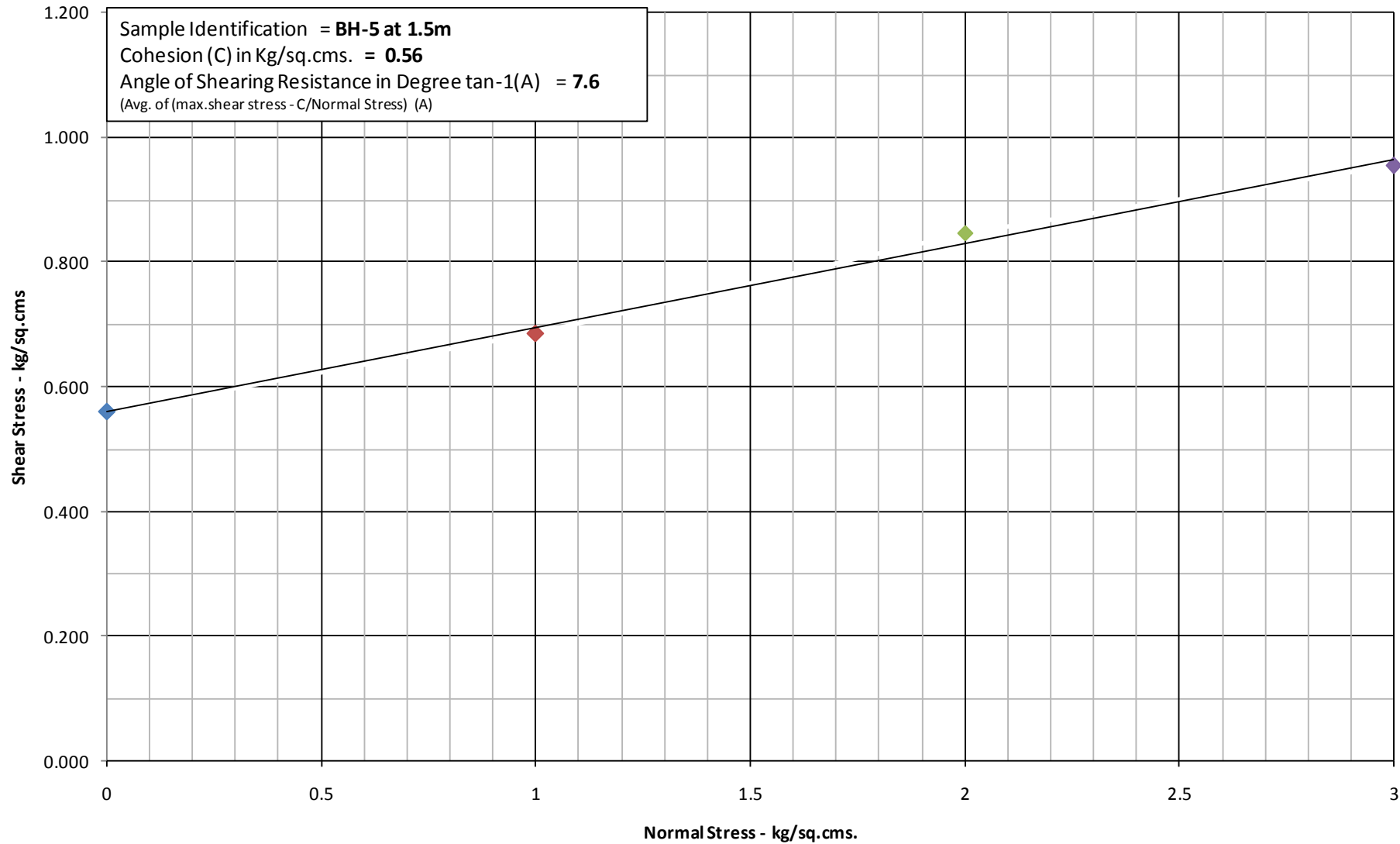
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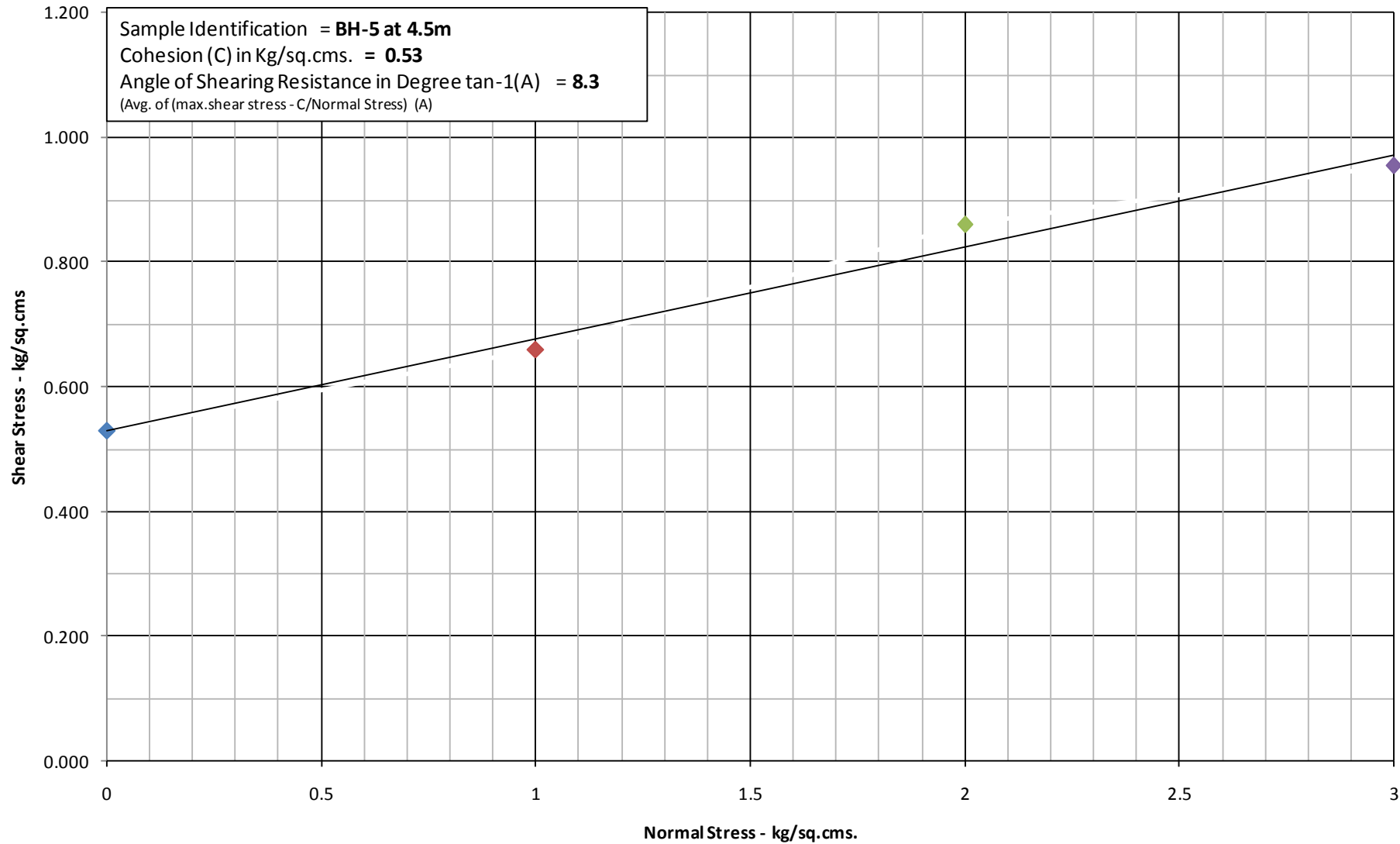
