Civil Baba Infra Consultants Pvt Ltd.

Geotechnical Investigation work for Proposed Elevated Track in Kurushetra City for elimination of five manned level crossing in Kurushetra - Narwana Section on Northern Railways.

Job No 2137

Final Report

Soil Engineering Consultants

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C O N T E N T S

1.0 INTRODUCTION

M/s Civil Baba Infra Consultants Pvt Ltd. has awarded the work of Geo technical Investigation for the proposed Elevated Track in Kurushetra City for elimination of five manned level crossing in Kurushetra - Narwana Section on Northern Railways to M/s Soil Engineering Consultants, New Delhi. This Draft report presents the details of Geotechnical investigations carried out and data obtained from various field and laboratory tests, their presentation in graphical form, and their compilation for the proposed structures.

2.0 SCOPE OF WORK

a) Drilling bore holes upto the maximum depth of 30.0 m as per IS code of practice and as per the direction of the Engineer-in-Charge.

b) Conducting Standard Penetration tests in the bore holes at regular intervals of 1.50m or wherever possible as per IRS/ IS Code of Practice.

c) Collecting undisturbed soil samples / core samples from the bore holes at regular intervals or change of strata or wherever possible as per IRS/ IS Code of Practice.

d) Recording of water table level in the bore holes after completion of borehole.

e) Preparation of report summarizing the details of soil classification, analysis of test data, type of foundation etc.

3.0 FIELD WORK

3.1 Boring

Bore holes of 150 mm dia. were drilled as per IS code of practice (IS 1892) and as per the directions of the Engineer in charge. The

details of Bore holes drilled, Depth of bore hole and the depth of water table are as given below:

Table 1 : Detail of the Boreholes.

CH	BH	Coordinates		R.L of the Borehole (m)	Depth of Borehole (m)	Water Table (m)
		Easting	Northing			
0+230	BH 1	673735.000	3315646.000	252.368	15.00	Not Met
0+460	BH 2	673920.000	3315723.000	251.998	30.00	Not Met
0+720	BH 3	674148.000	3315835.000	250.703	30.00	Not Met
0+930	BH 4	674409.000	3315947.000	251.596	30.00	Not Met
1+235	BH 5	674673.000	3316078.000	252.444	30.00	Not Met
1+495	BH 6	674913.000	3316190.000	251.293	30.00	Not Met
1+750	BH 7	675143.000	3316289.000	251.305	30.00	Not Met
2+010	BH 8	675347.000	3316357.000	251.659	30.00	Not Met
2+270	BH 9	675628.000	3316421.000	253.211	30.00	Not Met
2+520	BH 10	675877.000	3316477.000	252.175	30.00	Not Met
2+730	BH 11	676038.000	3316505.000	252.391	15.00	Not Met
2+750	BH 12	676109.000	3316515.000	252.948	15.00	Not Met
2+780	BH 13	676134.000	3316516.000	252.941	30.00	Not Met
3+040	BH 14	676405.000	3316569.000	252.133	30.00	Not Met
3+300	BH 15	676626.000	3316660.000	252.306	30.00	Not Met
3+560	BH 16	676851.000	3316787.000	252.625	30.00	Not Met
3+820	BH 17	677031.000	3316972.000	253.065	30.00	Not Met
4+080	BH 18	677177.000	3317163.000	252.634	30.00	Not Met
4+340	BH 19	677335.000	3317391.000	252.644	30.00	Not Met
4+600	BH 20	677550.000	3317501.000	252.733	30.00	Not Met
4+460	BH 21	677782.000	3317600.000	252.766	30.00	Not Met
5+080	BH 22	677997.000	3317582.000	253.040	15.00	Not Met

3.2 Standard Penetration Test (SPT)

These tests were conducted at every 1.50m intervals and every change of strata or wherever possible. The tests were performed by driving into the soil (bore holes cleaned of any loose material) a standard split spoon sampler with the help of a standard hammer

with a free fall of 75 cms on a driving head as described in IS: 2131. This head was attached to "A" drill rod to the other end of which the sampler was fitted. The number of blows needed to penetrate the first, second and third stages (each of 15 cms) depth of the sampler length, were noted. The number of blows (N- value) as given in the bore hole data sheets is the numerical sum of blows counted during the second & third stage only i.e. for a depth of 30 cms.

3.3 Collection of Samples

Disturbed and Undisturbed soil samples were collected from the boreholes at regular intervals as per IS Code of practice.

3.4 Recording of water table

Water table was Not met in the boreholes at the time of Soil investigation which was carried out during the months of August-September 2019. The details are given at Table I above.

4.0 LABORATORY TESTS

A visual and discrete examination of all the soil samples collected was carried out for deciding the number and type of tests to be tested from each bore hole. Based on the strata met at site the following tests were conducted on samples to classify them and to evaluate their index and Engineering properties.

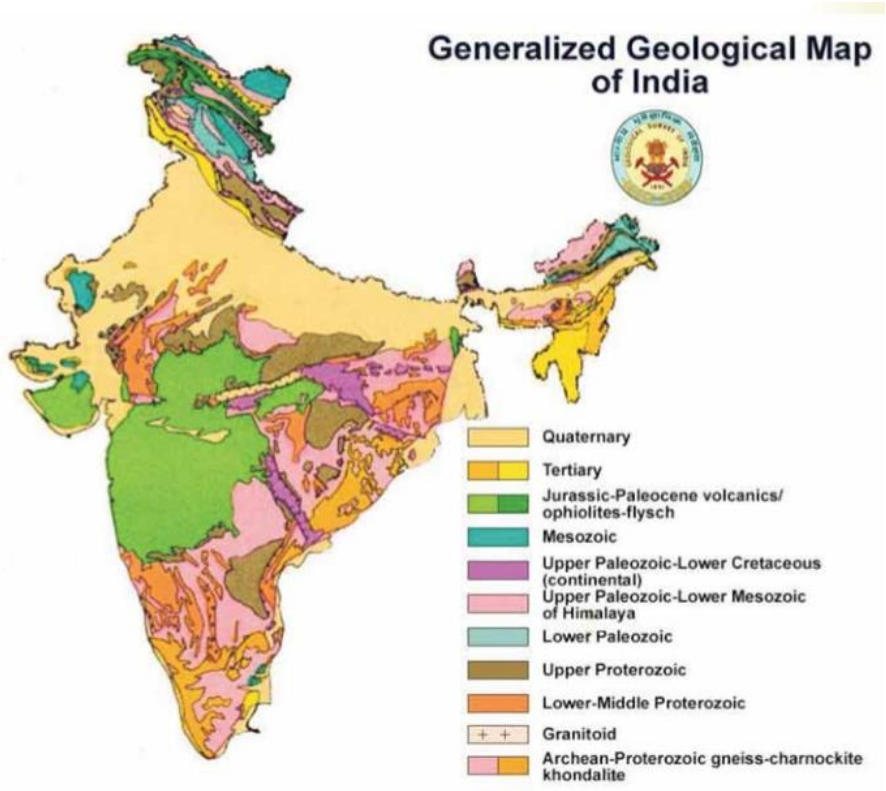
SOIL SAMPLES

a) Grain size distribution as per IS: 2720(Part IV).
b) Hydrometer Analysis as per IS: 2720(Part IV).
c) Specific gravity as per IS: 2720(Part III).
d) Bulk density and dry density as per IS: 2720(Part II).
e) Moisture content as per IS: 2720(Part II).
f) Liquid and plastic limits as per IS: 2720(Part V).
g) Direct shear test as per IS: 2720(Part XIII).
h) Unconsolidated undrained Shear Test as per IS: 2720 (Part XII).

5.0 GENERAL GEOLOGY OF THE AREA

The geology of Haryana is predominated by the Quaternary alluvium and Aeolian sediments covering nearing 95% of area. The rest of the area compromises Proterozoic rocks and Tertiary rocks exposed in the southern and northern extremities of the states, respectively. The Proterozoic rocks of Haryana, represented by the Delhi Super group, are the northeastern continuation of rocks of the Alwar and Khetri basins of northeastern Rajasthan. They occur as isolated hills, parallel ridges, inselberg and discontinuous ridges, confined to the southern parts of the state and extend up to Delhi in the north-east.

The lithology of the Delhi Super group comprises schists, quartzite and marble of Proterozoic age with associated basic flows, tuffs, acid and basic intrusive.



Reproduced from Geological Survey of India (GSI) annual report 2009-2010

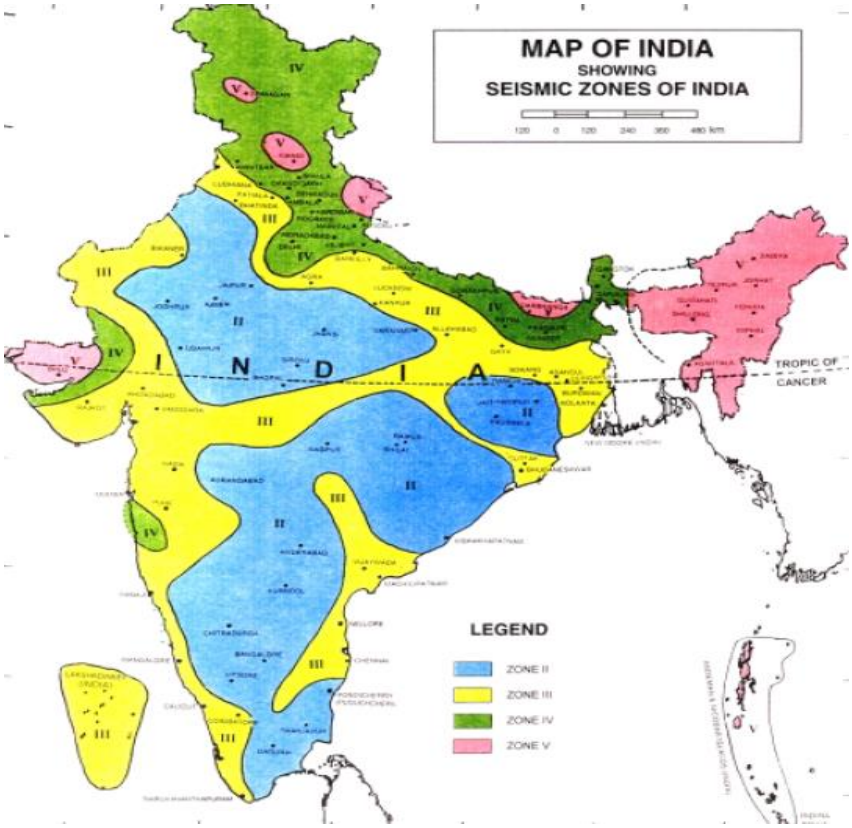
6.0 SEISMICITY

The Haryana falls in the seismic zone IV, III, & II and therefore, the region is vulnerable to earthquakes creating low to moderate damage risk from earthquakes. Ambala, Sonepat, Rohtak, Karnal, Gurgaon, Faridabad, Panipat, Rewari and Yamunanagar districts lie in Zone IV. The districts of Kurukshetra, Jind, Hissar, Bhiwani, Mahendragarh and Kaithal lie in Zone III while only Sirsa District lies in Zone II. Although, in recent past, no major earthquakes have occurred in Haryana, yet tremors have been felt whenever there is an earthquake in the Himalayan foot-hills. The feet remains that the region is not free from potential affecting the region are:-

1. The hidden Moradabad fault
2. The Sohna fault
3. Junction of Aravali and Alluvium near Delhi
4. Mathura fault
5. Delhi Haridwar fault

Earthquakes which have occurred during 1820-1988 with their epicentre between latitude 26.00 to 33.00 North and longitude 73.00 to 79.00 East with in which the state of Haryana falls are around 125 of magnitude varying between 4.0 – 8.0 on Richer Scale. The project area lies in Zone III. In Seismic design Zone factor, Z of 0.16 is recommended.

Seismic Map of India



The area under study and its surroundings are seismically active and falls in Seismic Zone –III. The tectonic elements of the area are considered capable of generating an earthquake of intensity MSK VII. In Seismic design Zone factor, Z of 0.16 is recommended.

7.0 LIQUEFACTION

Liquefaction is a process in which a saturated soil loose strength during an earthquake and acquires a degree of mobility sufficient to permit significant movements. In general, fine uniform sands are found to be most susceptible for liquefaction in terms of grain size. It can be stated that soils containing less than 10% fines, D_{60} between 0.20 mm to 1.0mm, uniformity coefficient between 2 to 5 are most susceptible to liquefaction for given relative density of soil and intensity of earthquake. Thus, uniformly graded materials are more susceptible to liquefaction than well graded materials. Also fine

sands are more susceptible than gravelly soils, silty sands, silts or clays.

Assessment of liquefaction potential of foundation strata is made by simplified approach proposed by Seed & Idriss (1983 - 1985) from the SPT data and peak ground acceleration likely to occur at the site. In this method, cyclic shear stress likely to be induced in the foundation strata is first evaluated. Next threshold cyclic shear stress, which is good enough to cause liquefaction, is determined from SPT data and the empirical relations. Finally, comparison of these two stresses is used in the estimation of liquefaction susceptibility of the foundation strata

Liquefaction Analysis:

Cyclic Stress Ratio under Earth Quake (CSR)

Stress ratio under earth quake (CSR)

$$= (\tau / \sigma_o)_{earthquake} = 0.65\ (\gamma h\ a_{max} / \sigma_o\ g)\lambda$$

σ_o= Effective overburden pressure at depth h

γ = Bulk density of soil

a_{max}= Max. Ground acceleration = 0.24g

Evaluation of Liquefaction Resistance (CRR)

$CRR_{7.50} = 1/\{(34-(N_1)_{60CS}\} + (N_1)_{60CS} / 135 + 50/\{10*(N_1)_{60CS} + 45\}^2 - 1/200$

$(N_1)_{60} = NC_{60}C_N$

N= Uncorrected SPT count

C_N= factor to normalize N_m to a common reference effective overburden stress = $(p_o / \sigma_o)^{0.5}$

$C_{60} = C_{HT}C_{HW}C_{SS}C_{RL}C_{BD}$

C_{HT}=Correction for Hammer Energy Ratio

C_{BD}= Correction factor for the borehole diameter

C_{RL}= correction factor for rod length

C_{SS}= Correction for samples with or without liners

Correction for Fineness content

$(N_1)_{60cs} = \alpha + \beta (N_1)_{60}$

$CRR_L = CRR_{7.50} * k_m$

k_m Correction factor

For earthquake magnitude other than 7.5 = $10_{2.24}/ (M_{7.5})^{2.56}$

Magnitude of Earth quake considered as 6.0.

Liquefaction occurs if $CSR_L \geq$ CRR

Data considered for Liquefaction:

Magnitude of Earth quake = 6.0

a_{max}/g= 0.16

Water table assumed for Calculation = 5m rise from the water table depth encountered at the time of investigation.

The Liquefaction analysis has been calculated and given at **Annexure II**.

8.0 SUB SOIL PROFILE &STRENGTH CHARACTERISTICS OF SOIL

This intern report consists of Twenty boreholes namely **(BH 1 To BH 22)** were drilled. BH 2 to BH 10, BH 13 to BH 22 were were drilled upto 30.0m depth and BH 1,BH 11, BH 12 & BH 22 were drilled upto 15.0m depth. In BH 5, BH 6, BH 8, BH 11 to BH 15 & BH 17 Filled up material was observed upto 1.0m to 3.0m depth below ground level. While advancing the bore holes SPT tests were conducted at regular intervals of 1.5m and representative samples were collected. These representative samples were analysed for soil classification by conducting sieve analysis, Hydrometer analysis & Atterberg Limits. From the classification it is revealed that the strata consists of non-plastic Medium dense to dense Sandy silt with gravel (SM-ML)/ Silty Sand with Gravel (SM) upto the depth drilled. However at intermittent depths a 1.0m to 4.0 m thick layer of Silty clay of low plasticity (CL) was observed. Except in BH 1, BH 8, BH 10 to BH 12 ,

BH 16, BH 21 & BH 22, wherein the strata is classified as Sandy Silt with Gravel (SM-ML)/ Silty Sand with Gravel (SM) upto the depth drilled. Attempts were made to collect Undisturbed soil samples at regular intervals of 3.0m depth. However at greater depth some of the samples could not be collected due to presence of dense strata. The SPT values obtained have been corrected for overburden pressure in non – plastic strata. These corrected values have been plotted against depth and are shown in the borelogs. It can be seen from the plot that the SPT values are generally varying from 16 to 40 upto the depth drilled. However at intermittent depths SPT values above 40 were this might be due the presence of Hard/ very dense strata. For evaluating the shear parameters Direct Shear tests / Unconsolidated undrained shear tests were conducted on the UDS samples collected. The results are given in the respective borelog. Liquefaction analysis has been carried out and the details are given at Annexure **II**. It can be seen from the results that the strata is not susceptible to liquefaction.

9.0 DESIGN CRITERIA

Any foundation is to be safe against possible failure against

a) Excessive Shear failure (the bearing pressure should be within permissible limits) and
b) Excessive settlement.

The latter depends upon not only on the type of soil in the foundation but also on the type of foundation, material used for construction and functionality of the structure.

9.1 DESIGN METHODOLOGY

BH 2 to BH 10 & BH 13 to BH 21

Bored - Cast - in situ Piles of 1.0m and 1.20m diameter are analyzed.

Station Building (BH 11 & BH 12)

Footing Foundation has been analysed at different depths. An allowable settlement for the footing foundation is considered as 50mm.

9.1.1 Shallow Foundation

a) Shear Failure Criteria

The safe bearing pressure from Shear failure criteria can be obtained, using the Equation given below

$Qu = q (Nq - 1) Sq Dq Iq + 0.5 B \gamma N\gamma S\gamma D\gamma I\gamma W'$

where,

B = Width of the footing in m

Dq,Dγ = Depth factors

Sq,Sγ = Shape factors

Iq,Iγ = Inclination factors

Nq,Nγ = Bearing capacity factor

q = Effective overburden pressure at foundation, in t/sqm

W' = Water table correction factor

γ = Bulk unit wt. of foundation soil, in t/cu.m

b) Settlements:

i) Soil profiles are given for each bore hole. The Soil profile which is likely to cause greater settlements is to be considered for calculations.

ii) The imposed load at the foundation level is likely to compress the soil upto a depth of approximately equal to 1.5 B below the foundations.

iii) The settlements can be calculated using IS-8009 part-I.

9.1.2 Bored cast in-situ concrete pile

The ultimate load carrying capacity (P_u) of piles is given by the following formula:

$P_u = A_p (N_c.C_p + ½ D \gamma N_r + P_d N_q) + \sum K P_{di} \tan \delta A_{si} + \alpha c.As$

$P_u = P_{pu} + P_{su}$

P_{pu} = Ultimate bearing resistance

$= A_p (N_c.C_p + ½ D \gamma N_r + P_d N_q)$

P_{Su}= Ultimate shaft resistance

$\sum K P_{di} \tan \delta A_{si} + \alpha c.As$

A_p = Cross sectional area of the pile toe m^2

D = Stem diameter in mm

γ = Effective unit weight of soil at pile toe in t/m^3

P_d = Effective overburden pressure at pile toe in t/m^2

N_r& N_q = Bearing capacity factors depending upon the angle of internal friction ∅ at toe

$\sum$ = Summation of n layers in which pile is installed

K = Coefficient of earth pressure

= Taken 1.0 to 1.5 (as per IS 2911-part 1)

P_{di}= Effective overburden pressure in t/m^2 for the i^{th} layer where i varies from i to n

δ = Angle of wall friction between pile and soil (may be taken equal to ∅)

For vertical Capacity of pile, weight of pile has not been considered

A_{si}= Surface area of pile stem in m^2 in i^{th} layer where i varies from 1 to n.

FOS= Factor of Safety considered as 2.5 (as per IS 2911 part 1 sec 2)

10.0 COMPUTATIONS

The Net safe bearing Pressure of footing Foundation , Vertical carrying capacities of the Bored Cast in Situ Piles of 1.0m & 1.20m dia are calculated and are given at **Annexure I.**

11.0 RECOMMENDATIONS

BH 2 to BH 10 & BH 13 to BH 21

Bored Cast in-situ Pile Foundation of 1.0 m and 1.20m dia are recommended at cut off level of 2.0m. The Length of pile and Safe load carrying capacity of the pile can be taken as given below:

Location	Pile Dia (cms)	Length of Pile (m)	Safe Load carrying capacity of Pile (t)		
			Vertical	Uplift	Lateral
BH 3,BH 4, BH 7 To BH 10 & BH 14 To BH 18, BH 20, BH 21	100	22.0	295.0	130.0	30.0
		24.0	320.0	150.0	30.0
		26.0	345.0	170.0	30.0
	120	22.0	400.0	170.0	60.0
		24.0	450.0	200.0	60.0
		26.0	500.0	230.0	60.0
BH 2, BH 5, BH 6 BH 13	100	22.0	265.0	145.0	30.0
		24.0	270.0	156.0	30.0
		26.0	275.0	185.0	30.0
	120	22.0	360.0	195.0	60.0
		24.0	365.0	220.0	60.0
		26.0	370.0	250.0	60.0

Station Building (BH 11 & BH 12)

For the proposed structure Footing foundation is recommended. The Net safe bearing pressure, Depth of foundation, size of foundation and modules of subgrade reaction can be taken as given below.

BH	Depth of Foundation (m)	Width of Foundation (m)	Net safe bearing pressure (t/m^2)
BH 11 & BH 12	2.50	3.0	15.0
		5.0	20.0
		7.0	24.0
	3.0	3.0	18.0
		5.0	22.0
		7.0	26.0
	3.50	3.0	20.0
		5.0	24.0
		7.0	28.0
	4.0	3.0	23.0
		5.0	26.0
		7.0	30.0

For Soil Engineering Consultants

(A.V.S. RANGA RAO)
Consultant

Annexure I

(Calculation)

Project no: 2137	BEARING CAPACITY ANALYSIS FOR SHALLOW FOUNDATIONS as per IS: 6403-1981	SOIL ENGINEERING CONSULTANTS

Structure @ Chainage :		2+730 & 2+750					
Borehole no:		BH 11 & BH 12					
Type of Foundation :		**Footing**	**Footing**	**Footing**	**Footing**	**Footing**	**Footing**
Depth of Foundation below Ground level (D_F) :		**2.50**	**2.50**	**2.50**	**3.00**	**3.00**	**3.00**
Width of the foundation (B) in "m":		**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Length of the foundation (L) in "m" :		**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Angle of Internal Friction ,Φ :		30	30	30	30	30	30
Cohension , C (T/m^2) :		0	0	0	0	0	0
Density of soil (ϒ) T/m^3 :		1.86	1.86	1.86	1.86	1.86	1.86
Effective unit weight (ϒ') T/m^3 :		0.86	0.86	0.86	0.86	0.86	0.86
Depth of water table (W.T) m from G.L :		Not met	Not met	Not met	Not met	Not met	Not met
Angle of Inclination factor :		0	0	0	0	0	0
Depth factors (assumed that backilling is not compacted properly		1.00	1.00	1.00	1.00	1.00	1.00
Surcharge at sub-base foundation level q= ϒ*D_f		2.5	2.5	2.5	3.0	3.0	3.0
Shape factors :	S_C	1.3	1.3	1.3	1.3	1.3	1.3
	S_q	1.2	1.2	1.2	1.2	1.2	1.2
	$S_ϒ$	0.8	0.8	0.8	0.8	0.8	0.8
Inclination factors :	i_c	1.00	1.00	1.00	1.00	1.00	1.00
	i_q	1.00	1.00	1.00	1.00	1.00	1.00
	$i_ϒ$	1.00	1.00	1.00	1.00	1.00	1.00
Depth factors :	dc =1+0.2(Df/B)√(NΦ)	1.00	1.00	1.00	1.00	1.00	1.00
	dq= 1+0.1*(Df/B)√(NΦ) for >10°	1.00	1.00	1.00	1.00	1.00	1.00
	dϒ = 1+0.1*(Df/B)√(NΦ) for >10°	1.00	1.00	1.00	1.00	1.00	1.00
Shear failure criteria							
Bearing capacity factor's for General Shear :	Φ	30	30	30	30	30	30
	N_c = (Nq-1)/tanø	30.12	30.12	30.12	30.12	30.12	30.12
	N_q = Nγ/(2∗tanø)-1	18.39	18.39	18.39	18.39	18.39	18.39
	$N_ϒ$ = 2[{(exp[π]tanø)∗} tan2(45+ø/2)+1}tanø]	22.40	22.40	22.40	22.40	22.40	22.40
Bearing capacity factor's for Local Shear :	Φ'	21	21	21	21	21	21
	N'_c	15.92	15.92	15.92	15.92	15.92	15.92
	N'_q	7.16	7.16	7.16	7.16	7.16	7.16
	$N'_ϒ$	6.32	6.32	6.32	6.32	6.32	6.32
Correction factor for W.T (W')		0.75	0.75	0.75	0.75	0.75	0.75
Factor of safety		2.50	2.50	2.50	2.50	2.50	2.50
General shear Net safe bearing pressure (T/m2) : C*NC*Sc*ic*dc+q(Nq-1)*sq*iq*dq+0.50*B*ϒ*Nϒ*sϒ*iϒ*dϒ*W'		33.77	42.37	55.87	40.04	50.04	60.04
Local shear safe bearing pressure (T/m2) : C*NC*Sc*ic*dc+q(Nq-1)*sq*iq*dq+0.50*B*ϒ*Nϒ*sϒ*iϒ*dϒ*W'		11.03	13.46	13.76	11.60	13.42	15.24
On interpolation Safe Bearing pressure (T/m2)		16.72	20.69	24.29	18.71	22.58	26.44

Settlement criteria as per IS 8009(Part I),fig 9 :

Structure @ Chainage :	**2+730 & 2+750**					
Borehole no:	**BH 11 & BH 12**					
Depth of the Foundation below Ground level (m) :	**2.50**	**2.50**	**2.50**	**3.00**	**3.00**	**3.00**
Width of the foundation (m) :	**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Length of the fooundation (m) :	**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Corrected SPT (N) value =	**21**	**21**	**21**	**21**	**21**	**21**
settlement under footing with a load of 10 T/m2 in dry cohensioness soil :	14	15	15	14	15	15
Settlement under footing with a load intensity of 10 T/m2 after water table correction :	19	20	20	19	20	20
Settlement under footing with load intensity of 10 T/m2 after depth correction (mm) :	15	17	18	14	17	18
Settlement under footing with load intensity of 10 T/m2 after rigidity correction	12	14	15	12	14	15
Net safe bearing pressure for 50 mm of settlements :	41	35	33	41	35	33

Project no: 2137	BEARING CAPACITY ANALYSIS FOR SHALLOW FOUNDATIONS as per IS: 6403-1981						
Structure @ Chainage :		2+730 & 2+750					
Borehole no:		BH 11 & BH 12					
Type of Foundation :		**Footing**	**Footing**	**Footing**	**Footing**	**Footing**	**Footing**
Depth of Foundation below Ground level (D_F) :		**3.50**	**3.50**	**3.50**	**4.00**	**4.00**	**4.00**
Width of the foundation (B) in "m":		**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Length of the foundation (L) in "m" :		**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Angle of Internal Friction ,Φ :		30	30	30	30	30	30
Cohension , C (T/m^2) :		0	0	0	0	0	0
Density of soil (ϒ) T/m^3 :		1.86	1.86	1.86	1.86	1.86	1.86
Effective unit weight (ϒ') T/m^3 :		0.86	0.86	0.86	0.86	0.86	0.86
Depth of water table (W.T) m from G.L :		Not met	Not met	Not met	Not met	Not met	Not met
Angle of Inclination factor :		0	0	0	0	0	0
Depth factors (assumed that backilling is not compacted properly		1.00	1.00	1.00	1.00	1.00	1.00
Surcharge at sub-base foundation level q= ϒ*D_f		3.5	3.5	3.5	4.0	4.0	4.0
Shape factors :	S_C	1.3	1.3	1.3	1.3	1.3	1.3
	S_q	1.2	1.2	1.2	1.2	1.2	1.2
	$S_ϒ$	0.8	0.8	0.8	0.8	0.8	0.8
Inclination factors :	i_c	1.00	1.00	1.00	1.00	1.00	1.00
	i_q	1.00	1.00	1.00	1.00	1.00	1.00
	$i_ϒ$	1.00	1.00	1.00	1.00	1.00	1.00
Depth factors :	dc =1+0.2(Df/B)√(NΦ)	1.00	1.00	1.00	1.00	1.00	1.00
	dq= 1+0.1*(Df/B)√(NΦ) for >10°	1.00	1.00	1.00	1.00	1.00	1.00
	dϒ = 1+0.1*(Df/B)√(NΦ) for >10°	1.00	1.00	1.00	1.00	1.00	1.00
Shear failure criteria							
Bearing capacity factor's for General Shear :	Φ	30	30	30	30	30	30
	N_c = (Nq-1)/tanø	30.12	30.12	30.12	30.12	30.12	30.12
	N_q = Nγ/(2∗tanø)-1	18.39	18.39	18.39	18.39	18.39	18.39
	$N_ϒ$ = 2[{(exp⁡[⁡πtanø)∗⁡] tan2(45+ø/2)+1}tanø]	22.40	22.40	22.40	22.40	22.40	22.40
Bearing capacity factor's for Local Shear :	Φ'	21	21	21	21	21	21
	N'_c	15.92	15.92	15.92	15.92	15.92	15.92
	N'_q	7.16	7.16	7.16	7.16	7.16	7.16
	$N'_ϒ$	6.32	6.32	6.32	6.32	6.32	6.32
Correction factor for W.T (W')		0.75	0.75	0.75	0.75	0.75	0.75
Factor of safety		2.50	2.50	2.50	2.50	2.50	2.50
General shear Net safe bearing pressure (T/m2) : C*NC*Sc*ic*dc+q(Nq-1)*sq*iq*dq+0.50*B*ϒ*Nϒ*sϒ*iϒ*dϒ*W'		42.12	50.72	64.21	48.39	58.39	68.39
Local shear safe bearing pressure (T/m2) : C*NC*Sc*ic*dc+q(Nq-1)*sq*iq*dq+0.50*B*ϒ*Nϒ*sϒ*iϒ*dϒ*W'		13.99	16.42	16.72	14.56	16.38	18.20
On interpolation Safe Bearing pressure (T/m2)		21.02	24.99	28.59	23.02	26.88	30.74

Settlement criteria as per IS 8009(Part I),fig 9 :

Structure @ Chainage :	**2+730 & 2+750**					
Borehole no:	**BH 11 & BH 12**					
Depth of the Foundation below Ground level (m) :	**3.50**	**3.50**	**3.50**	**4.00**	**4.00**	**4.00**
Width of the foundation (m) :	**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Length of the fooundation (m) :	**3.00**	**5.00**	**7.00**	**3.00**	**5.00**	**7.00**
Corrected SPT (N) value =	**21**	**21**	**21**	**21**	**21**	**21**
settlement under footing with a load of 10 T/m2 in dry cohensioness soil :	14	15	15	14	15	15
Settlement under footing with a load intensity of 10 T/m2 after water table correction :	19	20	20	19	20	20
Settlement under footing with load intensity of 10 T/m2 after depth correction (mm) :	14	16	17	13	16	17
Settlement under footing with load intensity of 10 T/m2 after rigidity correction	12	13	14	11	13	14
Net safe bearing pressure for 50 mm of settlements :	41	38	35	45	38	35

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**	Type of Structure		Structure @ Chainage	0+460	Based on Bore Hole	**BH 2**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_{d'}N_q+0.5\gamma_y D.N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum(K_s P_{di'}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_y D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	30	30	1.83	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML	2	Not met	0	30	30	1.83	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.77	85.04	4.39	34.01	8.24	4
3	SM-ML	2	Not met	0	30	30	1.86	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	3	Not met	0	31	31	1.92	1.00	8.8	1.05	0	23.9	26	0.79	0	211	12.990	175.47	7.3	9.42	43.38	0	0	60.78	236.25	9.89	94.5	26.9	9
5	SM-ML / SM	3	Not met	0	31	31	1.92	1.00	11.8	1.05	0	23.9	26	0.79	0	282	12.990	231.81	10.3	9.42	61.21	0	0	122	353.8	13.18	141.52	47.33	12
6	SM-ML / SM	3	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.3	9.42	86.11	0	0	208.1	555.47	16.48	222.18	74.74	15
7	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	240	587.41	17.58	234.96	84.79	16
8	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	326.64	14.8	6.28	63.88	0	0	303.9	630.56	19.78	252.22	104.87	18
9	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	305.9	14.8	3.14	31.94	0	0	335.9	641.76	20.88	256.7	114.92	19
10	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	264.42	14.8	6.28	63.88	0	0	399.7	664.16	23.07	265.66	134.99	21
11	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	243.68	14.8	3.14	31.94	0	0	431.7	675.36	24.17	270.14	145.04	22
12	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	202.21	14.8	6.28	63.88	0	0	495.6	697.77	26.37	279.1	165.12	24
13	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	160.73	14.8	6.28	63.88	0	0	559.4	720.17	28.57	288.06	185.21	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	265.0	275.0	285.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**	Type of Structure		Structure @ Chainage	0+460	Based on Bore Hole	**BH 2**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_{d}N_q+0.5\gamma_y D.N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_y D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	SM-ML	2	Not met	0	30	30	1.83	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML	2	Not met	0	30	30	1.83	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16.51	121.64	6.32	48.65	10.94	4
3	SM-ML	2	Not met	0	30	30	1.86	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	3	Not met	0	31	31	1.92	1.00	8.8	1.05	0	23.9	26	1.13	0	211	15.590	255.52	7.3	11.3	52.04	0	0	72.9	328.42	14.23	131.36	34.64	9
5	SM-ML / SM	3	Not met	0	31	31	1.92	1.00	11.8	1.05	0	23.9	26	1.13	0	282	15.590	336.62	10.3	11.3	73.43	0	0	146.3	482.95	18.98	193.18	59.95	12
6	SM-ML / SM	3	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.3	11.3	103.3	0	0	249.6	753.09	23.73	301.23	93.62	15
7	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	289.2	825.25	25.31	330.1	106.27	16
8	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	501.01	16.8	7.53	86.95	0	0	376.1	877.13	28.47	350.85	133.78	18
9	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	467.56	17.8	3.76	46	0	0	422.1	889.68	30.05	355.87	148.24	19
10	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	400.67	17.8	7.53	92.12	0	0	514.2	914.91	33.22	365.96	177.2	21
11	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	367.23	17.8	3.76	46	0	0	560.2	927.47	34.8	370.98	191.66	22
12	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	300.33	17.8	7.53	92.12	0	0	652.4	952.69	37.96	381.07	220.62	24
13	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	233.44	17.8	7.53	92.12	0	0	744.5	977.92	41.13	391.16	249.58	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	365.0	375.0	390.0
e) Uplift pile capacity (Tonnes)	185.0	215.0	245.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.		Type of Structure		Structure @ Chainage	0+460	Based on Bore Hole	BH 3	Pile Cut -off level (m)	2.0		
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)			
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)			
						Liquefaction depth below cut-off level(m) :	**0.0**						

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{di}N_q+0.5\gamma_1 D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_{si})$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, α	a.c.A_{si}	P_{su}					
1	CL	2	Not met	18	0	0	1.97	1.00	1.8	1.00	9	0	0	0.79	162	0	0.000	127.17	1	6.28	0	0.3	33.91	0	127.17	2.19	50.86	2.19	2
2	SM	2	Not met	0	32	32	1.95	1.00	3.8	1.10	0	28.9	30.2	0.79	0	110	15.100	97.99	2.8	6.28	12.08	0	0	12.08	110.07	4.39	44.02	7.77	4
3	SM-ML	2	Not met	0	32	32	1.95	1.00	5.8	1.10	0	28.9	30.2	0.79	0	168	15.100	143.34	4.8	6.28	20.71	0	0	20.71	164.05	6.59	65.62	12.38	6
4	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	8.8	1.10	0	28.9	30.2	0.79	0	254	15.100	211.35	7.3	9.42	47.26	0	0	67.97	279.32	9.89	111.72	28.92	9
5	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	11.8	1.10	0	28.9	30.2	0.79	0	341	15.100	279.36	10.3	9.42	66.69	0	0	134.7	414.02	13.18	165.6	50.88	12
6	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.3	9.42	86.11	0	0	220.8	568.14	16.48	227.25	78.29	15
7	SM-ML / SM	1	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	252.7	600.08	17.58	240.03	88.33	16
8	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	316.6	663.96	19.78	265.58	108.42	18
9	SM-ML / SM	1	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	348.5	695.9	20.88	278.36	118.46	19
10	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	412.4	759.78	23.07	303.91	138.54	21
11	SM-ML / SM	1	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	444.4	791.72	24.17	316.68	148.58	22
12	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	508.2	855.6	26.37	342.24	168.67	24
13	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	572.1	919.48	28.57	367.79	188.76	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	310.0	340.0	365.0
e) Uplift pile capacity (Tonnes)	145.0	165.0	185.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.		Type of Structure		Structure @ Chainage	0+460	Based on Bore Hole	BH 3	Pile Cut -off level (m)	2.0		
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)			
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)			
						Liquefaction depth below cut-off level(m) :	**0.0**						

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{di}N_q+0.5\gamma_1 D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, α	a.c.A_{si}	P_{su}					
1	CL	2	Not met	18	0	0	1.97	1.00	1.8	1.00	9	0	0	1.13	162	0	0.000	183.06	1	7.53	0	0.3	40.66	0	183.06	3.16	73.22	3.16	2
2	SM	2	Not met	0	32	32	1.95	1.00	3.8	1.10	0	28.9	30.2	1.13	0	110	18.120	144.48	2.8	7.53	14.49	0	0	14.49	158.97	6.32	63.58	10.37	4
3	SM-ML	2	Not met	0	32	32	1.95	1.00	5.8	1.10	0	28.9	30.2	1.13	0	168	18.120	209.75	4.8	7.53	24.84	0	0	24.84	234.59	9.49	93.83	16.44	6
4	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	8.8	1.10	0	28.9	30.2	1.13	0	254	18.120	307.65	7.3	11.3	56.7	0	0	81.54	389.19	14.23	155.67	37.06	9
5	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	11.8	1.10	0	28.9	30.2	1.13	0	341	18.120	405.55	10.3	11.3	80	0	0	161.5	567.09	18.98	226.83	64.21	12
6	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.3	11.3	103.3	0	0	264.8	768.3	23.73	307.32	97.88	15
7	SM-ML / SM	1	Not met	0	32	32	1.95	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	304.4	840.46	25.31	336.18	110.53	16
8	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.8	7.53	86.95	0	0	391.3	992.68	28.47	397.07	138.04	18
9	SM-ML / SM	1	Not met	0	32	32	1.95	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	437.3	1038.68	30.05	415.47	152.5	19
10	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	529.5	1130.8	33.22	452.32	181.46	21
11	SM-ML / SM	1	Not met	0	32	32	1.95	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	575.5	1176.8	34.8	470.72	195.92	22
12	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	667.6	1268.92	37.96	507.56	224.87	24
13	SM-ML / SM	2	Not met	0	32	32	1.95	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	759.7	1361.04	41.13	544.41	253.84	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	460.0	500.0	540.0
e) Uplift pile capacity (Tonnes)	190.0	220.0	250.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.		Type of Structure		Structure @ Chainage	0+980	Based on Bore Hole	BH 4	Pile Cut -off level (m)	2.0		
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)			
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)			
						Liquefaction depth below cut-off level(m) :	**0.0**						

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{di}N_q+0.5\gamma_y.D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_{si})$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, α	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	31	31	1.86	1.00	1.8	1.05	0	23.9	26	0.79	0	43.1	12.000	43.22	1	6.28	3.96	0	0	3.96	47.18	2.19	18.87	3.29	2
2	SM-ML	2	Not met	0	31	31	1.86	1.00	3.8	1.05	0	23.9	26	0.79	0	90.9	12.990	81.56	2.8	6.28	11.09	0	0	15.05	96.61	4.39	38.64	8.6	4
3	SM-ML	2	Not met	0	31	31	1.86	1.00	5.8	1.05	0	23.9	26	0.79	0	139	12.990	119.12	4.8	6.28	19.01	0	0	19.01	138.13	6.59	55.25	11.91	6
4	SM-ML / SM	3	Not met	0	32	32	1.88	1.00	8.8	1.10	0	28.9	30.2	0.79	0	254	15.100	211.35	7.3	9.42	47.26	0	0	66.27	277.62	9.89	111.04	28.44	9
5	SM-ML / SM	3	Not met	0	32	32	1.97	1.00	11.8	1.10	0	28.9	30.2	0.79	0	341	15.100	279.36	10.3	9.42	66.69	0	0	133	412.32	13.18	164.92	50.4	12
6	SM-ML / SM	3	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.3	9.42	86.11	0	0	219.1	566.44	16.48	226.57	77.81	15
7	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	251	598.38	17.58	239.35	87.86	16
8	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	314.9	662.26	19.78	264.9	107.94	18
9	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	346.8	694.2	20.88	277.68	117.99	19
10	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	410.7	758.08	23.07	303.23	138.06	21
11	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	442.7	790.02	24.17	316	148.11	22
12	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	506.5	853.9	26.37	341.56	168.19	24
13	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	570.4	917.78	28.57	367.11	188.28	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	310.0	335.0	365.0
e) Uplift pile capacity (Tonnes)	145.0	165.0	185.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.		Type of Structure		Structure @ Chainage	0+980	Based on Bore Hole	BH 4	Pile Cut -off level (m)	2.0		
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)			
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)			
						Liquefaction depth below cut-off level(m) :	**0.0**						

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{di}N_q+0.5\gamma_1 D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_{si})$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, α	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	31	31	1.86	1.00	1.8	1.05	0	23.9	26	1.13	0	43.1	15.000	65.6	1	7.53	4.75	0	0	4.75	70.35	3.16	28.14	4.49	2
2	SM-ML	2	Not met	0	31	31	1.86	1.00	3.8	1.05	0	23.9	26	1.13	0	90.9	15.590	120.34	2.8	7.53	13.3	0	0	18.05	138.39	6.32	55.35	11.37	4
3	SM-ML	2	Not met	0	31	31	1.86	1.00	5.8	1.05	0	23.9	26	1.13	0	139	15.590	174.41	4.8	7.53	22.8	0	0	22.8	197.21	9.49	78.88	15.87	6
4	SM-ML / SM	3	Not met	0	32	32	1.88	1.00	8.8	1.10	0	28.9	30.2	1.13	0	254	18.120	307.65	7.3	11.3	56.7	0	0	79.5	387.15	14.23	154.86	36.49	9
5	SM-ML / SM	3	Not met	0	32	32	1.97	1.00	11.8	1.10	0	28.9	30.2	1.13	0	341	18.120	405.55	10.3	11.3	80	0	0	159.5	565.05	18.98	226.02	63.64	12
6	SM-ML / SM	3	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.3	11.3	103.3	0	0	262.8	766.26	23.73	306.5	97.31	15
7	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	302.3	838.42	25.31	335.36	109.96	16
8	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.8	7.53	86.95	0	0	389.3	990.64	28.47	396.25	137.47	18
9	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	435.3	1036.64	30.05	414.65	151.93	19
10	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	527.4	1128.76	33.22	451.5	180.89	21
11	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	573.4	1174.76	34.8	469.9	195.35	22
12	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	665.5	1266.88	37.96	506.75	224.3	24
13	SM-ML / SM	2	Not met	0	32	32	1.97	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	757.7	1359	41.13	543.6	253.27	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	465.0	500.0	540.0
e) Uplift pile capacity (Tonnes)	190.0	220.0	250.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**			Type of Structure		Structure @ Chainage	1+285	Based on Bore Hole	**BH 5**	Pile Cut -off level (m)	2.0		
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)			
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)			
						Liquefaction depth below cut-off level(m) :	**0.0**						

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{di}N_q+0.5\gamma_1 D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	c.N_C	PdN_q	0.5.γ.D.N_γ	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, α	a.c.A_{si}	P_{su}				
1	SM-ML	2	Not met	0	29	29	1.82	1.00	1.8	1.00	0	18.1	19.3	0.79	0	32.5	9.000	32.6	1	6.28	3.48	0	0	3.48	36.08	2.19	14.43	3.16	2
2	SM-ML	2	Not met	0	31	31	1.89	1.00	3.8	1.05	0	23.9	26	0.79	0	90.9	12.990	81.56	2.8	6.28	11.09	0	0	14.57	96.13	4.39	38.45	8.46	4
3	SM-ML	2	Not met	0	31	31	1.89	1.00	5.8	1.05	0	23.9	26	0.79	0	139	12.990	119.12	4.8	6.28	19.01	0	0	19.01	138.13	6.59	55.25	11.91	6
4	SM-ML / SM	3	Not met	0	32	32	1.92	1.00	8.8	1.10	0	28.9	30.2	0.79	0	254	15.100	211.35	7.3	9.42	47.26	0	0	66.27	277.62	9.89	111.04	28.44	9
5	SM-ML / SM	3	Not met	0	32	32	1.92	1.00	11.8	1.10	0	28.9	30.2	0.79	0	341	15.100	279.36	10.3	9.42	66.69	0	0	133	412.32	13.18	164.92	50.4	12
6	SM-ML / SM	3	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.3	9.42	86.11	0	0	219.1	566.44	16.48	226.57	77.81	15
7	SM-ML / SM	1	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	251	598.38	17.58	239.35	87.86	16
8	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	314.9	662.26	19.78	264.9	107.94	18
9	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	312.9	14.8	3.14	31.94	0	0	346.8	659.73	20.88	263.89	117.99	19
10	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	278.42	14.8	6.28	63.88	0	0	410.7	689.13	23.07	275.65	138.06	21
11	SM-ML / SM	1	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	261.18	14.8	3.14	31.94	0	0	442.7	703.83	24.17	281.53	148.11	22
12	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	226.71	14.8	6.28	63.88	0	0	506.5	733.24	26.37	293.29	168.19	24
13	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	192.23	14.8	6.28	63.88	0	0	570.4	762.64	28.57	305.05	188.28	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	280.0	290.0	300.0
e) Uplift pile capacity (Tonnes)	145.0	165.0	185.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.			Type of Structure		Structure @ Chainage	1+285	Based on Bore Hole	BH 5	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{di}N_q+0.5\gamma_1 D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_{si})$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, α	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	29	29	1.82	1.00	1.8	1.00	0	18.1	19.3	1.13	0	32.5	11.000	49.2	1	7.53	4.17	0	0	4.17	53.37	3.16	21.34	4.32	2
2	SM-ML	2	Not met	0	31	31	1.89	1.00	3.8	1.05	0	23.9	26	1.13	0	90.9	15.590	120.34	2.8	7.53	13.3	0	0	17.47	137.81	6.32	55.12	11.21	4
3	SM-ML	2	Not met	0	31	31	1.89	1.00	5.8	1.05	0	23.9	26	1.13	0	139	15.590	174.41	4.8	7.53	22.8	0	0	22.8	197.21	9.49	78.88	15.87	6
4	SM-ML / SM	3	Not met	0	32	32	1.92	1.00	8.8	1.10	0	28.9	30.2	1.13	0	254	18.120	307.65	7.3	11.3	56.7	0	0	79.5	387.15	14.23	154.86	36.49	9
5	SM-ML / SM	3	Not met	0	32	32	1.92	1.00	11.8	1.10	0	28.9	30.2	1.13	0	341	18.120	405.55	10.3	11.3	80	0	0	159.5	565.05	18.98	226.02	63.64	12
6	SM-ML / SM	3	Not met	0	32	32	1.96	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.3	11.3	103.3	0	0	262.8	766.26	23.73	306.5	97.31	15
7	SM-ML / SM	1	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	302.3	838.42	25.31	335.36	109.96	16
8	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	542.79	16.8	7.53	86.95	0	0	389.3	932.08	28.47	372.83	137.47	18
9	SM-ML / SM	1	Not met	0	32	32	1.97	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	484.23	17.8	3.76	46	0	0	435.3	919.52	30.05	367.8	151.93	19
10	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	425.67	17.8	7.53	92.12	0	0	527.4	953.08	33.22	381.23	180.89	21
11	SM-ML / SM	1	Not met	0	32	32	1.96	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	396.39	17.8	3.76	46	0	0	573.4	969.8	34.8	387.92	195.35	22
12	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	337.83	17.8	7.53	92.12	0	0	665.5	1003.36	37.96	401.34	224.3	24
13	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	279.27	17.8	7.53	92.12	0	0	757.7	1036.92	41.13	414.76	253.27	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	385.0	400.0	410.0
e) Uplift pile capacity (Tonnes)	190.0	220.0	250.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	1+495	Based on Bore Hole	**BH 6**	Pile Cut -off level (m)	2.0		
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)			
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)			
						Liquefaction depth below cut-off level(m) :	**0.0**						