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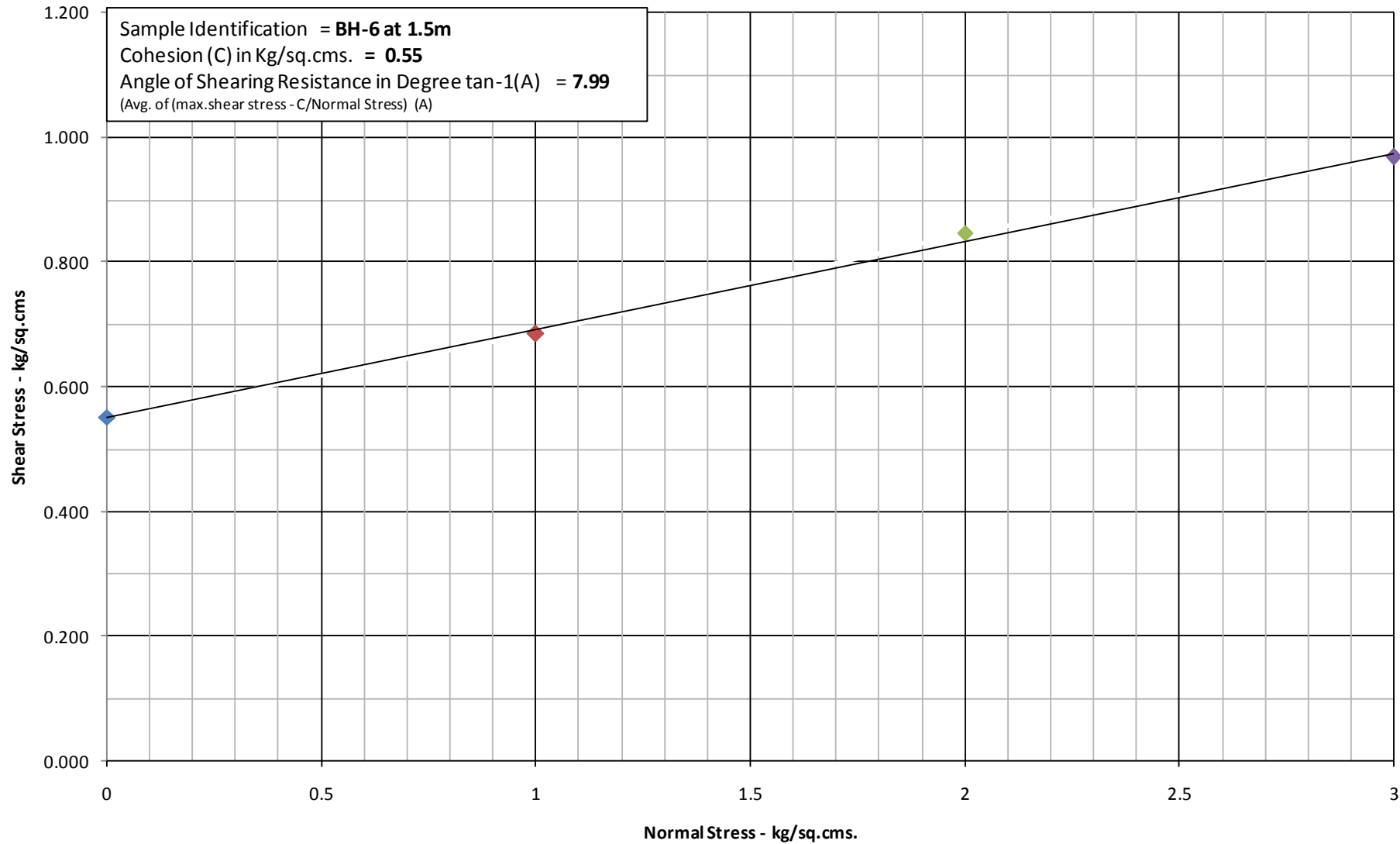
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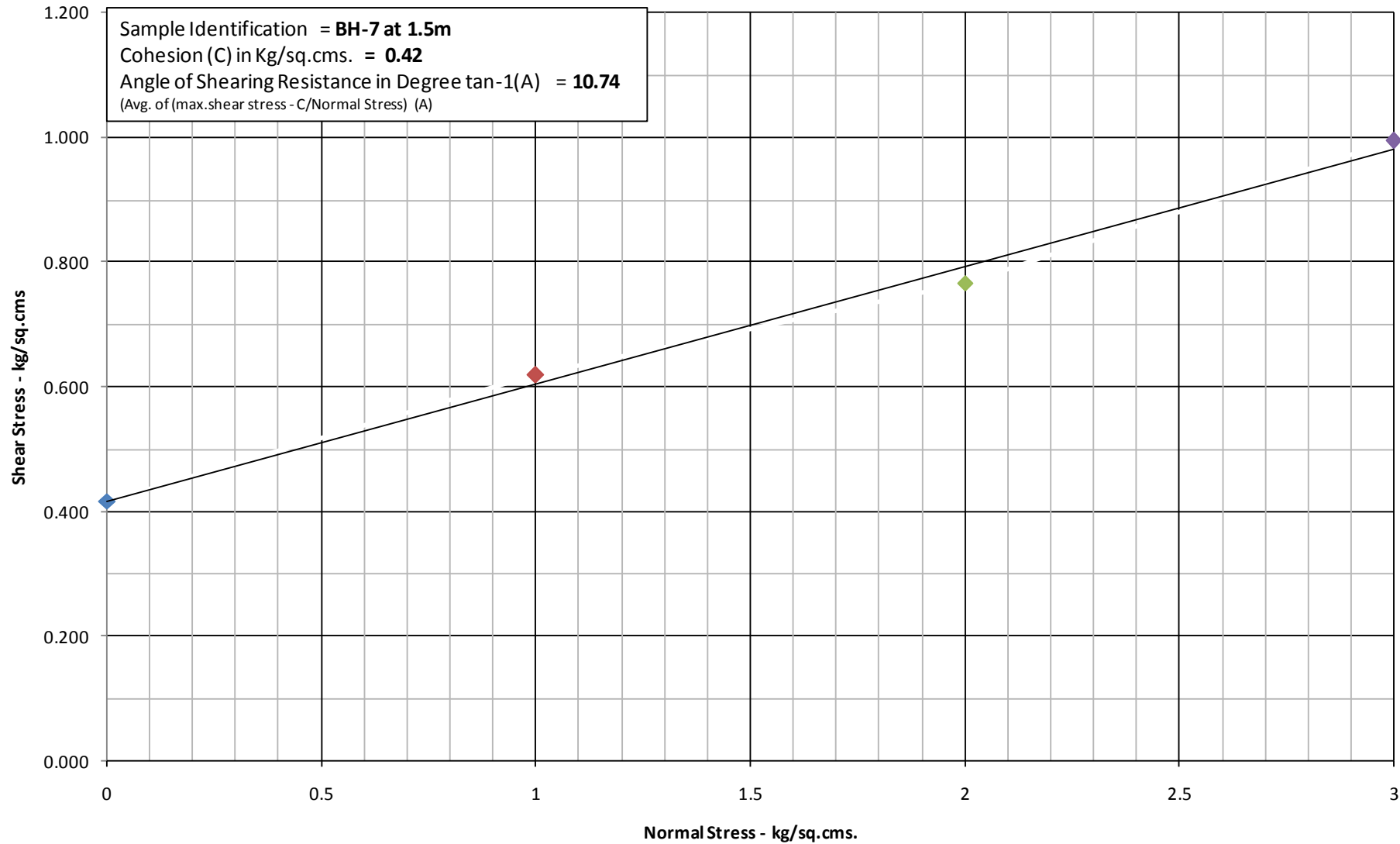
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