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{di}N_q+0.5\gamma_1 D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	(K_s P_{di}Tanδ).A_{si}	Adhesion Factor, α	a.c.A_{si}	P_{su}				
1	SM-ML	2	Not met	0	30	30	1.83	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML	2	Not met	0	31	31	1.88	1.00	3.8	1.05	0	23.9	26	0.79	0	90.9	12.990	81.56	2.8	6.28	11.09	0	0	14.71	96.27	4.39	38.5	8.5	4
3	SM-ML	2	Not met	0	31	31	1.88	1.00	5.8	1.05	0	23.9	26	0.79	0	139	12.990	119.12	4.8	6.28	19.01	0	0	19.01	138.13	6.59	55.25	11.91	6
4	SM-ML / SM	3	Not met	0	31	31	1.91	1.00	8.8	1.05	0	23.9	26	0.79	0	211	12.990	175.47	7.3	9.42	43.38	0	0	62.39	237.86	9.89	95.14	27.35	9
5	SM-ML / SM	3	Not met	0	31	31	1.91	1.00	11.8	1.05	0	23.9	26	0.79	0	282	12.990	231.81	10.3	9.42	61.21	0	0	123.6	355.41	13.18	142.16	47.78	12
6	SM-ML / SM	3	Not met	0	30	30	1.86	1.00	14.8	1.00	0	20.9	22.4	0.79	0	310	11.200	252.17	13.3	9.42	72.33	0	0	195.9	448.1	16.48	179.24	71.34	15
7	SM-ML / SM	1	Not met	0	32	32	1.86	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	227.9	575.24	17.58	230.09	81.38	16
8	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	291.8	639.12	19.78	255.64	101.47	18
9	SM-ML / SM	1	Not met	0	32	32	1.86	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	302.9	14.8	3.14	31.94	0	0	323.7	626.59	20.88	250.63	111.51	19
10	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	258.42	14.8	6.28	63.88	0	0	387.6	645.99	23.07	258.39	131.58	21
11	SM-ML / SM	1	Not met	0	32	32	1.86	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	236.18	14.8	3.14	31.94	0	0	419.5	655.69	24.17	262.27	141.63	22
12	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	191.71	14.8	6.28	63.88	0	0	483.4	675.1	26.37	270.04	161.71	24
13	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	147.23	14.8	6.28	63.88	0	0	547.3	694.5	28.57	277.8	181.8	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	260.0	265.0	275.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.		Type of Structure		Structure @ Chainage	1+495	Based on Bore Hole	BH 6	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{d}N_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	c.N_C	P.N_q	0.5.γ.D.N_γ	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	30	30	1.83	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML	2	Not met	0	31	31	1.88	1.00	3.8	1.05	0	23.9	26	1.13	0	90.9	15.590	120.34	2.8	7.53	13.3	0	0	17.64	137.98	6.32	55.19	11.25	4
3	SM-ML	2	Not met	0	31	31	1.88	1.00	5.8	1.05	0	23.9	26	1.13	0	139	15.590	174.41	4.8	7.53	22.8	0	0	22.8	197.21	9.49	78.88	15.87	6
4	SM-ML / SM	3	Not met	0	31	31	1.91	1.00	8.8	1.05	0	23.9	26	1.13	0	211	15.590	255.52	7.3	11.3	52.04	0	0	74.84	330.36	14.23	132.14	35.18	9
5	SM-ML / SM	3	Not met	0	31	31	1.91	1.00	11.8	1.05	0	23.9	26	1.13	0	282	15.590	336.62	10.3	11.3	73.43	0	0	148.3	484.89	18.98	193.95	60.49	12
6	SM-ML / SM	3	Not met	0	30	30	1.86	1.00	14.8	1.00	0	20.9	22.4	1.13	0	310	13.440	365.53	13.3	11.3	86.76	0	0	235	600.56	23.73	240.22	89.53	15
7	SM-ML / SM	1	Not met	0	32	32	1.86	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	274.6	810.65	25.31	324.26	102.18	16
8	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	531.12	16.8	7.53	86.95	0	0	361.5	892.64	28.47	357.05	129.69	18
9	SM-ML / SM	1	Not met	0	32	32	1.86	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	460.9	17.8	3.76	46	0	0	407.5	868.42	30.05	347.36	144.15	19
10	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	390.67	17.8	7.53	92.12	0	0	499.6	890.31	33.22	356.12	173.11	21
11	SM-ML / SM	1	Not met	0	32	32	1.86	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	355.56	17.8	3.76	46	0	0	545.6	901.2	34.8	360.48	187.57	22
12	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	285.33	17.8	7.53	92.12	0	0	637.8	923.09	37.96	369.23	216.53	24
13	SM-ML / SM	2	Not met	0	32	32	1.86	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	215.11	17.8	7.53	92.12	0	0	729.9	944.99	41.13	377.99	245.49	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	355.0	365.0	375.0
e) Uplift pile capacity (Tonnes)	185.0	210.0	240.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	1+750	Based on Bore Hole	**BH 7**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_dN_q+0.5\gamma_1 DN_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_1 DN_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	30	30	1.89	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML	2	Not met	0	30	30	1.85	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.77	85.04	4.39	34.01	8.24	4
3	SM-ML	2	Not met	0	30	30	1.89	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	3	Not met	0	30	30	1.92	1.00	8.8	1.00	0	20.9	22.4	0.79	0	184	11.200	170.45	7.3	9.42	39.7	0	0	57.1	227.55	9.89	91.02	25.87	9
5	SM-ML / SM	3	Not met	0	30	30	1.92	1.00	11.8	1.00	0	20.9	22.4	0.79	0	247	11.200	207.13	10.3	9.42	56.01	0	0	113.1	320.24	13.18	128.09	44.85	12
6	SM-ML / SM	3	Not met	0	30	30	1.92	1.00	14.8	1.00	0	20.9	22.4	0.79	0	310	11.200	214.21	13.3	9.42	72.33	0	0	185.4	399.65	16.48	159.86	68.4	15
7	SM-ML / SM	1	Not met	0	30	30	1.92	1.00	14.8	1.00	0	20.9	22.4	0.79	0	310	11.200	210	14.8	3.14	26.83	0	0	212.3	422.27	17.58	168.9	77.01	16
8	Cl	2	Not met	30	0	0	1.92	1.00	14.8	1.00	9	0	0	0.79	270	0	0.000	211.95	14.8	6.28	0	0.3	56.52	268.8	480.74	19.78	192.29	95.04	18
9	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	300.7	648.1	20.88	259.24	105.08	19
10	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	364.6	711.98	23.07	284.79	125.16	21
11	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	396.6	743.92	24.17	297.56	135.2	22
12	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	460.4	807.8	26.37	323.12	155.29	24
13	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	524.3	871.68	28.57	348.67	175.37	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	295.0	320.0	345.0
e) Uplift pile capacity (Tonnes)	130.0	150.0	170.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**	Type of Structure		Structure @ Chainage	1+750	Based on Bore Hole	**BH 7**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{d}N_q+0.5\gamma_y D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_y D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di} \tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	30	30	1.89	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML	2	Not met	0	30	30	1.85	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16.51	121.64	6.32	48.65	10.94	4
3	SM-ML	2	Not met	0	30	30	1.89	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	3	Not met	0	30	30	1.92	1.00	8.8	1.00	0	20.9	22.4	1.13	0	184	13.440	290.79	7.3	11.3	47.62	0	0	68.48	359.27	14.23	143.7	33.4	9
5	SM-ML / SM	3	Not met	0	30	30	1.92	1.00	11.8	1.00	0	20.9	22.4	1.13	0	247	13.440	298.17	10.3	11.3	67.19	0	0	135.7	433.84	18.98	173.53	56.96	12
6	SM-ML / SM	3	Not met	0	30	30	1.92	1.00	14.8	1.00	0	20.9	22.4	1.13	0	310	13.440	305.46	13.3	11.3	86.76	0	0	222.4	527.89	23.73	211.15	86.01	15
7	SM-ML / SM	1	Not met	0	30	30	1.92	1.00	15.8	1.00	0	20.9	22.4	1.13	0	331	13.440	300	15.3	3.76	33.21	0	0	255.6	555.64	25.31	222.25	96.88	16
8	CI	2	Not met	30	0	0	1.92	1.00	17.8	1.00	9	0	0	1.13	270	0	0.000	305.1	16.8	7.53	0	0.3	67.77	323.4	628.51	28.47	251.4	119.02	18
9	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	369.4	970.76	30.05	388.3	133.48	19
10	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	461.5	1062.88	33.22	425.15	162.44	21
11	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	507.5	1108.88	34.8	443.55	176.9	22
12	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	599.7	1201	37.96	480.4	205.86	24
13	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	691.8	1293.12	41.13	517.24	234.82	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	440.0	475.0	510.0
e) Uplift pile capacity (Tonnes)	170.0	200.0	230.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**		Type of Structure		Structure @ Chainage	3+820	Based on Bore Hole	**BH 8**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = Ap^*(cN_c+P_dN_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_c	N_q	N_γ	A_p (m^2)	$c.N_c$	PdN_q	$0.5\gamma.D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	SM-ML	1	Not met	0	30	30	1.9	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	0.5	3.14	0.9	0	0	0.9	39.12	1.09	15.64	1.34	1
2	SM-ML / SM	2	Not met	0	30	30	1.9	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	11.05	82.32	3.29	32.92	6.38	3
3	SM-ML / SM	2	Not met	0	30	30	1.9	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	5.49	48.62	10.36	5
4	SM-ML / SM	3	Not met	0	30	30	1.9	1.00	8.8	1.00	0	20.9	22.4	0.79	0	184	11.200	153.5	7.3	9.42	39.7	0	0	57.1	210.6	8.79	84.24	24.77	8
5	SM-ML / SM	2	Not met	0	31	31	1.96	1.00	10.8	1.05	0	23.9	26	0.79	0	258	12.990	213.03	9.8	6.28	38.82	0	0	95.92	308.95	10.99	123.58	37.84	10
6	SM-ML / SM	2	Not met	0	31	31	1.96	1.00	12.8	1.05	0	23.9	26	0.79	0	306	12.990	250.59	11.8	6.28	46.75	0	0	142.7	393.26	13.18	157.3	53.12	12
7	SM-ML / SM	3	Not met	0	31	31	1.9	1.00	15.8	1.05	0	23.9	26	0.79	0	378	12.990	306.94	14.3	9.42	84.98	0	0	227.7	534.59	16.48	213.83	80.22	15
8	SM-ML / SM	1	Not met	0	31	31	1.9	1.00	15.8	1.05	0	23.9	26	0.79	0	378	12.990	306.94	15.8	3.14	31.3	0	0	259	565.89	17.58	226.35	90.08	16
9	Cl	1	Not met	30	0	0	1.9	1.00	15.8	1.00	9	0	0	0.79	270	0	0.000	211.95	15.8	3.14	0	0.3	28.26	287.2	499.16	18.68	199.66	99.09	17
10	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	3.14	34.1	0	0	321.3	691.35	19.78	276.54	109.74	18
11	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	389.5	759.55	21.98	303.82	131.04	20
12	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	457.7	827.75	24.17	331.1	152.32	22
13	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	525.9	895.95	26.37	358.38	173.62	24
14	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	594.1	964.15	28.57	385.66	194.92	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	330.0	350.0	380.0
e) Uplift pile capacity (Tonnes)	150.0	170.0	190.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**		Type of Structure		Structure @ Chainage	3+820	Based on Bore Hole	**BH 8**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^*(cN_c+P_dN_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_U=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	$c.N_C$	PdN_q	$0.5\gamma.D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	SM-ML	1	Not met	0	30	30	1.9	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	0.5	3.76	1.08	0	0	1.08	58.37	1.58	23.34	1.88	1
2	SM-ML / SM	2	Not met	0	30	30	1.9	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	13.25	118.38	4.74	47.35	8.45	3
3	SM-ML / SM	2	Not met	0	30	30	1.9	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	7.91	69.33	13.75	5
4	SM-ML / SM	3	Not met	0	30	30	1.9	1.00	8.8	1.00	0	20.9	22.4	1.13	0	184	13.440	223.5	7.3	11.3	47.62	0	0	68.48	291.98	12.65	116.79	31.82	8
5	SM-ML / SM	2	Not met	0	31	31	1.96	1.00	10.8	1.05	0	23.9	26	1.13	0	258	15.590	309.59	9.8	7.53	46.55	0	0	115	424.62	15.82	169.84	48.02	10
6	SM-ML / SM	2	Not met	0	31	31	1.96	1.00	12.8	1.05	0	23.9	26	1.13	0	306	15.590	363.66	11.8	7.53	56.05	0	0	171.1	534.74	18.98	213.89	66.88	12
7	SM-ML / SM	2	Not met	0	31	31	1.9	1.00	14.8	1.05	0	23.9	26	1.13	0	354	15.590	417.73	13.8	7.53	65.55	0	0	236.6	654.36	22.14	261.74	88.39	14
8	SM-ML / SM	2	Not met	0	31	31	1.9	1.00	16.8	1.05	0	23.9	26	1.13	0	402	15.590	471.8	15.8	7.53	75.06	0	0	311.7	783.49	25.31	313.39	112.58	16
9	CI	1	Not met	30	0	0	1.9	1.00	17.8	1.00	9	0	0	1.13	270	0	0.000	305.1	17.3	3.76	0	0.3	33.84	345.5	650.63	26.89	260.25	123.63	17
10	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.3	3.76	47.29	0	0	392.8	1026.8	28.47	410.72	138.45	18
11	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	490.1	1124.1	31.64	449.64	168.87	20
12	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	587.4	1221.4	34.8	488.56	199.27	22
13	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	684.7	1318.7	37.96	527.48	229.68	24
14	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	782	1416	41.13	566.4	260.09	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	480.0	520.0	560.0
e) Uplift pile capacity (Tonnes)	195.0	220.0	255.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**	Type of Structure		Structure @ Chainage	2+270	Based on Bore Hole	**BH 9**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_dN_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	c.N_C	PdN_q	0.5.γ.D.N_γ	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	30	30	1.84	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML	2	Not met	0	30	30	1.9	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.77	85.04	4.39	34.01	8.24	4
3	SM-ML	2	Not met	0	30	30	1.9	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	3	Not met	0	30	30	1.9	1.00	8.8	1.00	0	20.9	22.4	0.79	0	184	11.200	153.5	7.3	9.42	39.7	0	0	57.1	210.6	9.89	84.24	25.87	9
5	SM-ML / SM	3	Not met	0	31	31	1.9	1.00	11.8	1.05	0	23.9	26	0.79	0	282	12.990	231.81	10.3	9.42	61.21	0	0	118.3	350.12	13.18	140.04	46.3	12
6	SM-ML / SM	3	Not met	0	31	31	1.9	1.00	14.8	1.05	0	23.9	26	0.79	0	354	12.990	288.15	13.3	9.42	79.04	0	0	197.4	485.5	16.48	194.2	71.73	15
7	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	229.3	576.66	17.58	230.66	81.78	16
8	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	293.2	640.54	19.78	256.21	101.86	18
9	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	325.1	672.48	20.88	268.99	111.91	19
10	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	389	736.36	23.07	294.54	131.98	21
11	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	420.9	768.3	24.17	307.32	142.03	22
12	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	484.8	832.18	26.37	332.87	162.11	24
13	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	548.7	896.06	28.57	358.42	182.2	26

Recommendation :

a) Pile Diameter (mm) 1000

b) Pile cut off level (m) **2.0**

c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	305.0	330.0	355.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**	Type of Structure		Structure @ Chainage	2+270	Based on Bore Hole	**BH 9**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_dN_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum K_s P_{di} \tan\delta).A_{si}+a.c.A_s$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	SM-ML	2	Not met	0	30	30	1.84	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML	2	Not met	0	30	30	1.9	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16.51	121.64	6.32	48.65	10.94	4
3	SM-ML	2	Not met	0	30	30	1.9	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	3	Not met	0	30	30	1.9	1.00	8.8	1.00	0	20.9	22.4	1.13	0	184	13.440	223.5	7.3	11.3	47.62	0	0	68.48	291.98	14.23	116.79	33.4	9
5	SM-ML / SM	3	Not met	0	31	31	1.9	1.00	11.8	1.05	0	23.9	26	1.13	0	282	15.590	336.62	10.3	11.3	73.43	0	0	141.9	478.53	18.98	191.41	58.71	12
6	SM-ML / SM	3	Not met	0	31	31	1.9	1.00	14.8	1.05	0	23.9	26	1.13	0	354	15.590	417.73	13.3	11.3	94.81	0	0	236.7	654.45	23.73	261.78	90.01	15
7	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	276.3	812.34	25.31	324.93	102.66	16
8	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.8	7.53	86.95	0	0	363.2	964.56	28.47	385.82	130.16	18
9	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	409.2	1010.56	30.05	404.22	144.62	19
10	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	501.3	1102.68	33.22	441.07	173.59	21
11	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	547.3	1148.68	34.8	459.47	188.05	22
12	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	639.5	1240.8	37.96	496.32	217	24
13	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	731.6	1332.92	41.13	533.16	245.96	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	455.0	490.0	530.0
e) Uplift pile capacity (Tonnes)	185.0	215.0	240.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**		Type of Structure		Structure @ Chainage	2+520	Based on Bore Hole	**BH 10**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = Ap^*(cN_c+P_dN_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_U=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m^2)	$c.N_C$	PdN_q	$0.5\gamma.D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	SM-ML /SM	2	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML /SM	2	Not met	0	30	30	1.86	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.77	85.04	4.39	34.01	8.24	4
3	SM-ML /SM	2	Not met	0	30	30	1.84	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML /SM	2	Not met	0	30	30	1.84	1.00	7.8	1.00	0	20.9	22.4	0.79	0	163	11.200	137.06	6.8	6.28	24.65	0	0	42.05	179.11	8.79	71.64	20.56	8
5	SM-ML /SM	2	Not met	0	32	32	1.91	1.00	9.8	1.10	0	28.9	30.2	0.79	0	283	15.100	234.02	8.8	6.28	37.98	0	0	80.03	314.05	10.99	125.62	33.39	10
6	SM-ML /SM	2	Not met	0	32	32	2.01	1.00	11.8	1.10	0	28.9	30.2	0.79	0	341	15.100	279.36	10.8	6.28	46.61	0	0	126.6	406	13.18	162.4	48.63	12
7	SM-ML /SM	3	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.3	9.42	86.11	0	0	212.8	560.12	16.48	224.04	76.05	15
8	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	276.6	624	18.68	249.6	96.13	17
9	SM-ML /SM	1	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	308.6	655.94	19.78	262.37	106.17	18
10	SM-ML /SM	1	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	340.5	687.88	20.88	275.15	116.22	19
11	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	404.4	751.76	23.07	300.7	136.29	21
12	SM-ML /SM	1	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	436.3	783.7	24.17	313.48	146.34	22
13	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	500.2	847.58	26.37	339.03	166.42	24
14	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	564.1	911.46	28.57	364.58	186.51	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	310.0	335.0	360.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**		Type of Structure		Structure @ Chainage	2+520	Based on Bore Hole	**BH 10**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors N_C	N_q	N_γ	Ultimate Base Resistance $P_{pu} = A_p(cN_C+P_dN_q+0.5\gamma.D.N_\gamma)$ A_p (m^2)	$c.N_C$	PdN_q	$0.5\gamma.D.N_\gamma$	P_{pu} (tonnes)	Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$ Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}	Total Ultimate Capacity, $P_U=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
1	SM-ML /SM	2	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML /SM	2	Not met	0	30	30	1.86	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16.51	121.64	6.32	48.65	10.94	4
3	SM-ML /SM	2	Not met	0	30	30	1.84	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML /SM	2	Not met	0	30	30	1.84	1.00	7.8	1.00	0	20.9	22.4	1.13	0	163	13.440	199.82	6.8	7.53	29.56	0	0	50.42	250.24	12.65	100.09	26.76	8
5	SM-ML /SM	2	Not met	0	32	32	1.91	1.00	9.8	1.10	0	28.9	30.2	1.13	0	283	18.120	340.28	8.8	7.53	45.54	0	0	95.96	436.24	15.82	174.49	42.68	10
6	SM-ML /SM	2	Not met	0	32	32	2.01	1.00	11.8	1.10	0	28.9	30.2	1.13	0	341	18.120	405.55	10.8	7.53	55.89	0	0	151.9	557.4	18.98	222.96	61.49	12
7	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	13.8	1.10	0	28.9	30.2	1.13	0	399	18.120	470.82	12.8	7.53	66.25	0	0	218.1	688.92	22.14	275.56	83.2	14
8	SM-ML /SM	3	Not met	0	32	32	2.04	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	568.71	15.3	11.3	118.83	0	0	336.9	905.64	26.89	362.25	121.23	17
9	SM-ML /SM	1	Not met	0	32	32	2.04	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.3	3.76	44.71	0	0	381.6	982.99	28.47	393.19	135.32	18
10	SM-ML /SM	1	Not met	0	32	32	2.04	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	427.6	1028.99	30.05	411.59	149.78	19
11	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	519.8	1121.11	33.22	448.44	178.75	21
12	SM-ML /SM	1	Not met	0	32	32	2.04	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	565.8	1167.11	34.8	466.84	193.21	22
13	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	657.9	1259.23	37.96	503.69	222.16	24
14	SM-ML /SM	2	Not met	0	32	32	2.04	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	750	1351.35	41.13	540.54	251.13	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	460.0	500.0	535.0
e) Uplift pile capacity (Tonnes)	190.0	220.0	245.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**	Type of Structure		Structure @ Chainage	2+780	Based on Bore Hole	**BH 13**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_{d1}N_q+0.5\gamma_1 DN_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum K_s P_{di}\tan\delta).A_{si}+a.c.A_{si}$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_c	N_q	N_γ	A_p (m²)	$c.N_c$	PdN_q	$0.5\gamma_1 DN_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	32	32	1.85	1.00	1.8	1.10	0	28.9	30.2	0.79	0	52	15.000	52.57	1	6.28	4.31	0	0	4.31	56.88	2.19	22.75	3.39	2
2	SM-ML	2	Not met	0	31	31	1.85	1.00	3.8	1.05	0	23.9	26	0.79	0	90.9	12.990	81.56	2.8	6.28	11.09	0	0	15.4	96.96	4.39	38.78	8.7	4
3	SM-ML	2	Not met	0	31	31	1.85	1.00	5.8	1.05	0	23.9	26	0.79	0	139	12.990	119.12	4.8	6.28	19.01	0	0	19.01	138.13	6.59	55.25	11.91	6
4	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	8.8	1.10	0	28.9	30.2	0.79	0	254	15.100	211.35	7.3	9.42	47.26	0	0	66.27	277.62	9.89	111.04	28.44	9
5	SM-ML	2	Not met	0	32	32	1.95	1.00	10.8	1.10	0	28.9	30.2	0.79	0	312	15.100	256.69	9.8	6.28	42.3	0	0	108.6	365.26	12.08	146.1	42.47	11
6	SM-ML	2	Not met	0	32	32	1.95	1.00	12.8	1.10	0	28.9	30.2	0.79	0	370	15.100	302.03	11.8	6.28	50.93	0	0	159.5	461.53	14.28	184.61	58.94	13
7	CL	2	Not met	35	0	0	1.98	1.00	14.8	1.00	9	0	0	0.79	315	0	0.000	247.27	13.8	6.28	0	0.3	65.94	225.4	472.71	16.48	189.08	79.6	15
8	SM-ML	2	Not met	0	32	32	1.98	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	289.3	636.69	18.68	254.67	99.68	17
9	SM-ML	2	Not met	0	32	32	1.98	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	295.9	14.8	6.28	63.88	0	0	353.2	649.1	20.88	259.64	119.77	19
10	SM-ML	1	Not met	0	32	32	1.98	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	270.16	14.8	3.14	31.94	0	0	385.1	655.3	21.98	262.12	129.81	20
11	SM-ML	2	Not met	0	32	32	1.98	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	218.68	14.8	6.28	63.88	0	0	449	667.7	24.17	267.08	149.89	22
12	SM-ML	2	Not met	0	32	32	1.98	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	167.21	14.8	6.28	63.88	0	0	512.9	680.11	26.37	272.04	169.98	24
13	SM-ML	2	Not met	0	32	32	1.98	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	115.73	14.8	6.28	63.88	0	0	576.8	692.51	28.57	277	190.06	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	265.0	270.0	275.0
e) Uplift pile capacity (Tonnes)	145.0	165.0	185.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**	Type of Structure		Structure @ Chainage	2+780	Based on Bore Hole	**BH 13**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{d}N_q+0.5\gamma_y D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_y D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	SM-ML	2	Not met	0	32	32	1.85	1.00	1.8	1.10	0	28.9	30.2	1.13	0	52	18.000	79.07	1	7.53	5.17	0	0	5.17	84.24	3.16	33.69	4.6	2
2	SM-ML	2	Not met	0	31	31	1.85	1.00	3.8	1.05	0	23.9	26	1.13	0	90.9	15.590	120.34	2.8	7.53	13.3	0	0	18.47	138.81	6.32	55.52	11.49	4
3	SM-ML	2	Not met	0	31	31	1.85	1.00	5.8	1.05	0	23.9	26	1.13	0	139	15.590	174.41	4.8	7.53	22.8	0	0	22.8	197.21	9.49	78.88	15.87	6
4	SM-ML / SM	3	Not met	0	32	32	1.95	1.00	8.8	1.10	0	28.9	30.2	1.13	0	254	18.120	307.65	7.3	11.3	56.7	0	0	79.5	387.15	14.23	154.86	36.49	9
5	SM-ML	2	Not met	0	32	32	1.95	1.00	10.8	1.10	0	28.9	30.2	1.13	0	312	18.120	372.92	9.8	7.53	50.72	0	0	130.2	503.14	17.4	201.25	53.86	11
6	SM-ML	2	Not met	0	32	32	1.95	1.00	12.8	1.10	0	28.9	30.2	1.13	0	370	18.120	438.19	11.8	7.53	61.07	0	0	191.3	629.48	20.56	251.79	74.12	13
7	CL	2	Not met	35	0	0	1.98	1.00	14.8	1.00	9	0	0	1.13	315	0	0.000	355.95	13.8	7.53	0	0.3	79.06	270.4	626.3	23.73	250.52	99.42	15
8	SM-ML	3	Not met	0	32	32	1.98	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	522.79	16.3	11.3	126.6	0	0	397	919.74	28.47	367.89	139.61	18
9	SM-ML	1	Not met	0	32	32	1.98	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	444.23	17.8	3.76	46	0	0	443	887.18	30.05	354.87	154.07	19
10	SM-ML	1	Not met	0	32	32	1.98	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	404.95	17.8	3.76	46	0	0	489	893.9	31.64	357.56	168.54	20
11	SM-ML	2	Not met	0	32	32	1.98	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	326.39	17.8	7.53	92.12	0	0	581.1	907.46	34.8	362.98	197.49	22
12	SM-ML	2	Not met	0	32	32	1.98	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	247.83	17.8	7.53	92.12	0	0	673.2	921.02	37.96	368.4	226.45	24
13	SM-ML	2	Not met	0	32	32	1.98	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	169.27	17.8	7.53	92.12	0	0	765.3	934.58	41.13	373.83	255.41	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	350.0	365.0	370.0
e) Uplift pile capacity (Tonnes)	195.0	225.0	250.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	3+040	Based on Bore Hole	**BH 14**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_dN_q+0.5\gamma_1 DN_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_1 DN_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di} \tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	27	27	1.78	1.00	1.8	1.00	0	13.5	14.5	0.79	0	24.2	7.000	24.51	1	6.28	3.19	0	0	3.19	27.7	2.19	11.08	3.08	2
2	SM-ML	2	Not met	0	30	30	1.82	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.34	84.61	4.39	33.84	8.12	4
3	SM-ML	2	Not met	0	30	30	1.83	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	3	Not met	0	30	30	1.83	1.00	8.8	1.00	0	20.9	22.4	0.79	0	184	11.200	153.5	7.3	9.42	39.7	0	0	57.1	210.6	9.89	84.24	25.87	9
5	SM-ML	2	Not met	0	31	31	1.87	1.00	10.8	1.05	0	23.9	26	0.79	0	258	12.990	213.03	9.8	6.28	38.82	0	0	95.92	308.95	12.08	123.58	38.93	11
6	CL	2	Not met	28	0	0	1.92	1.00	12.8	1.00	9	0	0	0.79	252	0	0.000	197.82	11.8	6.28	0	0.3	52.75	148.7	346.49	14.28	138.59	55.9	13
7	SM-ML/ SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.8	6.28	59.56	0	0	208.2	555.6	16.48	222.24	74.78	15
8	SM-ML	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	272.1	619.48	18.68	247.79	94.87	17
9	SM-ML	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	336	683.36	20.88	273.34	114.95	19
10	SM-ML	1	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	367.9	715.3	21.98	286.12	125	20
11	SM-ML	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	431.8	779.18	24.17	311.67	145.07	22
12	SM-ML	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	495.7	843.06	26.37	337.22	165.16	24
13	SM-ML	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	559.6	906.94	28.57	362.77	185.24	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	300.0	335.0	360.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	3+040	Based on Bore Hole	**BH 14**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{d}N_q+0.5\gamma_{'}DN_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_{'}DN_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	27	27	1.78	1.00	1.8	1.00	0	13.5	14.5	1.13	0	24.2	8.000	36.41	1	7.53	3.83	0	0	3.83	40.24	3.16	16.09	4.23	2
2	SM-ML	2	Not met	0	30	30	1.82	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16	121.13	6.32	48.45	10.8	4
3	SM-ML	2	Not met	0	30	30	1.83	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	3	Not met	0	30	30	1.83	1.00	8.8	1.00	0	20.9	22.4	1.13	0	184	13.440	223.5	7.3	11.3	47.62	0	0	68.48	291.98	14.23	116.79	33.4	9
5	SM-ML	2	Not met	0	31	31	1.87	1.00	10.8	1.05	0	23.9	26	1.13	0	258	15.590	309.59	9.8	7.53	46.55	0	0	115	424.62	17.4	169.84	49.6	11
6	CL	2	Not met	28	0	0	1.92	1.00	12.8	1.00	9	0	0	1.13	252	0	0.000	284.76	11.8	7.53	0	0.3	63.25	178.3	463.04	20.56	185.21	70.47	13
7	SM-ML/ SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.8	7.53	71.42	0	0	249.7	753.16	23.73	301.26	93.64	15
8	SM-ML	2	Not met	0	32	32	1.92	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	568.71	15.8	7.53	81.77	0	0	331.5	900.18	26.89	360.07	119.7	17
9	SM-ML	2	Not met	0	32	32	1.92	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	568.71	16.8	7.53	86.95	0	0	418.4	987.13	30.05	394.85	147.2	19
10	SM-ML	1	Not met	0	32	32	1.92	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	568.71	16.8	3.76	43.41	0	0	461.8	1030.54	31.64	412.21	160.95	20
11	SM-ML	2	Not met	0	32	32	1.92	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	568.71	16.8	7.53	86.95	0	0	548.8	1117.49	34.8	446.99	188.45	22
12	SM-ML	2	Not met	0	32	32	1.92	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	568.71	16.8	7.53	86.95	0	0	635.7	1204.44	37.96	481.77	215.96	24
13	SM-ML	2	Not met	0	32	32	1.92	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	568.71	16.8	7.53	86.95	0	0	722.7	1291.39	41.13	516.55	243.48	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	440.0	475.0	510.0
e) Uplift pile capacity (Tonnes)	180.0	210.0	240.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	3+300	Based on Bore Hole	**BH 15**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{d}N_q+0.5\gamma_y D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_y D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di} \tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	27	27	1.76	1.00	1.8	1.00	0	13.5	14.5	0.79	0	24.2	7.000	24.51	1	6.28	3.19	0	0	3.19	27.7	2.19	11.08	3.08	2
2	SM-ML	2	Not met	0	30	30	1.83	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.34	84.61	4.39	33.84	8.12	4
3	SM-ML	2	Not met	0	30	30	1.83	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	3	Not met	0	30	30	1.83	1.00	8.8	1.00	0	20.9	22.4	0.79	0	184	11.200	153.5	7.3	9.42	39.7	0	0	57.1	210.6	9.89	84.24	25.87	9
5	SM-ML / SM	2	Not met	0	31	31	1.9	1.00	10.8	1.05	0	23.9	26	0.79	0	258	12.990	212.12	9.8	6.28	38.82	0	0	95.92	308.04	12.08	123.21	38.93	11
6	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	12.8	1.10	0	28.9	30.2	0.79	0	370	15.100	256.01	11.8	6.28	50.93	0	0	146.9	402.86	14.28	161.14	55.39	13
7	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	251.21	13.8	6.28	59.56	0	0	206.4	457.62	16.48	183.04	74.27	15
8	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	223.73	14.8	6.28	63.88	0	0	270.3	494.02	18.68	197.6	94.36	17
9	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	210	14.8	3.14	31.94	0	0	302.2	512.23	19.78	204.89	104.4	18
10	CI	2	Not met	30	0	0	1.92	1.00	14.8	1.00	9	0	0	0.79	270	0	0.000	211.95	14.8	6.28	0	0.3	56.52	358.8	570.7	21.98	228.28	122.43	20
11	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	422.6	770	24.17	308	142.5	22
12	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	486.5	833.88	26.37	333.55	162.59	24
13	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	550.4	897.76	28.57	359.1	182.67	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	305.0	330.0	350.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	3+300	Based on Bore Hole	**BH 15**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_dN_q+0.5\gamma_1 DN_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_1 DN_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di} \tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	27	27	1.76	1.00	1.8	1.00	0	13.5	14.5	1.13	0	24.2	8.000	36.41	1	7.53	3.83	0	0	3.83	40.24	3.16	16.09	4.23	2
2	SM-ML	2	Not met	0	30	30	1.83	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16	121.13	6.32	48.45	10.8	4
3	SM-ML	2	Not met	0	30	30	1.83	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	3	Not met	0	30	30	1.83	1.00	8.8	1.00	0	20.9	22.4	1.13	0	184	13.440	223.5	7.3	11.3	47.62	0	0	68.48	291.98	14.23	116.79	33.4	9
5	SM-ML / SM	2	Not met	0	31	31	1.9	1.00	10.8	1.05	0	23.9	26	1.13	0	258	15.590	305.59	9.8	7.53	46.55	0	0	115	420.62	17.4	168.24	49.6	11
6	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	12.8	1.10	0	28.9	30.2	1.13	0	370	18.120	357.57	11.8	7.53	61.07	0	0	176.1	533.67	20.56	213.46	69.86	13
7	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	350.86	13.8	7.53	71.42	0	0	247.5	598.38	23.73	239.35	93.03	15
8	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	16.8	1.10	0	28.9	30.2	1.13	0	485	18.120	322.39	15.8	7.53	81.77	0	0	329.3	651.68	26.89	260.67	119.09	17
9	SM-ML / SM	1	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	300	17.3	3.76	44.71	0	0	374	674	28.47	269.6	133.19	18
10	CI	2	Not met	30	0	0	1.92	1.00	17.8	1.00	9	0	0	1.13	270	0	0.000	305.1	17.8	7.53	0	0.3	67.77	441.8	746.87	31.64	298.74	155.33	20
11	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	533.9	1135.24	34.8	454.09	184.28	22
12	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	626	1227.36	37.96	490.94	213.24	24
13	SM-ML / SM	2	Not met	0	32	32	1.92	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	718.1	1319.48	41.13	527.79	242.2	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	440.0	485.0	520.0
e) Uplift pile capacity (Tonnes)	180.0	210.0	240.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**	Type of Structure		Structure @ Chainage	3+560	Based on Bore Hole	**BH 16**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^*(cN_c+P_{d}N_q+0.5\gamma_1 D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_1 D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	32	32	1.88	1.00	1.8	1.10	0	28.9	30.2	0.79	0	52	15.000	52.57	1	6.28	4.31	0	0	4.31	56.88	2.19	22.75	3.39	2
2	SM-ML	2	Not met	0	31	31	1.88	1.00	3.8	1.05	0	23.9	26	0.79	0	90.9	12.990	81.56	2.8	6.28	11.09	0	0	15.4	96.96	4.39	38.78	8.7	4
3	SM-ML	2	Not met	0	31	31	1.88	1.00	5.8	1.05	0	23.9	26	0.79	0	139	12.990	119.12	4.8	6.28	19.01	0	0	19.01	138.13	6.59	55.25	11.91	6
4	SM-ML / SM	3	Not met	0	31	31	1.88	1.00	8.8	1.05	0	23.9	26	0.79	0	211	12.990	175.47	7.3	9.42	43.38	0	0	62.39	237.86	9.89	95.14	27.35	9
5	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	10.8	1.10	0	28.9	30.2	0.79	0	312	15.100	256.69	9.8	6.28	42.3	0	0	104.7	361.38	12.08	144.55	41.39	11
6	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	12.8	1.10	0	28.9	30.2	0.79	0	370	15.100	302.03	11.8	6.28	50.93	0	0	155.6	457.65	14.28	183.06	57.85	13
7	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.8	6.28	59.56	0	0	215.2	562.55	16.48	225.02	76.73	15
8	SM-ML / SM	3	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	9.42	95.82	0	0	311	658.37	19.78	263.34	106.86	18
9	SM-ML / SM	1	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	342.9	690.31	20.88	276.12	116.9	19
10	SM-ML / SM	1	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	374.9	722.25	21.98	288.9	126.94	20
11	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	438.8	786.13	24.17	314.45	147.02	22
12	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	502.6	850.01	26.37	340	167.1	24
13	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	566.5	913.89	28.57	365.55	187.19	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	310.0	335.0	360.0
e) Uplift pile capacity (Tonnes)	145.0	165.0	185.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**	Type of Structure		Structure @ Chainage	3+560	Based on Bore Hole	**BH 16**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_{d}N_q+0.5\gamma_y D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_y D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	32	32	1.88	1.00	1.8	1.10	0	28.9	30.2	1.13	0	52	18.000	79.07	1	7.53	5.17	0	0	5.17	84.24	3.16	33.69	4.6	2
2	SM-ML	2	Not met	0	31	31	1.88	1.00	3.8	1.05	0	23.9	26	1.13	0	90.9	15.590	120.34	2.8	7.53	13.3	0	0	18.47	138.81	6.32	55.52	11.49	4
3	SM-ML	2	Not met	0	31	31	1.88	1.00	5.8	1.05	0	23.9	26	1.13	0	139	15.590	174.41	4.8	7.53	22.8	0	0	22.8	197.21	9.49	78.88	15.87	6
4	SM-ML / SM	3	Not met	0	31	31	1.88	1.00	8.8	1.05	0	23.9	26	1.13	0	211	15.590	255.52	7.3	11.3	52.04	0	0	74.84	330.36	14.23	132.14	35.18	9
5	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	10.8	1.10	0	28.9	30.2	1.13	0	312	18.120	372.92	9.8	7.53	50.72	0	0	125.6	498.48	17.4	199.39	52.55	11
6	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	12.8	1.10	0	28.9	30.2	1.13	0	370	18.120	438.19	11.8	7.53	61.07	0	0	186.6	624.82	20.56	249.92	72.81	13
7	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.8	7.53	71.42	0	0	258.1	761.51	23.73	304.6	95.98	15
8	SM-ML / SM	3	Not met	0	32	32	2.09	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.3	11.3	126.6	0	0	384.7	986	28.47	394.4	136.17	18
9	SM-ML / SM	1	Not met	0	32	32	2.09	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	430.7	1032	30.05	412.8	150.63	19
10	SM-ML / SM	1	Not met	0	32	32	2.09	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	476.7	1078	31.64	431.2	165.1	20
11	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	568.8	1170.12	34.8	468.04	194.05	22
12	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	660.9	1262.24	37.96	504.89	223	24
13	SM-ML / SM	2	Not met	0	32	32	2.09	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	753	1354.36	41.13	541.74	251.97	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	465.0	500.0	535.0
e) Uplift pile capacity (Tonnes)	190.0	220.0	245.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**	Type of Structure		Structure @ Chainage	3+820	Based on Bore Hole	**BH 17**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p^* (cN_c+P_{d}N_q+0.5.\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5.\gamma.D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di} \tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	Filledup	1	Not met	0	28	28	1.84	1.00	1.8	1.00	0	15.6	16.7	0.79	0	28.1	8.000	28.32	0.5	3.14	0.83	0	0	0.83	29.15	1.09	11.66	1.32	1
2	SM-ML / SM	2	Not met	0	30	30	1.84	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	10.98	82.25	3.29	32.9	6.36	3
3	SM-ML / SM	2	Not met	0	31	31	1.9	1.00	5.8	1.05	0	23.9	26	0.79	0	139	12.990	119.12	4.8	6.28	19.01	0	0	19.01	138.13	5.49	55.25	10.81	5
4	SM-ML / SM	3	Not met	0	31	31	1.9	1.00	8.8	1.05	0	23.9	26	0.79	0	211	12.990	175.47	7.3	9.42	43.38	0	0	62.39	237.86	8.79	95.14	26.25	8
5	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	10.8	1.10	0	28.9	30.2	0.79	0	312	15.100	256.69	9.8	6.28	42.3	0	0	104.7	361.38	10.99	144.55	40.3	10
6	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	12.8	1.10	0	28.9	30.2	0.79	0	370	15.100	302.03	11.8	6.28	50.93	0	0	155.6	457.65	13.18	183.06	56.75	12
7	SM-ML / SM	3	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	14.3	9.42	92.59	0	0	248.2	618.25	16.48	247.3	85.97	15
8	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	316.4	686.45	18.68	274.58	107.27	17
9	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	3.14	34.1	0	0	350.5	720.55	19.78	288.22	117.92	18
10	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	418.7	788.75	21.98	315.5	139.21	20
11	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	486.9	856.95	24.17	342.78	160.5	22
12	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	555.1	925.15	26.37	370.06	181.8	24
13	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	623.3	993.35	28.57	397.34	203.09	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	340.0	365.0	395.0
e) Uplift pile capacity (Tonnes)	155.0	180.0	200.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track in Kurushetra.**		Type of Structure		Structure @ Chainage	3+820	Based on Bore Hole	**BH 17**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion , C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_{d}N_q+0.5\gamma_y D.N_\gamma)$					Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	$c.N_C$	PdN_q	$0.5\gamma_y D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	$(K_s P_{di}\tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	Filledup	1	Not met	0	28	28	1.84	1.00	1.8	1.00	0	15.6	16.7	1.13	0	28.1	10.000	43.03	0.5	3.76	0.99	0	0	0.99	44.02	1.58	17.6	1.85	1
2	SM-ML / SM	2	Not met	0	30	30	1.84	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	13.16	118.29	4.74	47.31	8.42	3
3	SM-ML / SM	2	Not met	0	31	31	1.9	1.00	5.8	1.05	0	23.9	26	1.13	0	139	15.590	174.41	4.8	7.53	22.8	0	0	22.8	197.21	7.91	78.88	14.29	5
4	SM-ML / SM	3	Not met	0	31	31	1.9	1.00	8.8	1.05	0	23.9	26	1.13	0	211	15.590	255.52	7.3	11.3	52.04	0	0	74.84	330.36	12.65	132.14	33.6	8
5	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	10.8	1.10	0	28.9	30.2	1.13	0	312	18.120	372.92	9.8	7.53	50.72	0	0	125.6	498.48	15.82	199.39	50.97	10
6	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	12.8	1.10	0	28.9	30.2	1.13	0	370	18.120	438.19	11.8	7.53	61.07	0	0	186.6	624.82	18.98	249.92	71.23	12
7	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.8	7.53	71.42	0	0	258.1	761.51	22.14	304.6	94.39	14
8	SM-ML / SM	3	Not met	0	32	32	1.9	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.3	11.3	126.6	0	0	384.7	986	26.89	394.4	134.59	17
9	SM-ML / SM	1	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.3	3.76	47.29	0	0	431.9	1065.92	28.47	426.36	149.41	18
10	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	529.2	1163.22	31.64	465.28	179.82	20
11	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	626.5	1260.52	34.8	504.2	210.23	22
12	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	723.8	1357.82	37.96	543.12	240.63	24
13	SM-ML / SM	2	Not met	0	32	32	1.9	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	821.1	1455.12	41.13	582.04	271.04	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	500.0	540.0	580.0
e) Uplift pile capacity (Tonnes)	205.0	235.0	265.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**			Type of Structure		Structure @ Chainage	4+080	Based on Bore Hole	**BH 9**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_dN_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{su}=(\sum(K_s P_{di}\tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_{si}	P_{su}				
1	SM-ML	2	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML	2	Not met	0	30	30	1.86	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.77	85.04	4.39	34.01	8.24	4
3	SM-ML	2	Not met	0	30	30	1.85	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	3	Not met	0	30	30	1.85	1.00	8.8	1.00	0	20.9	22.4	0.79	0	184	11.200	153.5	7.3	9.42	39.7	0	0	57.1	210.6	9.89	84.24	25.87	9
5	SM-ML / SM	3	Not met	0	31	31	1.85	1.00	11.8	1.05	0	23.9	26	0.79	0	282	12.990	231.81	10.3	9.42	61.21	0	0	118.3	350.12	13.18	140.04	46.3	12
6	SM-ML / SM	3	Not met	0	31	31	1.85	1.00	14.8	1.05	0	23.9	26	0.79	0	354	12.990	288.15	13.3	9.42	79.04	0	0	197.4	485.5	16.48	194.2	71.73	15
7	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	229.3	576.66	17.58	230.66	81.78	16
8	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	293.2	640.54	19.78	256.21	101.86	18
9	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	325.1	672.48	20.88	268.99	111.91	19
10	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	389	736.36	23.07	294.54	131.98	21
11	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	420.9	768.3	24.17	307.32	142.03	22
12	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	484.8	832.18	26.37	332.87	162.11	24
13	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	548.7	896.06	28.57	358.42	182.2	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	300.0	330.0	350.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**	Type of Structure		Structure @ Chainage	4+080	Based on Bore Hole	**BH 9**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m²)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m³	Total/ Submerged Unit Weight of Soil (t/m³)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m²)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p(cN_c+P_dN_q+0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum(K_s P_{di} \tan\delta).A_{si}+a.c.A_s)$						Total Ultimate Capacity, $P_u=P_{pu}+P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s=\frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_C	N_q	N_γ	A_p (m²)	c.N_C	PdN$_q$	0.5.γ.D.N$_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m²)	A_{si} (m²)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_{si}	P_{su}					
1	SM-ML	2	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML	2	Not met	0	30	30	1.86	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16.51	121.64	6.32	48.65	10.94	4
3	SM-ML	2	Not met	0	30	30	1.85	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	3	Not met	0	30	30	1.85	1.00	8.8	1.00	0	20.9	22.4	1.13	0	184	13.440	223.5	7.3	11.3	47.62	0	0	68.48	291.98	14.23	116.79	33.4	9
5	SM-ML / SM	3	Not met	0	31	31	1.85	1.00	11.8	1.05	0	23.9	26	1.13	0	282	15.590	336.62	10.3	11.3	73.43	0	0	141.9	478.53	18.98	191.41	58.71	12
6	SM-ML / SM	3	Not met	0	31	31	1.85	1.00	14.8	1.05	0	23.9	26	1.13	0	354	15.590	417.73	13.3	11.3	94.81	0	0	236.7	654.45	23.73	261.78	90.01	15
7	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	276.3	812.34	25.31	324.93	102.66	16
8	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.8	7.53	86.95	0	0	363.2	964.56	28.47	385.82	130.16	18
9	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	409.2	1010.56	30.05	404.22	144.62	19
10	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	501.3	1102.68	33.22	441.07	173.59	21
11	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	547.3	1148.68	34.8	459.47	188.05	22
12	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	639.5	1240.8	37.96	496.32	217	24
13	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	731.6	1332.92	41.13	533.16	245.96	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	455.0	490.0	530.0
e) Uplift pile capacity (Tonnes)	185.0	215.0	240.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	4+080	Based on Bore Hole	**BH 19**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors N_c	N_q	N_γ	Ultimate Base Resistance $P_{pu} = A_p * (cN_c + P_d N_q + 0.5\gamma.D.N_\gamma)$ A_p (m^2)	c.N_c	PdN_q	0.5γ.D.N_γ	P_{pu} (tonnes)	Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si} + a.c.A_s)$ Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_s	P_{su}	Total Ultimate Capacity, $P_u = P_{pu} + P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, $P_s = \frac{Ps}{2.5}$ (Tonnes)	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
1	SM-ML	2	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML	2	Not met	0	30	30	1.86	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.77	85.04	4.39	34.01	8.24	4
3	SM-ML	2	Not met	0	30	30	1.85	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	7.8	1.00	0	20.9	22.4	0.79	0	163	11.200	137.06	6.8	6.28	24.65	0	0	42.05	179.11	8.79	71.64	20.56	8
5	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	9.8	1.00	0	20.9	22.4	0.79	0	205	11.200	169.94	8.8	6.28	31.9	0	0	73.95	243.89	10.99	97.55	31.69	10
6	CL	1.5	Not met	13	0	0	1.85	1.00	11.3	1.00	9	0	0	0.79	117	0	0.000	91.84	10.55	4.71	0	0.3	18.36	92.31	184.15	12.63	73.66	38.47	11.5
7	SM-ML / SM	1.5	Not met	0	32	32	1.85	1.00	12.8	1.10	0	28.9	30.2	0.79	0	370	15.100	302.03	12.05	4.71	39.01	0	0	131.3	433.35	14.28	173.34	51.04	13
8	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.8	6.28	59.56	0	0	190.9	538.25	16.48	215.3	69.92	15
9	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	222.8	570.19	17.58	228.07	79.96	16
10	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	286.7	634.07	19.78	253.62	100.05	18
11	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	318.6	666.01	20.88	266.4	110.09	19
12	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	382.5	729.89	23.07	291.95	130.17	21
13	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	414.5	761.83	24.17	304.73	140.21	22
14	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	478.3	825.71	26.37	330.28	160.3	24
15	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0.3	0	542.2	889.59	28.57	355.83	180.39	26

Recommendation :

a) Pile Diameter (mm) 1000

b) Pile cut off level (m) **2.0**

c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	300.0	325.0	350.0
e) Uplift pile capacity (Tonnes)	135.0	155.0	175.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	4+080	Based on Bore Hole	**BH 19**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors N_c	N_q	N_γ	Ultimate Base Resistance $P_{pu} = A_p * (cN_c + P_d N_q + 0.5\gamma.D.N_\gamma)$ A_p (m^2)	c.N_c	PdN_q	0.5γ.D.N_γ	P_{pu} (tonnes)	Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si} + a.c.A_s)$ Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_s	P_{su}	Total Ultimate Capacity, $P_u = P_{pu} + P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, $P_s = \frac{Ps}{2.5}$ (Tonnes)	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
1	SM-ML	2	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML	2	Not met	0	30	30	1.86	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16.51	121.64	6.32	48.65	10.94	4
3	SM-ML	2	Not met	0	30	30	1.85	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	7.8	1.00	0	20.9	22.4	1.13	0	163	13.440	199.82	6.8	7.53	29.56	0	0	50.42	250.24	12.65	100.09	26.76	8
5	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	9.8	1.00	0	20.9	22.4	1.13	0	205	13.440	247.16	8.8	7.53	38.25	0	0	88.67	335.83	15.82	134.33	40.64	10
6	CL	1.5	Not met	13	0	0	1.85	1.00	11.3	1.00	9	0	0	1.13	117	0	0.000	132.21	10.55	5.65	0	0.3	22.03	110.7	242.91	18.19	97.16	49.18	11.5
7	SM-ML / SM	1.5	Not met	0	32	32	1.85	1.00	12.8	1.10	0	28.9	30.2	1.13	0	370	18.120	438.19	12.05	5.65	46.79	0	0	157.5	595.68	20.56	238.27	64.65	13
8	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.8	7.53	71.42	0	0	228.9	732.37	23.73	292.94	87.82	15
9	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	268.5	804.53	25.31	321.81	100.47	16
10	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.8	7.53	86.95	0	0	355.4	956.75	28.47	382.7	127.98	18
11	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	401.4	1002.75	30.05	401.1	142.44	19
12	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	493.5	1094.87	33.22	437.94	171.4	21
13	SM-ML / SM	1	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	539.5	1140.87	34.8	456.34	185.86	22
14	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	631.6	1232.99	37.96	493.19	214.81	24
15	SM-ML / SM	2	Not met	0	32	32	1.85	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0.3	0	723.8	1325.11	41.13	530.04	243.78	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	450.0	490.0	525.0
e) Uplift pile capacity (Tonnes)	180.0	210.0	240.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	4+080	Based on Bore Hole	**BH 20**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p * (cN_c + P_d N_q + 0.5\gamma . D . N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum (K_s P_{di} \tan\delta) . A_{si} + a . c . A_s)$						Total Ultimate Capacity, $P_u = P_{pu} + P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_c	N_q	N_γ	A_p (m^2)	c.N_c	PdN_q	$0.5\gamma . D . N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s P_{di} \tan\delta) . A_{si}$	Adhesion Factor, a	a.c.A_s	P_{su}					
1	SM-ML	1	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	0.5	3.14	0.9	0	0	0.9	39.12	1.09	15.64	1.34	1
2	Cl	2	Not met	10	0	0	1.86	1.00	3.8	1.00	9	0	0	0.79	90	0	0.000	70.65	2.8	6.28	0	0.3	18.84	0.9	71.55	3.29	28.62	3.54	3
3	SM-ML	2	Not met	0	30	30	1.9	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	5.49	48.62	10.36	5
4	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	7.8	1.00	0	20.9	22.4	0.79	0	163	11.200	137.06	6.8	6.28	24.65	0	0	42.05	179.11	7.69	71.64	19.46	7
5	Cl	1	Not met	15	0	0	1.85	1.00	8.8	1.00	9	0	0	0.79	135	0	0.000	105.97	8.3	3.14	0	0.3	14.13	56.18	162.15	8.79	64.86	24.52	8
6	SM-ML /SM	1.5	Not met	0	32	32	1.96	1.00	10.3	1.10	0	28.9	30.2	0.79	0	297	15.100	245.35	9.55	4.71	30.91	0	0	87.09	332.44	10.44	132.97	34.82	9.5
7	SM-ML / SM	1.5	Not met	0	32	32	1.96	1.00	11.8	1.10	0	28.9	30.2	0.79	0	341	15.100	279.36	11.05	4.71	35.77	0	0	122.9	402.22	12.08	160.88	46.48	11
8	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	13.8	1.10	0	28.9	30.2	0.79	0	399	15.100	324.7	12.8	6.28	55.25	0	0	178.1	502.81	14.28	201.12	64.15	13
9	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	14.8	6.28	63.88	0	0	242	612.03	16.48	244.81	84.23	15
10	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	310.2	680.23	18.68	272.09	105.53	17
11	SM-ML / SM	1	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	3.14	34.1	0	0	344.3	714.33	19.78	285.73	116.18	18
12	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	412.5	782.53	21.98	313.01	137.47	20
13	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	480.7	850.73	24.17	340.29	158.76	22
14	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0	0	548.9	918.93	26.37	367.57	180.05	24
15	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	0.79	0	456	15.100	370.04	15.8	6.28	68.2	0.3	0	617.1	987.13	28.57	394.85	201.35	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	335.0	365.0	390.0
e) Uplift pile capacity (Tonnes)	155.0	175.0	200.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	4+080	Based on Bore Hole	**BH 20**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p * (cN_c + P_d N_q + 0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum(K_s P_{di} \tan\delta).A_{si} + a.c.A_s)$						Total Ultimate Capacity, $P_u = P_{pu} + P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_c	N_q	N_γ	A_p (m^2)	c.N_c	PdN_q	$0.5\gamma.D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s P_{di} \tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_s	P_{su}					
1	SM-ML	1	Not met	0	30	30	1.86	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	0.5	3.76	1.08	0	0	1.08	58.37	1.58	23.34	1.88	1
2	Cl	2	Not met	10	0	0	1.86	1.00	3.8	1.00	9	0	0	1.13	90	0	0.000	101.7	2.8	7.53	0	0.3	22.59	1.08	102.78	4.74	41.11	5.04	3
3	SM-ML	2	Not met	0	30	30	1.9	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	7.91	69.33	13.75	5
4	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	7.8	1.00	0	20.9	22.4	1.13	0	163	13.440	199.82	6.8	7.53	29.56	0	0	50.42	250.24	11.07	100.09	25.18	7
5	Cl	1	Not met	15	0	0	1.85	1.00	8.8	1.00	9	0	0	1.13	135	0	0.000	152.55	8.3	3.76	0	0.3	16.92	67.34	219.89	12.65	87.95	31.5	8
6	SM-ML /SM	1.5	Not met	0	32	32	1.96	1.00	10.3	1.10	0	28.9	30.2	1.13	0	297	18.120	356.6	9.55	5.65	37.08	0	0	104.4	461.02	15.02	184.4	44.25	9.5
7	SM-ML / SM	1.5	Not met	0	32	32	1.96	1.00	11.8	1.10	0	28.9	30.2	1.13	0	341	18.120	405.55	11.05	5.65	42.91	0	0	147.3	552.88	17.4	221.15	58.65	11
8	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	13.8	1.10	0	28.9	30.2	1.13	0	399	18.120	470.82	12.8	7.53	66.25	0	0	213.6	684.4	20.56	273.76	80.36	13
9	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	14.8	7.53	76.6	0	0	290.2	826.26	23.73	330.5	104.98	15
10	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.8	7.53	86.95	0	0	377.1	978.48	26.89	391.39	132.48	17
11	SM-ML / SM	1	Not met	0	32	32	1.96	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.3	3.76	47.29	0	0	424.4	1058.4	28.47	423.36	147.3	18
12	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	521.7	1155.7	31.64	462.28	177.72	20
13	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	619	1253	34.8	501.2	208.12	22
14	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0	0	716.3	1350.3	37.96	540.12	238.52	24
15	SM-ML / SM	2	Not met	0	32	32	1.96	1.00	18.8	1.10	0	28.9	30.2	1.13	0	543	18.120	633.98	18.8	7.53	97.3	0.3	0	813.6	1447.6	41.13	579.04	268.94	26

Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	500.0	535.0	575.0
e) Uplift pile capacity (Tonnes)	200.0	235.0	265.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	4+860	Based on Bore Hole	**BH 20**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1000			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors N_c	N_q	N_γ	Ultimate Base Resistance $P_{pu} = A_p * (cN_c + P_d N_q + 0.5\gamma.D.N_\gamma)$ A_p (m^2)	c.N_c	PdN_q	0.5γ.D.N_γ	P_{pu} (tonnes)	Ultimate Shaft Friction $P_{SU} = (\sum(K_s P_{di} \tan\delta).A_{si} + a.c.A_s)$ Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	(K_s P_{di}.Tanδ).A_{si}	Adhesion Factor, a	a.c.A_s	P_{su}	Total Ultimate Capacity, $P_u = P_{pu} + P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
1	SM-ML	2	Not met	0	30	30	1.82	1.00	1.8	1.00	0	20.9	22.4	0.79	0	37.7	11.000	38.22	1	6.28	3.62	0	0	3.62	41.84	2.19	16.73	3.2	2
2	SM-ML	2	Not met	0	30	30	1.82	1.00	3.8	1.00	0	20.9	22.4	0.79	0	79.6	11.200	71.27	2.8	6.28	10.15	0	0	13.77	85.04	4.39	34.01	8.24	4
3	SM-ML	2	Not met	0	30	30	1.85	1.00	5.8	1.00	0	20.9	22.4	0.79	0	122	11.200	104.16	4.8	6.28	17.4	0	0	17.4	121.56	6.59	48.62	11.46	6
4	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	7.8	1.00	0	20.9	22.4	0.79	0	163	11.200	137.06	6.8	6.28	24.65	0	0	42.05	179.11	8.79	71.64	20.56	8
5	SM-ML / SM	2	Not met	0	30	30	1.87	1.00	9.8	1.00	0	20.9	22.4	0.79	0	205	11.200	169.94	8.8	6.28	31.9	0	0	73.95	243.89	10.99	97.55	31.69	10
6	SM-ML / SM	1.5	Not met	0	31	31	1.93	1.00	11.3	1.05	0	23.9	26	0.79	0	270	12.990	222.42	10.55	4.71	31.34	0.3	0	105.3	327.71	12.63	131.08	42.11	11.5
7	SM-ML / SM	1.5	Not met	0	31	31	1.93	1.00	12.8	1.05	0	23.9	26	0.79	0	306	12.990	250.59	12.05	4.71	35.8	0	0	141.1	391.68	14.28	156.67	53.78	13
8	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	13.8	6.28	59.56	0	0	200.7	548.02	16.48	219.2	72.66	15
9	SM-ML / SM	1	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	232.6	579.96	17.58	231.98	82.7	16
10	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	296.5	643.84	19.78	257.53	102.79	18
11	SM-ML / SM	1	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	328.4	675.78	20.88	270.31	112.83	19
12	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	392.3	739.66	23.07	295.86	132.91	21
13	SM-ML / SM	1	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	3.14	31.94	0	0	424.2	771.6	24.17	308.64	142.95	22
14	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0	0	488.1	835.48	26.37	334.19	163.04	24
15	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	0.79	0	427	15.100	347.37	14.8	6.28	63.88	0.3	0	552	899.36	28.57	359.74	183.12	26

Recommendation :

a) Pile Diameter (mm)	1000		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	300.0	330.0	355.0
e) Uplift pile capacity (Tonnes)	140.0	160.0	180.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Design of Pile Foundation
Estimation of Safe Vertical Load carrying Capacity of "Bored Cast in situ Concrete Pile"as per IS 2911 (part 1 / sec 2) 2010

Name of Project	**Geotechnical Investigation work for proposed Elevated Railway Track at Kurushetra.**		Type of Structure		Structure @ Chainage	4+860	Based on Bore Hole	**BH 20**	Pile Cut -off level (m)	2.0
Type of Pile Foundation	Bored Cast-in-situ Concrete Pile	Inclination of pile with Vertical Axis (deg)	0	Factor of Safety for base Resitance	2.5	River or Stream Bed Level/Ground level (m)		water Level (m)	Not met	Pile Cap Bottom Level RL(m)	
Pile Diameter (mm)	1200			Factor of Safety for Shaft Friction	2.5	Scour Level below the cut off level (m)	0.0	Pile Cap Top Level (m)	0	Pile Tip Level RL(m)	
						Liquefaction depth below cut-off level(m) :	**0.0**				

Layer No.	Type of Sub Soil Layer	Thickness of Layer (m)	Water table (W.T) m	Cohesion, C (t/m^2)	Angle of Shearing Resistance, φ (deg)	Angle of Wall Friction δ(deg)	γ (density of soil) t/m^3	Total/ Submerged Unit Weight of Soil (t/m^3)	Effective over-burden Pressure at pile tip "q_{tip}" (t/m^2)	Earth Presure Coefficient Ks	Bearing Capacity Factors			Ultimate Base Resistance $P_{pu} = A_p * (cN_c + P_d N_q + 0.5\gamma.D.N_\gamma)$					Ultimate Shaft Friction $P_{su} = (\sum(K_s P_{di} \tan\delta).A_{si} + a.c.A_s)$						Total Ultimate Capacity, $P_u = P_{pu} + P_{su}$ (tonnes)	Weight of pile, W_p (Tonnes)	Total Safe Capacity, P_s (Tonnes) $P_s = \frac{Ps}{2.5}$	Total safe uplift capactiy (Tonnes)	Pile Length (meters)
											N_c	N_q	N_γ	A_p (m^2)	c.N_c	PdN_q	$0.5\gamma.D.N_\gamma$	P_{pu} (tonnes)	Effective over burder Pressure at c.g of the layer 'P_{di}' (t/m^2)	A_{si} (m^2)	$(K_s P_{di} \tan\delta).A_{si}$	Adhesion Factor, a	a.c.A_s	P_{su}					
1	SM-ML	2	Not met	0	30	30	1.82	1.00	1.8	1.00	0	20.9	22.4	1.13	0	37.7	13.000	57.29	1	7.53	4.34	0	0	4.34	61.63	3.16	24.65	4.37	2
2	SM-ML	2	Not met	0	30	30	1.82	1.00	3.8	1.00	0	20.9	22.4	1.13	0	79.6	13.440	105.13	2.8	7.53	12.17	0	0	16.51	121.64	6.32	48.65	10.94	4
3	SM-ML	2	Not met	0	30	30	1.85	1.00	5.8	1.00	0	20.9	22.4	1.13	0	122	13.440	152.48	4.8	7.53	20.86	0	0	20.86	173.34	9.49	69.33	15.33	6
4	SM-ML / SM	2	Not met	0	30	30	1.85	1.00	7.8	1.00	0	20.9	22.4	1.13	0	163	13.440	199.82	6.8	7.53	29.56	0	0	50.42	250.24	12.65	100.09	26.76	8
5	SM-ML / SM	2	Not met	0	30	30	1.87	1.00	9.8	1.00	0	20.9	22.4	1.13	0	205	13.440	247.16	8.8	7.53	38.25	0	0	88.67	335.83	15.82	134.33	40.64	10
6	SM-ML / SM	1.5	Not met	0	31	31	1.93	1.00	11.3	1.05	0	23.9	26	1.13	0	270	15.590	323.11	10.55	5.65	37.6	0.3	0	126.3	449.38	18.19	179.75	53.54	11.5
7	SM-ML / SM	1.5	Not met	0	31	31	1.93	1.00	12.8	1.05	0	23.9	26	1.13	0	306	15.590	363.66	12.05	5.65	42.95	0	0	169.2	532.88	20.56	213.15	67.94	13
8	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	14.8	1.10	0	28.9	30.2	1.13	0	427	18.120	503.46	13.8	7.53	71.42	0	0	240.6	744.1	23.73	297.64	91.1	15
9	SM-ML / SM	1	Not met	0	32	32	1.93	1.00	15.8	1.10	0	28.9	30.2	1.13	0	456	18.120	536.08	15.3	3.76	39.54	0	0	280.2	816.26	25.31	326.5	103.76	16
10	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	16.8	7.53	86.95	0	0	367.1	968.48	28.47	387.39	131.26	18
11	SM-ML / SM	1	Not met	0	32	32	1.93	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	413.1	1014.48	30.05	405.79	145.72	19
12	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	505.3	1106.6	33.22	442.64	174.69	21
13	SM-ML / SM	1	Not met	0	32	32	1.93	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	3.76	46	0	0	551.3	1152.6	34.8	461.04	189.15	22
14	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0	0	643.4	1244.72	37.96	497.88	218.1	24
15	SM-ML / SM	2	Not met	0	32	32	1.93	1.00	17.8	1.10	0	28.9	30.2	1.13	0	514	18.120	601.35	17.8	7.53	92.12	0.3	0	735.5	1336.84	41.13	534.73	247.06	26

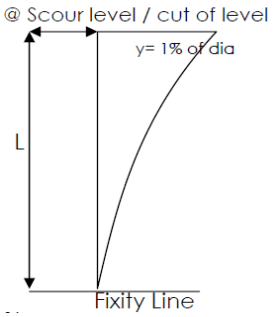
Recommendation :

a) Pile Diameter (mm)	1200		
b) Pile cut off level (m)	**2.0**		
c) Pile Shaft Length from Cut off Level (m)	22.0	24.0	26.0
d) Vertical Pile Capacity (tonnes)	455.0	495.0	530.0
e) Uplift pile capacity (Tonnes)	185.0	215.0	245.0

* For Vertical Capacity of Pile , weight of the Pile has not been Considered.

Project no : 2137	Lateral Load Capacity of pile [As per IS 2911-2010 Part 1Section-2] Annex-C	
Project :	Geotechnical Investigation work for Proposed Elevated Railway track in Kurushetra.	

Borehole no :	BH 2 To BH10, BH 13 To BH 22	
Type of pile :	Bored cast in situ	
Diameter of the pile in "mm" **:**	1000	1200
Cut off Level of the Pile in "m" :	2.0	2.0
Length of the Pile below the cut off level in "m" :	24.0	24.0
Type of Pile Head :	fixed	fixed
Crossection of the Pile :	Circle	Circle
Gade of the concrete **(M):**	35.0	35.0
Type of Soil :	Granular	Granular
Density condition of soil **:**	medium	medium
Condition of Soil with w.r.t Ground water :	Submerged	Submerged
No. of Blow (N)	20.00	20.00
Type of consolidation (normally consolidated or Preconsolidated)	N.A	N.A
Moment of Inertia , **I** in "cm^4" :	4.909E+06	1.018E+07
Modulus of elasticity of the Pile , **E** (Kg/cm^2) **:**	2.74E+05	2.74E+05
Modulus of subgrade reaction for granular soil (K1) in Kn/m3 :	2.84E+03	2.84E+03
Stiffness factor for Cohesionless soil (T) in m :	3.41	3.95
Free standing length of pile or length of the pile below cut off level not contributing substantially to lateral capacities (L_1) in "m"**:**	0.0	0.0
therefore L_1/T or L_1/R :	0.00	0.00
Embedded Length of the Pile (L_e) in "m" :	24.00	24.00
Reading from the graph **L_f/T** or **L_f/R** (As per Appendix C,Clause 5.5.2 Fig 2):	2.19	2.19
Depth of Fixidity **L_F** in "m":	7.47	8.65
Depth of Fixity + free standing length **($L_{xx}=L_1+L_f$)** in "m"	7.47	8.65
Considering 1% of dia for Horizontal Deflection :		
Permissible Horizontal Deflection pile (Y) " in mm" :	**10.00**	**12.00**
Lateral capcity of pile ,**Q** (Tonnes) for 1% dia. deflection :	38.75	62.04
Considering 1 % of dia for Horizontal Deflection :		
Recommended Lateral Capacity of Pile (T) for 1% dia deflection :	35.00	60.00



Equations :

$T=(EI/n_h)^{1/5}$; $R=(EI/K_1)^{1/4}$

For Free Head (Y) $=[QLxx^3]/3EI$; For Fixed head (Y)$=[QLxx^3]/12EI$

Annexure II

(Liquefaction Analysis)

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%" :	60
Structure @ Chainage	0+230	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 1	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N $_{Field}$	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	47	20.60	10.60	91	0.99	35.24	37.08	0.10	1.64	1.00	77.18	5.00	1.20	97.62	NA	NA	>1	Non Liquefiable
3.3	SM-ML	73	20.60	10.60	89	0.97	66.14	67.98	0.10	1.21	1.00	88.54	5.00	1.20	111.25	NA	NA	>1	Non Liquefiable
4.8	SM-ML	73	20.60	10.60	81	0.96	97.04	98.88	0.10	1.01	1.00	73.41	5.00	1.20	93.09	NA	NA	>1	Non Liquefiable
6.3	SM	32	19.40	9.40	49	0.95	126.14	122.22	0.10	0.90	1.00	28.95	5.00	1.20	39.73	NA	NA	>1	Non Liquefiable
7.80	SM	43	19.40	9.40	34	0.94	155.24	151.32	0.10	0.81	1.00	34.96	4.93	1.19	46.47	NA	NA	>1	Non Liquefiable
9.30	SM	41	19.60	9.60	50	0.93	184.64	182.28	0.10	0.74	1.00	30.37	5.00	1.20	41.44	NA	NA	>1	Non Liquefiable
10.80	SM	47	19.60	9.60	39	0.89	214.04	211.68	0.09	0.66	1.00	31.17	5.00	1.20	42.41	NA	NA	>1	Non Liquefiable
12.30	SM-ML	42	19.60	9.60	56	0.85	243.44	241.08	0.09	0.61	1.00	25.59	5.00	1.20	35.71	NA	NA	>1	Non Liquefiable
13.80	SM	58	19.60	9.60	43	0.81	272.84	270.48	0.08	0.56	1.00	32.68	5.00	1.20	44.21	NA	NA	>1	Non Liquefiable
15.30	SM	66	19.60	9.60	44	0.77	302.24	299.88	0.08	0.52	1.00	34.58	5.00	1.20	46.50	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seismsic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage	0+460	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 2	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	10	18.30	8.30	77	0.99	32.86	32.94	0.10	1.70	1.00	17.00	5.00	1.20	25.40	NA	NA	>1	Non Liquefiable
3.3	SM-ML	14	18.30	8.30	88	0.97	60.31	60.39	0.10	1.29	1.00	18.02	5.00	1.20	26.62	NA	NA	>1	Non Liquefiable
4.8	SM-ML	19	18.30	8.30	92	0.96	87.76	87.84	0.10	1.07	1.00	20.27	5.00	1.20	29.33	NA	NA	>1	Non Liquefiable
6.3	SM-ML	25	18.30	8.30	84	0.95	115.21	115.29	0.10	0.93	1.00	23.28	5.00	1.20	32.94	NA	NA	>1	Non Liquefiable
7.80	SM-ML	29	18.30	8.30	85	0.94	142.66	142.74	0.10	0.84	1.00	24.27	5.00	1.20	34.13	NA	NA	>1	Non Liquefiable
9.30	SM-ML	34	18.60	8.60	81	0.93	170.56	172.98	0.09	0.76	1.00	25.85	5.00	1.20	36.02	NA	NA	>1	Non Liquefiable
10.80	SM	38	18.60	8.60	41	0.89	198.46	200.88	0.09	0.69	1.00	26.05	5.00	1.20	36.26	NA	NA	>1	Non Liquefiable
12.30	SM-ML	44	19.20	9.20	85	0.85	227.26	236.16	0.08	0.62	1.00	27.18	5.00	1.20	37.61	NA	NA	>1	Non Liquefiable
13.80	SM-ML	37	19.20	9.20	87	0.81	256.06	264.96	0.08	0.57	1.00	21.15	5.00	1.20	30.37	NA	NA	>1	Non Liquefiable
15.30	SM-ML	73	19.20	9.20	88	0.77	284.86	293.76	0.08	0.53	1.00	38.81	5.00	1.20	51.58	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "9	60
Structure @ chainage	0+720	DesignPGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 3	nportance Factor of the Structur	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	CI	97	19.70	9.70	92	0.99	35.22	35.46	0.10	1.68	1.00	162.89	5.00	1.20	200.47	NA	NA	>1	Non Liquefiable
3.3	CI	35	19.70	9.70	86	0.97	64.77	65.01	0.10	1.24	1.00	43.41	5.00	1.20	57.09	NA	NA	>1	Non Liquefiable
4.8	SM	34	19.70	9.70	43	0.96	94.32	94.56	0.10	1.03	1.00	34.96	5.00	1.20	46.96	NA	NA	>1	Non Liquefiable
6.3	SM-ML	28	19.50	9.50	51	0.95	123.57	122.85	0.10	0.90	1.00	25.26	5.00	1.20	35.31	NA	NA	>1	Non Liquefiable
7.8	SM-ML	35	19.50	9.50	52	0.94	152.82	152.10	0.10	0.81	1.00	28.38	5.00	1.20	39.06	NA	NA	>1	Non Liquefiable
9.3	SM-ML	39	19.50	9.50	66	0.93	182.07	181.35	0.10	0.74	1.00	28.96	5.00	1.20	39.75	NA	NA	>1	Non Liquefiable
10.8	SM-ML	40	19.50	9.50	64	0.89	211.32	210.60	0.09	0.67	1.00	26.62	5.00	1.20	36.94	NA	NA	>1	Non Liquefiable
12.3	SM-ML	46	19.60	9.60	92	0.85	240.72	241.08	0.09	0.61	1.00	28.03	5.00	1.20	38.63	NA	NA	>1	Non Liquefiable
13.8	SM-ML	72	19.60	9.60	87	0.81	270.12	270.48	0.08	0.56	1.00	40.57	5.00	1.20	53.68	NA	NA	>1	Non Liquefiable
15.3	SM-ML	35	19.60	9.60	71	0.77	299.52	299.88	0.08	0.52	1.00	18.34	5.00	1.20	27.01	NA	NA	>1	Non Liquefiable

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage	0+980	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 4	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	CI	24	18.60	8.60	72	0.99	34.68	33.48	0.11	1.70	1.00	40.80	5.00	1.20	53.96	NA	NA	>1	Non Liquefiable
3.3	SM-ML	18	18.60	8.60	62	0.97	62.58	61.38	0.10	1.28	1.00	22.98	5.00	1.20	32.57	NA	NA	>1	Non Liquefiable
4.8	SM-ML	22	18.60	8.60	77	0.96	90.48	89.28	0.10	1.06	1.00	23.28	5.00	1.20	32.94	NA	NA	>1	Non Liquefiable
6.3	SM	25	18.80	8.80	32	0.95	118.68	118.44	0.10	0.92	1.00	22.97	4.83	1.17	31.73	NA	NA	>1	Non Liquefiable
7.80	SM	30	18.80	8.80	38	0.94	146.88	146.64	0.10	0.83	1.00	24.77	5.00	1.20	34.73	NA	NA	>1	Non Liquefiable
9.30	SM-ML	49	18.80	8.80	54	0.93	175.08	174.84	0.10	0.76	1.00	37.06	5.00	1.20	49.47	NA	NA	>1	Non Liquefiable
10.80	SM-ML	56	18.80	8.80	60	0.89	203.28	203.04	0.09	0.68	1.00	38.14	5.00	1.20	50.77	NA	NA	>1	Non Liquefiable
12.30	SM-ML	64	19.70	9.70	71	0.85	232.83	242.31	0.08	0.61	1.00	38.86	5.00	1.20	51.63	NA	NA	>1	Non Liquefiable
13.80	SM-ML	84	19.70	9.70	91	0.81	262.38	271.86	0.08	0.56	1.00	47.16	5.00	1.20	61.59	NA	NA	>1	Non Liquefiable
15.30	SM-ML	100	19.70	9.70	89	0.77	291.93	301.41	0.08	0.52	1.00	52.21	5.00	1.20	67.65	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage :	1+235	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 5	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	8	18.20	8.20	90	0.99	34.44	32.76	0.11	1.70	1.00	13.60	5.00	1.20	21.32	NA	NA	>1	Non Liquefiable
3.3	SM-ML	11	18.20	8.20	88	0.97	61.74	60.06	0.10	1.29	1.00	14.19	5.00	1.20	22.03	NA	NA	>1	Non Liquefiable
4.8	SM-ML	25	18.20	8.20	71	0.96	89.04	87.36	0.10	1.07	1.00	26.75	5.00	1.20	37.10	NA	NA	>1	Non Liquefiable
6.3	SM-ML	25	18.90	8.90	78	0.95	117.39	119.07	0.10	0.92	1.00	22.91	5.00	1.20	32.49	NA	NA	1.00	Non Liquefiable
7.80	SM-ML	31	18.90	8.90	69	0.94	145.74	147.42	0.10	0.82	1.00	25.53	5.00	1.20	35.64	NA	NA	1.00	Non Liquefiable
9.30	SM	34	19.00	9.00	20	0.93	174.24	176.70	0.09	0.75	1.00	25.58	3.61	1.08	31.22	NA	NA	>1	Non Liquefiable
10.80	SM-ML	38	19.00	9.00	15	0.89	202.74	205.20	0.09	0.68	1.00	25.71	2.50	1.05	29.44	NA	NA	>1	Non Liquefiable
12.30	SM-ML	58	19.20	9.20	62	0.85	231.54	236.16	0.09	0.62	1.00	35.83	5.00	1.20	47.99	NA	NA	>1	Non Liquefiable
13.80	SM-ML	44	19.20	9.20	61	0.81	260.34	255.96	0.09	0.57	1.00	25.15	5.00	1.20	35.17	NA	NA	>1	Non Liquefiable
15.30	SM-ML	51	19.20	9.20	88	0.77	289.14	269.76	0.09	0.53	1.00	27.12	5.00	1.20	37.54	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%" :	60
Structure @ Chainage :	1+495	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 6	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	12	18.30	8.30	70	0.99	33.34	32.94	0.10	1.70	1.00	20.40	5.00	1.20	29.48	NA	NA	>1	Non Liquefiable
3.3	SM-ML	14	18.30	8.30	88	0.97	60.79	60.39	0.10	1.29	1.00	18.02	5.00	1.20	26.62	NA	NA	>1	Non Liquefiable
4.8	SM-ML	25	18.30	8.30	36	0.96	88.24	87.84	0.10	1.07	1.00	26.67	5.00	1.20	37.01	NA	NA	>1	Non Liquefiable
6.3	SM-ML	26	18.80	8.80	45	0.95	116.44	118.44	0.10	0.92	1.00	23.89	5.00	1.20	33.67	NA	NA	>1	Non Liquefiable
7.80	SM-ML	30	18.80	8.80	33	0.94	144.64	146.64	0.10	0.83	1.00	24.77	4.88	1.18	34.10	NA	NA	>1	Non Liquefiable
9.30	SM	29	18.80	8.80	41	0.93	172.84	174.84	0.10	0.76	1.00	21.93	5.00	1.20	31.32	NA	NA	>1	Non Liquefiable
10.80	SM	38	18.80	8.80	44	0.89	201.04	203.04	0.09	0.68	1.00	25.88	5.00	1.20	36.05	NA	NA	>1	Non Liquefiable
12.30	SM-ML	40	19.10	9.10	77	0.85	229.69	234.93	0.09	0.62	1.00	24.79	5.00	1.20	34.75	NA	NA	>1	Non Liquefiable
13.80	SM-ML	25	19.10	9.10	88	0.81	258.34	263.58	0.08	0.57	1.00	14.34	5.00	1.20	22.21	NA	NA	>1	Non Liquefiable
15.30	SM-ML	38	19.10	9.10	92	0.77	286.99	292.23	0.08	0.53	1.00	20.28	5.00	1.20	29.34	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%" :	60
Structure @ Chainage	1+750	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 7	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	22	19.00	9.00	75	0.99	33.64	34.20	0.10	1.70	1.00	37.40	5.00	1.20	49.88	NA	NA	>1	Non Liquefiable
3.3	SM	24	19.00	9.00	47	0.97	62.14	62.70	0.10	1.26	1.00	30.31	5.00	1.20	41.37	NA	NA	>1	Non Liquefiable
4.8	SM-ML	24	19.00	9.00	73	0.96	90.64	91.20	0.10	1.05	1.00	25.13	5.00	1.20	35.16	NA	NA	>1	Non Liquefiable
6.3	SM-ML	24	18.90	8.90	63	0.95	118.99	119.07	0.10	0.92	1.00	21.99	5.00	1.20	31.39	NA	NA	>1	Non Liquefiable
7.80	SM	14	18.90	8.90	28	0.94	147.34	147.42	0.10	0.82	1.00	11.53	4.56	1.14	17.69	0.19	0.33	3.41	Non Liquefiable
9.30	SM-ML	36	18.50	8.50	74	0.93	175.09	172.05	0.10	0.76	1.00	27.45	5.00	1.20	37.93	NA	NA	>1	Non Liquefiable
10.80	SM-ML	47	18.50	8.50	53	0.89	202.84	199.80	0.09	0.71	1.00	33.25	5.00	1.20	44.90	NA	NA	>1	Non Liquefiable
12.30	SM-ML	32	18.90	8.90	85	0.85	231.19	232.47	0.09	0.62	1.00	19.97	5.00	1.20	28.97	NA	NA	>1	Non Liquefiable
13.80	SM-ML	59	18.90	8.90	92	0.81	259.54	260.82	0.08	0.58	1.00	34.08	5.00	1.20	45.90	NA	NA	>1	Non Liquefiable
15.30	SM-ML	37	19.20	9.20	87	0.77	288.34	293.76	0.08	0.53	1.00	19.67	5.00	1.20	28.61	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage	2+010	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 8	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	17	19.00	9.00	87	0.99	33.56	34.20	0.10	1.70	1.00	28.90	5.00	1.20	39.68	NA	NA	>1	Non Liquefiable
3.3	SM-ML	20	19.00	9.00	91	0.97	62.06	62.70	0.10	1.26	1.00	25.26	5.00	1.20	35.31	NA	NA	>1	Non Liquefiable
4.8	SM-ML	22	19.00	9.00	54	0.96	90.56	91.20	0.10	1.05	1.00	23.04	5.00	1.20	32.64	NA	NA	>1	Non Liquefiable
6.3	SM-ML	24	19.10	9.10	51	0.95	119.21	120.33	0.10	0.91	1.00	21.88	5.00	1.20	31.25	NA	NA	>1	Non Liquefiable
7.80	SM	25	19.10	9.10	29	0.94	147.86	148.98	0.10	0.82	1.00	20.48	4.64	1.15	28.11	NA	NA	>1	Non Liquefiable
9.30	SM	19	18.60	8.60	43	0.93	175.76	172.98	0.10	0.76	1.00	14.45	5.00	1.20	22.34	NA	NA	>1	Non Liquefiable
10.80	SM	30	18.60	8.60	46	0.89	203.66	200.88	0.09	0.69	1.00	20.57	5.00	1.20	29.68	NA	NA	>1	Non Liquefiable
12.30	SM-ML	39	19.40	9.40	90	0.85	232.76	238.62	0.09	0.61	1.00	23.93	5.00	1.20	33.71	NA	NA	>1	Non Liquefiable
13.80	SM-ML	59	19.40	9.40	78	0.81	261.86	267.72	0.08	0.57	1.00	33.48	5.00	1.20	45.17	NA	NA	>1	Non Liquefiable
15.30	SM-ML	94	19.40	9.40	95	0.77	290.96	296.82	0.08	0.53	1.00	49.61	5.00	1.20	64.54	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%" :	60
Structure @ Chainage	2+270	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 9	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N $_{Field}$	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	CI	19	18.40	8.40	83	0.99	33.04	33.12	0.10	1.70	1.00	32.30	5.00	1.20	43.76	NA	NA	>1	Non Liquefiable
3.3	SM-ML	26	18.40	8.40	86	0.97	60.64	60.72	0.10	1.28	1.00	33.37	5.00	1.20	45.04	NA	NA	>1	Non Liquefiable
4.8	SM-ML	49	18.40	8.40	91	0.96	88.24	88.32	0.10	1.06	1.00	52.14	5.00	1.20	67.57	NA	NA	>1	Non Liquefiable
6.3	SM-ML	28	19.00	9.00	60	0.95	116.74	119.70	0.10	0.91	1.00	25.59	5.00	1.20	35.71	NA	NA	>1	Non Liquefiable
7.80	SM	34	19.00	9.00	32	0.94	145.24	148.20	0.10	0.82	1.00	27.93	4.83	1.17	37.53	NA	NA	>1	Non Liquefiable
9.30	SM	27	18.80	8.80	43	0.93	173.44	174.84	0.10	0.76	1.00	20.42	5.00	1.20	29.50	NA	NA	>1	Non Liquefiable
10.80	SM-ML	33	18.80	8.80	22	0.89	201.64	203.04	0.09	0.68	1.00	22.47	3.93	1.09	28.49	NA	NA	>1	Non Liquefiable
12.30	SM-ML	50	18.80	8.80	91	0.85	229.84	231.24	0.09	0.63	1.00	31.32	5.00	1.20	42.58	NA	NA	>1	Non Liquefiable
13.80	SM-ML	100	19.00	9.00	88	0.81	258.34	262.20	0.08	0.58	1.00	57.56	5.00	1.20	74.07	NA	NA	>1	Non Liquefiable
15.30	SM-ML	100	19.00	9.00	89	0.77	286.84	290.70	0.08	0.54	1.00	53.57	5.00	1.20	69.28	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "9	60
Structure @ chainage	2+520	DesignPGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 10	nportance Factor of the Structur	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	18	18.00	8.00	94	0.99	33.52	32.40	0.11	1.70	1.00	30.60	5.00	1.20	41.72	NA	NA	>1	Non Liquefiable
3.3	SM-ML	43	18.00	8.00	85	0.97	60.52	59.40	0.10	1.30	1.00	55.79	5.00	1.20	71.95	NA	NA	>1	Non Liquefiable
4.8	SM-ML	56	18.00	8.00	91	0.96	87.52	86.40	0.10	1.08	1.00	60.25	5.00	1.20	77.30	NA	NA	>1	Non Liquefiable
6.3	SM-ML	28	18.60	8.60	95	0.95	115.42	117.18	0.10	0.92	1.00	25.87	5.00	1.20	36.04	NA	NA	>1	Non Liquefiable
7.8	SM	19	18.60	8.60	32	0.94	143.32	145.08	0.10	0.83	1.00	15.77	4.83	1.17	23.30	NA	NA	>1	Non Liquefiable
9.3	SM	18	18.80	8.80	36	0.93	171.52	174.84	0.09	0.76	1.00	13.61	5.00	1.20	21.34	NA	NA	>1	Non Liquefiable
10.8	SM-ML	52	18.80	8.80	78	0.89	199.72	203.04	0.09	0.68	1.00	35.41	5.00	1.20	47.50	NA	NA	>1	Non Liquefiable
12.3	SM-ML	54	18.80	8.80	89	0.85	227.92	231.24	0.09	0.63	1.00	33.82	5.00	1.20	45.59	NA	NA	>1	Non Liquefiable
13.8	SM-ML	67	18.80	8.80	96	0.81	256.12	259.44	0.08	0.58	1.00	38.85	5.00	1.20	51.62	NA	NA	>1	Non Liquefiable
15.3	SM-ML	84	18.80	8.80	90	0.77	284.32	287.64	0.08	0.54	1.00	45.33	5.00	1.20	59.40	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage :	2+730	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 11	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	12	18.60	8.60	84	0.99	34.84	33.48	0.11	1.70	1.00	20.40	5.00	1.20	29.48	NA	NA	>1	Non Liquefiable
3.3	SM-ML	36	18.60	8.60	87	0.97	62.74	61.38	0.10	1.28	1.00	45.95	5.00	1.20	60.14	NA	NA	>1	Non Liquefiable
4.8	SM-ML	29	18.60	8.60	55	0.96	90.64	89.28	0.10	1.06	1.00	30.69	5.00	1.20	41.83	NA	NA	>1	Non Liquefiable
6.3	SM-ML	22	18.80	8.80	51	0.95	118.84	118.44	0.10	0.92	1.00	20.21	5.00	1.20	29.26	NA	NA	1.00	Non Liquefiable
7.80	SM-ML	24	18.80	8.80	73	0.94	147.04	146.64	0.10	0.83	1.00	19.82	5.00	1.20	28.78	NA	NA	1.00	Non Liquefiable
9.30	SM-ML	20	18.70	8.70	43	0.93	175.09	173.91	0.10	0.76	1.00	15.17	5.00	1.20	23.20	NA	NA	>1	Non Liquefiable
10.80	SM-ML	31	18.70	8.70	95	0.89	203.14	201.96	0.09	0.68	1.00	21.18	5.00	1.20	30.42	NA	NA	>1	Non Liquefiable
12.30	SM-ML	45	19.20	9.20	85	0.85	231.94	236.16	0.09	0.62	1.00	27.80	5.00	1.20	38.36	NA	NA	>1	Non Liquefiable
13.80	SM-ML	39	19.20	9.20	95	0.81	260.74	255.96	0.09	0.57	1.00	22.29	5.00	1.20	31.75	NA	NA	>1	Non Liquefiable
15.30	SM-ML	57	19.20	9.20	94	0.77	289.54	269.76	0.09	0.53	1.00	30.31	5.00	1.20	41.37	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%" :	60
Structure @ Chainage :	2+750	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 12	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	12	18.30	8.30	98	0.99	33.34	32.94	0.10	1.70	1.00	20.40	5.00	1.20	29.48	NA	NA	>1	Non Liquefiable
3.3	SM-ML	17	18.30	8.30	85	0.97	60.79	60.39	0.10	1.29	1.00	21.88	5.00	1.20	31.25	NA	NA	>1	Non Liquefiable
4.8	SM-ML	47	18.30	8.30	93	0.96	88.24	87.84	0.10	1.07	1.00	50.15	5.00	1.20	65.18	NA	NA	>1	Non Liquefiable
6.3	SM-ML	28	18.50	8.50	82	0.95	115.99	116.55	0.10	0.93	1.00	25.94	5.00	1.20	36.12	NA	NA	>1	Non Liquefiable
7.80	SM-ML	27	18.50	8.50	40	0.94	143.74	144.30	0.10	0.83	1.00	22.48	5.00	1.20	31.97	NA	NA	>1	Non Liquefiable
9.30	SM-ML	35	19.00	9.00	55	0.93	172.24	176.70	0.09	0.75	1.00	26.33	5.00	1.20	36.60	NA	NA	>1	Non Liquefiable
10.80	SM-ML	58	19.00	9.00	95	0.89	200.74	205.20	0.09	0.68	1.00	39.24	5.00	1.20	52.08	NA	NA	>1	Non Liquefiable
12.30	SM-ML	56	19.40	9.40	94	0.85	229.84	238.62	0.08	0.61	1.00	34.35	5.00	1.20	46.22	NA	NA	>1	Non Liquefiable
13.80	SM-ML	67	19.40	9.40	94	0.81	258.94	267.72	0.08	0.57	1.00	38.02	5.00	1.20	50.62	NA	NA	>1	Non Liquefiable
15.30	SM-ML	70	19.60	9.60	89	0.77	288.34	299.88	0.08	0.52	1.00	36.68	5.00	1.20	49.01	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage	2+780	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 13	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	29	18.60	8.60	92	0.99	34.68	33.48	0.11	1.70	1.00	49.30	5.00	1.20	64.16	NA	NA	>1	Non Liquefiable
3.3	SM-ML	42	18.60	8.60	80	0.97	62.58	61.38	0.10	1.28	1.00	53.61	5.00	1.20	69.33	NA	NA	>1	Non Liquefiable
4.8	SM-ML	31	18.60	8.60	80	0.96	90.48	89.28	0.10	1.06	1.00	32.81	5.00	1.20	44.37	NA	NA	>1	Non Liquefiable
6.3	SM-ML	26	18.30	8.30	82	0.95	117.93	115.29	0.10	0.93	1.00	24.21	5.00	1.20	34.06	NA	NA	>1	Non Liquefiable
7.80	SM-ML	19	18.30	8.30	59	0.94	145.38	142.74	0.10	0.84	1.00	15.90	5.00	1.20	24.08	NA	NA	>1	Non Liquefiable
9.30	SM	25	18.00	8.00	42	0.93	172.38	167.40	0.10	0.77	1.00	19.32	5.00	1.20	28.19	NA	NA	>1	Non Liquefiable
10.80	SM-ML	30	18.00	8.00	69	0.89	199.38	194.40	0.09	0.72	1.00	21.52	5.00	1.20	30.82	NA	NA	>1	Non Liquefiable
12.30	SM-ML	41	19.50	9.50	95	0.85	228.63	239.85	0.08	0.61	1.00	25.07	5.00	1.20	35.08	NA	NA	>1	Non Liquefiable
13.80	SM-ML	52	19.50	9.50	90	0.81	257.88	269.10	0.08	0.57	1.00	29.40	5.00	1.20	40.28	NA	NA	>1	Non Liquefiable
15.30	SM-ML	67	19.50	9.50	93	0.77	287.13	298.35	0.08	0.53	1.00	35.23	5.00	1.20	47.28	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%" :	60
Structure @ Chainage	3+040	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 14	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N $_{Field}$	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	CI	6	17.80	7.80	95	0.99	32.44	32.04	0.10	1.70	1.00	10.20	5.00	1.20	17.24	0.18	0.32	3.13	Non Liquefiable
3.3	SM-ML	6	17.80	7.80	87	0.97	59.14	58.74	0.10	1.30	1.00	7.83	5.00	1.20	14.39	0.15	0.27	2.67	Non Liquefiable
4.8	SM-ML	16	17.80	7.80	83	0.96	85.84	85.44	0.10	1.08	1.00	17.31	5.00	1.20	25.77	NA	NA	>1	Non Liquefiable
6.3	SM-ML	31	18.20	8.20	65	0.95	113.14	114.66	0.10	0.93	1.00	28.95	5.00	1.20	39.74	NA	NA	>1	Non Liquefiable
7.80	SM	19	18.20	8.20	34	0.94	140.44	141.96	0.10	0.84	1.00	15.95	4.93	1.19	23.88	NA	NA	>1	Non Liquefiable
9.30	SM	38	18.30	8.30	38	0.93	167.89	170.19	0.09	0.77	1.00	29.13	5.00	1.20	39.95	NA	NA	>1	Non Liquefiable
10.80	SM-ML	33	18.30	8.30	97	0.89	195.34	197.64	0.09	0.71	1.00	23.47	5.00	1.20	33.17	NA	NA	>1	Non Liquefiable
12.30	SM-ML	32	18.70	8.70	91	0.85	223.39	230.01	0.09	0.63	1.00	20.11	5.00	1.20	29.14	NA	NA	>1	Non Liquefiable
13.80	CL	40	18.70	8.70	88	0.81	251.44	258.06	0.08	0.58	1.00	23.28	5.00	1.20	32.93	NA	NA	>1	Non Liquefiable
15.30	SM-ML	33	18.70	8.70	91	0.77	279.49	286.11	0.08	0.54	1.00	17.88	5.00	1.20	26.45	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details