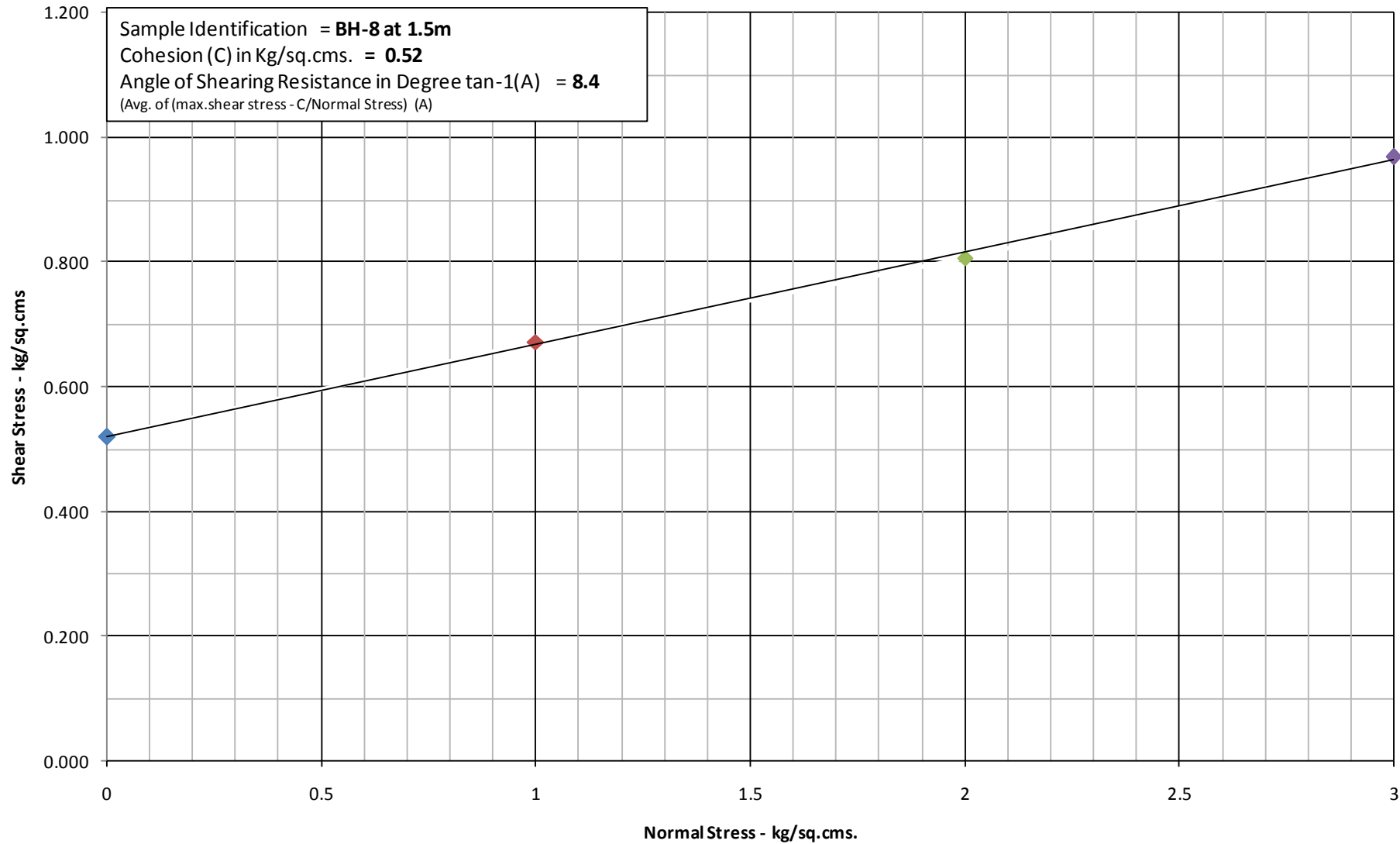
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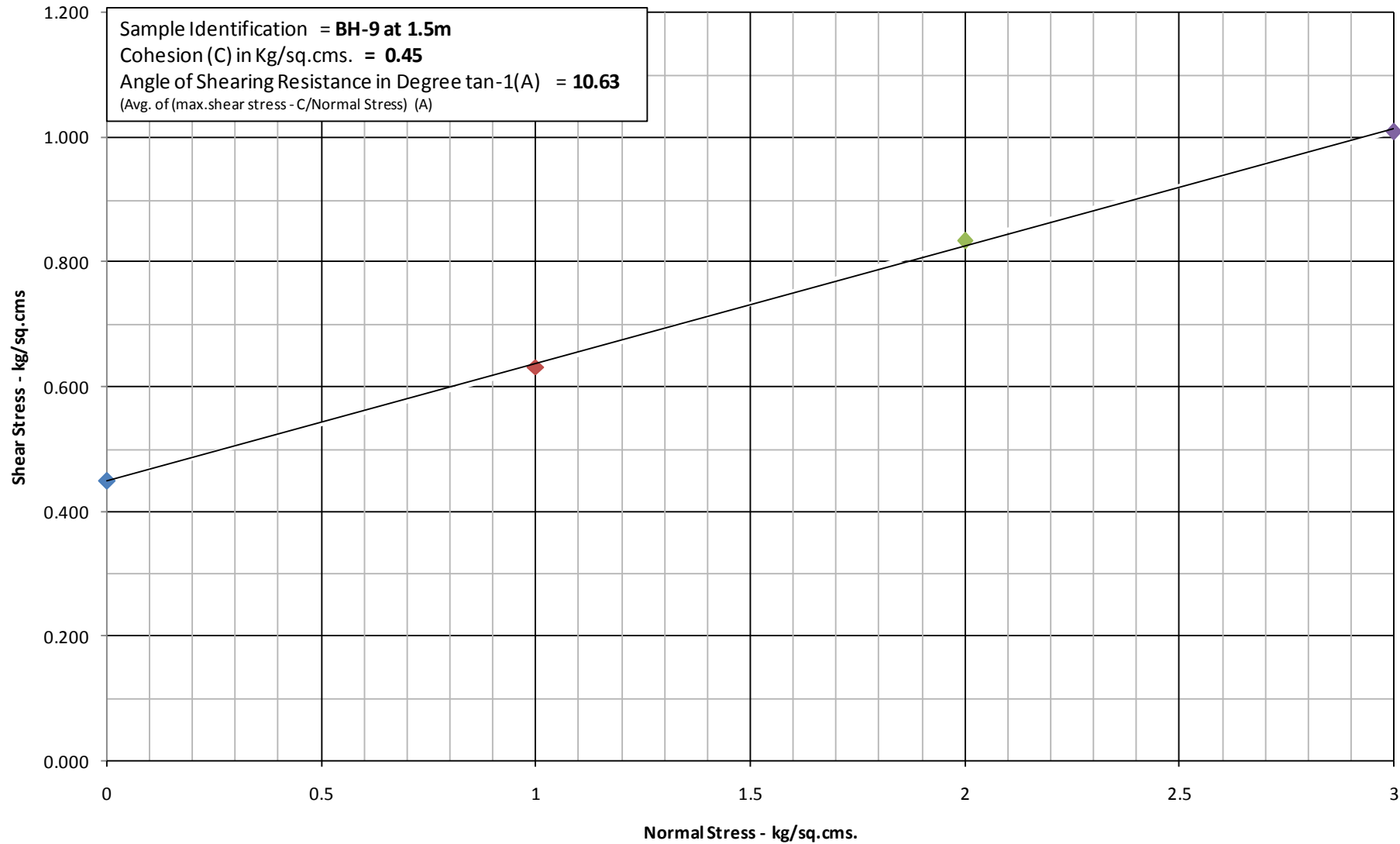