Location

Structure @ Chainage 3+300

Borehole no : BH 15

Actual Water Table Depth (m) Not met

Seimsmic Parameters

Magnitude of Earthquake	6
Design PGA	0.16 g
Importance Factor of the Struct	1

Parameters from SPT Boring

Efficiency in SPT Boring (for C_E factor) "%	60
Borehole diameter (mm)	150
Was liner used in SPT boring	No

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	5	17.60	7.60	89	0.99	32.16	31.68	0.10	1.70	1.00	8.50	5.00	1.20	15.20	0.16	0.29	2.75	Non Liquefiable
3.3	SM-ML	24	17.60	7.60	65	0.97	58.56	58.08	0.10	1.31	1.00	31.49	5.00	1.20	42.79	NA	NA	>1	Non Liquefiable
4.8	SM-ML	24	17.60	7.60	78	0.96	84.96	84.48	0.10	1.09	1.00	26.11	5.00	1.20	36.33	NA	NA	>1	Non Liquefiable
6.3	SM-ML	20	18.30	8.30	72	0.95	112.41	115.29	0.10	0.93	1.00	18.63	5.00	1.20	27.35	NA	NA	>1	Non Liquefiable
7.80	SM-ML	30	19.10	9.10	89	0.94	141.06	148.98	0.09	0.82	1.00	24.58	5.00	1.20	34.49	NA	NA	>1	Non Liquefiable
9.30	SM	19	18.60	8.60	27	0.93	168.96	172.98	0.09	0.76	1.00	14.45	4.48	1.13	20.81	NA	NA	>1	Non Liquefiable
10.80	SM	30	18.60	8.60	42	0.89	196.86	200.88	0.09	0.69	1.00	20.57	5.00	1.20	29.68	NA	NA	>1	Non Liquefiable
12.30	SM	67	19.40	9.40	20	0.85	225.96	238.62	0.08	0.61	1.00	41.10	3.61	1.08	47.98	NA	NA	>1	Non Liquefiable
13.80	SM	70	19.40	9.40	34	0.81	255.06	267.72	0.08	0.57	1.00	39.72	4.93	1.19	52.13	NA	NA	>1	Non Liquefiable
15.30	SM	74	19.40	9.40	9	0.77	284.16	296.82	0.08	0.53	1.00	39.06	0.56	1.02	40.28	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seismsic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ chainage	3+560	DesignPGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 16	nportance Factor of the Structur	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	35	20.10	10.10	96	0.99	35.62	36.18	0.10	1.66	1.00	58.19	5.00	1.20	74.83	NA	NA	>1	Non Liquefiable
3.3	SM-ML	74	20.10	10.10	83	0.97	65.77	66.33	0.10	1.23	1.00	90.86	5.00	1.20	114.03	NA	NA	>1	Non Liquefiable
4.8	SM-ML	84	20.10	10.10	70	0.96	95.92	96.48	0.10	1.02	1.00	85.52	5.00	1.20	107.62	NA	NA	>1	Non Liquefiable
6.3	SM-ML	26	18.80	8.80	68	0.95	124.12	118.44	0.10	0.92	1.00	23.89	5.00	1.20	33.67	NA	NA	>1	Non Liquefiable
7.8	SM	31	18.80	8.80	41	0.94	152.32	146.64	0.10	0.83	1.00	25.60	5.00	1.20	35.72	NA	NA	>1	Non Liquefiable
9.3	SM-ML	37	18.80	8.80	53	0.93	180.52	174.84	0.10	0.76	1.00	27.98	5.00	1.20	38.58	NA	NA	>1	Non Liquefiable
10.8	SM	43	19.00	9.00	40	0.89	209.02	205.20	0.09	0.68	1.00	29.09	5.00	1.20	39.91	NA	NA	>1	Non Liquefiable
12.3	SM-ML	47	19.00	9.00	96	0.85	237.52	233.70	0.09	0.62	1.00	29.23	5.00	1.20	40.08	NA	NA	>1	Non Liquefiable
13.8	SM-ML	79	20.90	10.90	74	0.81	268.87	288.42	0.08	0.54	1.00	42.55	5.00	1.20	56.07	NA	NA	>1	Non Liquefiable
15.3	SM	82	20.90	10.90	45	0.77	300.22	319.77	0.07	0.50	1.00	41.02	5.00	1.20	54.23	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage	3+820	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 17	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
3.3	SM-ML	24	18.40	8.40	86	0.97	62.28	60.72	0.10	1.28	1.00	30.80	5.00	1.20	41.96	NA	NA	>1	Non Liquefiable
4.8	SM-ML	19	18.40	8.40	65	0.96	89.88	88.32	0.10	1.06	1.00	20.22	5.00	1.20	29.26	NA	NA	>1	Non Liquefiable
6.3	SM-ML	39	18.40	8.40	66	0.95	117.48	115.92	0.10	0.93	1.00	36.22	5.00	1.20	48.47	NA	NA	>1	Non Liquefiable
7.80	SM-ML	41	19.00	9.00	72	0.94	145.98	148.20	0.10	0.82	1.00	33.68	5.00	1.20	45.41	NA	NA	>1	Non Liquefiable
9.30	SM	61	19.00	9.00	34	0.93	174.48	176.70	0.10	0.75	1.00	45.89	4.93	1.19	59.46	NA	NA	>1	Non Liquefiable
10.80	SM-ML	38	18.70	8.70	96	0.89	202.53	201.96	0.09	0.68	1.00	25.97	5.00	1.20	36.16	NA	NA	>1	Non Liquefiable
12.30	SM-ML	50	18.70	8.70	86	0.85	230.58	230.01	0.09	0.63	1.00	31.43	5.00	1.20	42.71	NA	NA	>1	Non Liquefiable
13.80	SM-ML	49	19.30	9.30	96	0.81	259.53	266.34	0.08	0.57	1.00	27.90	5.00	1.20	38.48	NA	NA	>1	Non Liquefiable
15.30	SM-ML	79	19.30	9.30	86	0.77	288.48	295.29	0.08	0.53	1.00	41.85	5.00	1.20	55.22	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage	4+080	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 18	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	17	18.60	8.60	72	0.99	33.16	33.48	0.10	1.70	1.00	28.90	5.00	1.20	39.68	NA	NA	>1	Non Liquefiable
3.3	SM-ML	31	18.60	8.60	56	0.97	61.06	61.38	0.10	1.28	1.00	39.57	5.00	1.20	52.48	NA	NA	>1	Non Liquefiable
4.8	SM-ML	25	18.60	8.60	79	0.96	88.96	89.28	0.10	1.06	1.00	26.46	5.00	1.20	36.75	NA	NA	>1	Non Liquefiable
6.3	SM	22	18.50	8.50	40	0.95	116.71	116.55	0.10	0.93	1.00	20.38	5.00	1.20	29.45	NA	NA	>1	Non Liquefiable
7.80	SM-ML	22	18.50	8.50	75	0.94	144.46	144.30	0.10	0.83	1.00	18.31	5.00	1.20	26.98	NA	NA	>1	Non Liquefiable
9.30	SM-ML	42	18.50	8.50	74	0.93	172.21	172.05	0.10	0.76	1.00	32.02	5.00	1.20	43.42	NA	NA	>1	Non Liquefiable
10.80	SM-ML	49	18.50	8.50	69	0.89	199.96	199.80	0.09	0.71	1.00	34.67	5.00	1.20	46.60	NA	NA	>1	Non Liquefiable
12.30	SM-ML	34	18.50	8.50	64	0.85	227.71	227.55	0.09	0.63	1.00	21.52	5.00	1.20	30.83	NA	NA	>1	Non Liquefiable
13.80	SM-ML	31	18.50	8.50	54	0.81	255.46	255.30	0.08	0.59	1.00	18.17	5.00	1.20	26.81	NA	NA	>1	Non Liquefiable
15.30	SM-ML	57	19.30	9.30	64	0.77	284.41	295.29	0.08	0.53	1.00	30.20	5.00	1.20	41.23	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "9	60
Structure @ chainage	4+340	DesignPGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 19	nportance Factor of the Structur	1	Was liner used in SPT boring	No
Actual Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	15	18.90	8.90	90	0.99	34.42	34.02	0.10	1.70	1.00	25.50	5.00	1.20	35.60	NA	NA	>1	Non Liquefiable
3.3	SM-ML	20	18.90	8.90	81	0.97	62.77	62.37	0.10	1.27	1.00	25.32	5.00	1.20	35.39	NA	NA	>1	Non Liquefiable
4.8	SM-ML	23	18.90	8.90	82	0.96	91.12	90.72	0.10	1.05	1.00	24.15	5.00	1.20	33.98	NA	NA	>1	Non Liquefiable
6.3	SM-ML	29	18.60	8.60	92	0.95	119.02	117.18	0.10	0.92	1.00	26.79	5.00	1.20	37.15	NA	NA	>1	Non Liquefiable
7.8	SM-ML	31	18.60	8.60	69	0.94	146.92	145.08	0.10	0.83	1.00	25.74	5.00	1.20	35.88	NA	NA	>1	Non Liquefiable
9.3	SM-ML	24	18.50	8.50	95	0.93	174.67	172.05	0.10	0.76	1.00	18.30	5.00	1.20	26.96	NA	NA	>1	Non Liquefiable
10.8	SM-ML	29	18.50	8.50	87	0.89	202.42	199.80	0.09	0.71	1.00	20.52	5.00	1.20	29.62	NA	NA	>1	Non Liquefiable
12.3	CI	26	18.50	8.50	86	0.85	230.17	227.55	0.09	0.63	1.00	16.46	5.00	1.20	24.75	NA	NA	>1	Non Liquefiable
13.8	SM-ML	80	18.50	8.50	89	0.81	257.92	255.30	0.08	0.59	1.00	46.90	5.00	1.20	61.27	NA	NA	>1	Non Liquefiable
15.3	SM-ML	100	18.50	8.50	74	0.77	285.67	283.05	0.08	0.55	1.00	54.58	5.00	1.20	70.50	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage	0+980	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 20	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	21	18.60	8.60	96	0.99	34.68	33.48	0.11	1.70	1.00	40.80	5.00	1.20	53.96	NA	NA	>1	Non Liquefiable
3.3	CI	20	18.60	8.60	70	0.97	62.58	61.38	0.10	1.28	1.00	22.98	5.00	1.20	32.57	NA	NA	>1	Non Liquefiable
4.8	SM-ML	40	18.60	8.60	93	0.96	90.48	89.28	0.10	1.06	1.00	23.28	5.00	1.20	32.94	NA	NA	>1	Non Liquefiable
6.3	SM-ML	16	18.20	8.80	35	0.95	118.68	118.44	0.10	0.92	1.00	22.97	4.83	1.17	31.73	NA	NA	>1	Non Liquefiable
7.80	SM-ML	28	18.20	8.80	93	0.94	146.88	146.64	0.10	0.83	1.00	24.77	5.00	1.20	34.73	NA	NA	>1	Non Liquefiable
9.30	CI	30	19.00	8.80	90	0.93	175.08	174.84	0.10	0.76	1.00	37.06	5.00	1.20	49.47	NA	NA	>1	Non Liquefiable
10.80	SM-ML	100	19.00	8.80	95	0.89	203.28	203.04	0.09	0.68	1.00	38.14	5.00	1.20	50.77	NA	NA	>1	Non Liquefiable
12.30	SM	60	19.00	9.70	22	0.85	232.83	242.31	0.08	0.61	1.00	38.86	5.00	1.20	51.63	NA	NA	>1	Non Liquefiable
13.80	SM	64	19.60	9.70	33	0.81	262.38	271.86	0.08	0.56	1.00	47.16	5.00	1.20	61.59	NA	NA	>1	Non Liquefiable
15.30	SM	67	19.60	9.70	29	0.77	291.93	301.41	0.08	0.52	1.00	52.21	5.00	1.20	67.65	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seismsic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%	60
Structure @ Chainage :	4+860	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 21	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	13	18.20	8.20	86	0.99	34.44	32.76	0.11	1.70	1.00	13.60	5.00	1.20	21.32	NA	NA	>1	Non Liquefiable
3.3	SM-ML	36	18.20	8.20	82	0.97	61.74	60.06	0.10	1.29	1.00	14.19	5.00	1.20	22.03	NA	NA	>1	Non Liquefiable
4.8	SM-ML	18	18.20	8.20	88	0.96	89.04	87.36	0.10	1.07	1.00	26.75	5.00	1.20	37.10	NA	NA	>1	Non Liquefiable
6.3	SM-ML	26	18.50	8.90	93	0.95	117.39	119.07	0.10	0.92	1.00	22.91	5.00	1.20	32.49	NA	NA	1.00	Non Liquefiable
7.80	SM-ML	32	18.50	8.90	91	0.94	145.74	147.42	0.10	0.82	1.00	25.53	5.00	1.20	35.64	NA	NA	1.00	Non Liquefiable
9.30	SM-ML	26	18.50	9.00	83	0.93	174.24	176.70	0.09	0.75	1.00	25.58	3.61	1.08	31.22	NA	NA	>1	Non Liquefiable
10.80	SM-ML	42	18.70	9.00	77	0.89	202.74	205.20	0.09	0.68	1.00	25.71	2.50	1.05	29.44	NA	NA	>1	Non Liquefiable
12.30	SM-ML	39	18.70	9.20	64	0.85	231.54	236.16	0.09	0.62	1.00	35.83	5.00	1.20	47.99	NA	NA	>1	Non Liquefiable
13.80	SM-ML	46	19.30	9.20	52	0.81	260.34	255.96	0.09	0.57	1.00	25.15	5.00	1.20	35.17	NA	NA	>1	Non Liquefiable
15.30	SM-ML	42	19.30	9.20	47	0.77	289.14	269.76	0.09	0.53	1.00	27.12	5.00	1.20	37.54	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Liquefaction Potential Evaluation as per IRC SP 114-2018

Computation Sheet

Project : **Geotechnical Investigation Work for the Proposed Elevated Railway Track in Kurushetra.**

Borehole Details		**Seimsmic Parameters**		**Parameters from SPT Boring**	
Location		Magnitude of Earthquake	6	Efficiency in SPT Boring (for C_E factor) "%" :	60
Structure @ Chainage :	5+080	Design PGA	0.16 g	Borehole diameter (mm)	150
Borehole no :	BH 22	Importance Factor of the Struct	1	Was liner used in SPT boring	No
Water Table Depth (m)	Not met				

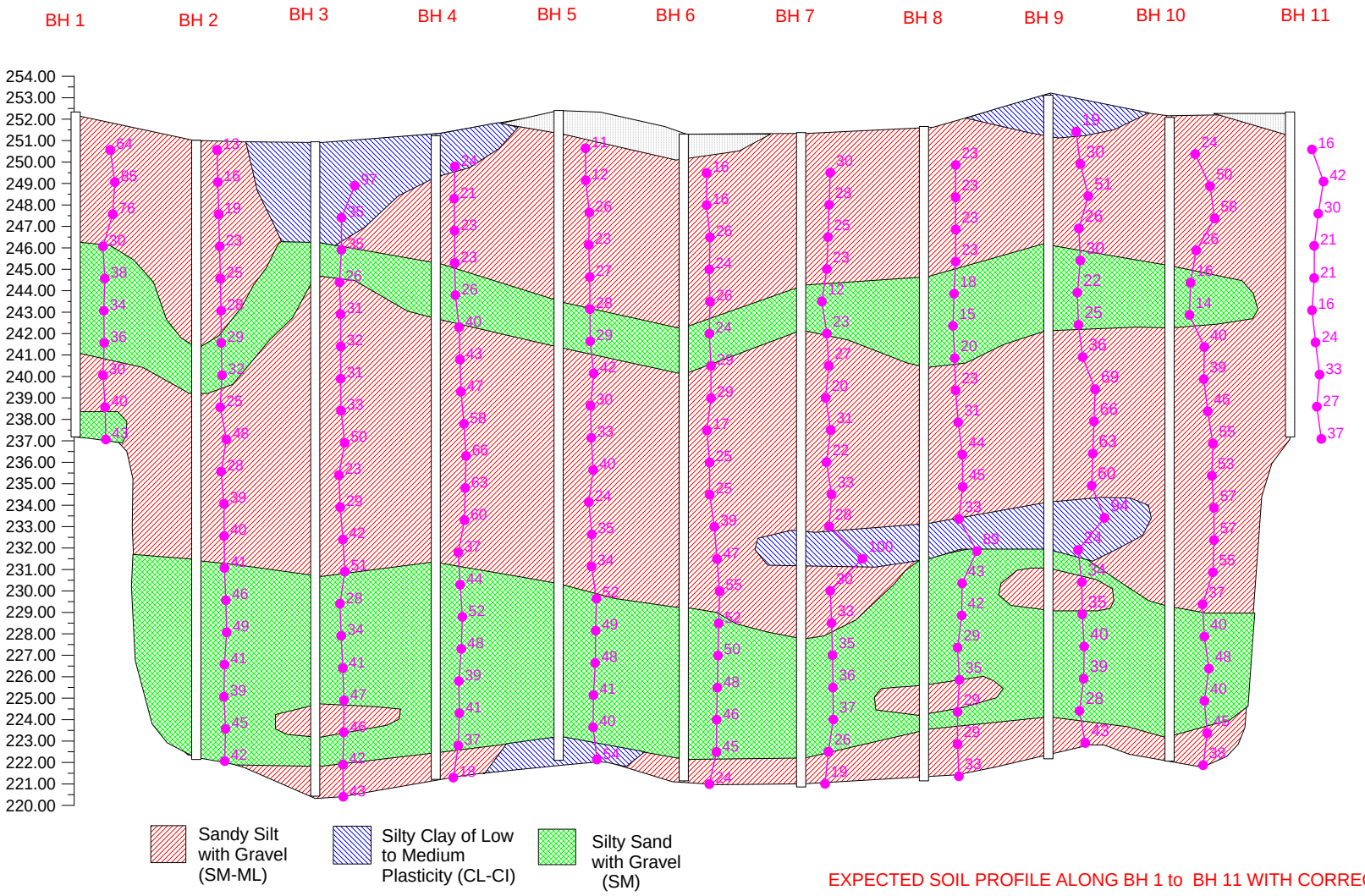
Depth below EGL, m	Type of Strata	Field SPT N_{Field}	Bulk unit weight (kN/m^3)	Submerged unit weight (kN/m^3)	Fines Content (%)	Stress reduction coefficient (r_d)	Total overburden pressure (s_o), kN/m^2	Effective overburden (s_o), kN/m^2	Cyclic Stress ratio (CSR)	C_N	C_{60}	SPT $(N_1)_{60}$	α	β	SPT $(N_1)_{60cs}$	$CRR_{M=7.5}$	CRR	FOS	Conclusion
1.8	SM-ML	16	18.20	8.30	75	0.99	33.34	32.94	0.10	1.70	1.00	20.40	5.00	1.20	29.48	NA	NA	>1	Non Liquefiable
3.3	SM-ML	17	18.20	8.30	82	0.97	60.79	60.39	0.10	1.29	1.00	18.02	5.00	1.20	26.62	NA	NA	>1	Non Liquefiable
4.8	SM-ML	21	18.20	8.30	77	0.96	88.24	87.84	0.10	1.07	1.00	26.67	5.00	1.20	37.01	NA	NA	>1	Non Liquefiable
6.3	SM-ML	18	18.70	8.80	85	0.95	116.44	118.44	0.10	0.92	1.00	23.89	5.00	1.20	33.67	NA	NA	>1	Non Liquefiable
7.80	SM-ML	56	18.70	8.80	62	0.94	144.64	146.64	0.10	0.83	1.00	24.77	4.88	1.18	34.10	NA	NA	>1	Non Liquefiable
9.30	SM-ML	62	20.30	8.80	51	0.93	172.84	174.84	0.10	0.76	1.00	21.93	5.00	1.20	31.32	NA	NA	>1	Non Liquefiable
10.80	SM	74	20.30	8.80	47	0.89	201.04	203.04	0.09	0.68	1.00	25.88	5.00	1.20	36.05	NA	NA	>1	Non Liquefiable
12.30	SM-ML	33	20.30	9.10	73	0.85	229.69	234.93	0.09	0.62	1.00	24.79	5.00	1.20	34.75	NA	NA	>1	Non Liquefiable
13.80	SM-ML	38	20.30	9.10	76	0.81	258.34	263.58	0.08	0.57	1.00	14.34	5.00	1.20	22.21	NA	NA	>1	Non Liquefiable
15.30	SM-ML	36	20.30	9.10	27	0.77	286.99	292.23	0.08	0.53	1.00	20.28	5.00	1.20	29.34	NA	NA	>1	Non Liquefiable

Annexure-II
Liquefaction Analysis

Borelogs & Figures

SUVIDHI Testing Engineers

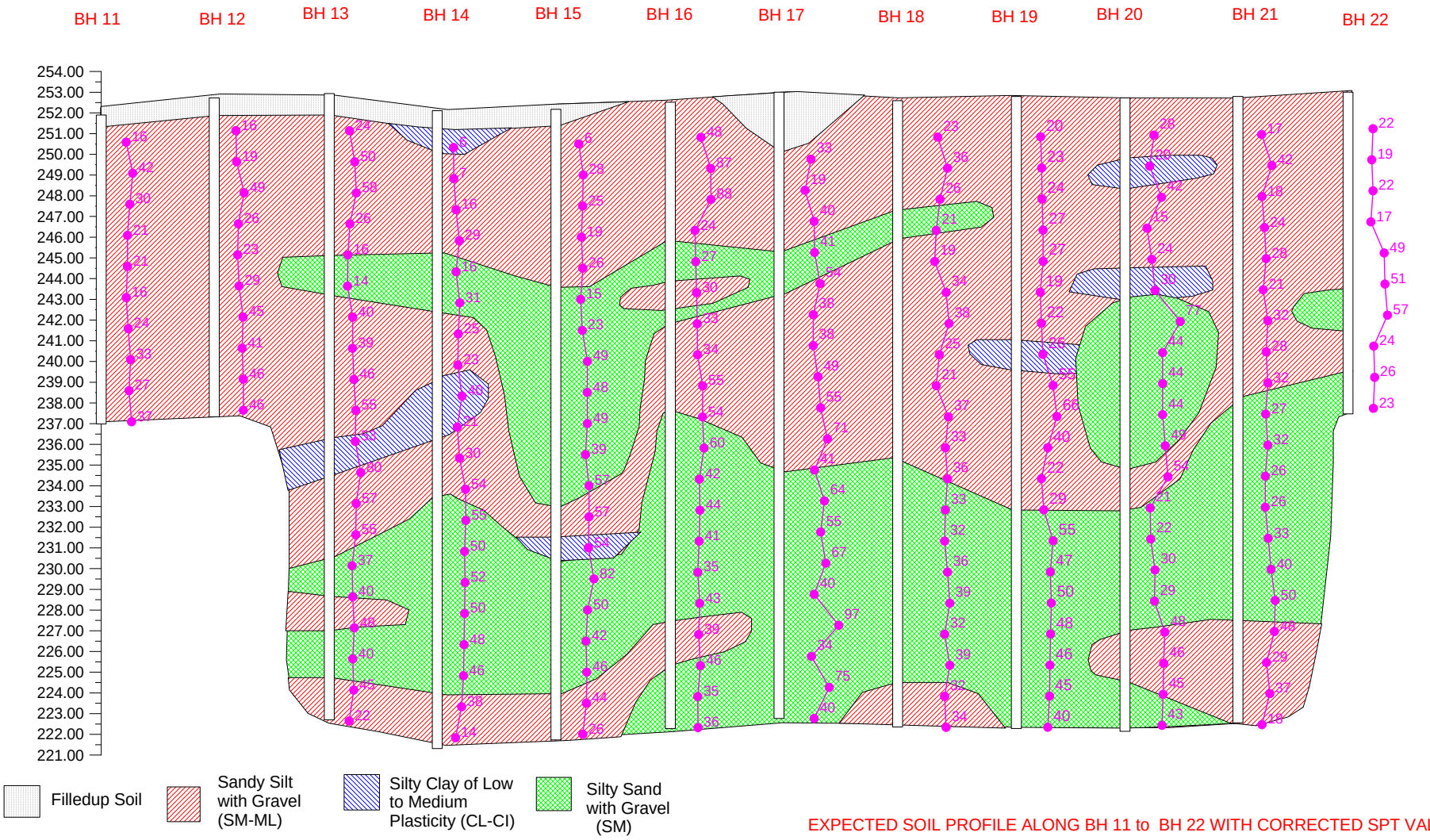
Project No. 2128



EXPECTED SOIL PROFILE ALONG BH 1 to BH 11 WITH CORRECTED SPT VALUES

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Figure : Soilpro A



EXPECTED SOIL PROFILE ALONG BH 11 to BH 22 WITH CORRECTED SPT VALUES

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Figure : Soilpro A

BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Project No. 2137 E: 673735.000 N: 3315646.000 RL: 252.368

CH 0+230
BH : 1
Depth : 15.00 m
Depth of Water table : Not met

Date of start : 11/09/2019

Date of finish : 12/09/2019

NABL CERTIFICATE NO. TC-8098

Reduced Level	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed / Corrected)	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.368																	
250.568	1.80	SPT	Sandy Silt with Gravel (SM-ML)	Observed 47 / Corrected 64	1	8	91				Non	Plastic					
249.868	2.50	UDS						2.06	1.86	10.86				DST		33	
249.068	3.30	SPT		Observed 73 / Corrected 85	1	10	89				Non	Plastic					
247.568	4.80	SPT		Observed 73 / Corrected 76	6	13	81				Non	Plastic					
246.868	5.50	UDS						1.94	1.74	11.53			2.59	DST	0.12	32	
246.068	6.30	SPT	Silty Sand with Gravel (SM)	Observed 32 / Corrected 30	0	51	49				Non	Plastic					
244.568	7.80	SPT		Observed 43 / Corrected 38	0	66	34				Non	Plastic					
243.868	8.50	UDS						1.96	1.75	12.32				DST		32	
243.068	9.30	SPT		Observed 41 / Corrected 34	0	50	50				Non	Plastic					
241.568	10.80	SPT	Sandy Silt with Gravel (SM-ML)	Observed 47 / Corrected 36	0	61	39				Non	Plastic					
240.868	11.50	UDS						1.96	1.73	13.16				DST	0.12	32	
240.068	12.30	SPT		Observed 42 / Corrected 30	0	44	56				Non	Plastic					
238.568	13.80	SPT	Silty Sand with Gravel (SM)	Observed 58 / Corrected 40	1	56	43				Non	Plastic					
237.068	15.30	SPT		Observed 66 / Corrected 43	1	55	44				Non	Plastic					

BORE LOG

SUVIDHI Testing Engineers

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

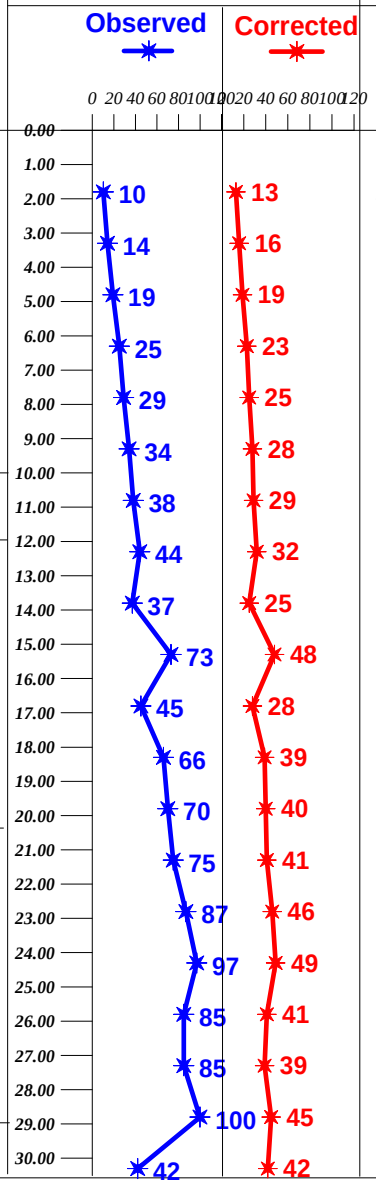
CH 0+460
BH : 2
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 09/09/2019

Date of finish : 10/09/2019

Project No. 2137 E: 673920.000 N: 3315723.000 RL : 251.998

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
251.998																
250.568	1.80	SPT		12	11	77				Non	Plastic					
249.868	2.50	UDS					1.83	1.65	10.98				DST	0.14	30	
249.068	3.30	SPT	Sandy Silt with Gravel (SM-ML)	1	11	88				Non	Plastic					
247.568	4.80	SPT		1	7	92				Non	Plastic					
246.868	5.50	UDS					1.83	1.64	11.43			2.60	DST	0.1	30	
246.068	6.30	SPT		1	15	84				Non	Plastic					
244.568	7.80	SPT		1	14	85				Non	Plastic					
243.868	8.50	UDS					1.86	1.65	12.62				DST	0.12	31	
243.068	9.30	SPT		0	19	81				Non	Plastic					
241.568	10.80	SPT	Silty Sand with Gravel (SM)	1	58	41				Non	Plastic					
240.868	11.50	UDS					1.92	1.70	13.09			2.65	DST		32	
240.068	12.30	SPT		1	14	85				Non	Plastic					
238.568	13.80	SPT		8	5	87				Non	Plastic					
237.068	15.30	SPT	Sandy Silt with Gravel (SM-ML)	4	8	88				Non	Plastic					
235.568	16.80	SPT		2	9	89				Non	Plastic					
234.068	18.30	SPT		0	21	79				Non	Plastic					
232.568	19.80	SPT		0	32	68				Non	Plastic					
231.068	21.30	SPT		1	65	34				Non	Plastic					
229.568	22.80	SPT		3	71	26				Non	Plastic					
228.068	24.30	SPT	Silty Sand with Gravel (SM)	1	73	26				Non	Plastic					
226.568	25.80	SPT		1	62	37				Non	Plastic					
225.068	27.30	SPT		1	62	37				Non	Plastic					
223.568	28.80	SPT		1	71	28				Non	Plastic					
222.068	30.30	SPT	Silty Clay of Medium Plasticity (CI)	3	15	82				Non	Plastic					



BORE LOG

SUVIDHI Testing Engineers

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

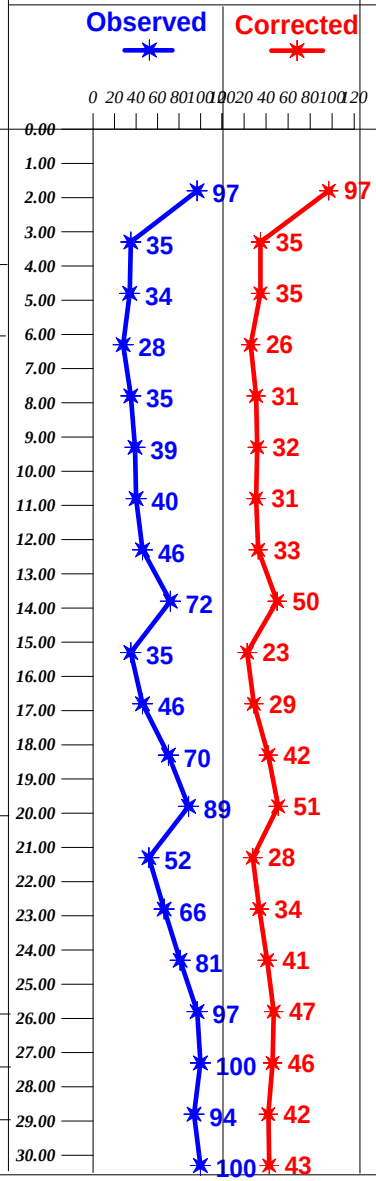
CH 0+720
BH : 3
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 14/09/2019

Date of finish : 15/09/2019

Project No. 2137 E: 674148.000 N: 3315835.000 RL: 250.703

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	Shear Parameters: C(kg/sq.cm)	Shear Parameters: phi(degrees)	Cc
250.703																
248.903	1.80	SPT	Silty Clay of Medium Plasticity (CI)	1	7	92				45	20					
248.203	2.50	UDS					1.97	1.79	10.32			2.70	UU	1.84	8	
247.403	3.30	SPT		9	5	86										
245.903	4.80	SPT	Silty Sand with Gravel (SM)	0	57	43				Non	Plastic					
245.203	5.50	UDS					1.95	1.75	11.42			2.64	DST		33	
244.403	6.30	SPT		0	49	51				Non	Plastic					
242.903	7.80	SPT	Sandy Silt with Gravel (SM-ML)	0	48	52				Non	Plastic					
242.203	8.50	UDS					1.95	1.75	11.35				DST	0.14	32	
241.403	9.30	SPT		1	33	66				Non	Plastic					
239.903	10.80	SPT		7	29	64				Non	Plastic					
239.203	11.50	UDS					1.96	1.73	13.09			2.61	DST	0.12	32	
238.403	12.30	SPT		2	6	92				Non	Plastic					
236.903	13.80	SPT		2	11	87				Non	Plastic					
236.203	14.50	UDS					1.90	1.67	13.65				DST	0.14	32	
235.403	15.30	SPT		10	19	71				Non	Plastic					
233.903	16.80	SPT		4	9	87				Non	Plastic					
232.403	18.30	SPT		0	4	96				Non	Plastic					
230.903	19.80	SPT		0	44	56				Non	Plastic					
229.403	21.30	SPT	Silty Sand with Gravel (SM)	2	65	33				Non	Plastic					
227.903	22.80	SPT		0	67	33				Non	Plastic					
226.403	24.30	SPT		0	58	42				Non	Plastic					
224.903	25.80	SPT		1	59	40				Non	Plastic					
223.403	27.30	SPT	Sandy Silt with Gravel (SM-ML)	1	45	54				Non	Plastic					
221.903	28.80	SPT	Silty Sand with Gravel (SM)	1	53	46				Non	Plastic					
220.403	30.30	SPT	Sandy Silt with Gravel (SM-ML)	1	33	66				Non	Plastic					



BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Project No. 2137 E: 674409.000 N: 3315947.000 RL: 251.596

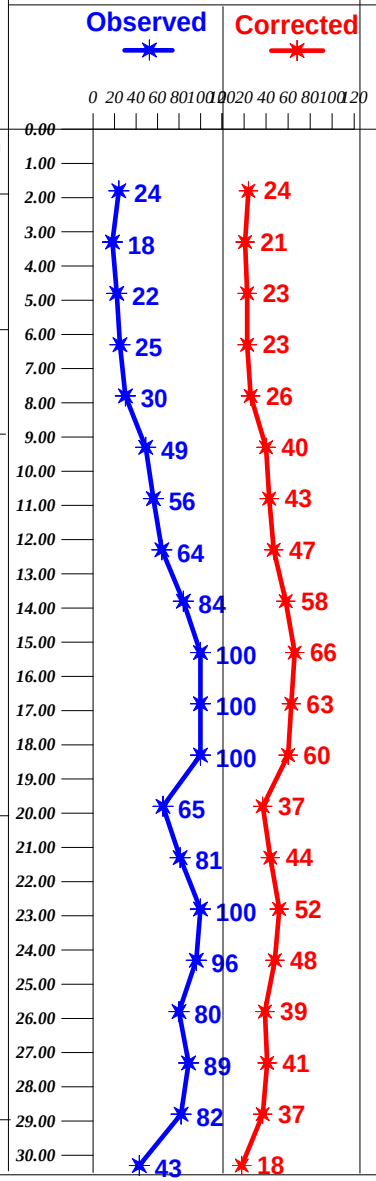
CH 0+980
BH : 4
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 13/09/2019

Date of finish : 15/09/2019

NABL CERTIFICATE NO. TC-8098

Reduced Level	Depth (m)	Type of sample	Soil Classification	Grain size (%)			Density (gm/cc)		W/C	Limits (%)		Sp.Gr	Shear Parameters			Cc
				Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L		Type of test	C(kg/sq.cm)	phi(degrees)	
251.596			Silty Clay of Medium Plasticity (CI)													
249.796	1.80	SPT		19	9	72				41	23					
249.096	2.50	UDS					1.86	1.67	11.09				DST	0.13	31	
248.296	3.30	SPT	Sandy Silt with Gravel (SM-ML)	1	37	62				Non	Plastic					
246.796	4.80	SPT		7	16	77				Non	Plastic					
246.096	5.50	UDS					1.88	1.68	12.13			2.65	DST	0.12	31	
245.296	6.30	SPT	Silty Sand with Gravel (SM)	0	68	32				Non	Plastic					
243.796	7.80	SPT		1	61	38				Non	Plastic					
243.096	8.50	UDS					1.88	1.67	12.88			2.61	DST		31	
242.296	9.30	SPT		0	46	54				Non	Plastic					
240.796	10.80	SPT		1	39	60				Non	Plastic					
240.096	11.50	UDS					1.97	1.74	13.01				DST	0.12	32	
239.296	12.30	SPT		0	29	71				Non	Plastic					
237.796	13.80	SPT	Sandy Silt with Gravel (SM-ML)	2	7	91				Non	Plastic					
236.296	15.30	SPT		1	10	89				Non	Plastic					
234.796	16.80	SPT		1	10	89				Non	Plastic					
233.296	18.30	SPT		2	10	88				Non	Plastic					
231.796	19.80	SPT		1	38	61				Non	Plastic					
230.296	21.30	SPT		1	77	22				Non	Plastic					
228.796	22.80	SPT		4	63	33				Non	Plastic					
227.296	24.30	SPT	Silty Sand with Gravel (SM)	0	58	42				Non	Plastic					
225.796	25.80	SPT		1	57	42				Non	Plastic					
224.296	27.30	SPT		1	71	28				Non	Plastic					
222.796	28.80	SPT		1	86	13				Non	Plastic					
221.296	30.30	SPT	Sandy Silt with Gravel (SM-ML)	19	11	70				Non	Plastic					



BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Project No. 2137 E: 674673.000 N: 3316078.000 RL: 252.444

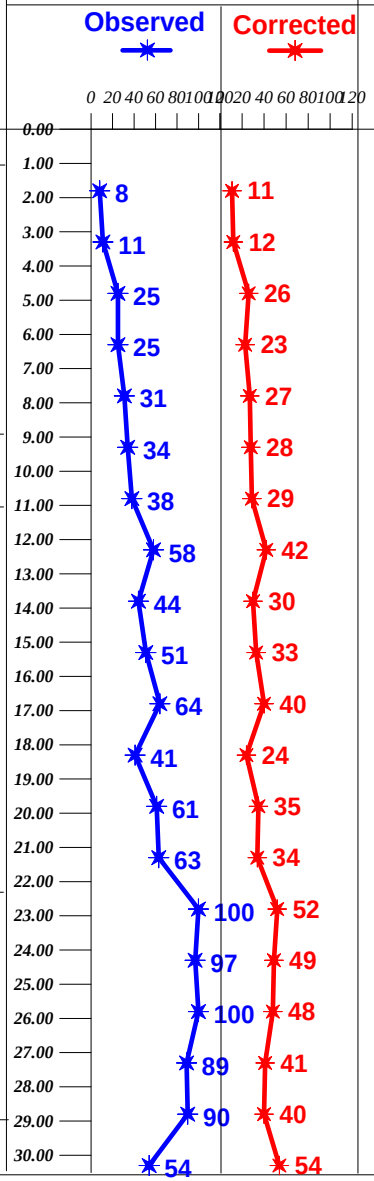
CH 1+235
BH : 5
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 06/09/2019