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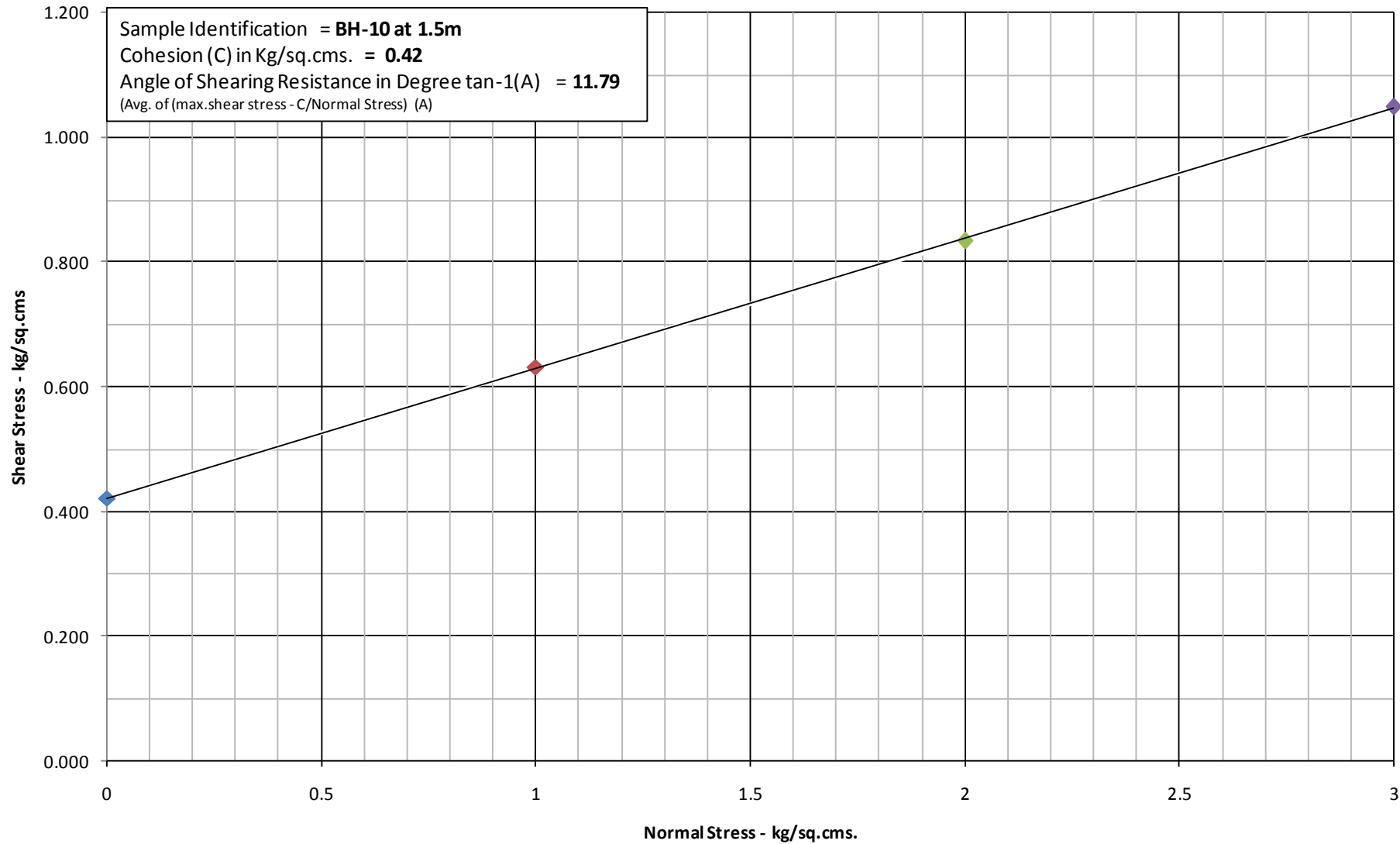
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