Date of finish : 07/09/2019

NABL CERTIFICATE NO. TC-8098

Reduced Level	Depth (m)	Type of sample	Soil Classification	Grain size (%)			Density (gm/cc)		W/C	Limits (%)		Sp.Gr	Shear Parameters			Cc
				Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L		Type of test	C(kg/sq.cm)	phi(degrees)	
252.444			Filledup Soil													
250.644	1.80	SPT	Sandy Silt with Gravel (SM-ML)	0	10	90				Non	Plastic					
249.944	2.50	UDS					1.82	1.65	10.32				DST	0.14	29	
249.144	3.30	SPT		3	9	88				Non	Plastic					
247.644	4.80	SPT		1	28	71				Non	Plastic					
246.944	5.50	UDS					1.89	1.69	11.76			2.61	DST	0.12	31	
246.144	6.30	SPT		0	22	78				Non	Plastic					
244.644	7.80	SPT		2	29	69				Non	Plastic					
243.944	8.50	UDS					1.90	1.69	12.32				DST	0.12	31	
243.144	9.30	SPT	Silty Sand with Gravel (SM)	1	79	20				Non	Plastic					
241.644	10.80	SPT	Sandy Silt with Gravel (SM-ML)	0	85	15				Non	Plastic					
240.944	11.50	UDS					1.92	1.71	12.45				DST	0.1	32	
240.144	12.30	SPT		0	38	62				Non	Plastic					
238.644	13.80	SPT		1	38	61				Non	Plastic					
237.144	15.30	SPT		1	11	88				Non	Plastic					
235.644	16.80	SPT		1	13	86				Non	Plastic					
234.144	18.30	SPT		3	9	88				Non	Plastic					
232.644	19.80	SPT		4	11	85				Non	Plastic					
231.144	21.30	SPT		1	26	73				Non	Plastic					
229.644	22.80	SPT	Silty Sand with Gravel (SM)	0	61	39				Non	Plastic					
228.144	24.30	SPT		1	71	28				Non	Plastic					
226.644	25.80	SPT		0	77	23				Non	Plastic					
225.144	27.30	SPT		0	72	28				Non	Plastic					
223.644	28.80	SPT		1	65	34				Non	Plastic					
222.144	30.30	SPT	Silty Clay of Medium Plasticity (CI)	1	10	89				38	21					



BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Project No. 2137 E: 674913.000 N: 3316190.000 RL: 251.293

CH 1+495
BH : 6
Depth : 30.00 m
Depth of Water table : Not met

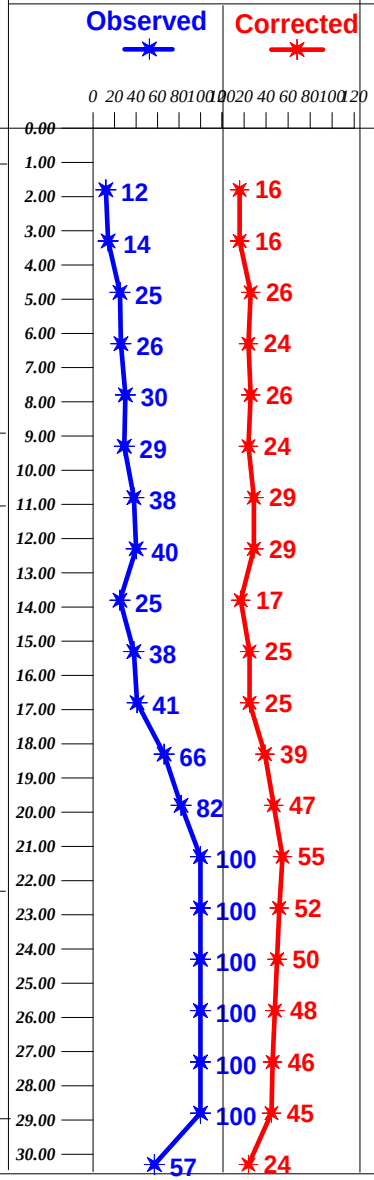
Date of start : 16/09/2019

Date of finish : 18/09/2019

NABL CERTIFICATE NO. TC-8098

Reduced Level	Depth (m)	Type of sample	Soil Classification	Grain size (%)			Density (gm/cc)		W/C	Limits (%)		Sp.Gr	Shear Parameters			Cc
				Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L		Type of test	C(kg/sq.cm)	phi(degrees)	
251.293			Filledup Soil													
249.493	1.80	SPT	Sandy Silt with Gravel (SM-ML)	0	30	70				Non	Plastic					
248.793	2.50	UDS					1.83	1.66	10.32				DST	0.14	30	
247.993	3.30	SPT		3	9	88				Non	Plastic					
246.493	4.80	SPT		0	64	36				Non	Plastic					
245.793	5.50	UDS					1.88	1.69	10.95				DST	0.14	31	
244.993	6.30	SPT		0	55	45				Non	Plastic					
243.493	7.80	SPT		0	67	33				Non	Plastic					
242.793	8.50	UDS					1.88	1.69	11.45			2.60	DST	0.13	31	
241.993	9.30	SPT	Silty Sand with Gravel (SM)	0	59	41				Non	Plastic					
240.493	10.80	SPT	Sandy Silt with Gravel (SM-ML)	0	56	44				Non	Plastic					
239.793	11.50	UDS					1.91	1.71	11.88				DST	0.12	31	
238.993	12.30	SPT		0	23	77				Non	Plastic					
237.493	13.80	SPT		1	11	88				Non	Plastic					
236.793	14.50	UDS					1.86	1.66	12.01				DST	0.12	30	
235.993	15.30	SPT		2	6	92				Non	Plastic					
234.493	16.80	SPT		1	9	90				Non	Plastic					
232.993	18.30	SPT		0	46	54				Non	Plastic					
231.493	19.80	SPT		0	48	52				Non	Plastic					
229.993	21.30	SPT		1	68	31				Non	Plastic					
228.493	22.80	SPT	Silty Sand with Gravel (SM)	1	77	22				Non	Plastic					
226.993	24.30	SPT		1	53	46				Non	Plastic					
225.493	25.80	SPT		1	78	21				Non	Plastic					
223.993	27.30	SPT		1	78	21				Non	Plastic					
222.493	28.80	SPT		0	62	38				Non	Plastic					
220.993	30.30	SPT	Sandy Silt with Gravel (SM-ML)	1	16	83				Non	Plastic					

S.P.T Plot



BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Project No. 2137 E: 675143.000 N: 3316289.000 RL: 251.305

CH 1+750
BH : 7
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 02/09/2019

Date of finish : 04/09/2019

NABL CERTIFICATE NO. TC-8098

Reduced Level	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed / Corrected)	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
251.305			Sandy Silt with Gravel (SM-ML)														
249.505	1.80	SPT		22 / 30	0	25	75				Non	Plastic					
248.805	2.50	UDS	Silty Sand with Gravel (SM)					1.90	1.71	10.85			2.65	DST		31	
248.005	3.30	SPT		24 / 28	0	53	47				Non	Plastic					
246.505	4.80	SPT		24 / 25	0	27	73				Non	Plastic					
245.805	5.50	UDS	Sandy Silt with Gravel (SM-ML)					1.89	1.70	11.23				DST	0.14	30	
245.005	6.30	SPT		24 / 23	0	37	63				Non	Plastic					
243.505	7.80	SPT	Silty Sand with Gravel (SM)	14 / 12	0	72	28				Non	Plastic					
242.805	8.50	UDS						1.85	1.65	12.09				DST		30	
242.005	9.30	SPT		36 / 23	0	26	74				Non	Plastic					
240.505	10.80	SPT		47 / 27	0	47	53				Non	Plastic					
239.805	11.50	UDS						1.89	1.67	13.39			2.61	DST	0.12	31	
239.005	12.30	SPT		32 / 20	2	13	85				Non	Plastic					
237.505	13.80	SPT	Sandy Silt with Gravel (SM-ML)	59 / 31	1	7	92				Non	Plastic					
236.805	14.50	UDS						1.92	1.66	15.64				DST	0.13	31	
236.005	15.30	SPT		37 / 22	3	10	87				Non	Plastic					
234.505	16.80	SPT		68 / 33	21	9	70				Non	Plastic					
233.805	17.50	UDS						1.95	1.67	16.71				DST	0.13	32	
233.005	18.30	SPT		55 / 28	1	17	82				Non	Plastic					
231.505	19.80	SPT	Silty Clay of Medium Plasticity (CI)	100 / 100	7	15	78				45	24					
230.005	21.30	SPT	Sandy Silt with Gravel (SM-ML)	65 / 30	5	14	81				Non	Plastic					
228.505	22.80	SPT		74 / 33	1	21	78				Non	Plastic					
227.005	24.30	SPT		83 / 35	0	60	40				Non	Plastic					
225.505	25.80	SPT	Silty Sand with Gravel (SM)	88 / 36	0	70	30				Non	Plastic					
224.005	27.30	SPT		93 / 37	0	58	42				Non	Plastic					
222.505	28.80	SPT		60 / 26	1	78	21				Non	Plastic					
221.005	30.30	SPT	Sandy Silt with Gravel (SM-ML)	40 / 19	1	8	91				Non	Plastic					

BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Project No. 2137 E: 675347.000 N: 3316357.000 RL: 251.659

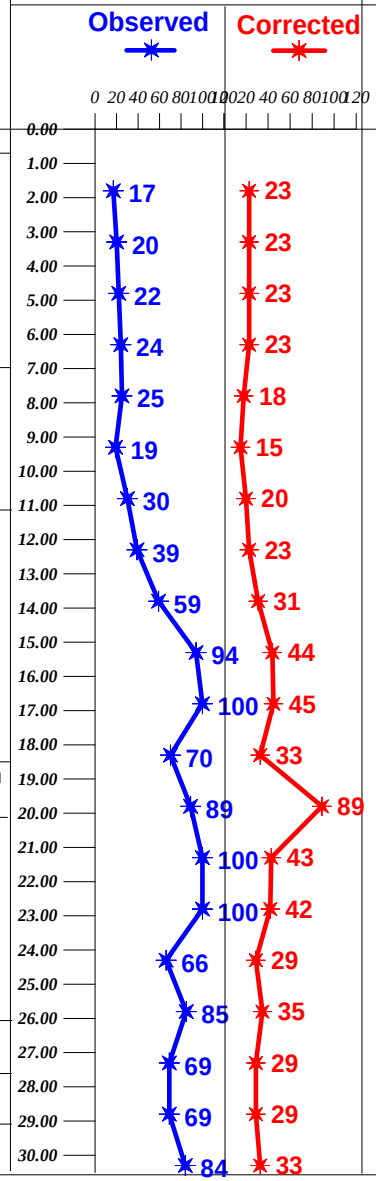
CH 2+010
BH : 8
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 31/08/2019

Date of finish : 01/09/2019

NABL CERTIFICATE NO. TC-8098

Reduced Level	Depth (m)	Type of sample	Soil Classification	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
251.659			Filledup Soil													
249.859	1.80	SPT	Sandy Silt with Gravel (SM-ML)	1	12	87				Non	Plastic					
249.159	2.50	UDS					1.90	1.73	9.86				DST	0.13	30	
248.359	3.30	SPT		1	8	91				Non	Plastic					
246.859	4.80	SPT		0	46	54				Non	Plastic					
246.159	5.50	UDS					1.91	1.73	10.45			2.61	DST	0.13	31	
245.359	6.30	SPT		0	49	51				Non	Plastic					
243.859	7.80	SPT	Silty Sand with Gravel (SM)	0	71	29				Non	Plastic					
243.159	8.50	UDS					1.86	1.67	11.09				DST		30	
242.359	9.30	SPT		2	55	43				Non	Plastic					
240.859	10.80	SPT	Sandy Silt with Gravel (SM-ML)	7	67	26				Non	Plastic					
240.159	11.50	UDS					1.94	1.74	11.32				DST	0.14	30	
239.359	12.30	SPT		2	8	90				Non	Plastic					
237.859	13.80	SPT		15	7	78				Non	Plastic					
237.159	14.50	UDS					1.96	1.71	14.79			2.61	DST	0.12	31	
236.359	15.30	SPT		5	9	86				Non	Plastic					
234.859	16.80	SPT		10	12	78				Non	Plastic					
234.159	17.50	UDS					2.09	1.80	15.83				DST	0.12	32	
233.359	18.30	SPT		1	4	95				Non	Plastic					
231.859	19.80	SPT	Silty Clay of Medium Plasticity (CI)	1	7	92				49	24					
231.159	20.50	UDS					2.22	1.91	16.28				DST		33	
230.359	21.30	SPT		0	58	42				Non	Plastic					
228.859	22.80	SPT	Silty Sand with Gravel (SM)	0	60	40				Non	Plastic					
228.159	23.50	UDS					2.11	1.81	16.32			2.64	DST		32	
227.359	24.30	SPT		0	84	16				Non	Plastic					
225.859	25.80	SPT		1	64	35				Non	Plastic					
224.359	27.30	SPT	Sandy Silt with Gravel (SM-ML)	1	34	65				Non	Plastic					
222.859	28.80	SPT	Silty Sand with Gravel (SM)	1	71	28				Non	Plastic					
221.359	30.30	SPT	Sandy Silt with Gravel (SM-ML)	0	20	80				Non	Plastic					



BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

CH 2+270
BH : 9
Depth : 30.00 m
Depth of Water table : Not met

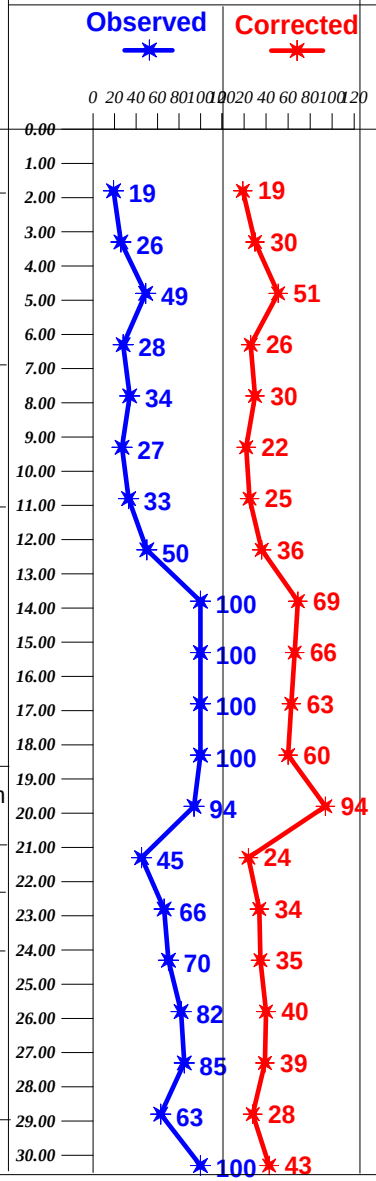
Date of start : 14/09/2019

Date of finish : 15/09/2019

NABL CERTIFICATE NO. TC-8098

Project No. 2137 E: 675628.000 N: 3316421.000 RL :253.211

Reduced Level	Depth (m)	Type of sample	Soil Classification	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
253.211			Silty Clay of Medium Plasticity (CI)													
251.411	1.80	SPT		7	10	83				46	21					
250.711	2.50	UDS					1.84	1.65	11.23				DST	0.13	30	
249.911	3.30	SPT	Sandy Silt with Gravel (SM-ML)	0	14	86				Non	Plastic					
248.411	4.80	SPT		0	9	91				Non	Plastic					
247.711	5.50	UDS					1.90	1.69	12.41				DST	0.13	31	
246.911	6.30	SPT		1	39	60				Non	Plastic					
245.411	7.80	SPT		0	68	32				Non	Plastic					
244.711	8.50	UDS					1.88	1.67	12.88			2.61	DST	0.1	30	
243.911	9.30	SPT	Silty Sand with Gravel (SM)	0	57	43				Non	Plastic					
242.411	10.80	SPT		0	78	22				Non	Plastic					
241.711	11.50	UDS					1.90	1.67	13.72				DST	0.1	31	
240.911	12.30	SPT		1	8	91				Non	Plastic					
239.411	13.80	SPT		1	11	88				Non	Plastic					
237.911	15.30	SPT	Sandy Silt with Gravel (SM-ML)	1	10	89				Non	Plastic					
236.411	16.80	SPT		2	6	92				Non	Plastic					
234.911	18.30	SPT		3	5	92				Non	Plastic					
233.411	19.80	SPT	Silty Clay of Medium Plasticity (CI)	0	5	95				45	25					
231.911	21.30	SPT	Silty Sand with Gravel (SM)	0	57	43				Non	Plastic					
230.411	22.80	SPT	Sandy Silt with Gravel (SM-ML)	1	48	51				Non	Plastic					
228.911	24.30	SPT		1	78	21				Non	Plastic					
227.411	25.80	SPT	Silty Sand with Gravel (SM)	1	52	47				Non	Plastic					
225.911	27.30	SPT		1	59	40				Non	Plastic					
224.411	28.80	SPT		1	63	36				Non	Plastic					
222.911	30.30	SPT	Sandy Silt with Gravel (SM-ML)	0	73	27				Non	Plastic					



BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track in Kurukshetra

CH 2+520
BH : 10
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 28/08/2019

Date of finish : 30/08/2019

NABL CERTIFICATE NO. TC-8098

Project No. 2137 E: 675877.000 N: 3316477.000 RL: 252.175

Reduced Level	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed / Corrected)	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.175																	
250.375	1.80	SPT	Sandy Silt with Gravel (SM-ML)	18 / 24	0	6	94				Non	Plastic					
249.675	2.50	UDS						1.86	1.68	10.85				DST	0.13	30	
248.875	3.30	SPT		43 / 50	6	9	85				Non	Plastic					
247.375	4.80	SPT		56 / 58	1	8	91				Non	Plastic					
246.675	5.50	UDS						1.86	1.67	11.21			2.61	DST	0.12	31	
245.875	6.30	SPT		28 / 26	1	4	95				Non	Plastic					
244.375	7.80	SPT	Silty Sand with Gravel (SM)	19 / 16	0	68	32				Non	Plastic					
243.675	8.50	UDS						1.84	1.64	12.35			2.65	DST		30	
242.875	9.30	SPT		18 / 14	0	64	36				Non	Plastic					
241.375	10.80	SPT	Sandy Silt with Gravel (SM-ML)	52 / 40	9	13	78				Non	Plastic					
240.675	11.50	UDS						1.91	1.69	13.01				DST	0.12	31	
239.875	12.30	SPT		54 / 39	2	9	89				Non	Plastic					
238.375	13.80	SPT		67 / 46	0	4	96				Non	Plastic					
237.675	14.50	UDS						2.04	1.80	13.28				DST	0.13	32	
236.875	15.30	SPT		84 / 55	1	9	90				Non	Plastic					
235.375	16.80	SPT		85 / 53	1	13	86				Non	Plastic					
234.675	17.50	UDS						2.06	1.80	14.45			2.65	DST	0.12	32	
233.875	18.30	SPT		95 / 57	4	9	87				Non	Plastic					
232.375	19.80	SPT		100 / 57	8	6	86				Non	Plastic					
231.675	20.50	UDS						2.13	1.86	14.68				DST	0.12	32	
230.875	21.30	SPT		100 / 55	6	6	88				Non	Plastic					
229.375	22.80	SPT	Silty Sand with Gravel (SM)	71 / 37	7	6	87				Non	Plastic					
228.675	23.50	UDS						2.03	1.76	15.22				DST	0.12	33	
227.875	24.30	SPT		79 / 40	1	72	27				Non	Plastic					
226.375	25.80	SPT		100 / 48	1	81	18				Non	Plastic					
224.875	27.30	SPT		87 / 40	1	76	23				Non	Plastic					
223.375	28.80	SPT	Sandy Silt with Gravel (SM-ML)	100 / 45	1	83	16				Non	Plastic					
221.875	30.30	SPT		89 / 38	5	28	67				Non	Plastic					

BORE LOG

SUVIDHI Testing Engineers

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

CH 2+730
BH : 11
Depth : 15.00 m
Depth of Water table : Not met

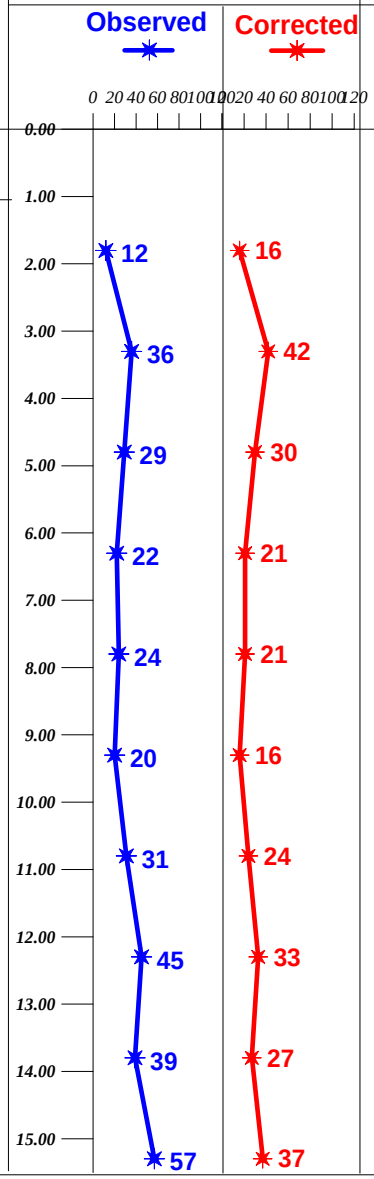
Date of start : 22/08/2019

Date of finish : 22/08/2019

Project No. 2137 E: 676038.000 N: 3316505.000 RL: 252.391

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.391			Filledup Soil													
250.591	1.80	SPT		1	15	84				Non	Plastic					
249.891	2.50	UDS					1.86	1.69	9.89				DST	0.14	30	
249.091	3.30	SPT		1	12	87				Non	Plastic					
247.591	4.80	SPT		7	38	55				Non	Plastic					
246.891	5.50	UDS					1.88	1.70	10.45			2.61	DST	0.14	31	
246.091	6.30	SPT		0	49	51				Non	Plastic					
244.591	7.80	SPT	Sandy Silt with Gravel (SM-ML)	0	27	73				Non	Plastic					
243.891	8.50	UDS					1.87	1.68	11.23				DST	0.13	30	
243.091	9.30	SPT		5	53	42				Non	Plastic					
241.591	10.80	SPT		0	5	95				Non	Plastic					
240.891	11.50	UDS					1.92	1.72	11.94				DST	0.12	31	
240.091	12.30	SPT		0	15	85				Non	Plastic					
238.591	13.80	SPT		0	5	95				Non	Plastic					
237.091	15.30	SPT		2	4	94				Non	Plastic					

S.P.T Plot



BORE LOG

SUVIDHI Testing Engineers

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

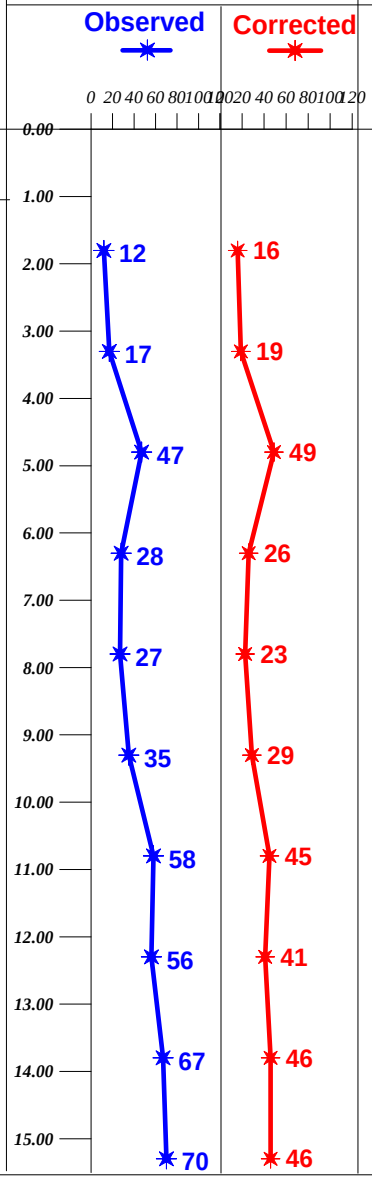
CH 2+750
BH : 12
Depth : 15.00 m
Depth of Water table : Not met

Date of start : 24/08/2019

Date of finish : 24/08/2019

Project No. 2137 E: 676109.000 N: 3316515.000 RL: 252.948

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.948			Filledup Soil													
251.148	1.80	SPT		0	2	98				Non	Plastic					
250.448	2.50	UDS					1.83	1.66	10.46				DST	0.13	30	
249.648	3.30	SPT		2	13	85				Non	Plastic					
248.148	4.80	SPT		0	7	93				Non	Plastic					
247.448	5.50	UDS					1.85	1.66	11.23				DST	0.12	31	
246.648	6.30	SPT		0	18	82				Non	Plastic					
245.148	7.80	SPT	Sandy Silt with Gravel (SM-ML)	1	59	40				Non	Plastic					
244.448	8.50	UDS					1.90	1.69	12.45			2.60	DST	0.12	31	
243.648	9.30	SPT		0	45	55				Non	Plastic					
242.148	10.80	SPT		0	5	95				Non	Plastic					
241.448	11.50	UDS					1.94	1.71	13.16				DST	0.12	32	
240.648	12.30	SPT		1	5	94				Non	Plastic					
239.148	13.80	SPT		0	6	94				Non	Plastic					
238.448	14.50	UDS					2.04	1.69	20.70				DST	0.1	32	
237.648	15.30	SPT		5	6	89				Non	Plastic					



BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

CH 2+780
BH : 13
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 25/08/2019

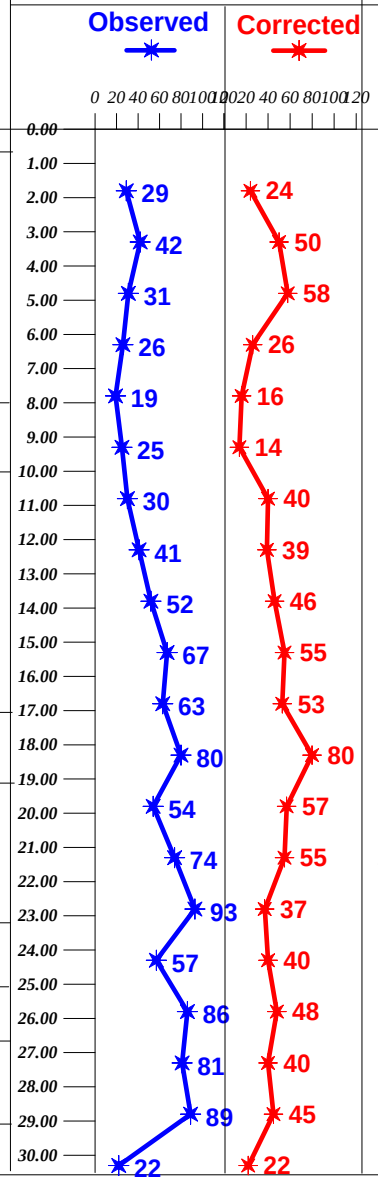
Date of finish : 27/08/2019

NABL CERTIFICATE NO. TC-8098

Project No. 2137 E: 676134.000 N: 3316516.000 RL: 252.941

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.941			Filledup Soil													
251.141	1.80	SPT	Sandy Silt with Gravel (SM-ML)	1	7	92				Non	Plastic					
250.441	2.50	UDS					1.86	1.69	10.01				DST	0.12	31	
249.641	3.30	SPT		0	20	80				Non	Plastic					
248.141	4.80	SPT		1	19	80				Non	Plastic					
247.441	5.50	UDS					1.83	1.66	10.42				DST	0.12	30	
246.641	6.30	SPT		0	18	82				Non	Plastic					
245.141	7.80	SPT		0	41	59				Non	Plastic					
244.441	8.50	UDS	Silty Sand with Gravel (SM)				1.80	1.62	10.81			2.65	DST		30	
243.641	9.30	SPT		0	58	42				Non	Plastic					
242.141	10.80	SPT	Sandy Silt with Gravel (SM-ML)	1	30	69				Non	Plastic					
241.441	11.50	UDS					1.95	1.76	10.95				DST	0.14	32	
240.641	12.30	SPT		0	5	95				Non	Plastic					
239.141	13.80	SPT		1	9	90				Non	Plastic					
238.441	14.50	UDS					1.98	1.78	11.23			2.60	DST	0.12	32	
237.641	15.30	SPT		1	6	93				Non	Plastic					
236.141	16.80	SPT		1	6	93				Non	Plastic					
234.641	18.30	SPT	Silty Clay of Low Plasticity (CL)	5	6	89				26	16					
233.141	19.80	SPT	Sandy Silt with Gravel (SM-ML)	1	8	91				Non	Plastic					
232.441	20.50	UDS					2.03	1.75	16.24				DST	0.13	32	
231.641	21.30	SPT		14	8	78				Non	Plastic					
230.141	22.80	SPT		1	24	75				Non	Plastic					
228.641	24.30	SPT	Silty Sand with Gravel (SM)	3	75	22				Non	Plastic					
227.141	25.80	SPT	Sandy Silt with Gravel (SM-ML)	0	41	59				Non	Plastic					
225.641	27.30	SPT	Silty Sand with Gravel (SM)	0	82	18				Non	Plastic					
224.141	28.80	SPT		3	77	20				Non	Plastic					
222.641	30.30	SPT	Silty Clay of Low Plasticity (CL)	1	27	72				29	18					

S.P.T Plot



BORE LOG

SUVIDHI Testing Engineers

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

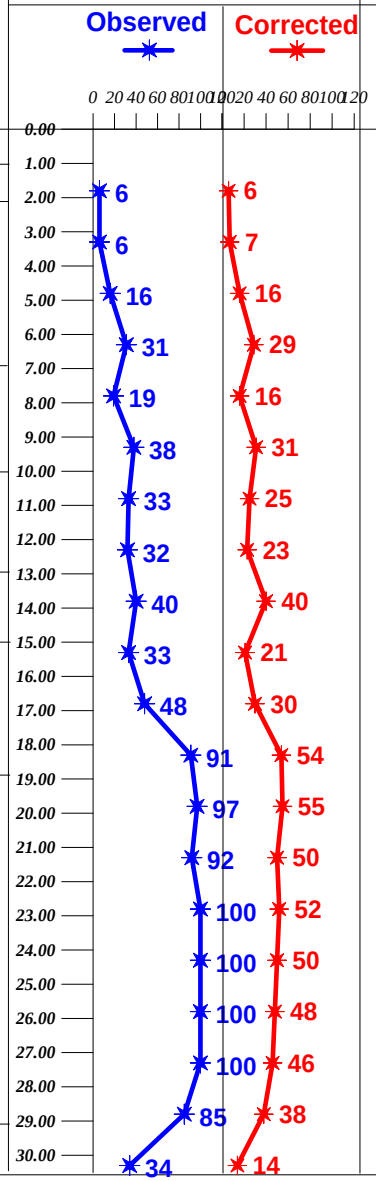
CH 3+040
BH : 14
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 28/08/2019

Date of finish : 29/08/2019

Project No. 2137 E: 676405.000 N: 3316569.000 RL: 252.133

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.133			Filledup Soil													
250.333	1.80	SPT	Silty Clay of Medium Plasticity (CI)	0	5	95				40	21					
249.633	2.50	UDS					1.78	1.61	10.32				DST	0.13	27	
248.833	3.30	SPT		0	13	87				Non	Plastic					
247.333	4.80	SPT	Sandy Silt with Gravel (SM-ML)	0	17	83				Non	Plastic					
246.633	5.50	UDS					1.82	1.63	11.41			2.60	DST	0.12	30	
245.833	6.30	SPT		0	35	65				Non	Plastic					
244.333	7.80	SPT	Silty Sand with Gravel (SM)	0	66	34				Non	Plastic					
243.633	8.50	UDS					1.83	1.63	11.96				DST		30	
242.833	9.30	SPT		0	62	38				Non	Plastic					
241.333	10.80	SPT	Sandy Silt with Gravel (SM-ML)	0	3	97				Non	Plastic					
240.633	11.50	UDS					1.87	1.65	13.21				DST	0.13	31	
239.833	12.30	SPT		1	8	91				Non	Plastic					
238.333	13.80	SPT	Silty Clay of Low Plasticity (CL)	1	11	88				33	19					
237.633	14.50	UDS					1.90	1.67	13.78			2.71	UU	2.93	8	
236.833	15.30	SPT	Sandy Silt with Gravel (SM-ML)	2	7	91				Non	Plastic					
235.333	16.80	SPT		4	16	80				Non	Plastic					
234.633	17.50	UDS					1.92	1.68	14.55				DST	0.12	31	
233.833	18.30	SPT		3	28	69				Non	Plastic					
232.333	19.80	SPT	Silty Sand with Gravel (SM)	1	69	30				Non	Plastic					
230.833	21.30	SPT		2	72	26				Non	Plastic					
229.333	22.80	SPT		0	70	30				Non	Plastic					
227.833	24.30	SPT		1	65	34				Non	Plastic					
226.333	25.80	SPT		0	84	16				Non	Plastic					
224.833	27.30	SPT		0	73	27				Non	Plastic					
223.333	28.80	SPT		1	78	21				Non	Plastic					
221.833	30.30	SPT	Sandy Silt with Gravel (SM-ML)	1	10	89				Non	Plastic					



BORE LOG

SUVIDHI Testing Engineers

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track in Kurukshetra

CH 3+300
BH : 15
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 30/08/2019

Date of finish : 31/08/2019

Project No. 2137 E: 676626.000 N: 3316660.000 RL: 252.306

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.306			Filledup Soil													
250.506	1.80	SPT	Sandy Silt with Gravel (SM-ML)	1	10	89				Non	Plastic					
249.806	2.50	UDS					1.76	1.57	11.98				DST	0.12	27	
249.006	3.30	SPT		3	32	65				Non	Plastic					
247.506	4.80	SPT		1	21	78				Non	Plastic					
246.806	5.50	UDS					1.83	1.66	10.42			2.61	DST	0.12	30	
246.006	6.30	SPT		1	27	72				Non	Plastic					
244.506	7.80	SPT		1	10	89				Non	Plastic					
243.806	8.50	UDS					1.83	1.63	12.11				DST	0.12	30	
243.006	9.30	SPT		0	73	27				Non	Plastic					
241.506	10.80	SPT	Silty Sand with Gravel (SM)	1	57	42				Non	Plastic					
240.806	11.50	UDS					1.90	1.68	13.28				DST		31	
240.006	12.30	SPT		0	80	20				Non	Plastic					
238.506	13.80	SPT		0	66	34				Non	Plastic					
237.806	14.50	UDS					2.04	1.79	14.09			2.65	DST		32	
237.006	15.30	SPT		1	90	9				Non	Plastic					
235.506	16.80	SPT		0	69	31				Non	Plastic					
234.806	17.50	UDS					2.04	1.78	14.56				DST		32	
234.006	18.30	SPT		0	81	19				Non	Plastic					
232.506	19.80	SPT	Sandy Silt with Gravel (SM-ML)	1	75	24				Non	Plastic					
231.006	21.30	SPT	Silty Clay of Medium Plasticity (CI)	1	36	63				Non	Plastic					
229.506	22.80	SPT		8	9	83				41	21					
228.006	24.30	SPT	Silty Sand with Gravel (SM)	3	68	29				Non	Plastic					
226.506	25.80	SPT		1	72	27				Non	Plastic					
225.006	27.30	SPT		1	61	38				Non	Plastic					
223.506	28.80	SPT		1	72	27				Non	Plastic					
222.006	30.30	SPT	Sandy Silt with Gravel (SM-ML)	5	9	86				Non	Plastic					

S.P.T Plot — Observed / Corrected

Depth (m)	Observed	Corrected
2.00	5	6
3.00	24	28
4.00	24	25
5.00	20	19
6.00	30	26
7.00	19	15
8.00	30	23
9.00	67	49
10.00	70	48
11.00	74	49
12.00	62	39
13.00	95	57
14.00	99	57
15.00	99	54
16.00	82	82
17.00	100	50
18.00	87	42
19.00	100	46
20.00	98	44
21.00	60	26

BORE LOG

SUVIDHI Testing Engineers

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Project No. 2137

E: 676851.000 N: 3316787.000 RL :252.625

CH 3+560
BH : 16
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 01/09/2019

Date of finish : 03/09/2019

NABL CERTIFICATE NO. TC-8098

Reduced Level	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed / Corrected)	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.625																	
250.825	1.80	SPT	Sandy Silt with Gravel (SM-ML)	35 / 48	0	4	96				Non	Plastic					
250.125	2.50	UDS						2.01	1.81	10.96				DST	0.14	33	
249.325	3.30	SPT		74 / 87	11	6	83				Non	Plastic					
247.825	4.80	SPT		84 / 88	10	20	70				Non	Plastic					
247.125	5.50	UDS						1.88	1.68	11.72			2.61	DST	0.12	31	
246.325	6.30	SPT		26 / 24	2	30	68				Non	Plastic					
244.825	7.80	SPT	Silty Sand with Gravel (SM)	31 / 27	0	59	41				Non	Plastic					
244.125	8.50	UDS						1.88	1.66	13.08				DST		31	
243.325	9.30	SPT	Sandy Silt with Gravel (SM-ML)	37 / 30	0	47	53				Non	Plastic					
241.825	10.80	SPT	Silty Sand with Gravel (SM)	43 / 33	0	60	40				Non	Plastic					
241.125	11.50	UDS						1.90	1.67	13.64				DST		32	
240.325	12.30	SPT	Sandy Silt with Gravel (SM-ML)	47 / 34	0	4	96				Non	Plastic					
238.825	13.80	SPT		79 / 55	1	25	74				Non	Plastic					
238.125	14.50	UDS						2.09	1.83	14.13			2.61	DST	0.1	33	
237.325	15.30	SPT	Silty Sand with Gravel (SM)	82 / 54	0	55	45				Non	Plastic					
235.825	16.80	SPT		95 / 60	0	75	25				Non	Plastic					
235.125	17.50	UDS						2.11	1.84	14.72			2.65	DST		33	
234.325	18.30	SPT		71 / 42	1	83	16				Non	Plastic					
232.825	19.80	SPT		78 / 44	1	82	17				Non	Plastic					
231.325	21.30	SPT		76 / 41	0	63	37				Non	Plastic					
229.825	22.80	SPT		67 / 35	1	58	41				Non	Plastic					
228.325	24.30	SPT		86 / 43	0	75	25				Non	Plastic					
226.825	25.80	SPT		80 / 39	0	75	25				Non	Plastic					
225.325	27.30	SPT	Sandy Silt with Gravel (SM-ML)	98 / 46	1	38	61				Non	Plastic					
223.825	28.80	SPT	Silty Sand with Gravel (SM)	79 / 35	2	71	27				Non	Plastic					
222.325	30.30	SPT		85 / 36	0	78	22				Non	Plastic					

SUVIDHI Testing Engineers

BORE LOG

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

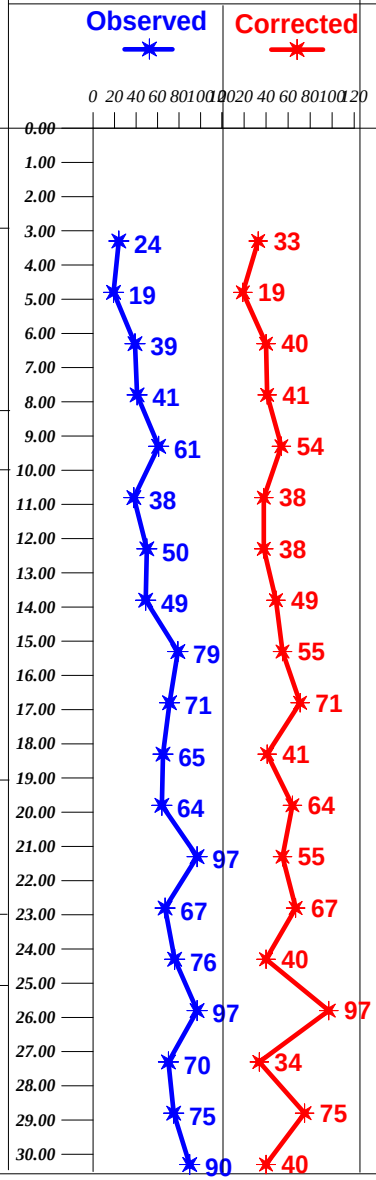
CH 3+820
BH : 17
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 04/09/2019

Date of finish : 06/09/2019

Project No. 2137 E: 677031.000 N: 3316972.000 RL: 253.065

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Shear Parameters: Type of test	Shear Parameters: C(kg/sq.cm)	Shear Parameters: phi(degrees)	Cc
253.065			Filledup Soil													
249.765	3.30	SPT		1	13	86				Non	Plastic					
248.265	4.80	SPT	Sandy Silt with Gravel (SM-ML)	1	34	65				Non	Plastic					
247.565	5.50	UDS					1.84	1.67	9.89				DST	0.12	30	
246.765	6.30	SPT		0	34	66				Non	Plastic					
245.265	7.80	SPT		4	24	72				Non	Plastic					
244.565	8.50	UDS	Silty Sand with Gravel (SM)				1.90	1.72	10.45			2.65	DST		32	
243.765	9.30	SPT		0	66	34				Non	Plastic					
242.265	10.80	SPT	Sandy Silt with Gravel (SM-ML)	0	4	96				Non	Plastic					
241.565	11.50	UDS					1.87	1.68	11.23				DST	0.12	31	
240.765	12.30	SPT		1	13	86				Non	Plastic					
239.265	13.80	SPT		0	4	96				Non	Plastic					
238.565	14.50	UDS					1.93	1.72	12.45			2.60	DST	0.12	32	
237.765	15.30	SPT		0	14	86				Non	Plastic					
236.265	16.80	SPT		1	41	58				Non	Plastic					
235.565	17.50	UDS					1.93	1.70	13.72				DST	0.1	31	
234.765	18.30	SPT		1	46	53				Non	Plastic					
233.265	19.80	SPT	Silty Sand with Gravel (SM)	0	60	40				Non	Plastic					
231.765	21.30	SPT		0	59	41				Non	Plastic					
230.265	22.80	SPT	Sandy Silt with Gravel (SM-ML)	0	52	48				Non	Plastic					
228.765	24.30	SPT		1	49	50				Non	Plastic					
227.265	25.80	SPT	Silty Sand with Gravel (SM)	1	53	46				Non	Plastic					
225.765	27.30	SPT		0	72	28				Non	Plastic					
224.265	28.80	SPT		1	69	30				Non	Plastic					
222.765	30.30	SPT		1	63	36				Non	Plastic					



SUVIDHI Testing Engineers

BORE LOG

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

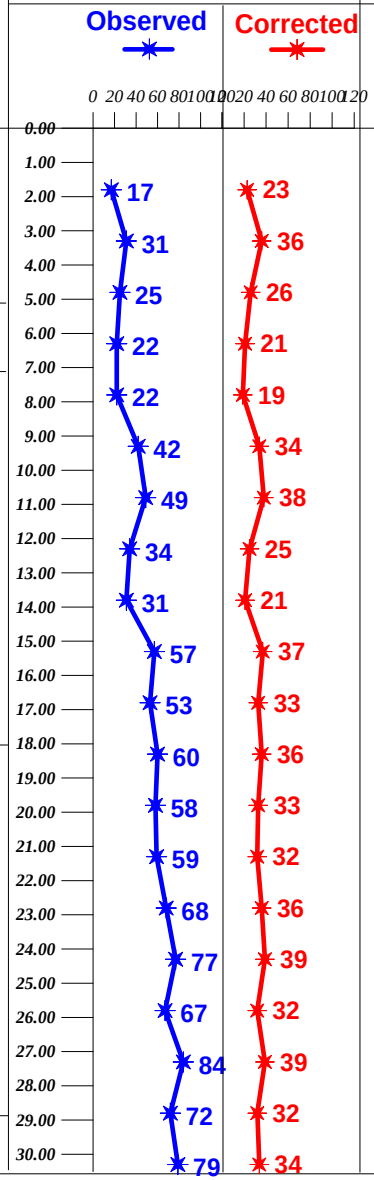
CH 4+080
BH : 18
Depth : 30.00 m
Depth of Water table : Not met

Date of start : 07/09/2019

Date of finish : 08/09/2019

Project No. 2137 E: 677177.000 N: 3317163.000 RL: 252.634

Reduced Level	Depth (m)	Type of sample	Soil Classification	Grain size (%) Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	r(dry)	W/C W(%)	Limits (%) L.L	P . L	Sp.Gr	Shear Parameters Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.634																
250.834	1.80	SPT	Sandy Silt with Gravel (SM-ML)	1	27	72				Non	Plastic					
250.134	2.50	UDS					1.86	1.68	10.96				DST	0.13	31	
249.334	3.30	SPT		3	41	56				Non	Plastic					
247.834	4.80	SPT		1	20	79				Non	Plastic					
247.134	5.50	UDS	Silty Sand with Gravel (SM)				1.85	1.65	12.03			2.65	DST	0.12	30	
246.334	6.30	SPT		1	59	40				Non	Plastic					
244.834	7.80	SPT		1	24	75				Non	Plastic					
244.134	8.50	UDS					1.85	1.65	12.31			2.62	DST	0.12	31	
243.334	9.30	SPT		0	26	74				Non	Plastic					
241.834	10.80	SPT		0	31	69				Non	Plastic					
241.134	11.50	UDS					1.85	1.63	13.65				DST	0.12	31	
240.334	12.30	SPT		1	35	64				Non	Plastic					
238.834	13.80	SPT	Sandy Silt with Gravel (SM-ML)	0	46	54				Non	Plastic					
237.334	15.30	SPT		0	36	64				Non	Plastic					
235.834	16.80	SPT		0	37	63				Non	Plastic					
234.334	18.30	SPT		0	58	42				Non	Plastic					
232.834	19.80	SPT		0	62	38				Non	Plastic					
231.334	21.30	SPT		1	68	31				Non	Plastic					
229.834	22.80	SPT	Silty Sand with Gravel (SM)	1	60	39				Non	Plastic					
228.334	24.30	SPT		1	67	32				Non	Plastic					
226.834	25.80	SPT		1	52	47				Non	Plastic					
225.334	27.30	SPT		2	52	46				Non	Plastic					
223.834	28.80	SPT		1	61	38				Non	Plastic					
222.334	30.30	SPT	Sandy Silt with Gravel (SM-ML)	1	37	62				Non	Plastic					



SUVIDHI Testing Engineers

BORE LOG

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

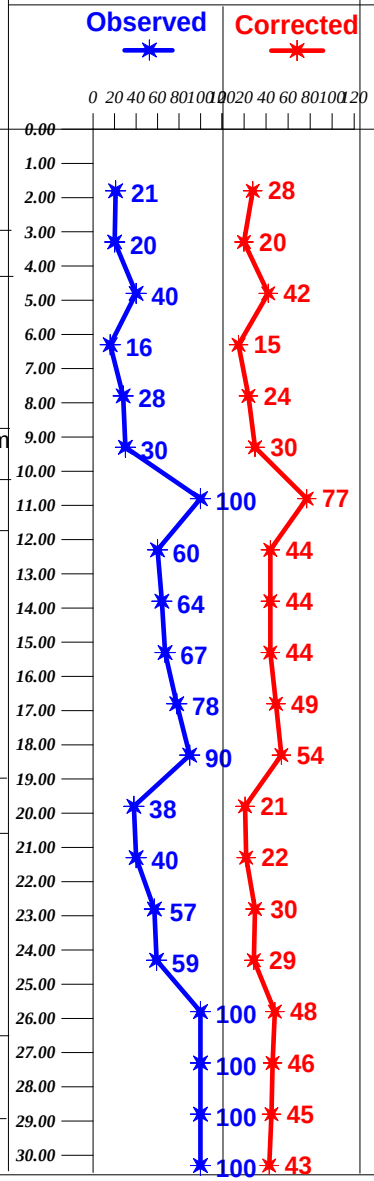
CH 4+600
BH : 20
Depth : 30.00 m
Depth of Water table : Not met.