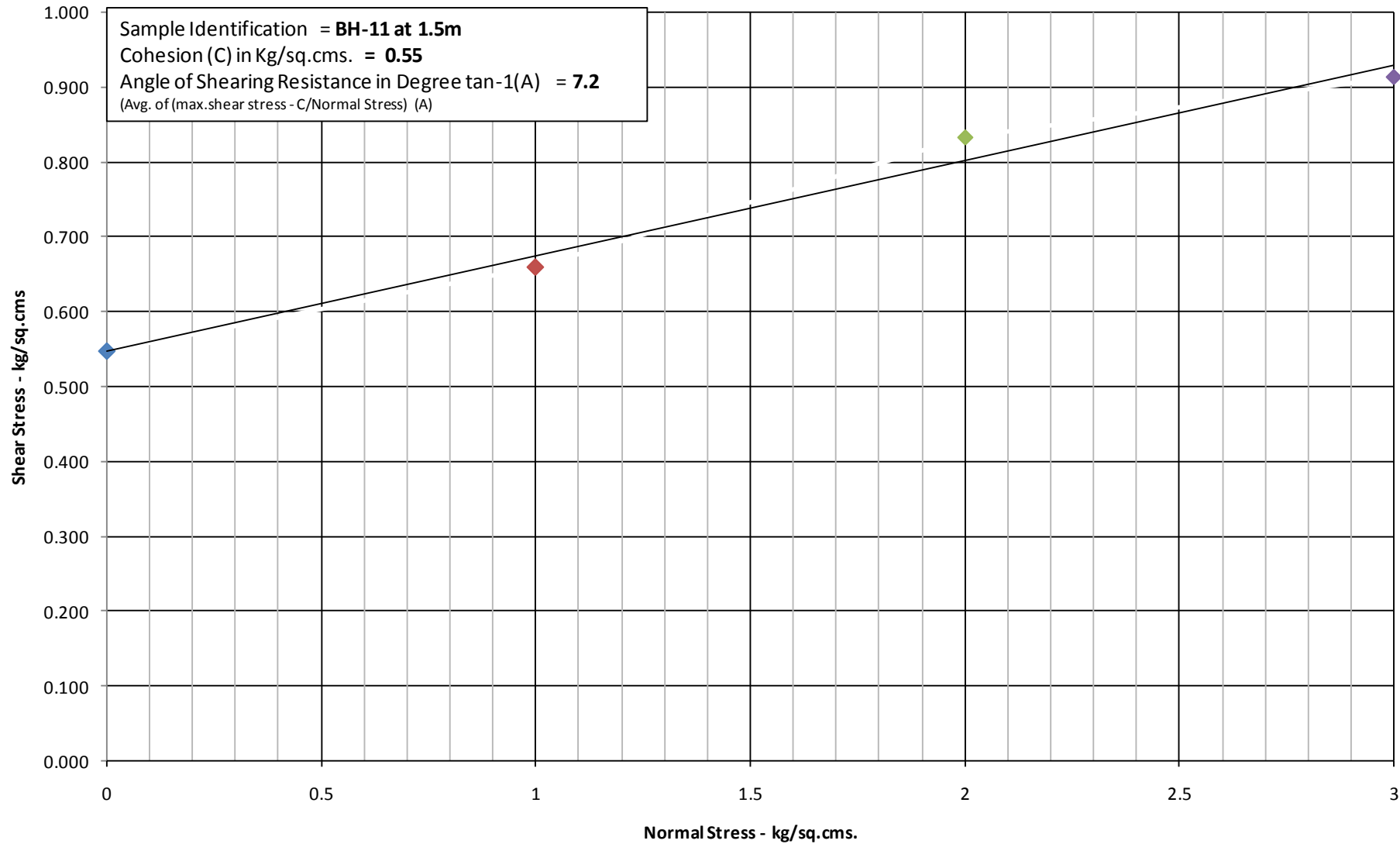
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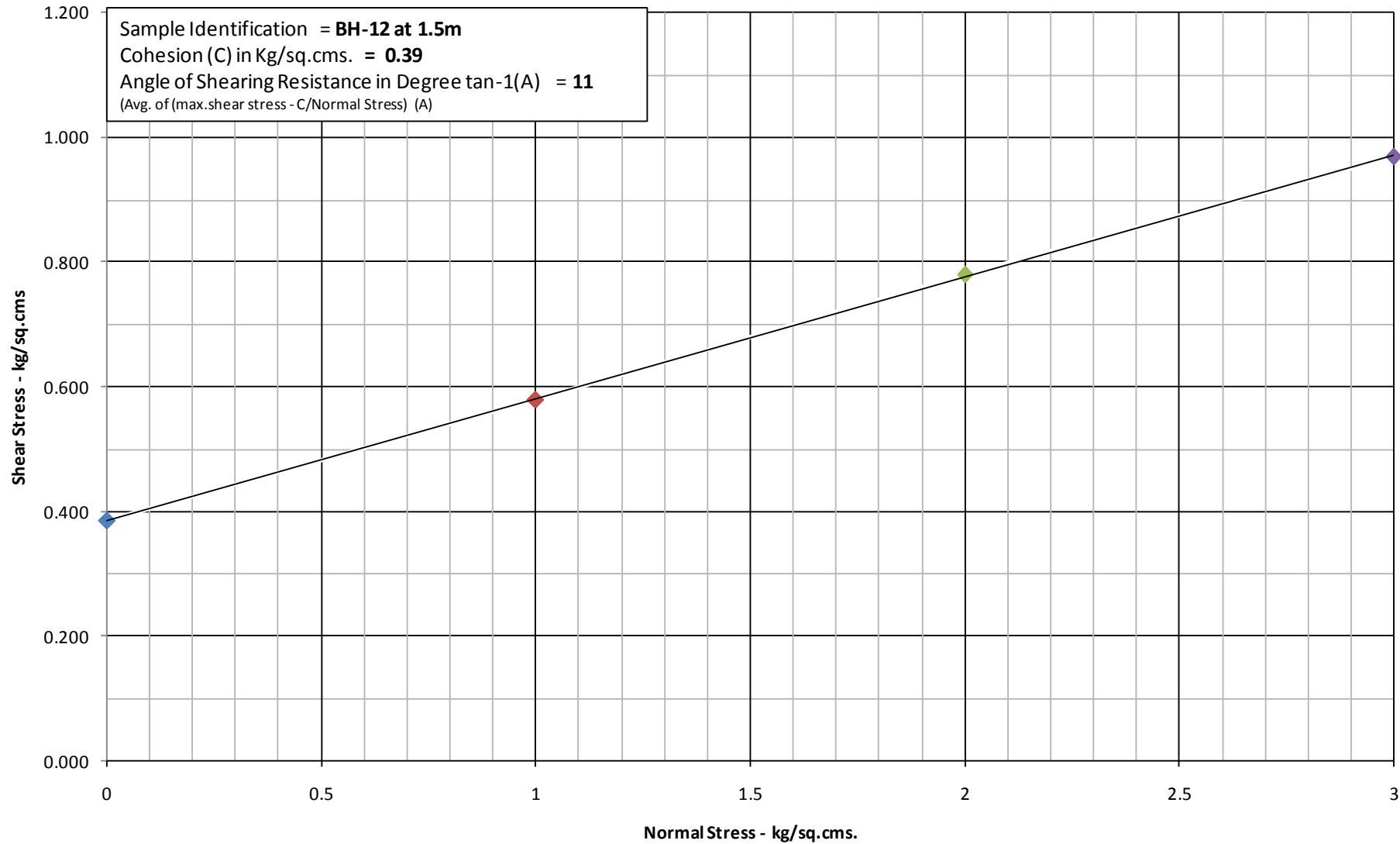
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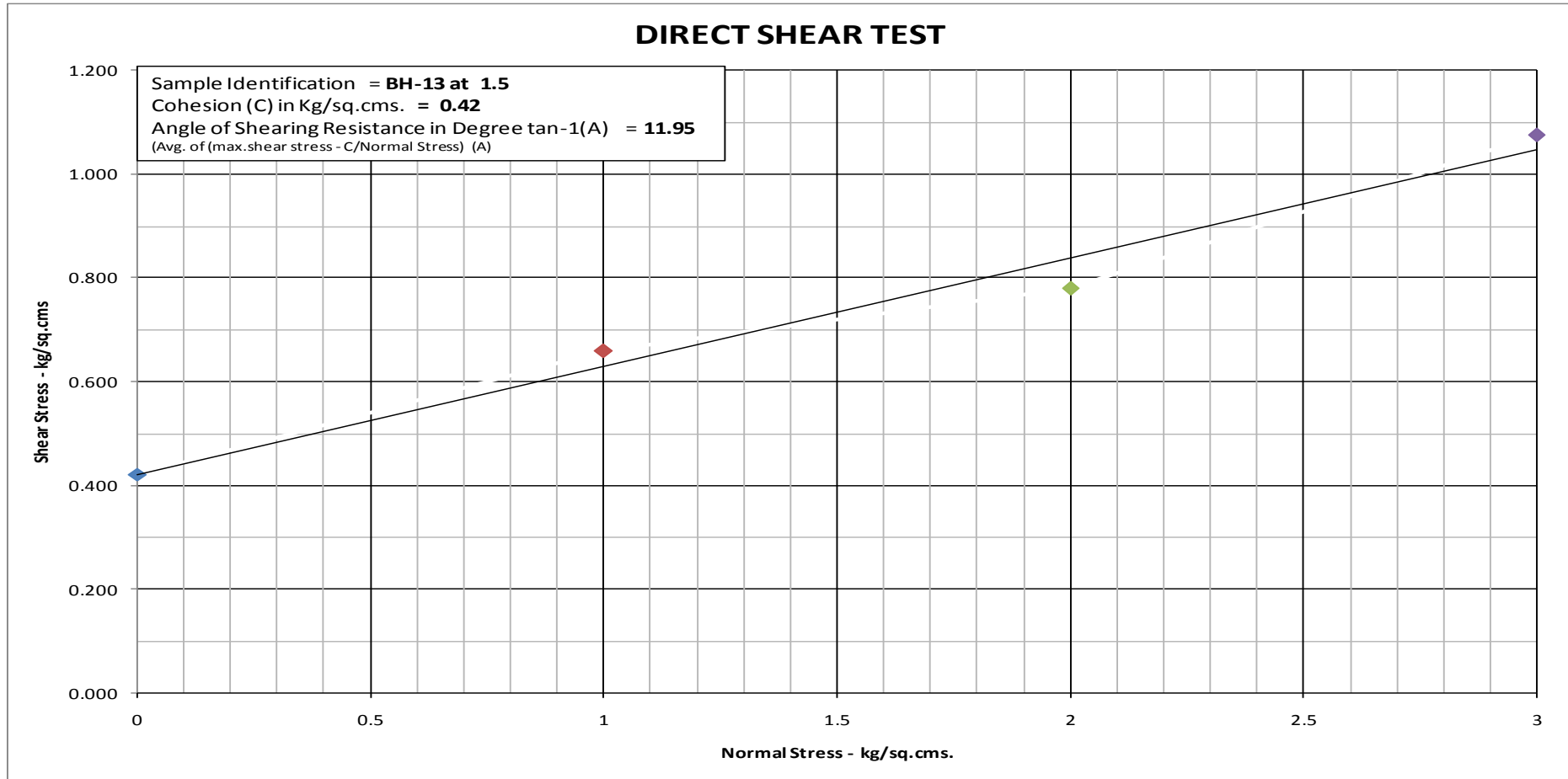