Date of start : 10/09/2019

Date of finish : 12/09/2019

Project No. 2137 E: 677550.000 N: 3317501.000 RL: 252.733

Reduced Level	Depth (m)	Type of sample	Soil Classification	Gravel	Sand	Silt/Clay	r(wet)	r(dry)	W(%)	L.L	P . L	Sp.Gr	Type of test	C(kg/sq.cm)	phi(degrees)	Cc
252.733																
250.933	1.80	SPT	Sandy Silt with Gravel (SM-ML)	0	4	96				Non	Plastic					
250.233	2.50	UDS					1.86	1.67	11.65				DST	0.14	31	
249.433	3.30	SPT	Silty Clay of Medium Plasticity (CI)	1	29	70				40	22					
247.933	4.80	SPT	Sandy Silt with Gravel (SM-ML)	1	6	93				Non	Plastic					
247.233	5.50	UDS					1.82	1.61	12.73				DST	0.14	29	
246.433	6.30	SPT		1	64	35				Non	Plastic					
244.933	7.80	SPT		3	4	93				Non	Plastic					
244.233	8.50	UDS					1.90	1.68	13.08			2.61	DST	0.12	31	
243.433	9.30	SPT	Silty Clay of Medium Plasticity (CI)	0	10	90				43	24					
241.933	10.80	SPT	Sandy Silt with Gravel (SM-ML)	1	4	95				Non	Plastic					
240.433	12.30	SPT	Silty Sand with Gravel (SM)	0	78	22				Non	Plastic					
238.933	13.80	SPT		1	66	33				Non	Plastic					
238.233	14.50	UDS					1.96	1.72	14.01				DST	0.1	32	
237.433	15.30	SPT		1	70	29				Non	Plastic					
235.933	16.80	SPT		1	67	32				Non	Plastic					
234.433	18.30	SPT		1	72	27				Non	Plastic					
232.933	19.80	SPT	Sandy Silt with Gravel (SM-ML)	0	21	79				Non	Plastic					
231.433	21.30	SPT	Silty Sand with Gravel (SM)	1	81	18				Non	Plastic					
229.933	22.80	SPT		1	53	46				Non	Plastic					
228.433	24.30	SPT		1	45	54				Non	Plastic					
226.933	25.80	SPT		1	55	44				Non	Plastic					
225.433	27.30	SPT	Sandy Silt with Gravel (SM-ML)	0	41	59				Non	Plastic					
223.933	28.80	SPT		1	48	51				Non	Plastic					
222.433	30.30	SPT	Silty Sand with Gravel (SM)	1	67	32				Non	Plastic					



SUVIDHI Testing Engineers

BORE LOG

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

CH 4+860
BH : 21
Depth : 30.00 m
Depth of Water table : Not met.

Date of start : 10/09/2019

Date of finish : 11/09/2019

Project No. 2137 E: 677782.000 N: 3317600.000 RL: 252.766

Reduced Level	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed / Corrected)	Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	Density (gm/cc) r(dry)	W/C W(%)	Limits (%) L.L	Limits (%) P . L	Sp.Gr	Shear Parameters Type of test	Shear Parameters C(kg/sq.cm)	Shear Parameters phi(degrees)	Cc
252.766																	
250.966	1.80	SPT		13 / 17	1	13	86				Non	Plastic					
250.266	2.50	UDS						1.82	1.64	10.92				DST	0.14	29	
249.466	3.30	SPT		36 / 42	1	17	82				Non	Plastic					
247.966	4.80	SPT		18 / 18	1	11	88				Non	Plastic					
247.266	5.50	UDS						1.85	1.66	11.41				DST	0.12	30	
246.466	6.30	SPT	Sandy Silt with Gravel (SM-ML)	26 / 24	1	6	93				Non	Plastic					
244.966	7.80	SPT		32 / 28	0	9	91				Non	Plastic					
244.266	8.50	UDS						1.87	1.67	11.86			2.60	DST	0.13	30	
243.466	9.30	SPT		26 / 21	1	16	83				Non	Plastic					
241.966	10.80	SPT		42 / 32	0	23	77				Non	Plastic					
241.266	11.50	UDS						1.93	1.71	12.78				DST	0.12	31	
240.466	12.30	SPT		39 / 28	0	36	64				Non	Plastic					
238.966	13.80	SPT		46 / 32	1	47	52				Non	Plastic					
238.266	14.50	UDS						1.93	1.70	13.21				DST	0.12	32	
237.466	15.30	SPT		42 / 27	0	53	47				Non	Plastic					
235.966	16.80	SPT		51 / 32	0	50	50				Non	Plastic					
234.466	18.30	SPT		44 / 26	0	59	41				Non	Plastic					
232.966	19.80	SPT	Silty Sand with Gravel (SM)	46 / 26	0	83	17				Non	Plastic					
231.466	21.30	SPT		60 / 33	1	71	28				Non	Plastic					
229.966	22.80	SPT		76 / 40	1	59	40				Non	Plastic					
228.466	24.30	SPT		100 / 50	1	65	34				Non	Plastic					
226.966	25.80	SPT		100 / 48	4	64	32				Non	Plastic					
225.466	27.30	SPT	Sandy Silt with Gravel (SM-ML)	63 / 29	2	9	89				Non	Plastic					
223.966	28.80	SPT		82 / 37	3	22	75				Non	Plastic					
222.466	30.30	SPT		43 / 18	2	7	91				Non	Plastic					

SUVIDHI Testing Engineers

BORE LOG

NABL CERTIFICATE NO. TC-8098

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

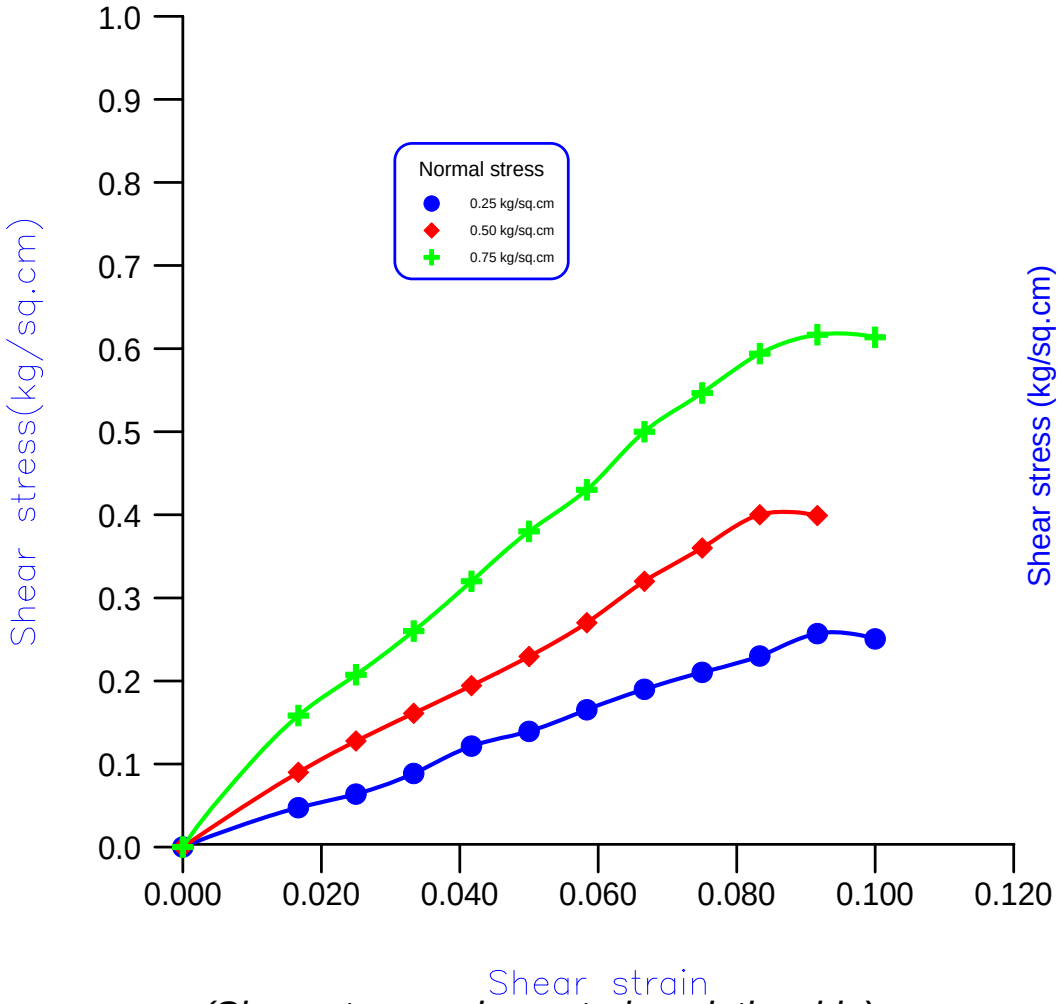
CH 5+080
BH : 22
Depth : 15.00 m
Depth of Water table : Not met.

Date of start : 12/09/2019

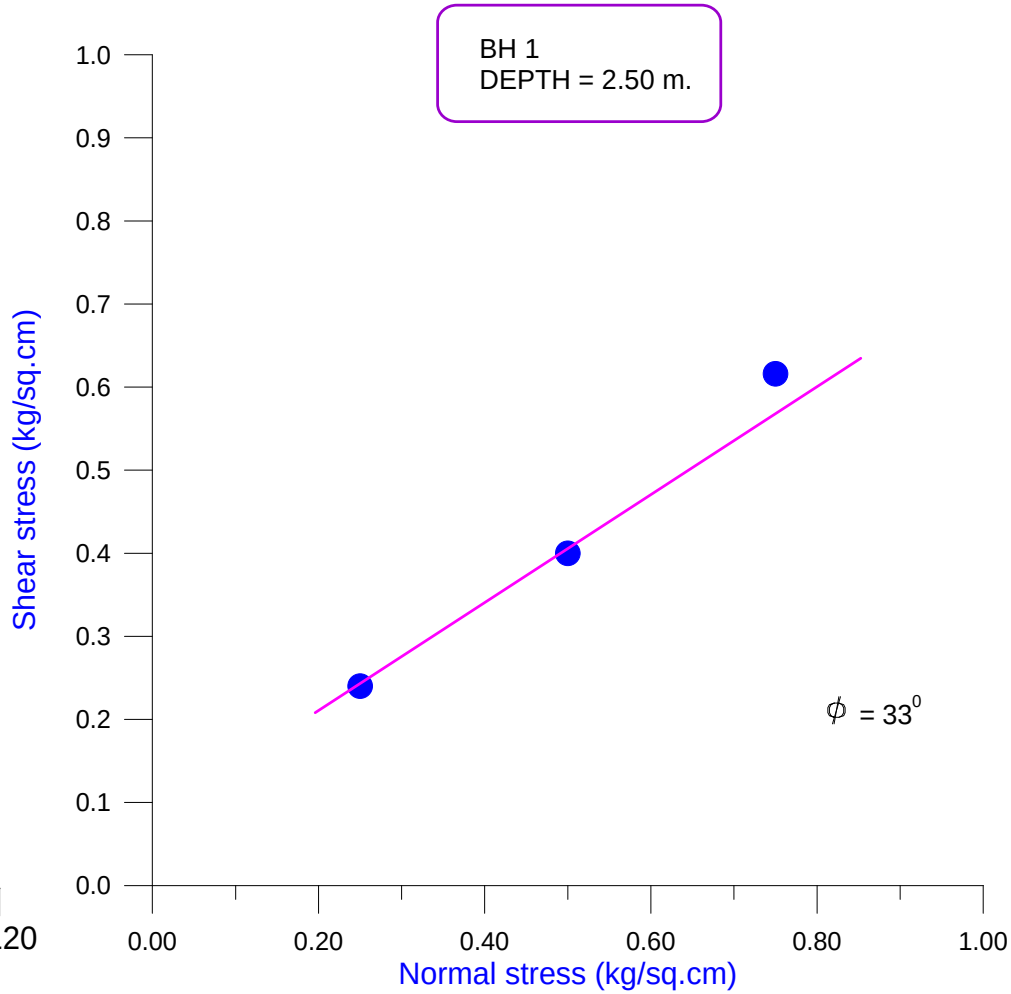
Date of finish : 13/09/2019

Project No. 2137 E: 677997.000 N: 3317582.000 RL: 253.040

Reduced Level	Depth (m)	Type of sample	Soil Classification	S.P.T Plot (Observed / Corrected)	Gravel	Sand	Silt/Clay	Density (gm/cc) r(wet)	Density (gm/cc) r(dry)	W/C W(%)	Limits (%) L.L	Limits (%) P . L	Sp.Gr	Shear Parameters Type of test	Shear Parameters C(kg/sq.cm)	Shear Parameters phi(degrees)	Cc
253.040																	
251.240	1.80	SPT		16 / 22	10	15	75				Non	Plastic					
250.540	2.50	UDS						1.82	1.64	10.98				DST	0.12	30	
249.740	3.30	SPT		17 / 19	4	14	82				Non	Plastic					
248.240	4.80	SPT		21 / 22	4	19	77				Non	Plastic					
247.540	5.50	UDS	Sandy Silt with Gravel (SM-ML)					1.81	1.62	11.45			2.60	DST	0.1	30	
246.740	6.30	SPT		18 / 17	1	14	85				Non	Plastic					
245.240	7.80	SPT		56 / 49	0	38	62				Non	Plastic					
244.540	8.50	UDS						2.03	1.81	12.03				DST	0.1	33	
243.740	9.30	SPT		62 / 51	0	49	51				Non	Plastic					
242.240	10.80	SPT	Silty Sand with Gravel (SM)	74 / 57	0	53	47				Non	Plastic					
240.740	12.30	SPT	Sandy Silt with Gravel (SM-ML)	33 / 24	0	27	73				Non	Plastic					
239.240	13.80	SPT		38 / 26	0	24	76				Non	Plastic					
238.540	14.50	UDS	Silty Sand with Gravel (SM)					1.89	1.66	13.78				DST		31	
237.740	15.30	SPT		36 / 23	0	73	27				Non	Plastic					



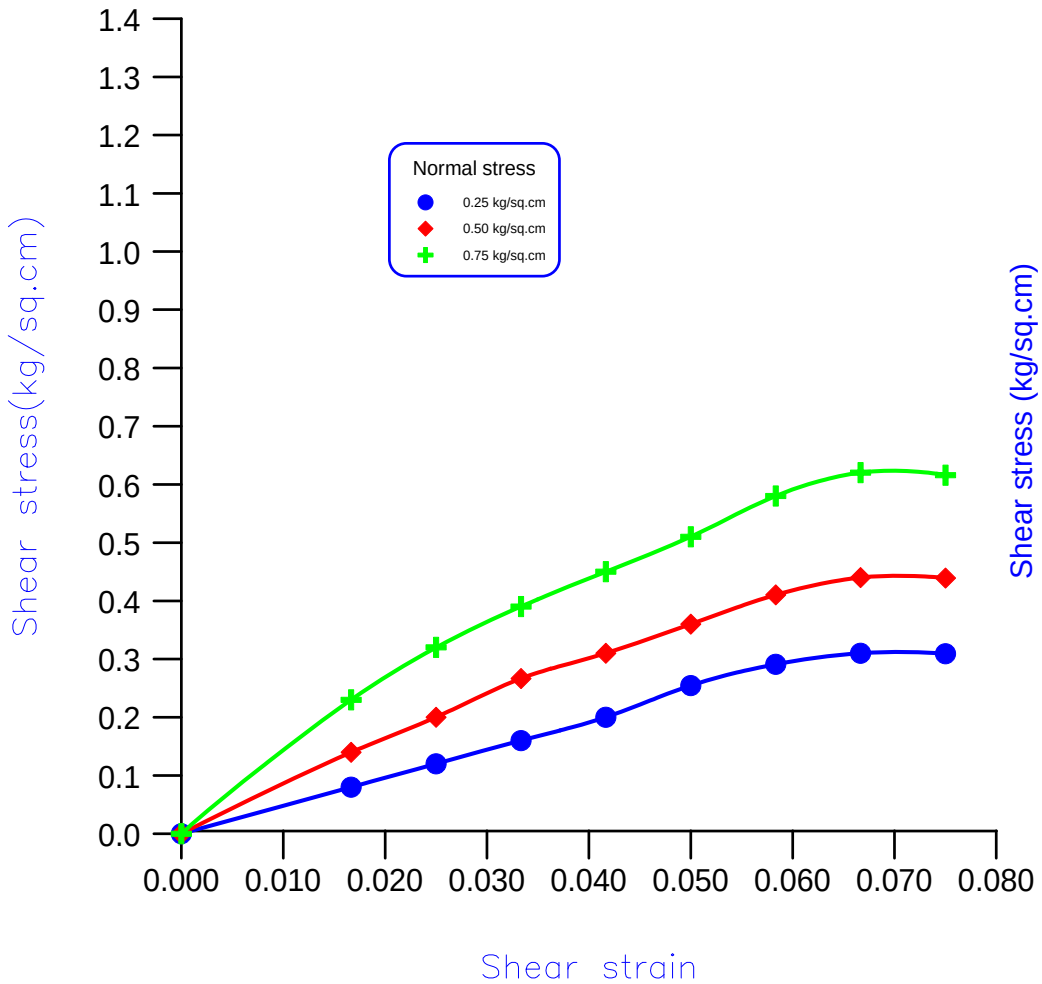
(Shear stress - shear strain relationship)



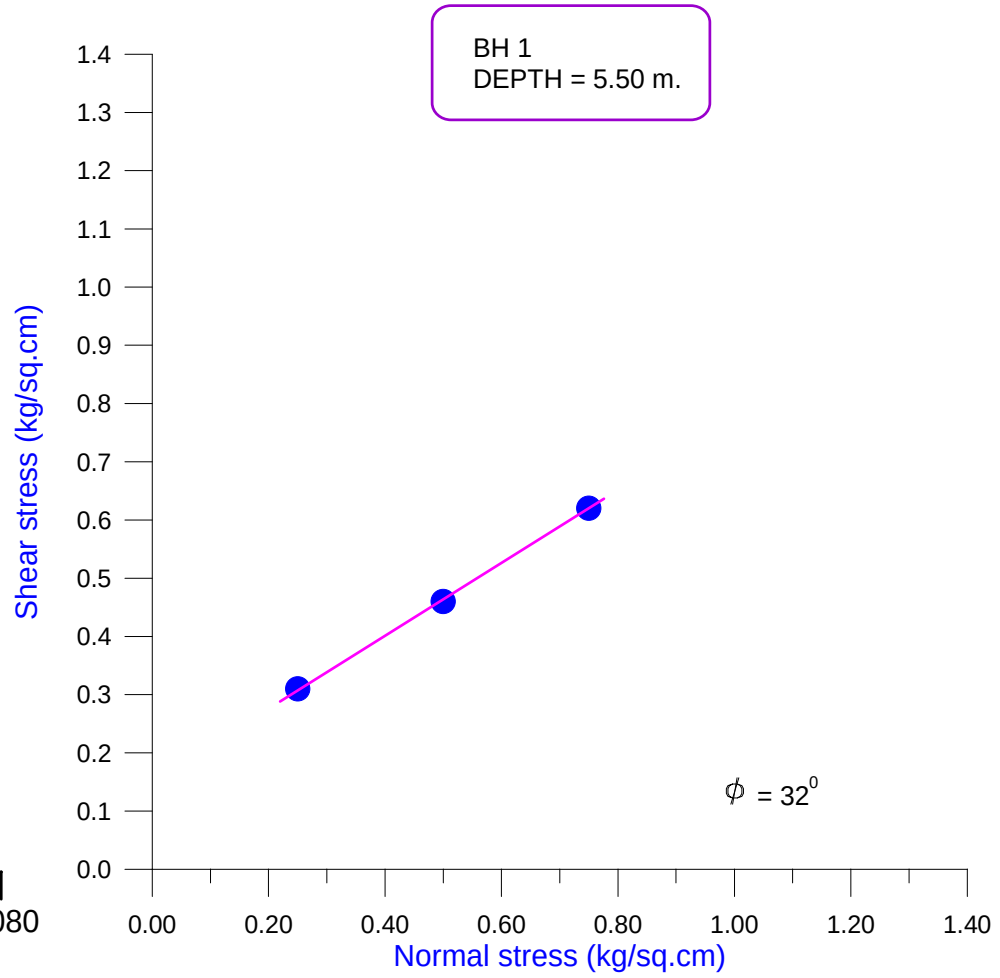
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

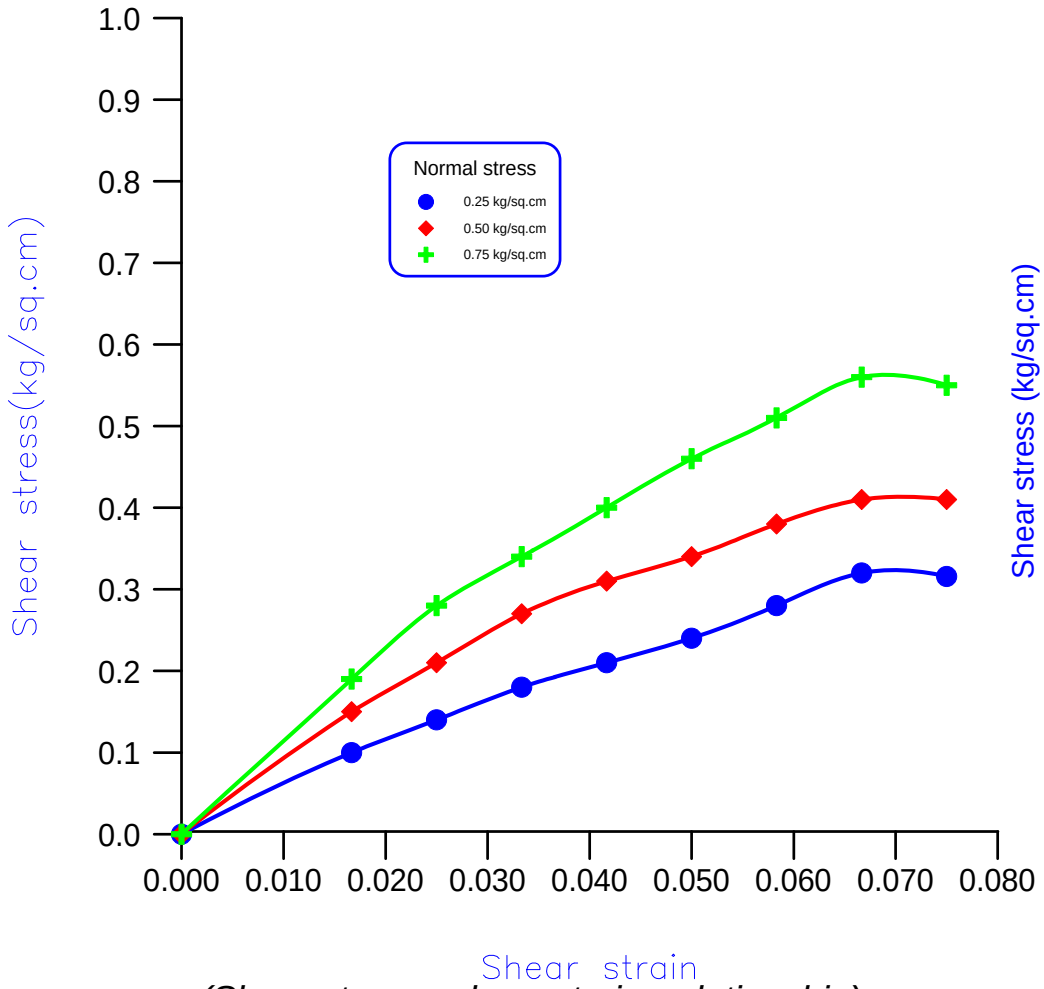
FIG- DS 1-1



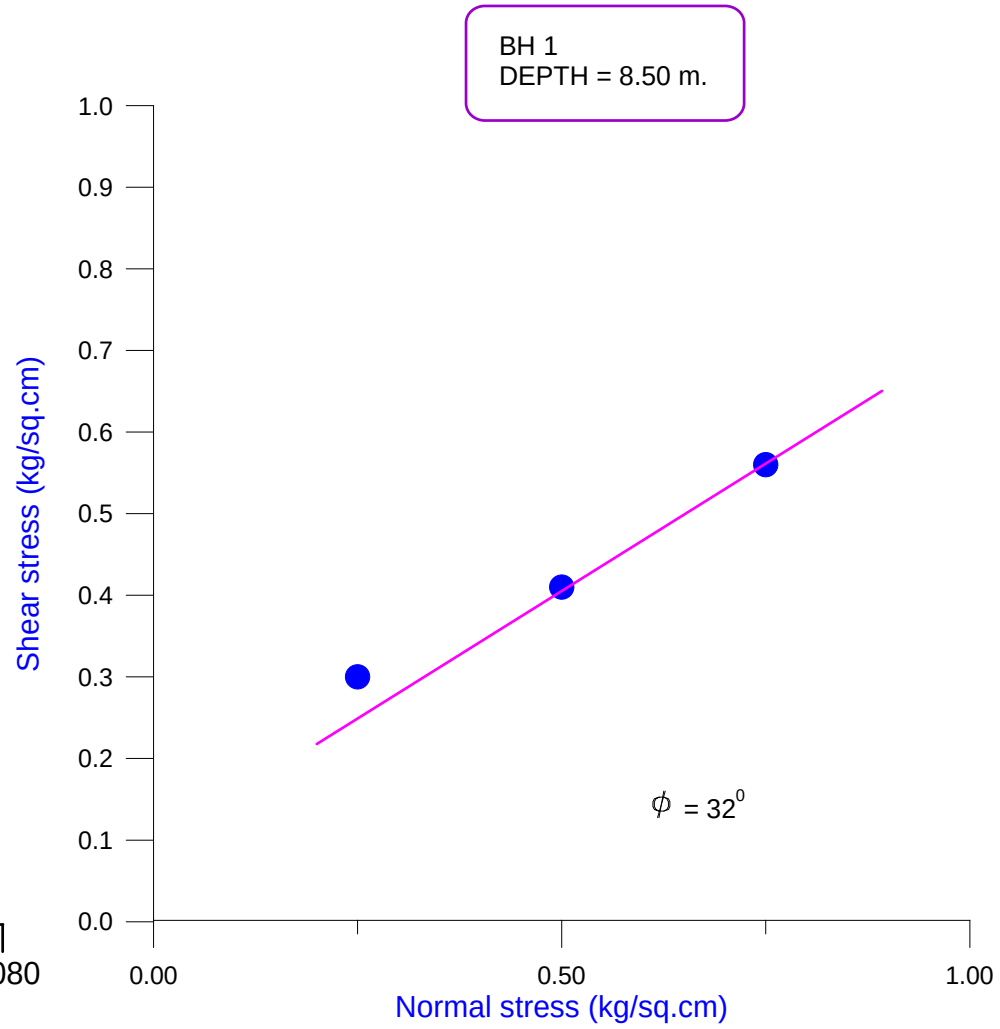
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



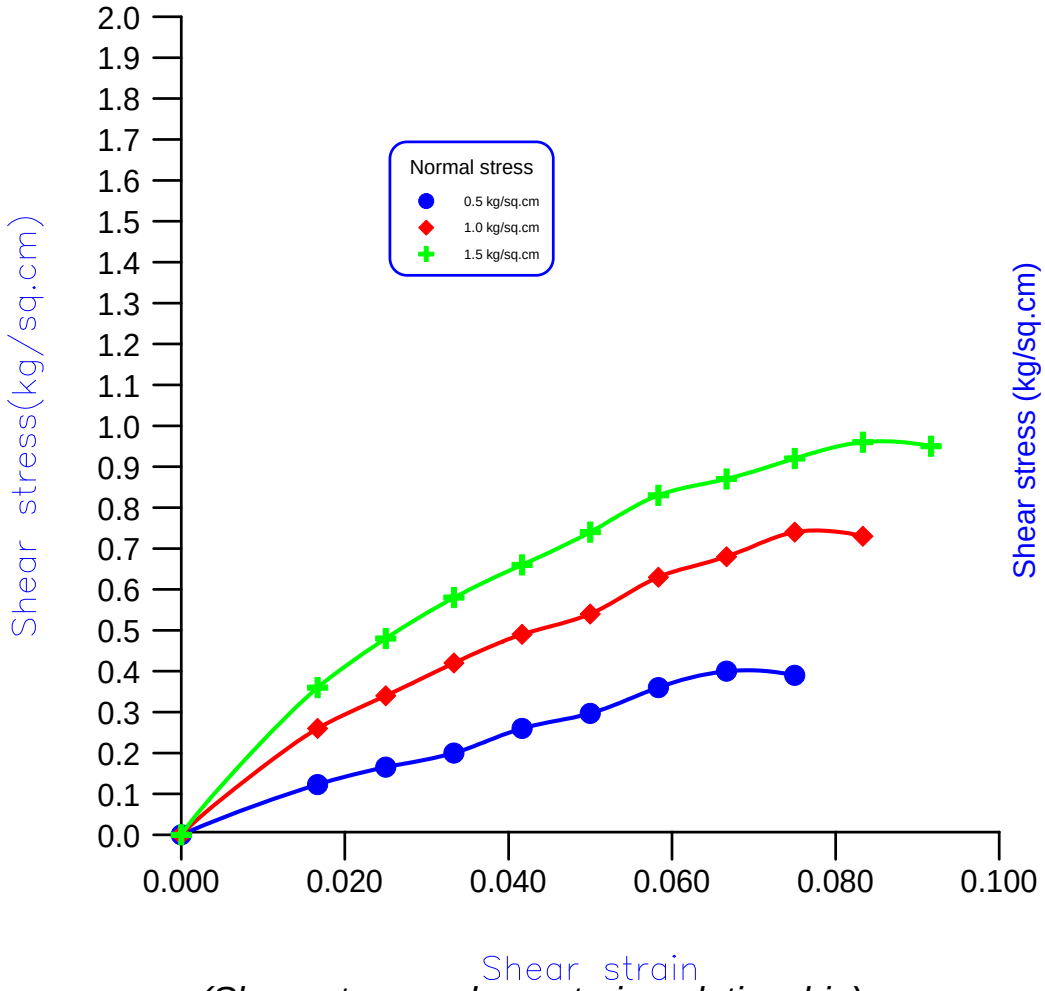
(Shear stress - shear strain relationship)



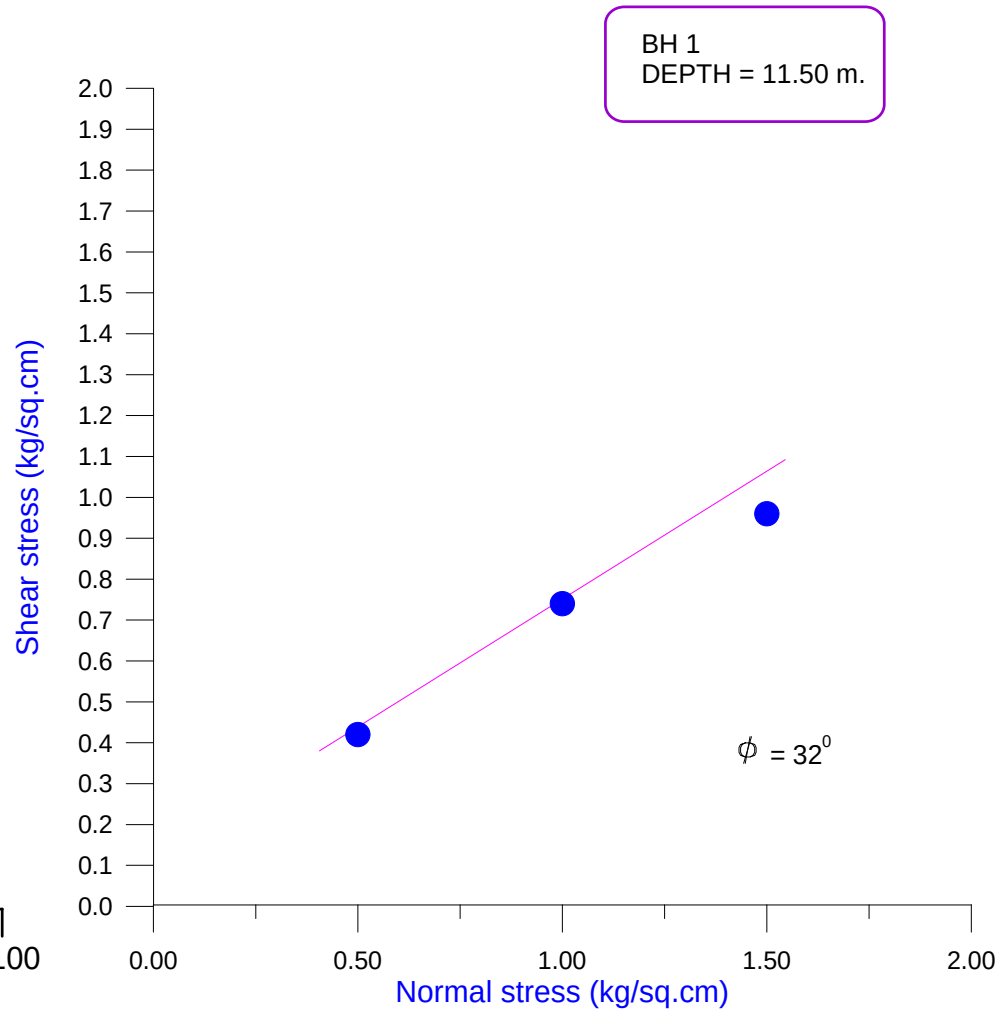
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 1-3



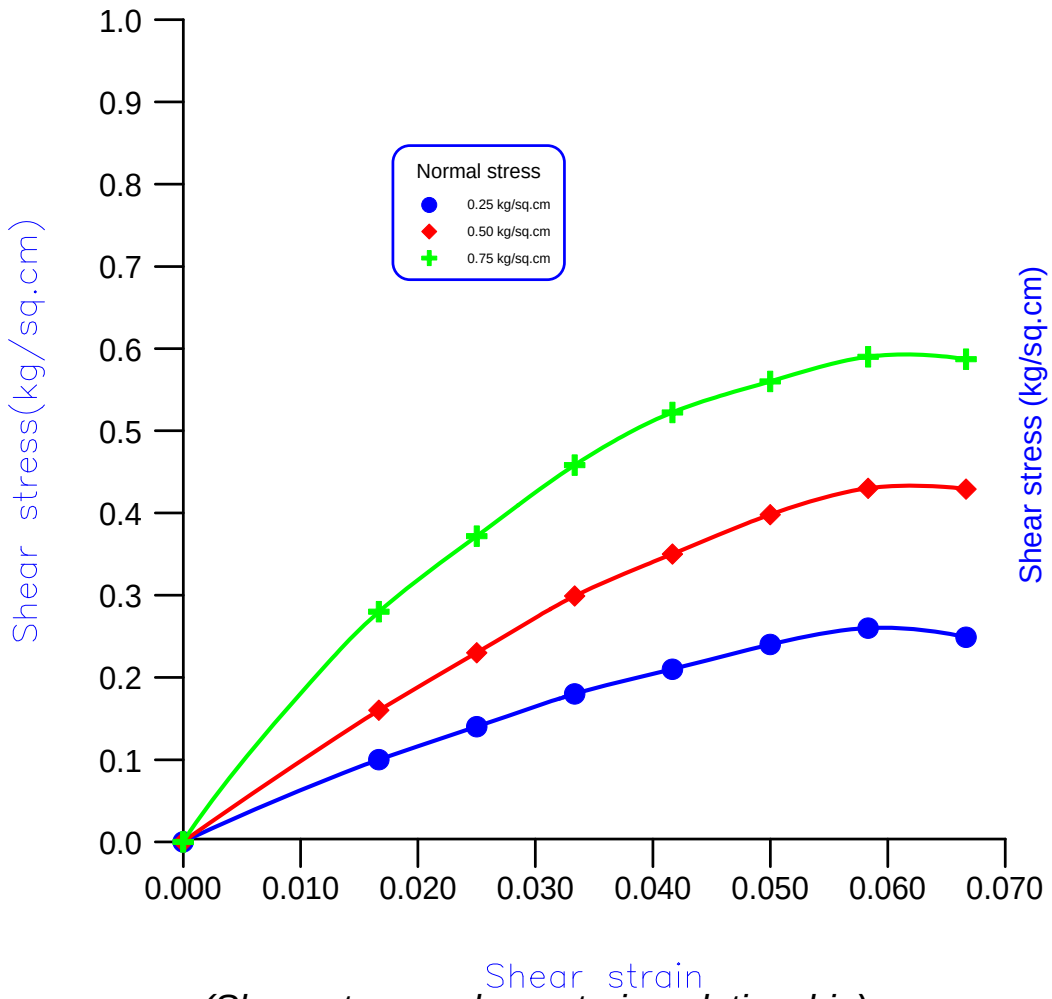
(Shear stress - shear strain relationship)



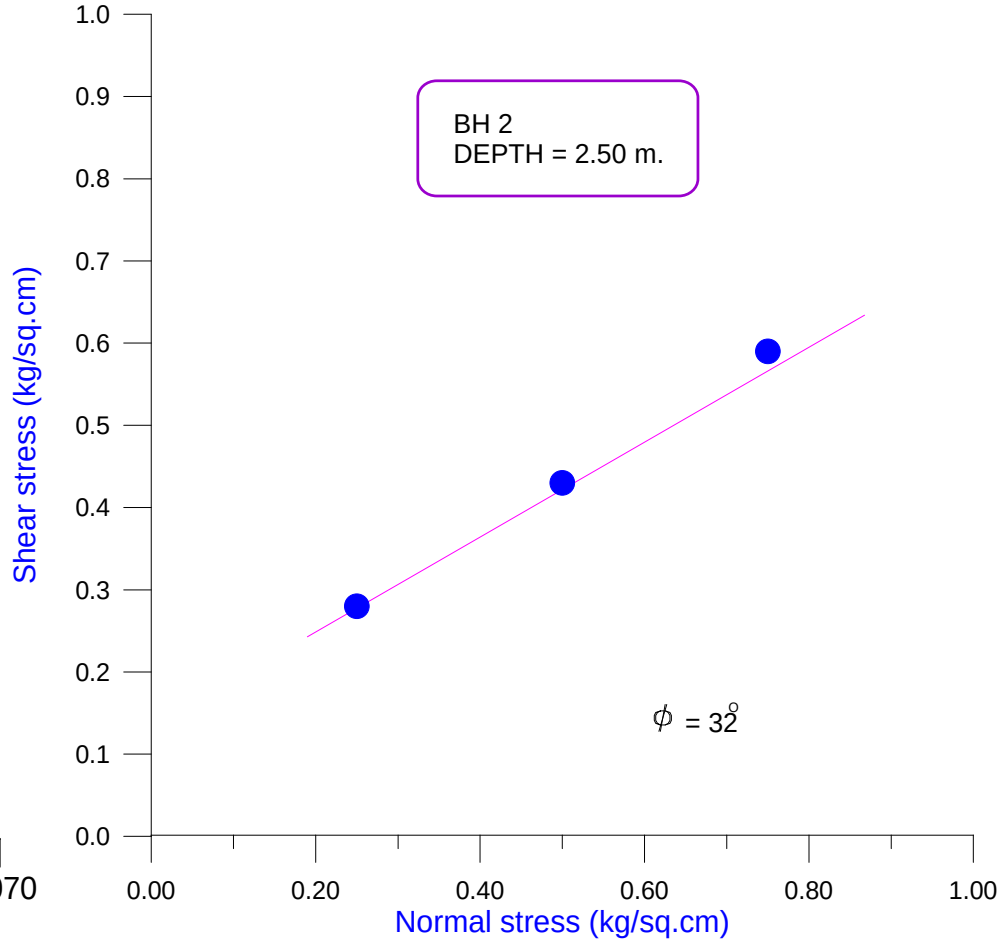
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- 1-4



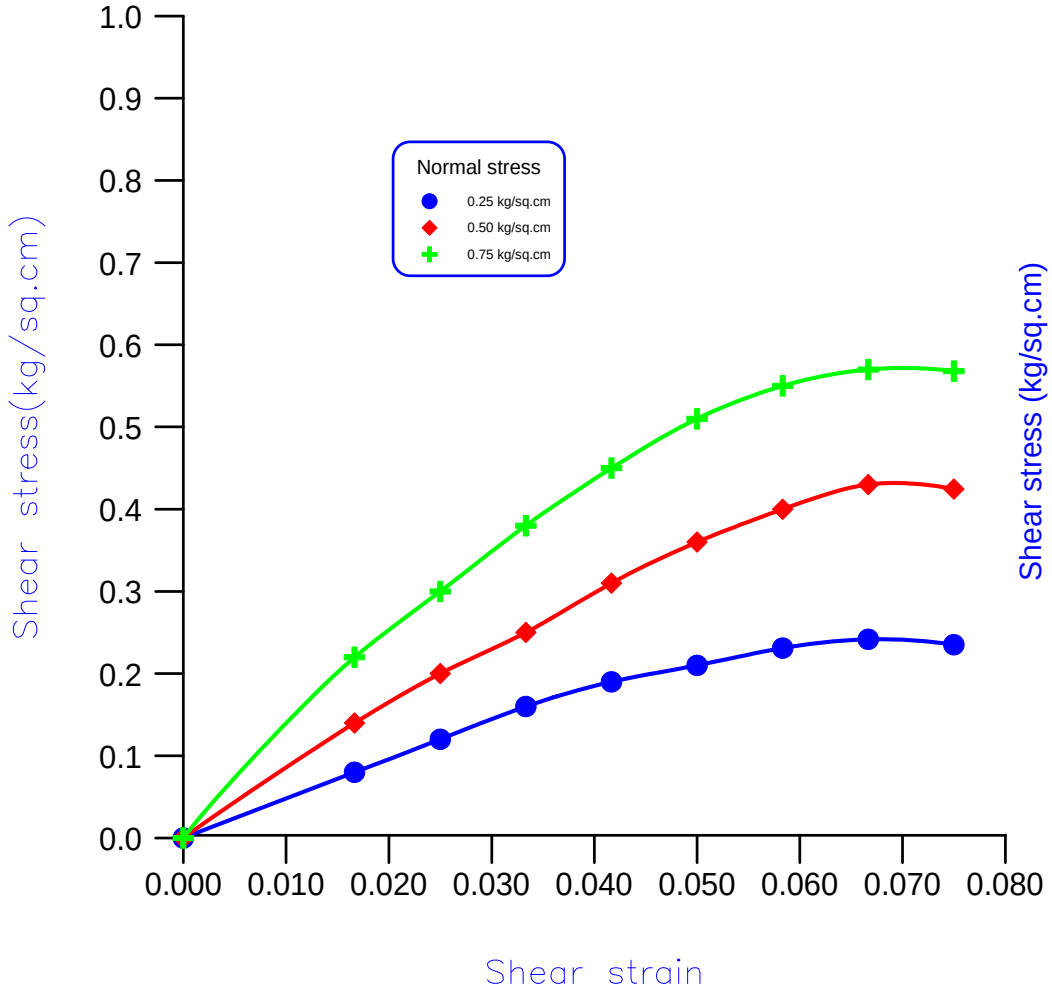
(Shear stress - shear strain relationship)



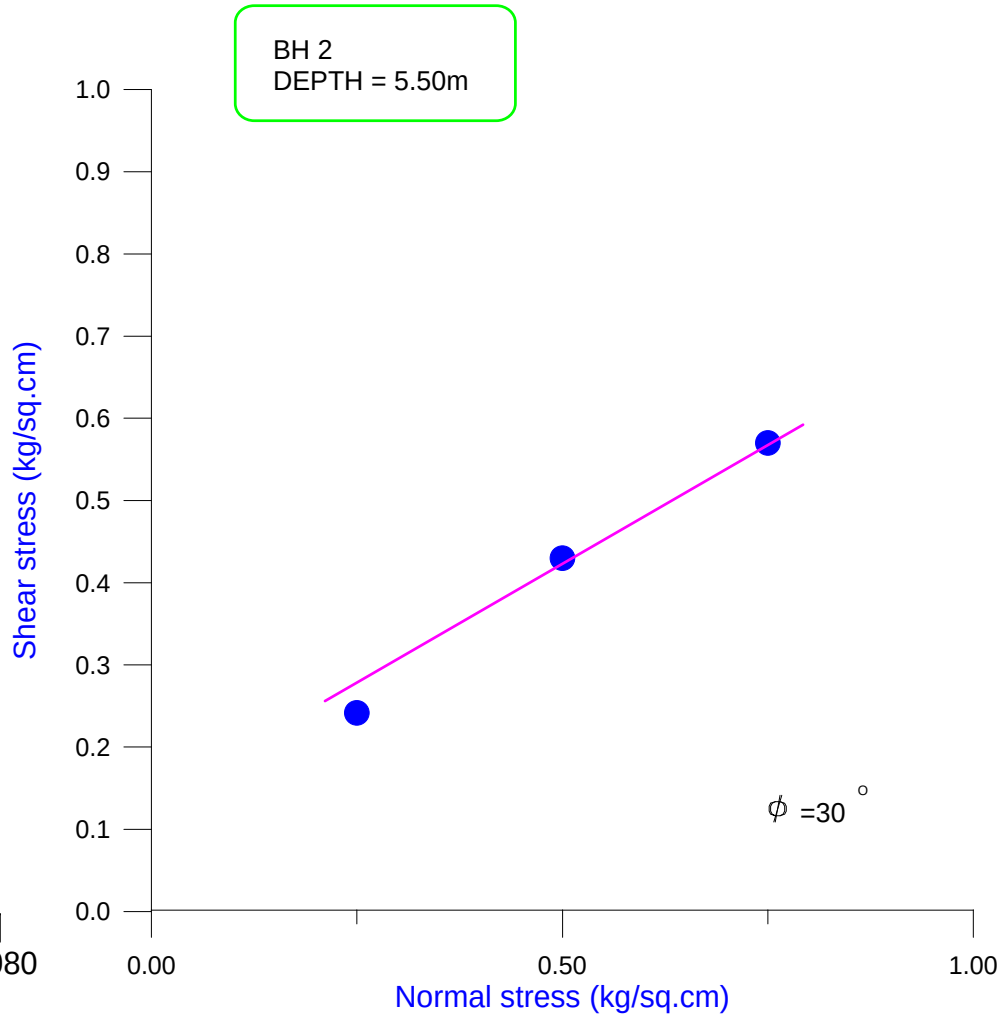
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 2-1