DIRECT SHEAR TEST

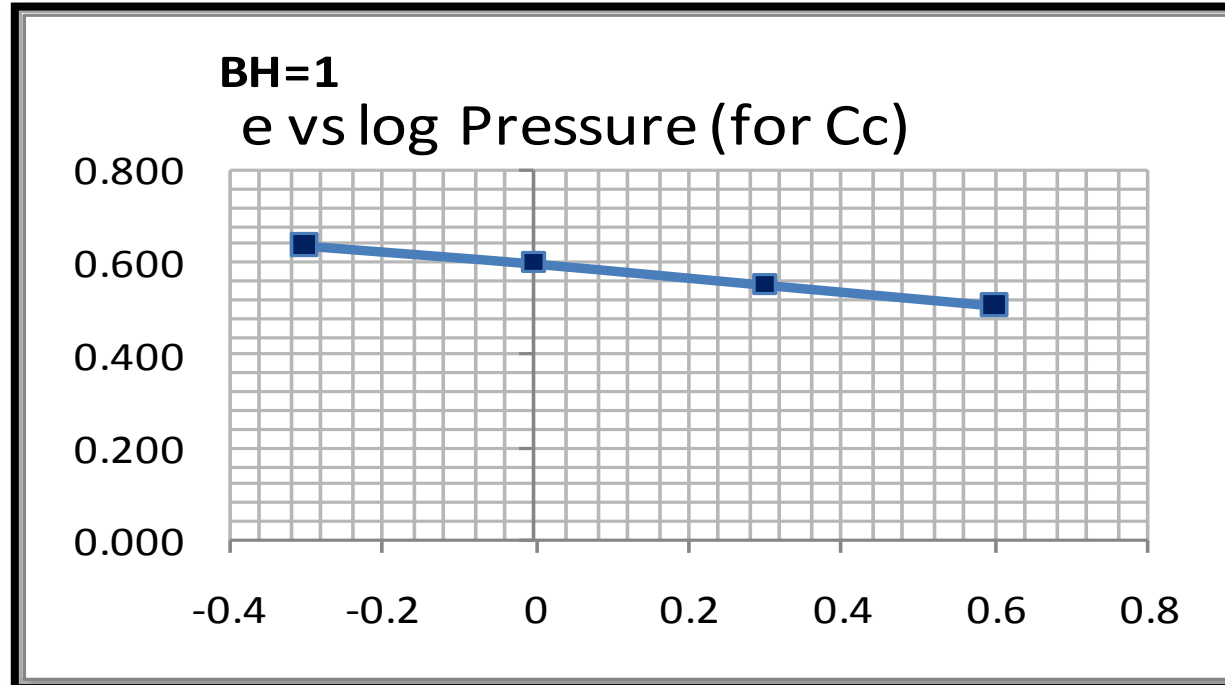


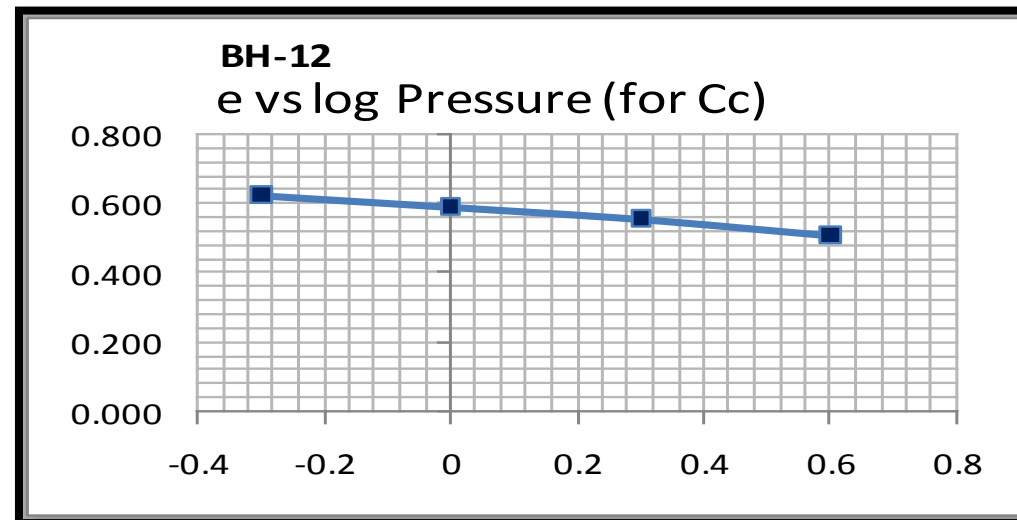
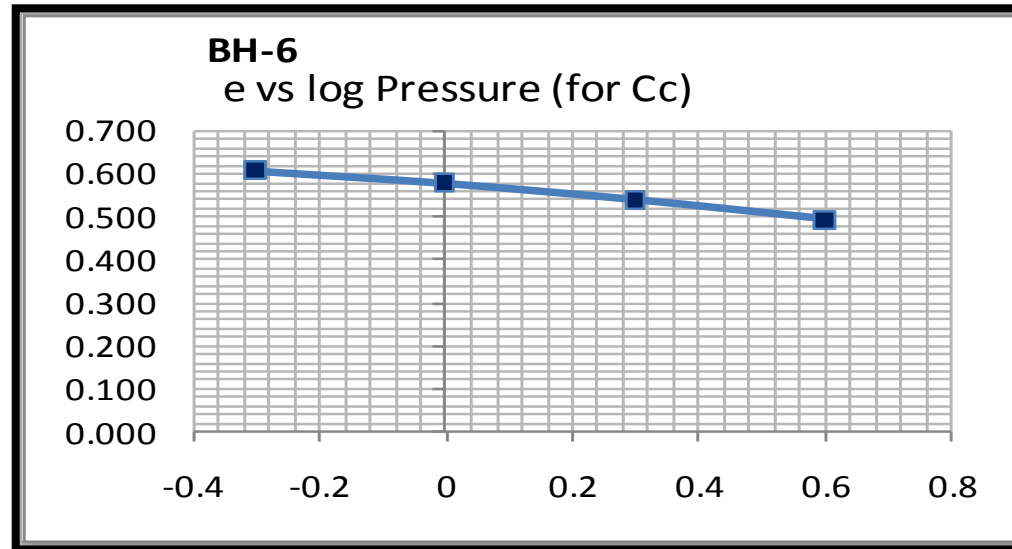
DIRECT SHEAR TEST





CONSOLIDATION GRAPHS





8.0 PHOTOGRAPHS

PHOTOGRAPHS

MACHINES AND CORE BOX







BH-3



Core Box-3









BH-7



Core Box-7



BH-8



Core Box-8





BH-10



Core Box-10



BH-12



Core Box-12