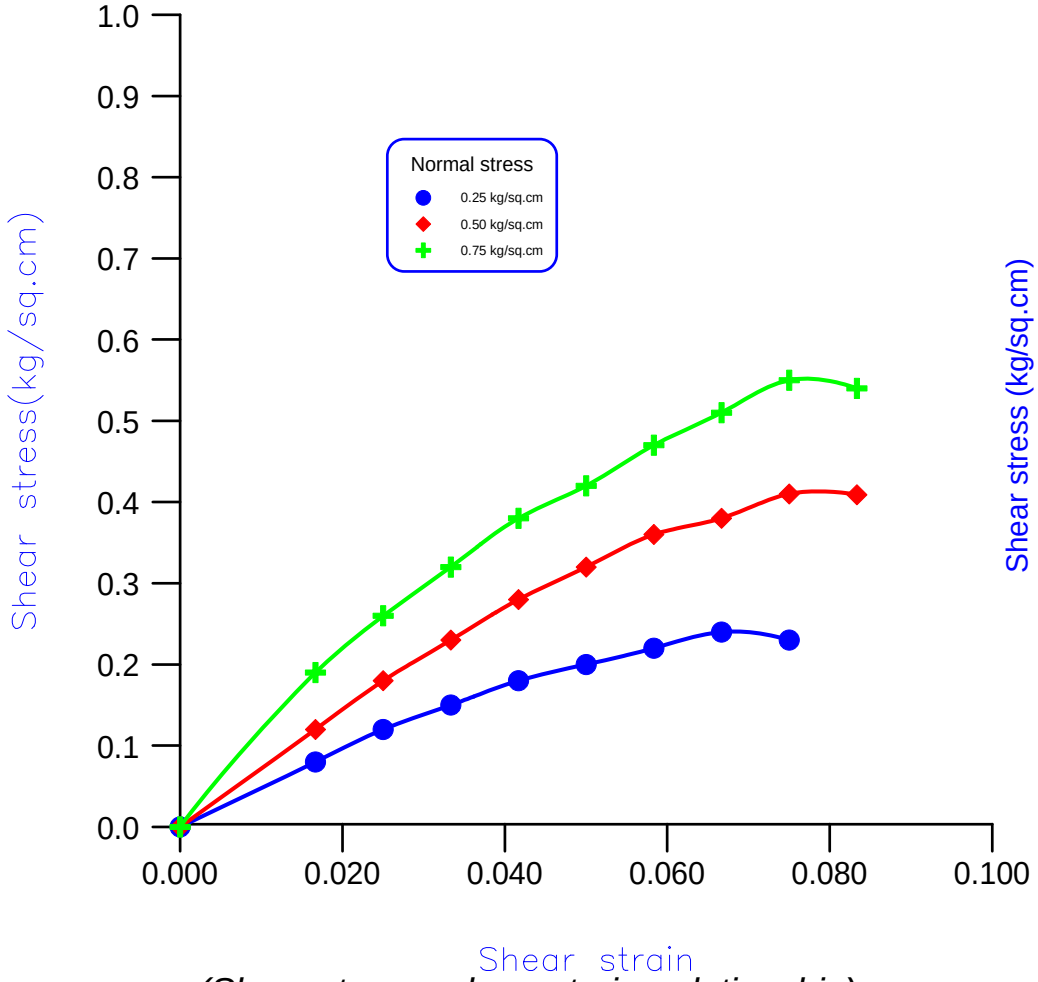
(Shear stress - shear strain relationship)



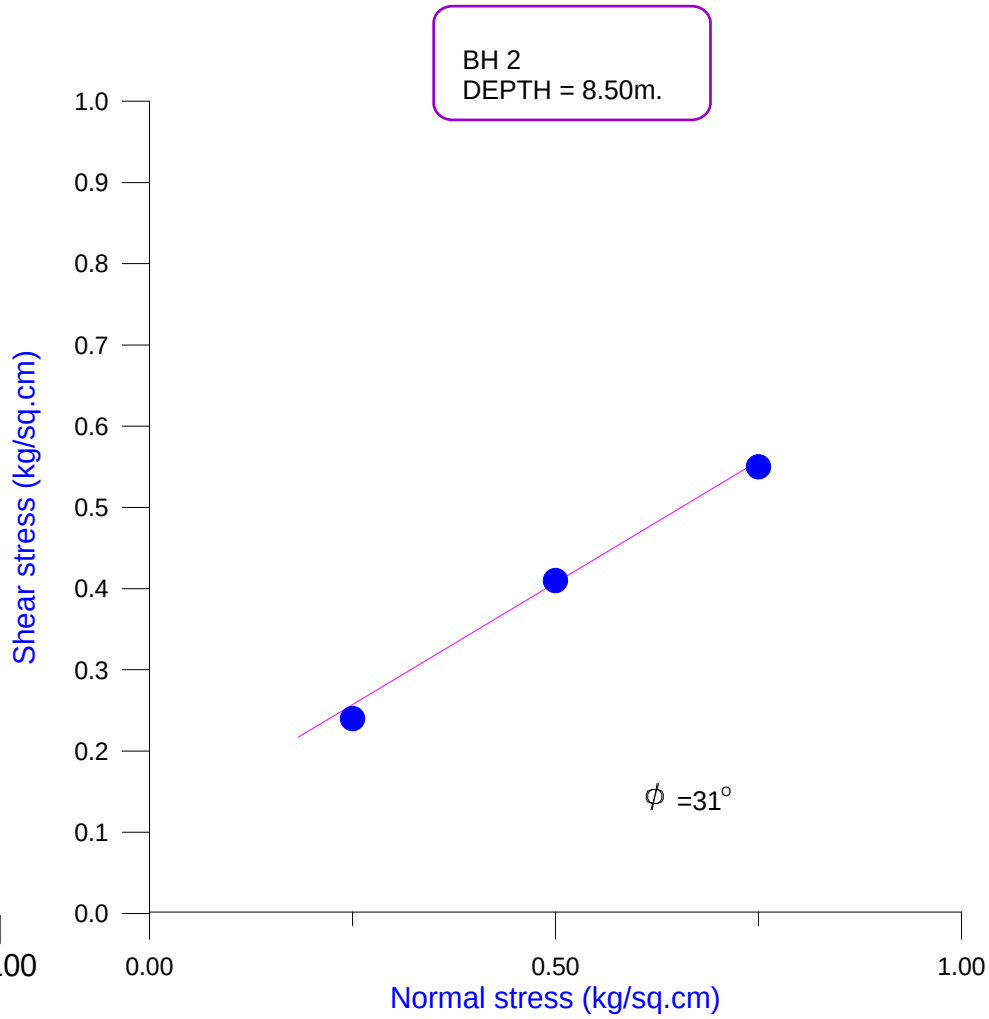
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 2-2



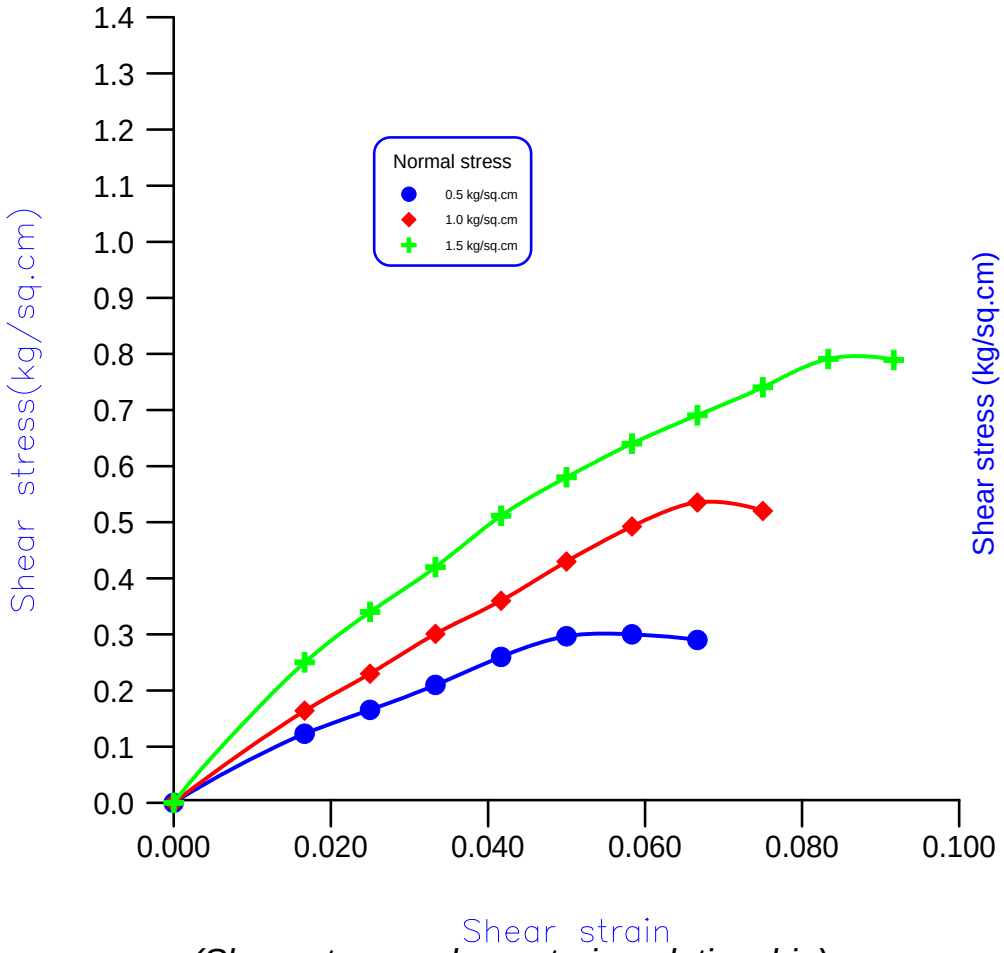
(Shear stress - shear strain relationship)



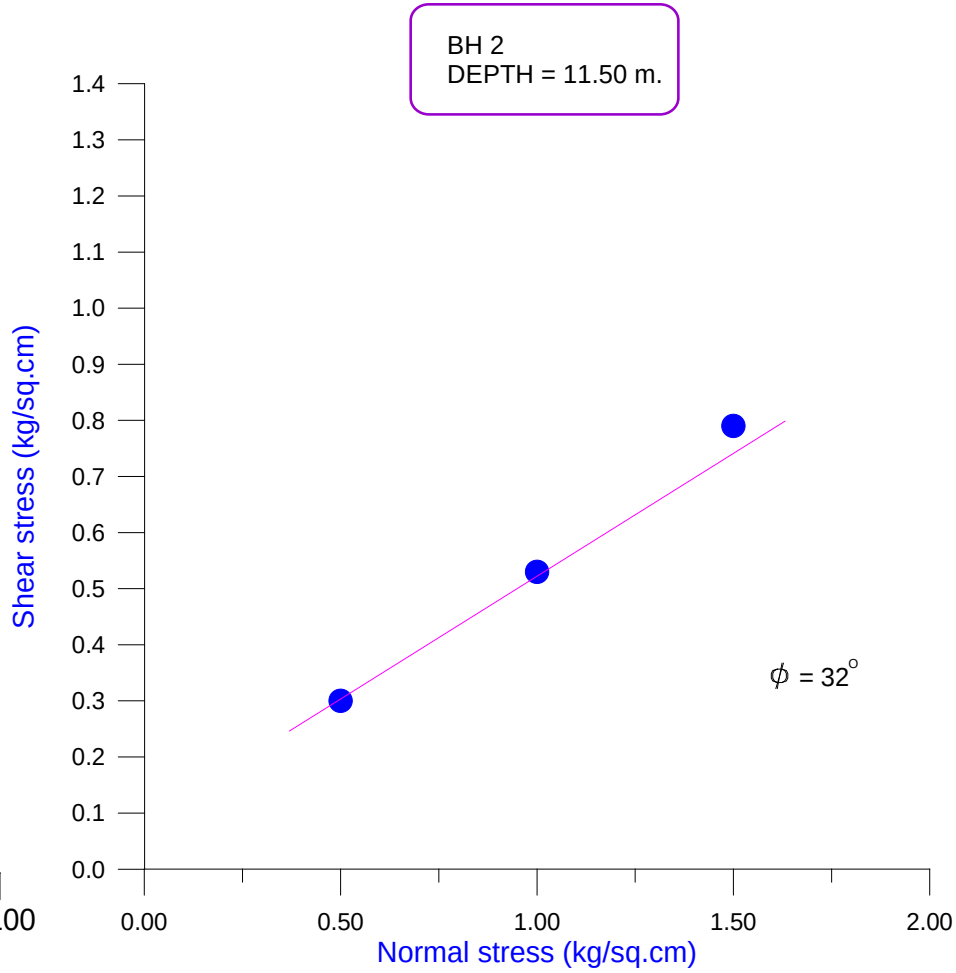
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 2-3



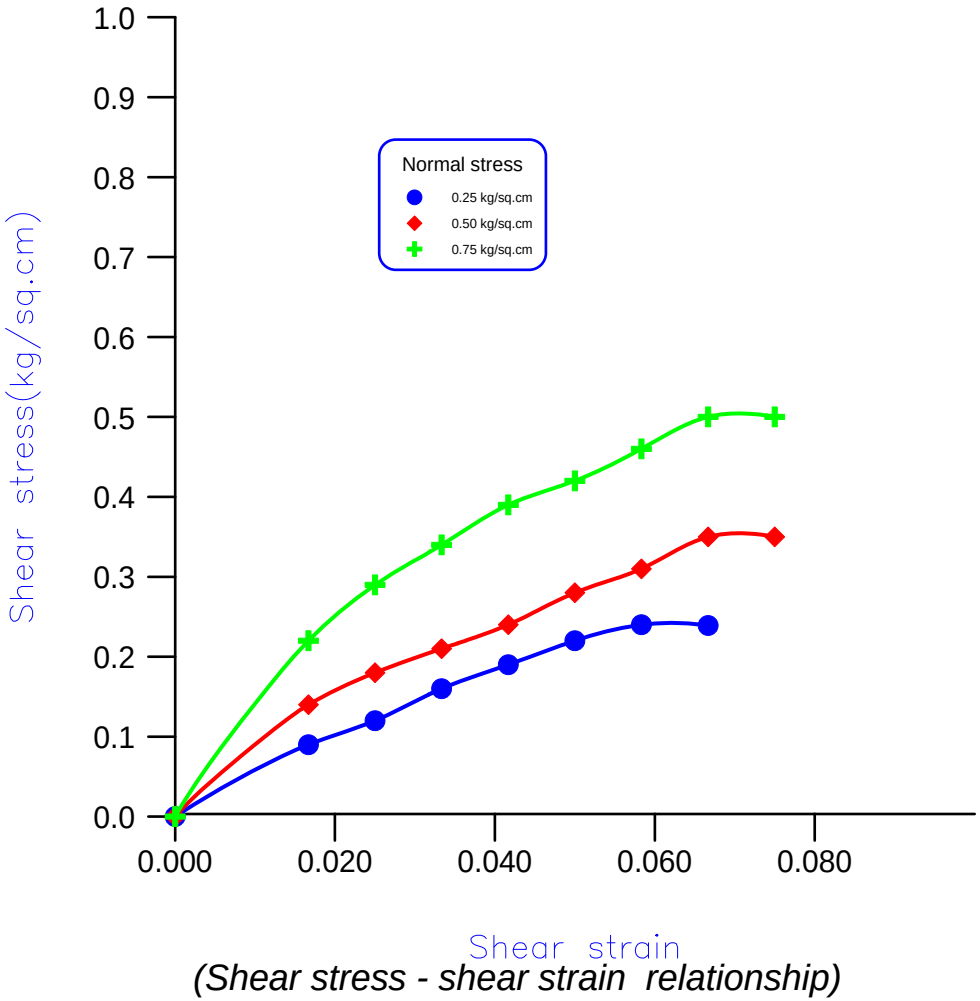
(Shear stress - shear strain relationship)



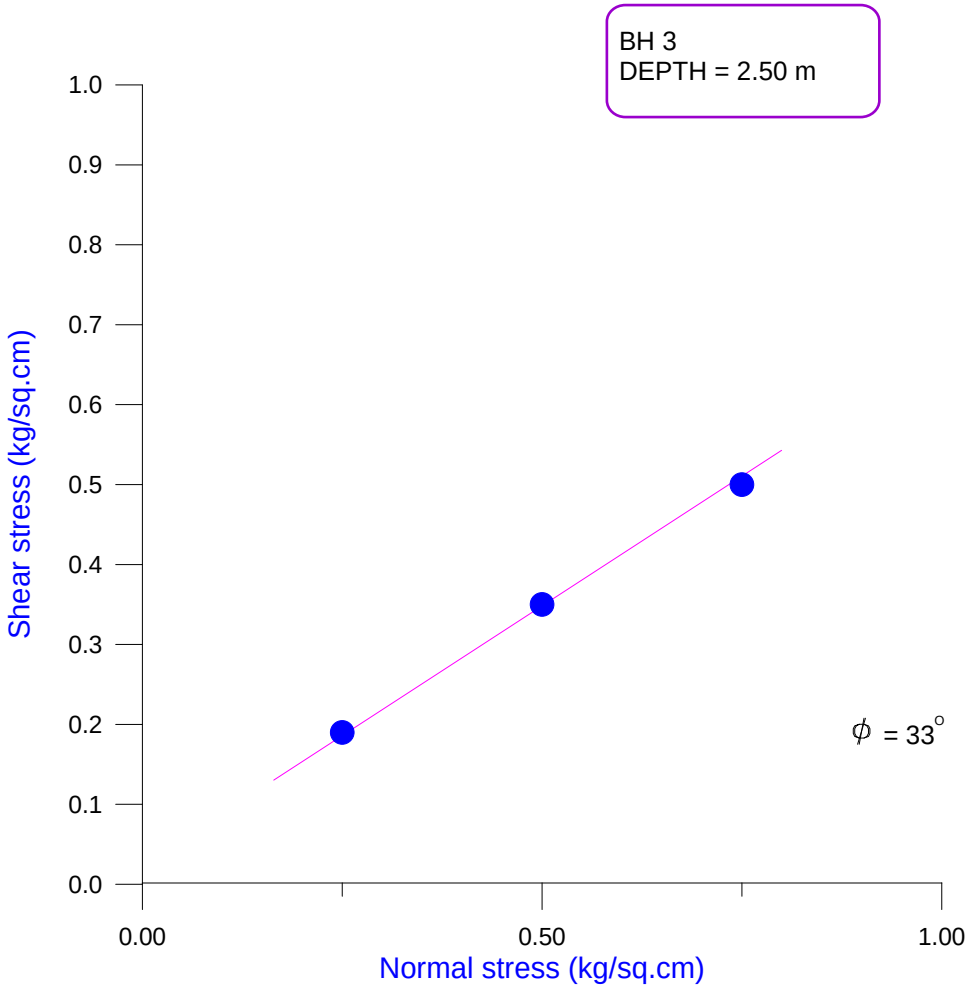
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 2-4



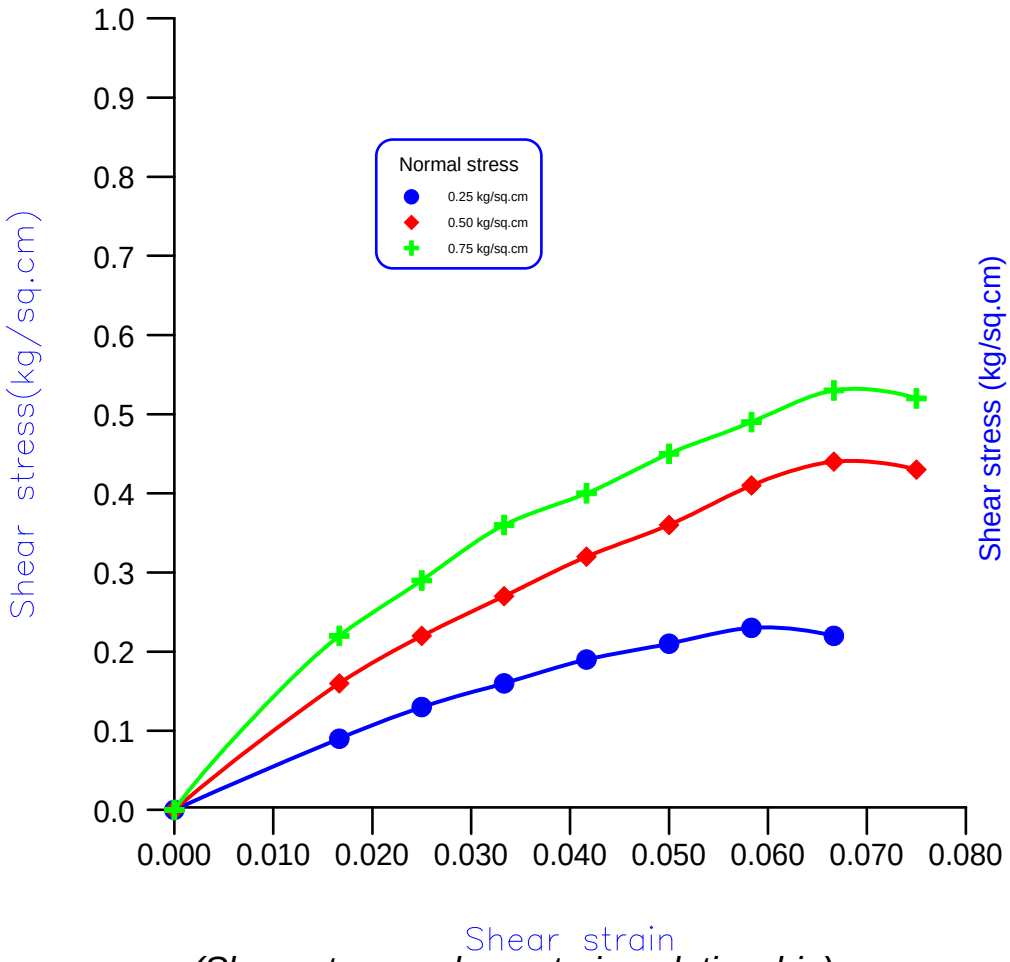
(Shear stress - shear strain relationship)



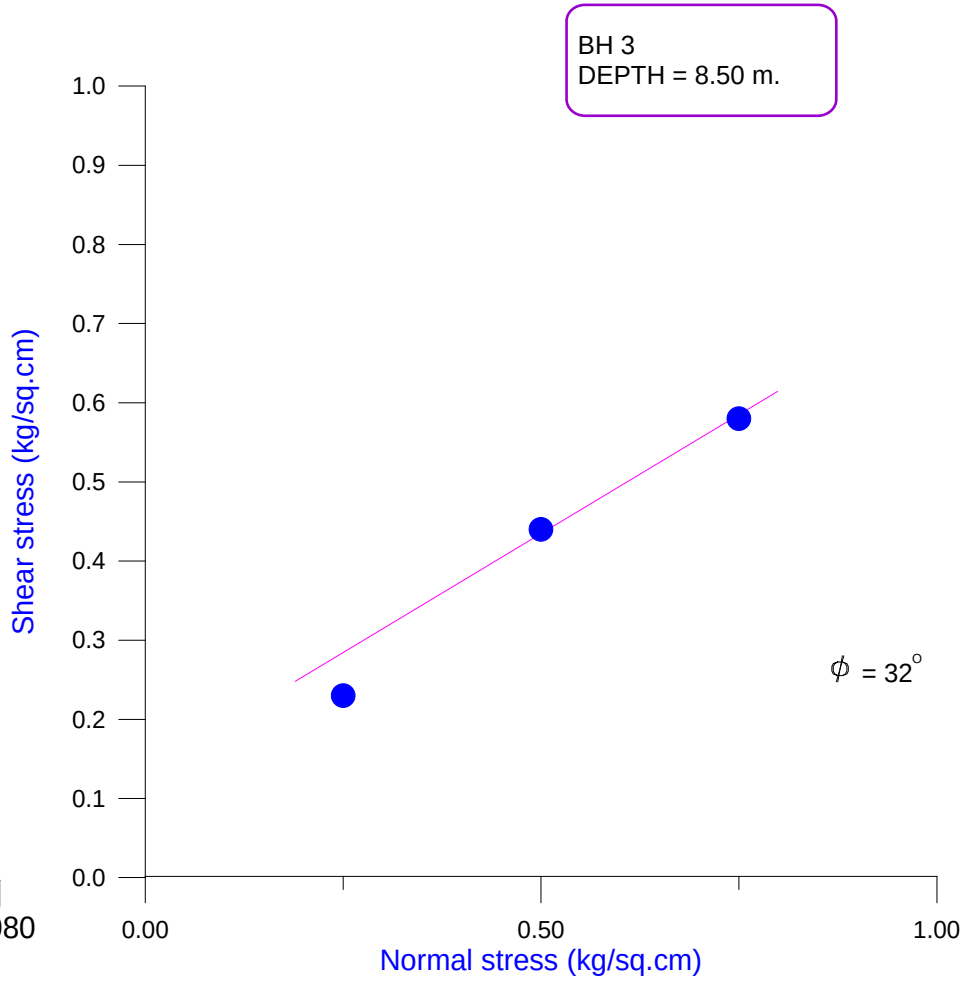
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

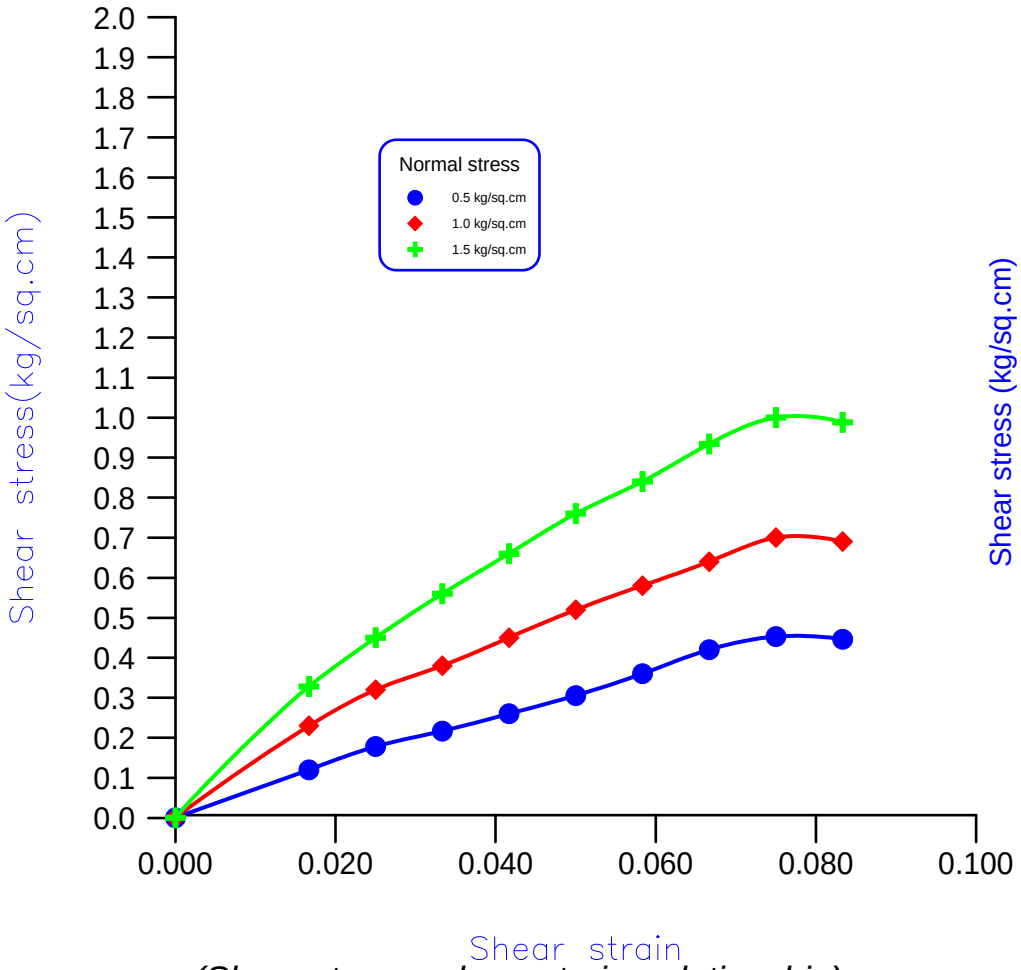
FIG- DS 3-1



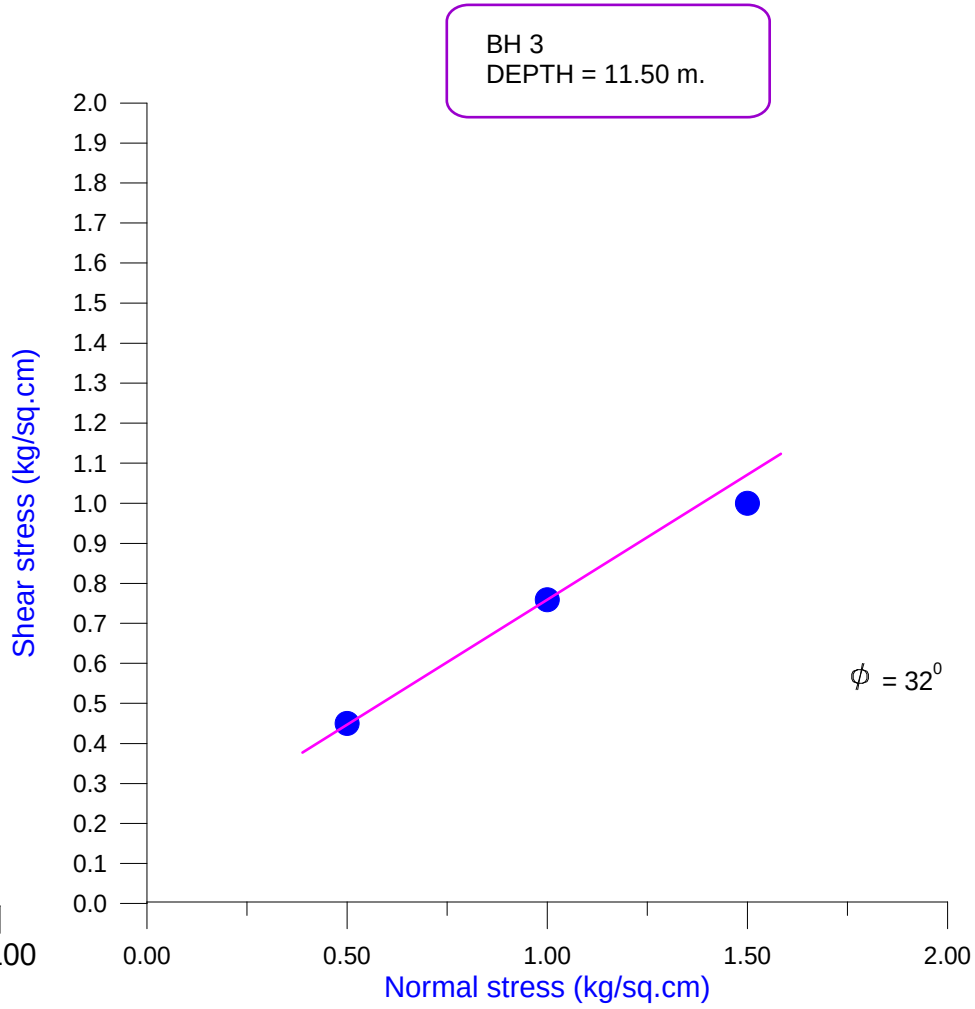
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



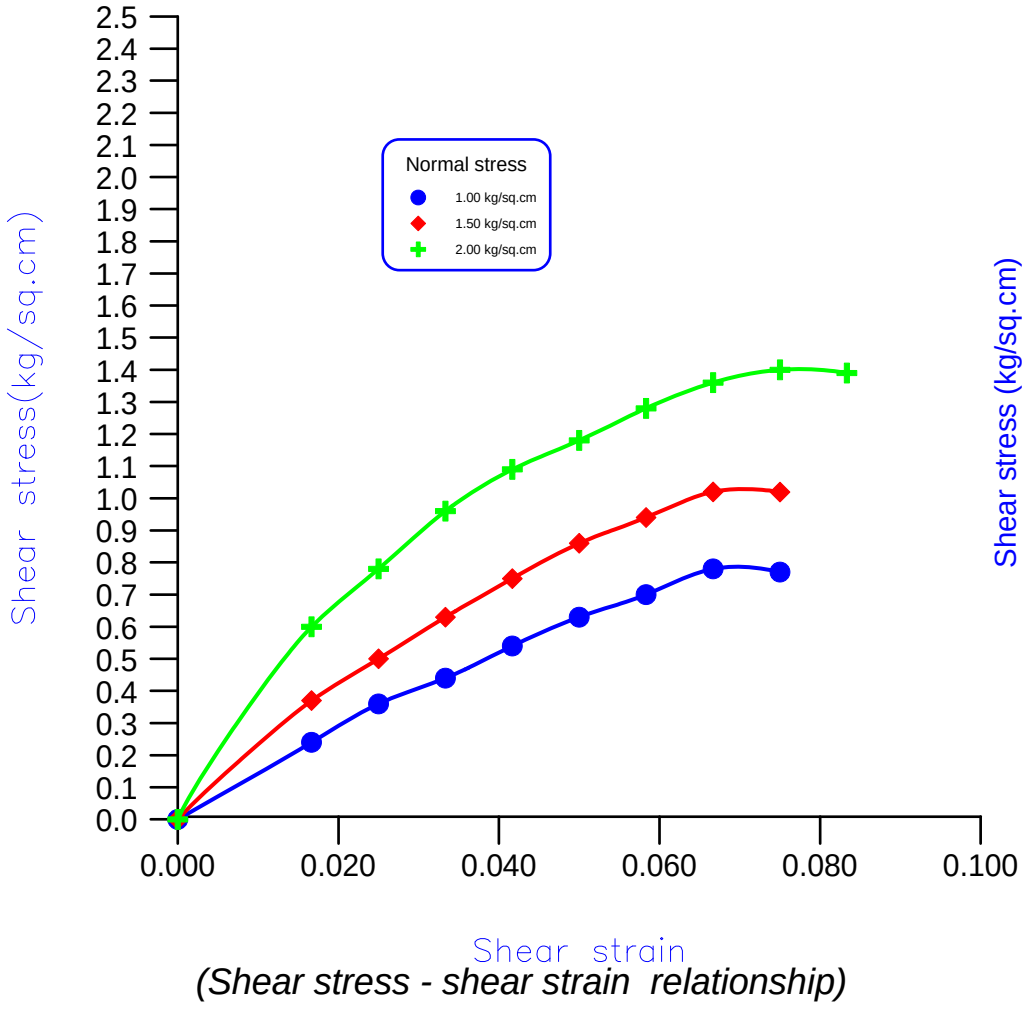
(Shear stress - shear strain relationship)



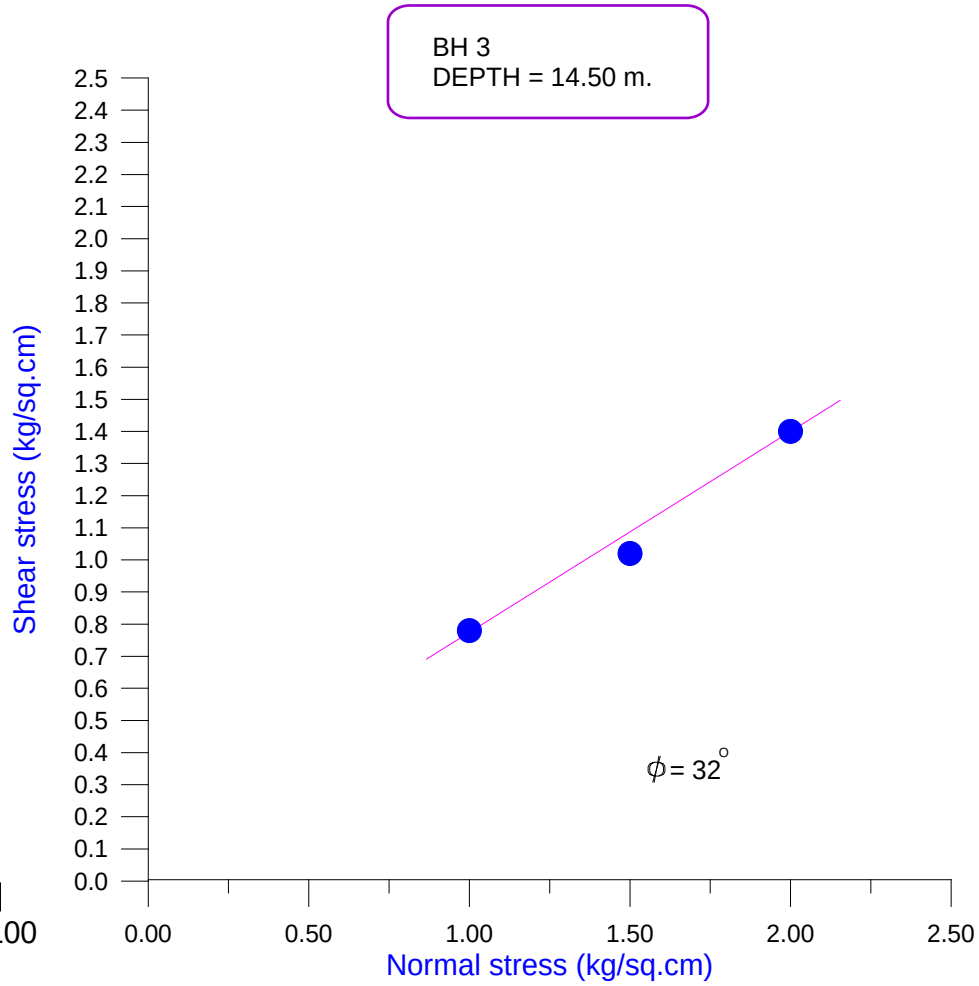
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

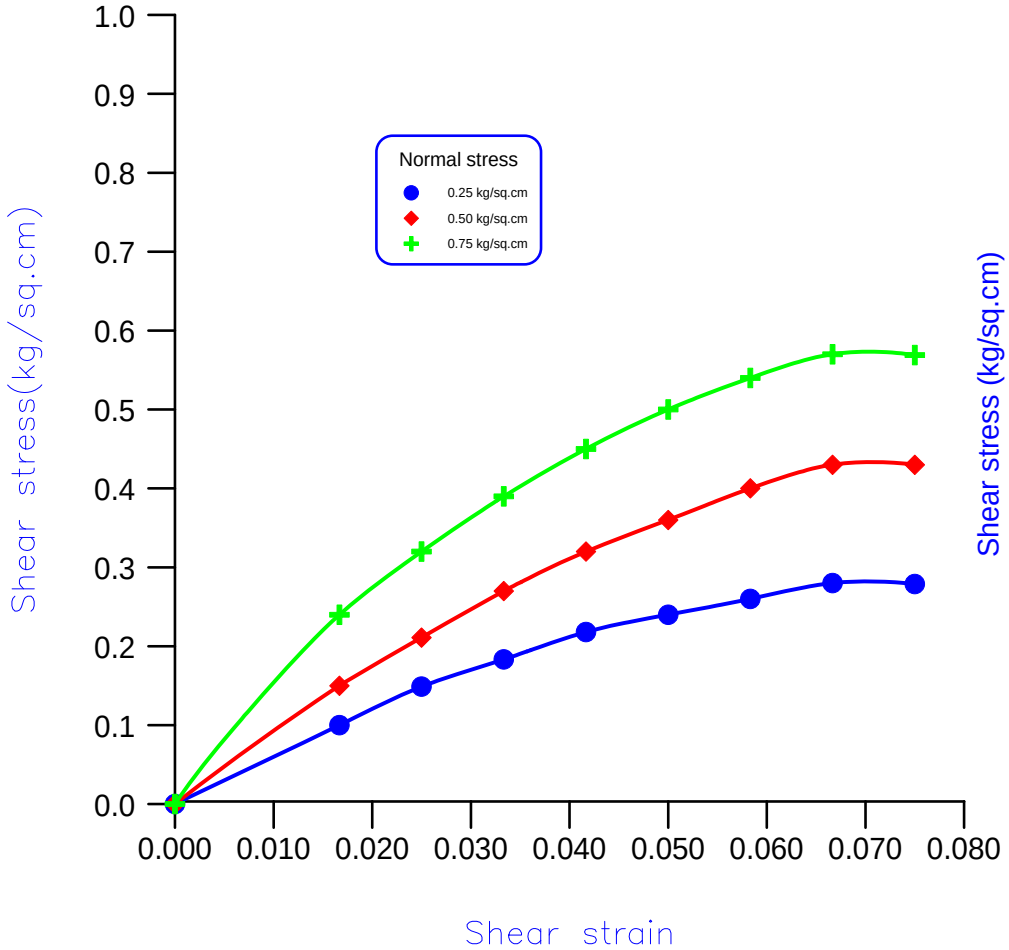
FIG- DS 3-3



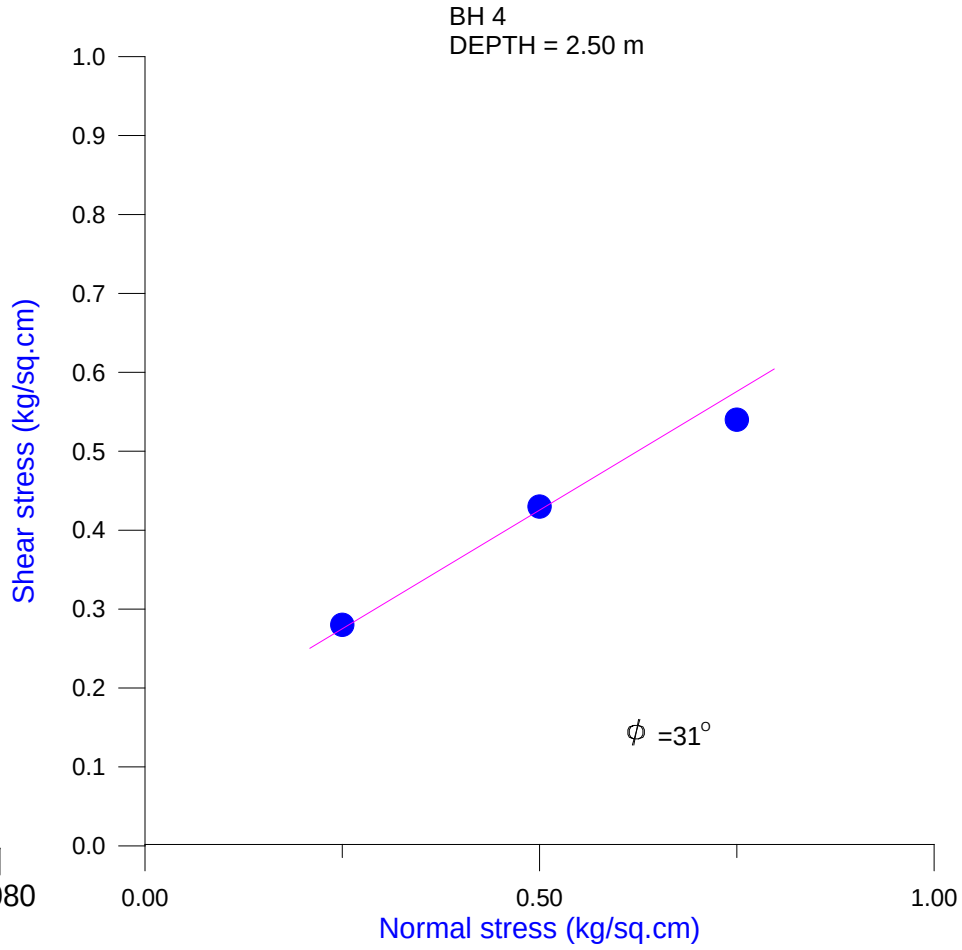
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



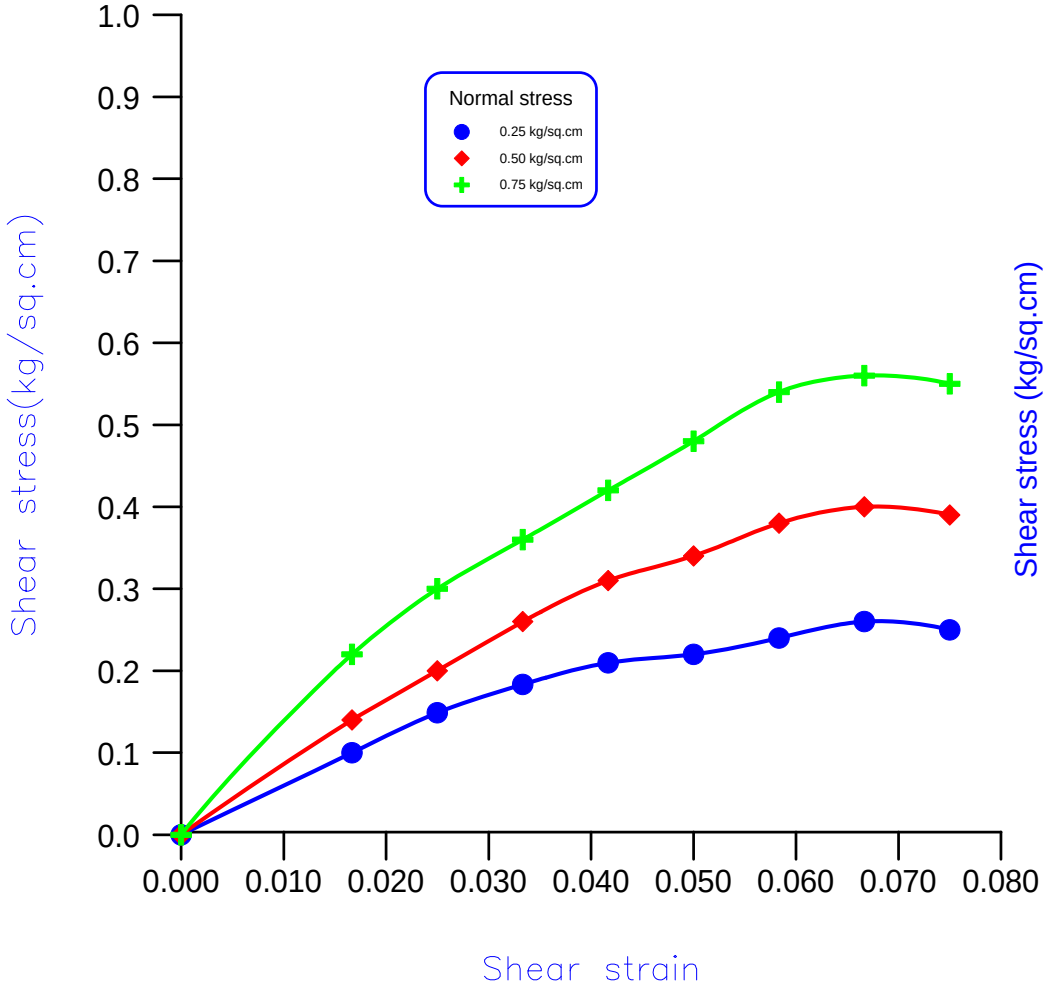
(Shear stress - shear strain relationship)



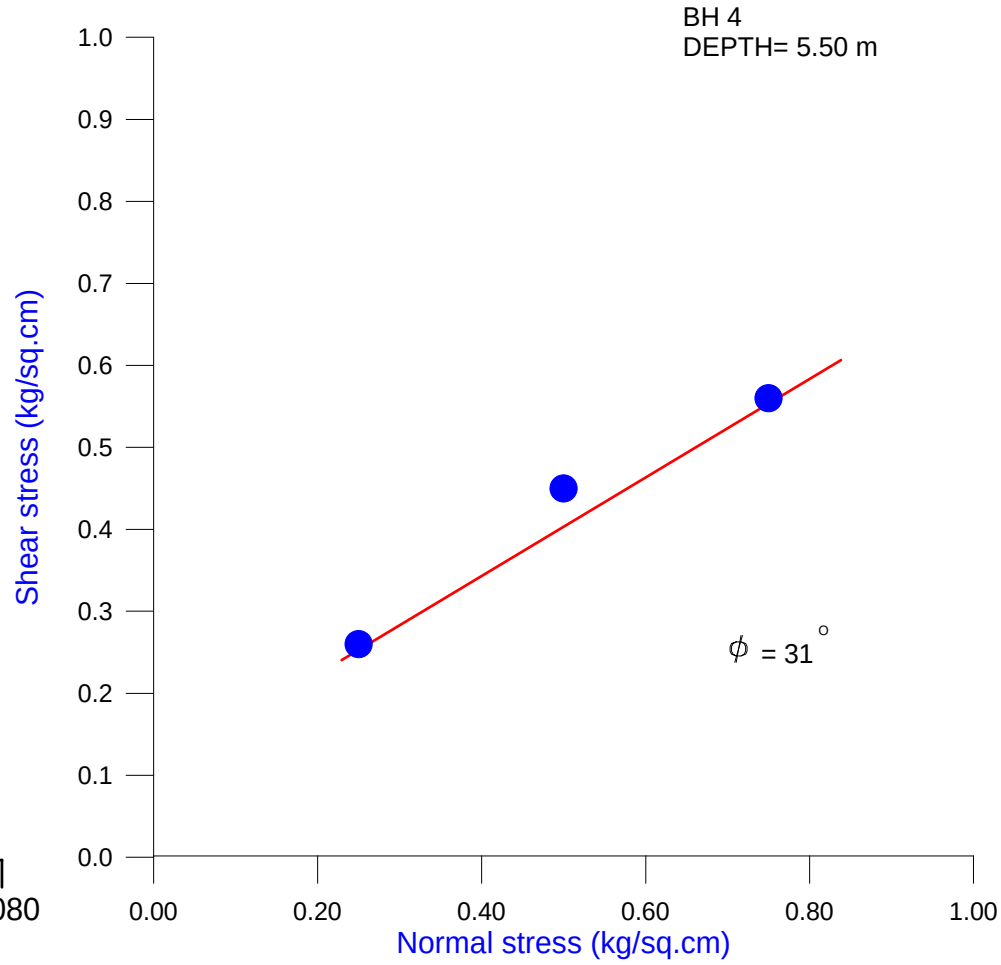
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS-4-1



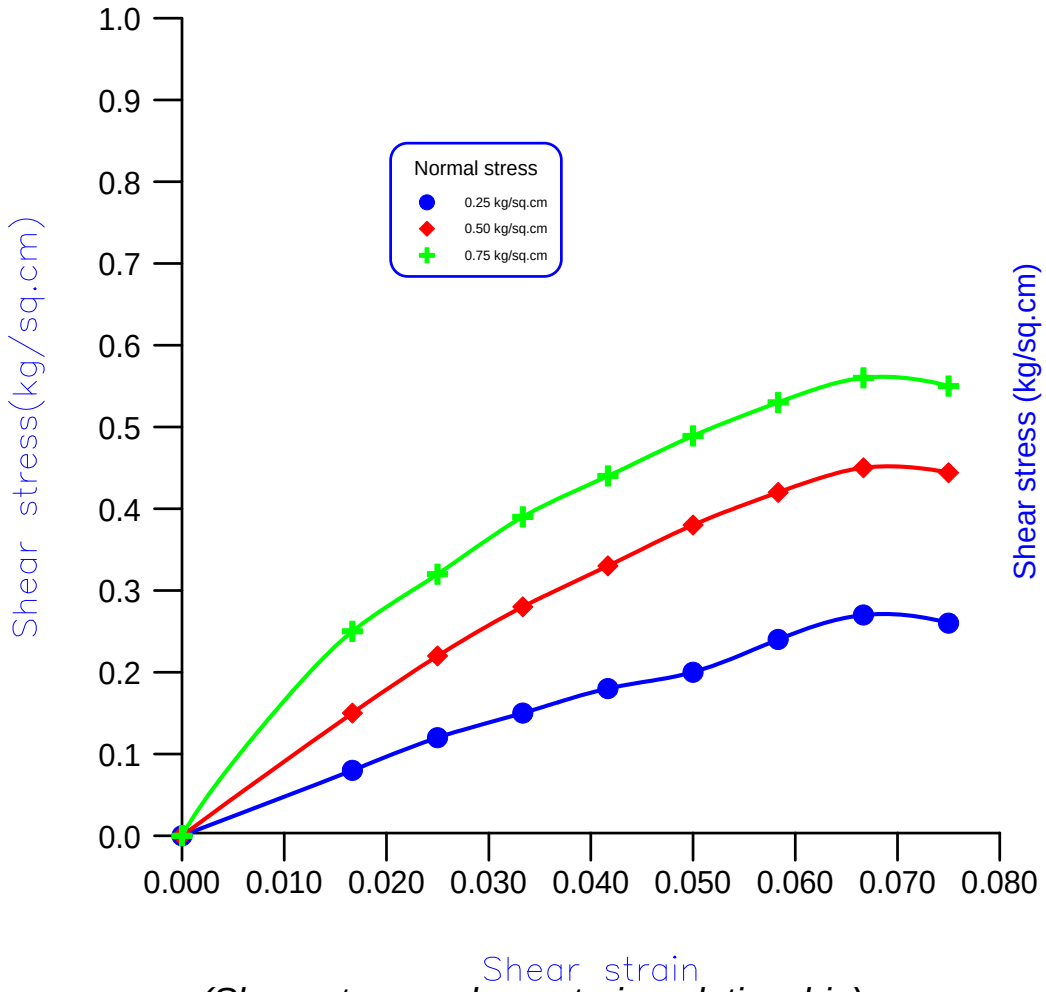
(Shear stress - shear strain relationship)



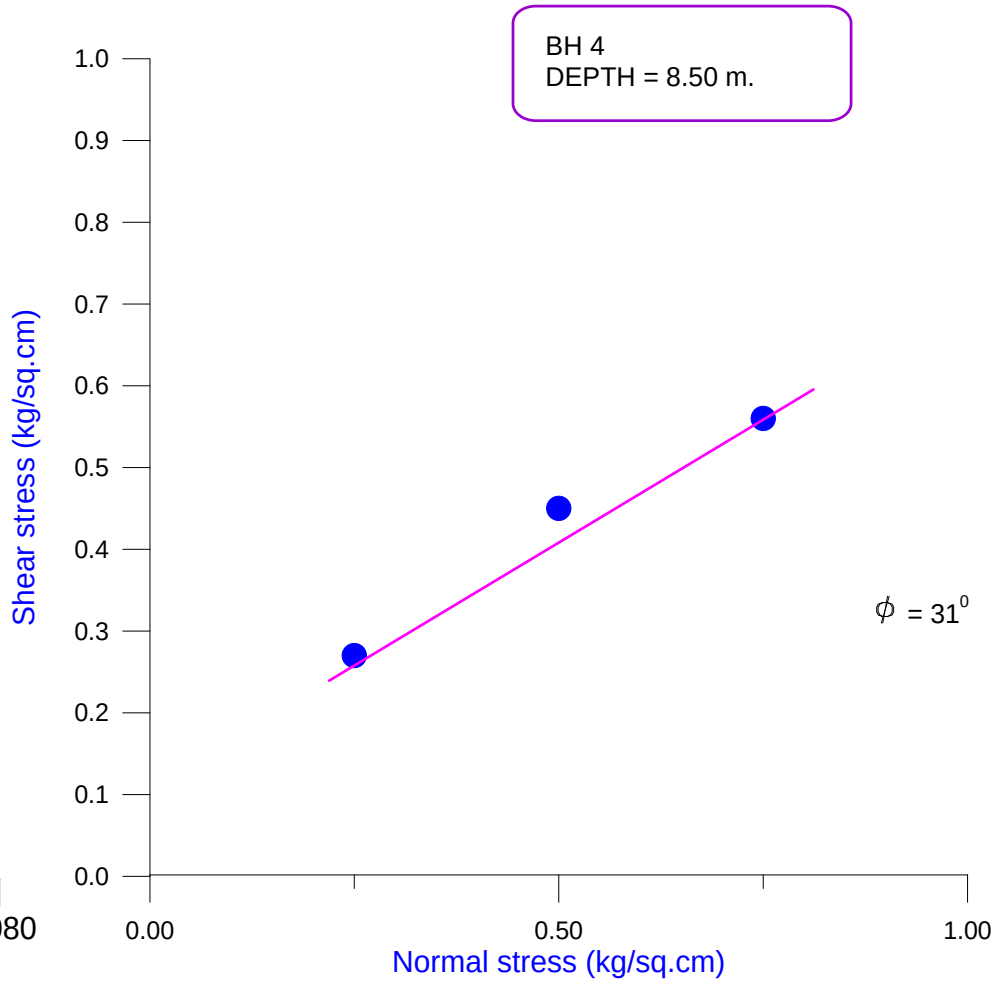
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

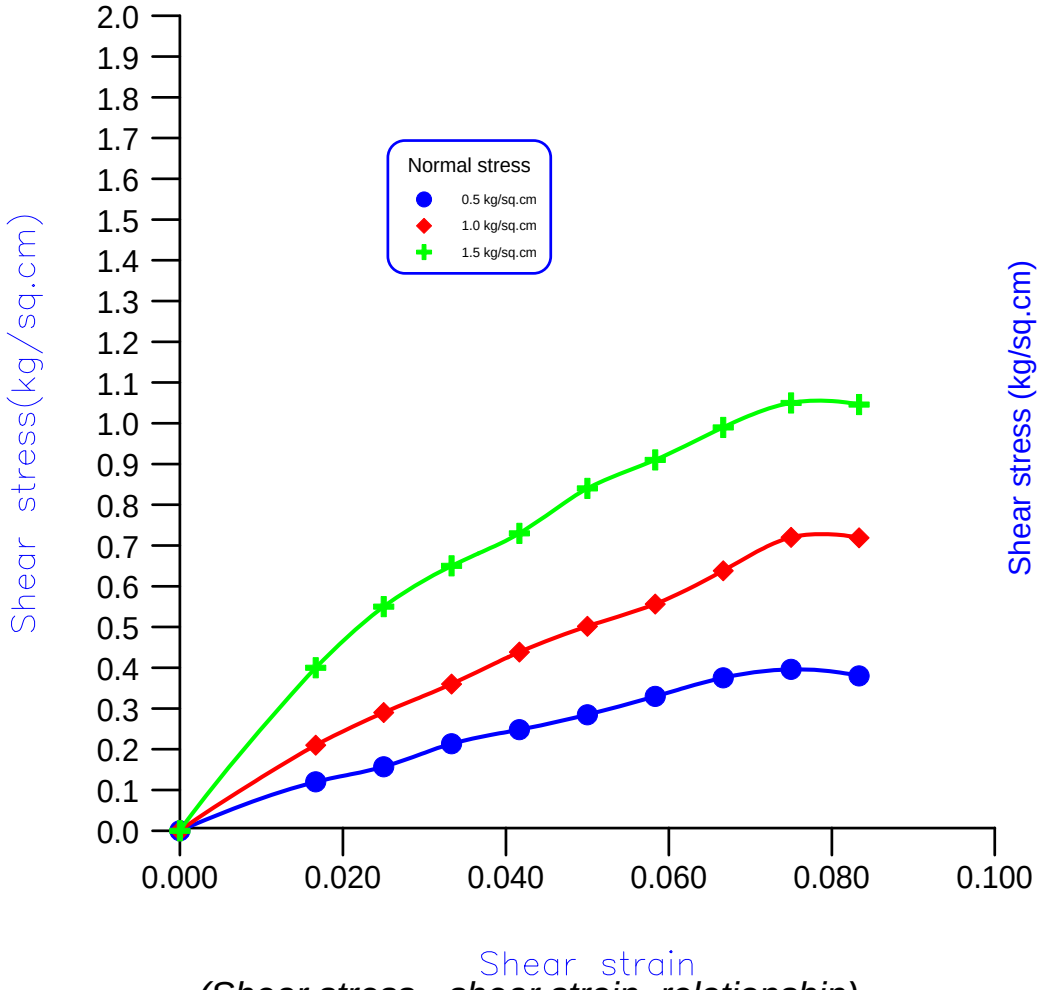
FIG- DS 4-2



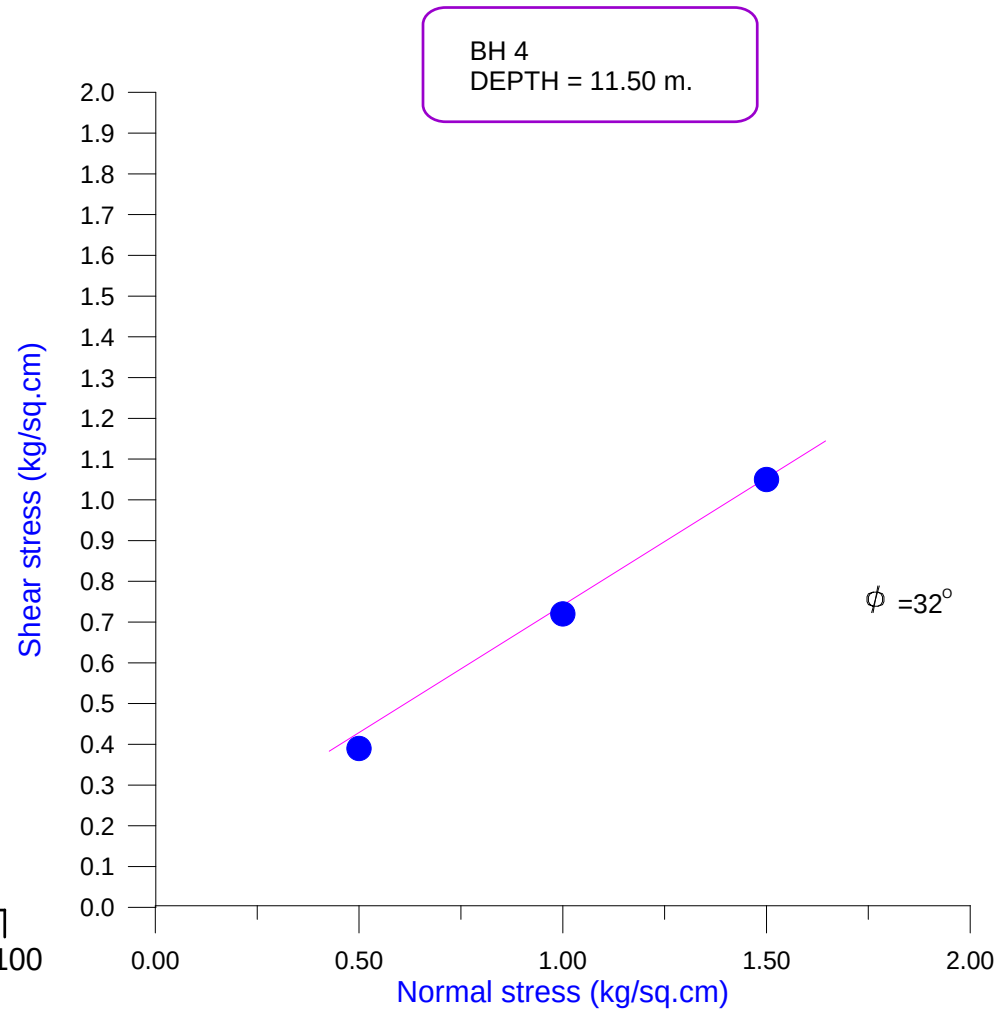
(Shear stress - shear strain relationship)



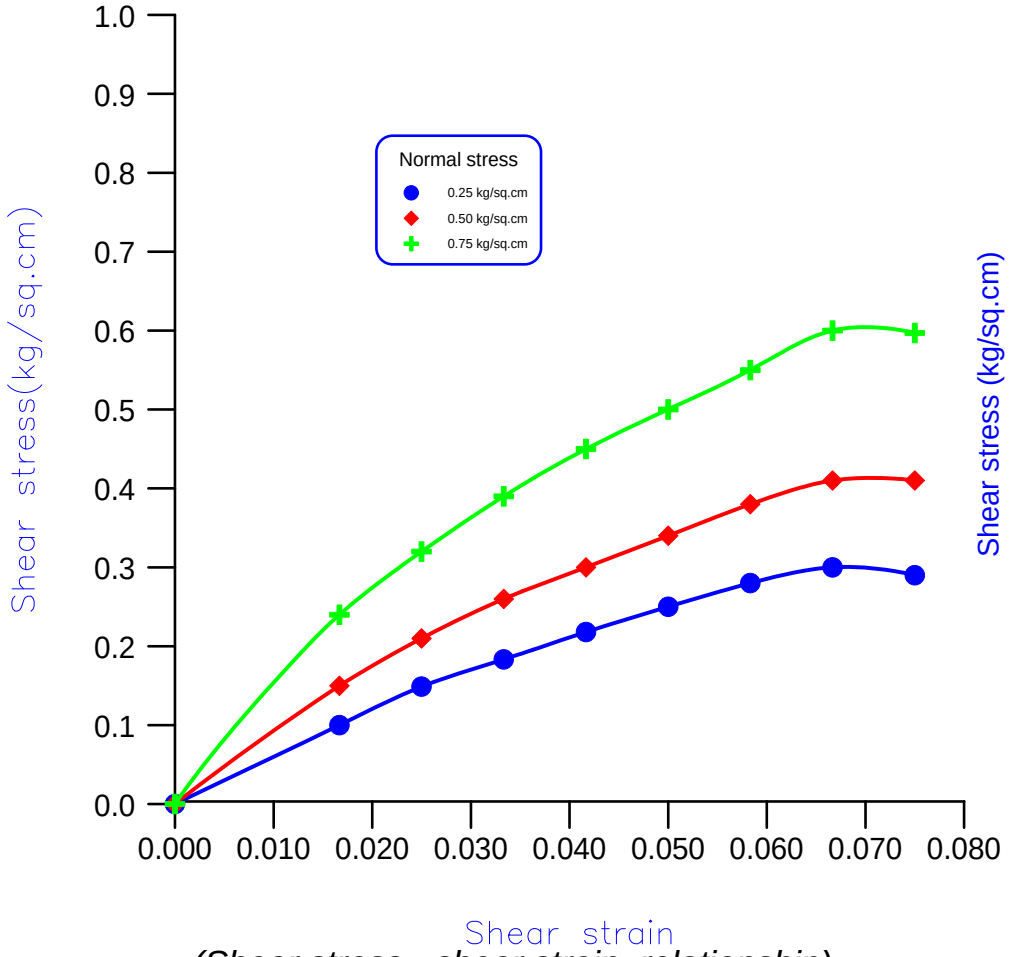
(Shear stress - Normal stress relationship)



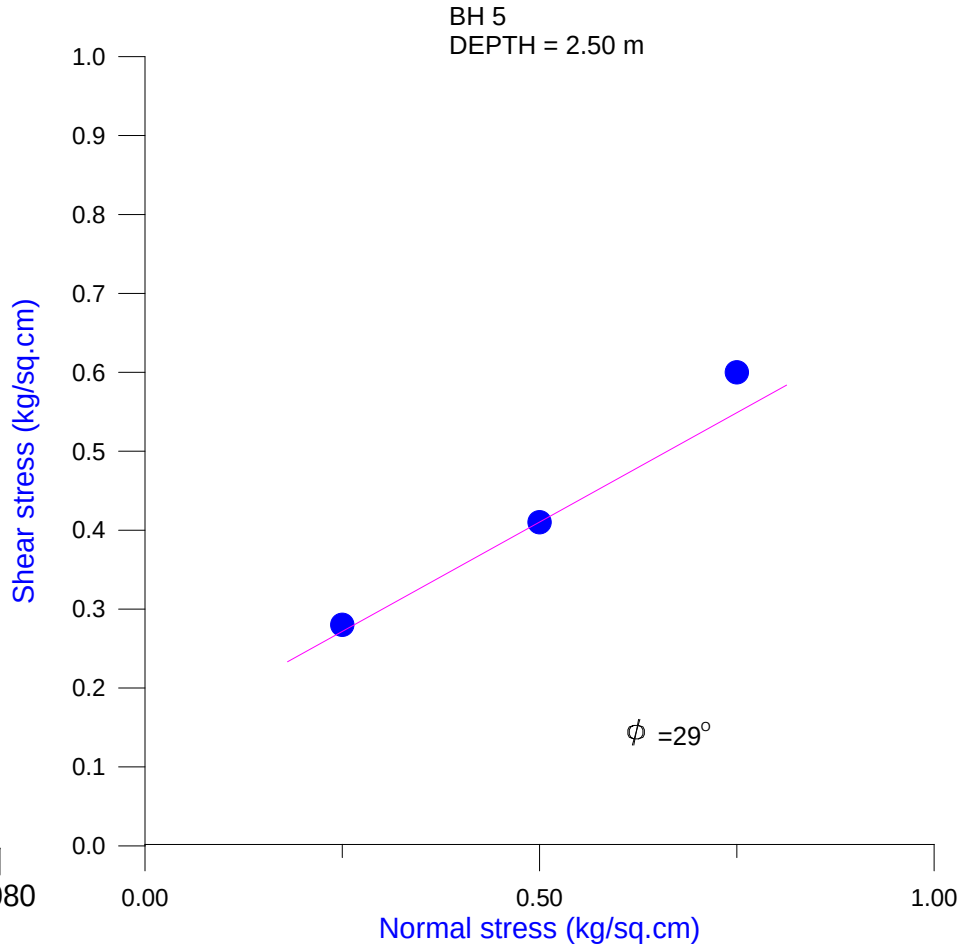
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



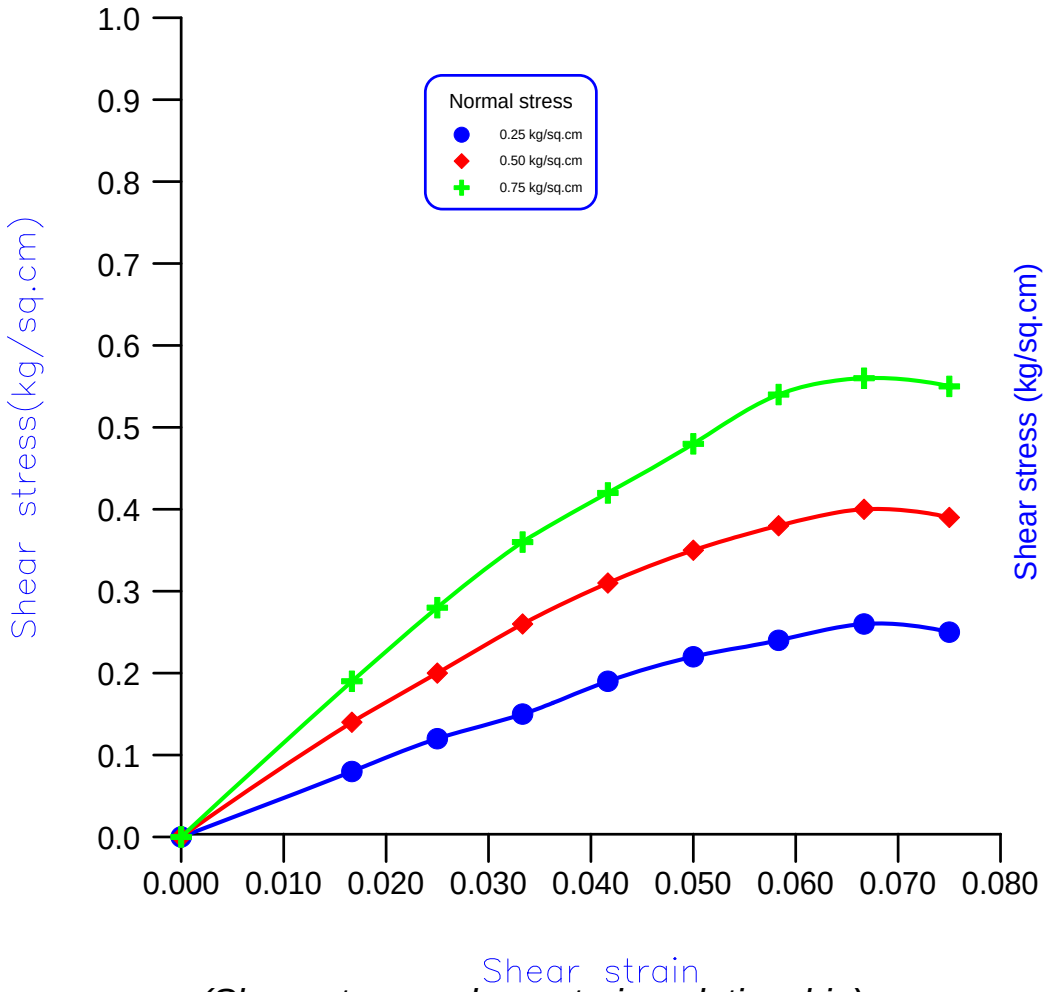
(Shear stress - shear strain relationship)



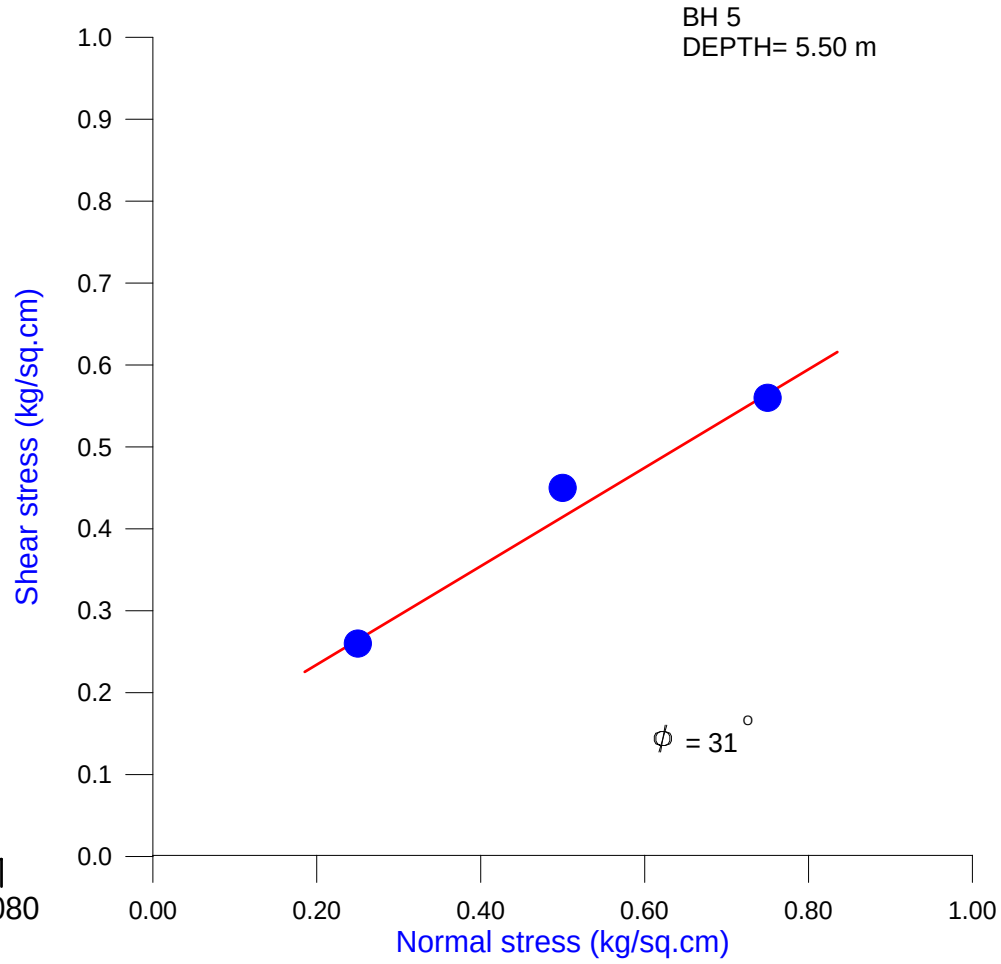
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 5-1



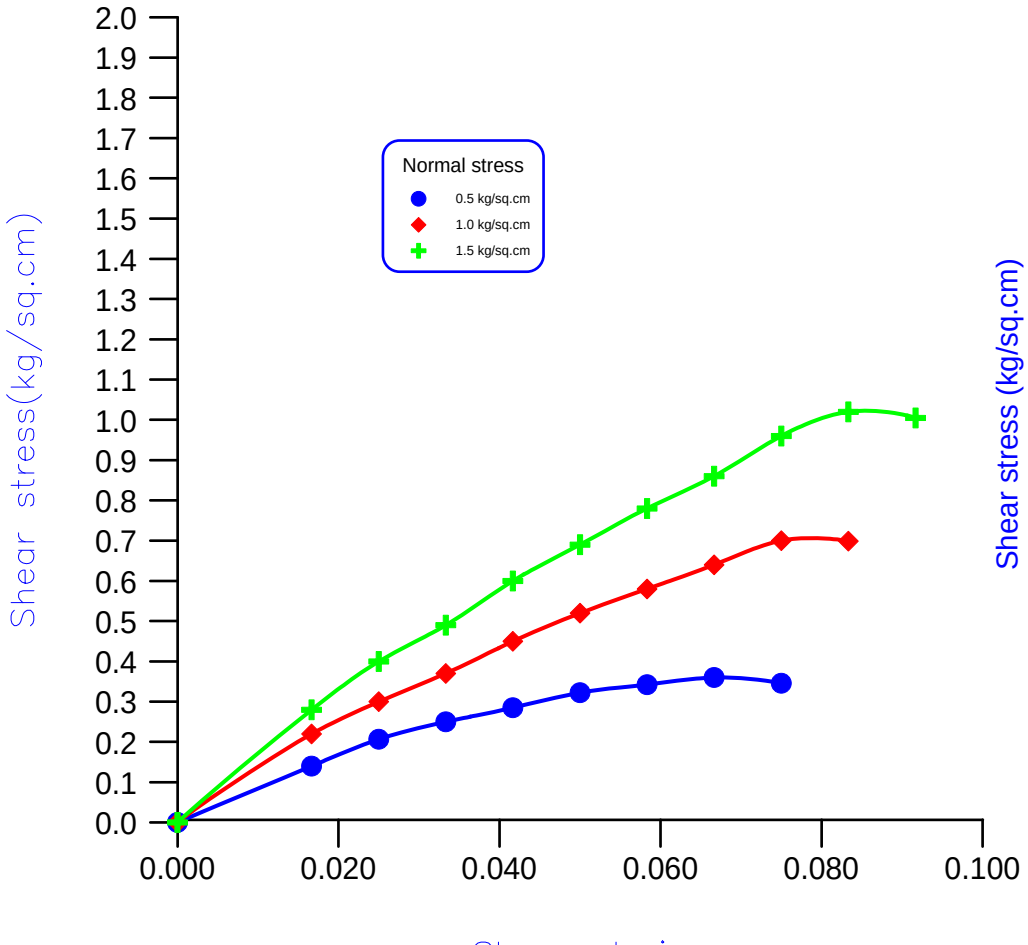
(Shear stress - shear strain relationship)



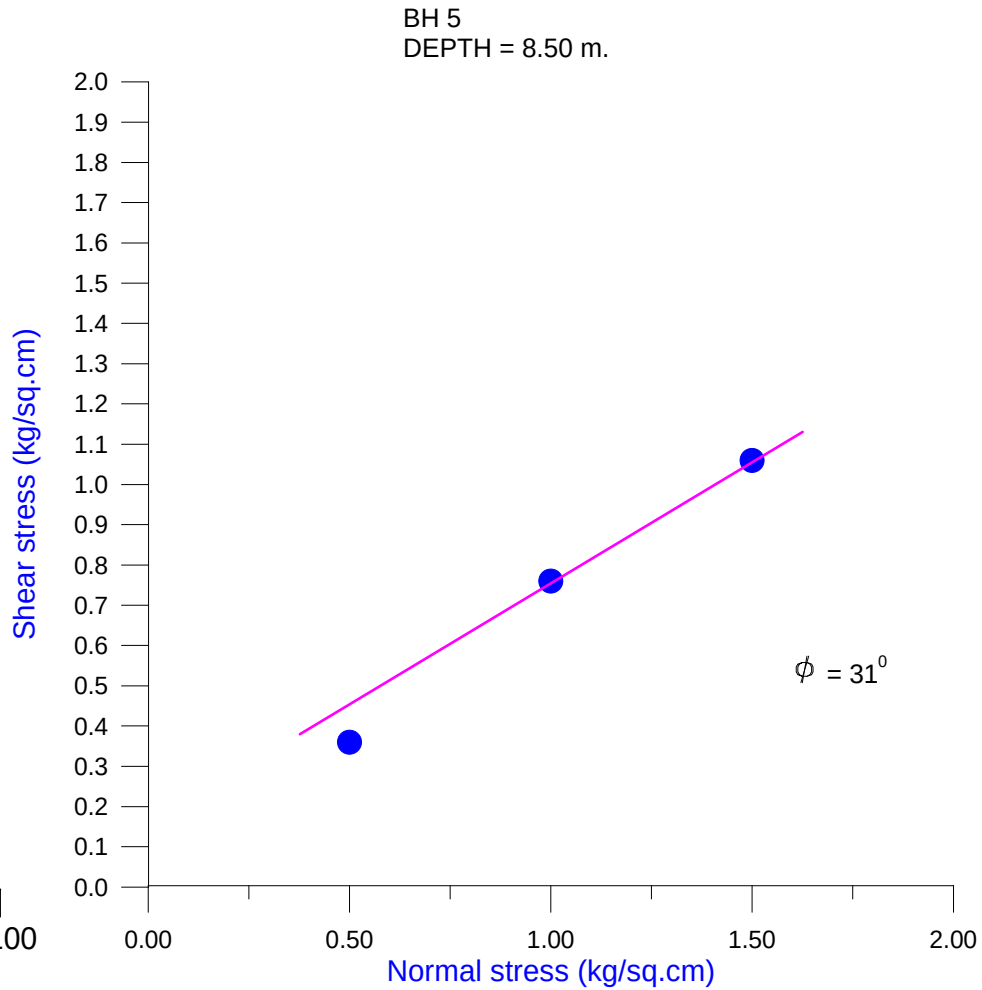
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

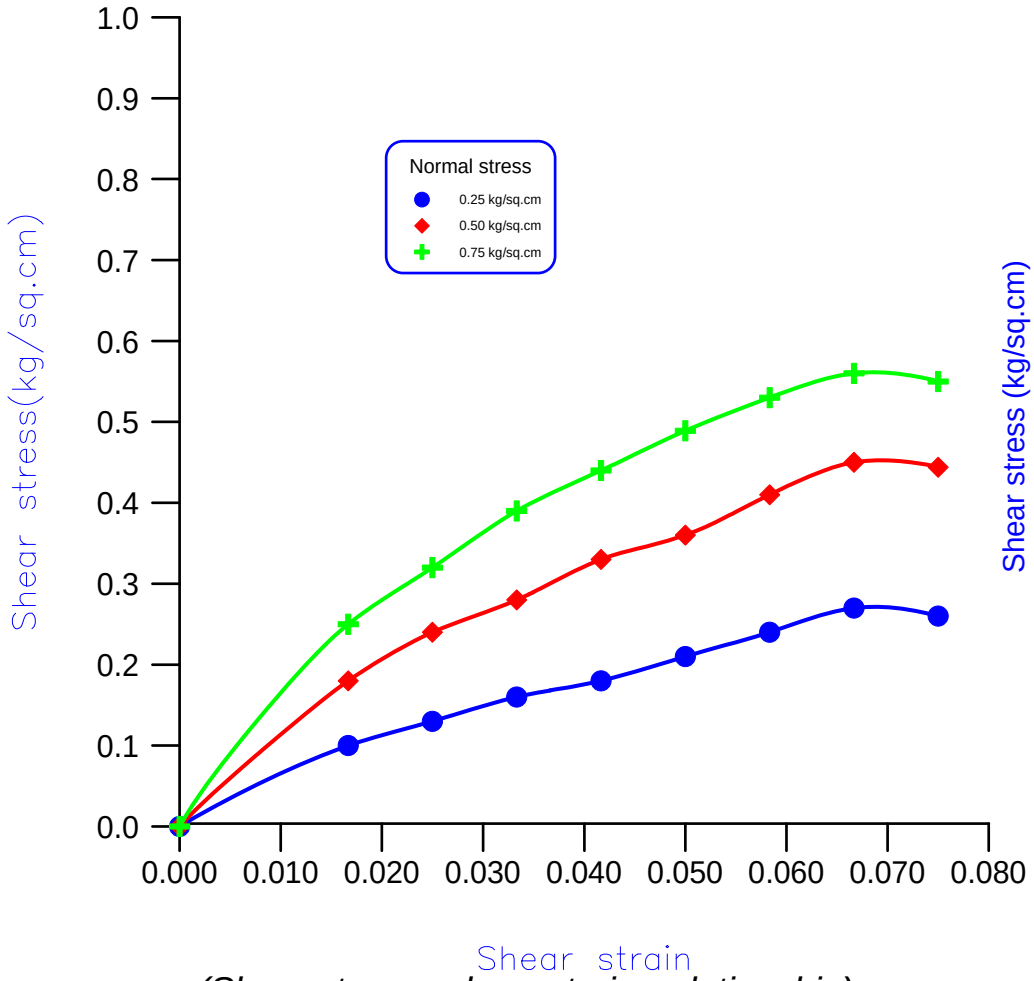
FIG- DS 5-2



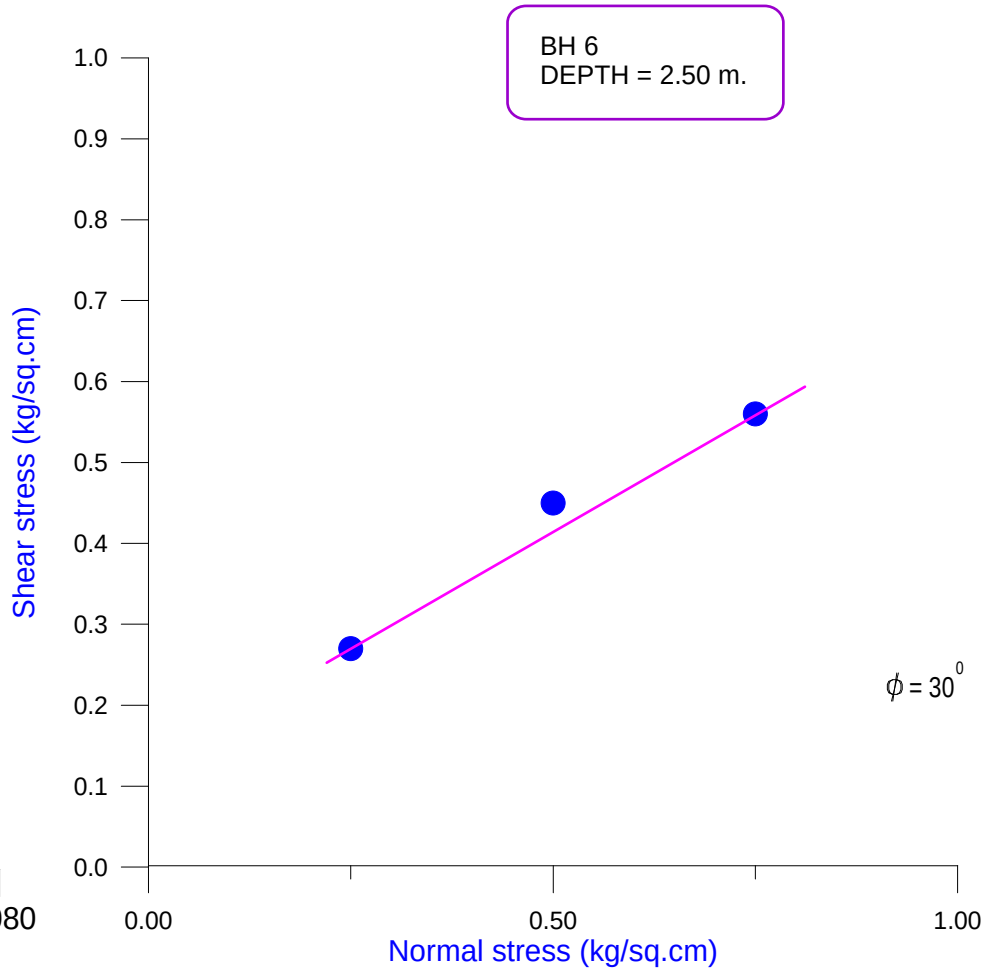
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



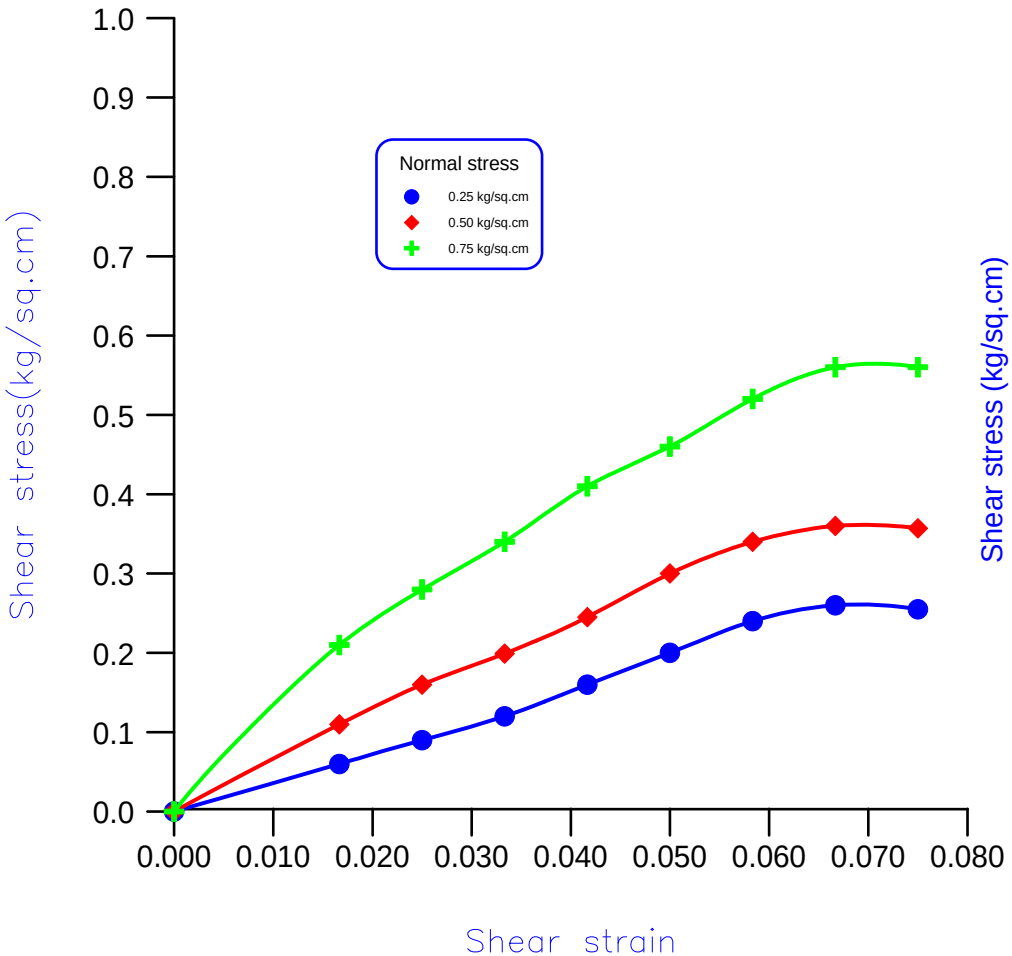
(Shear stress - shear strain relationship)



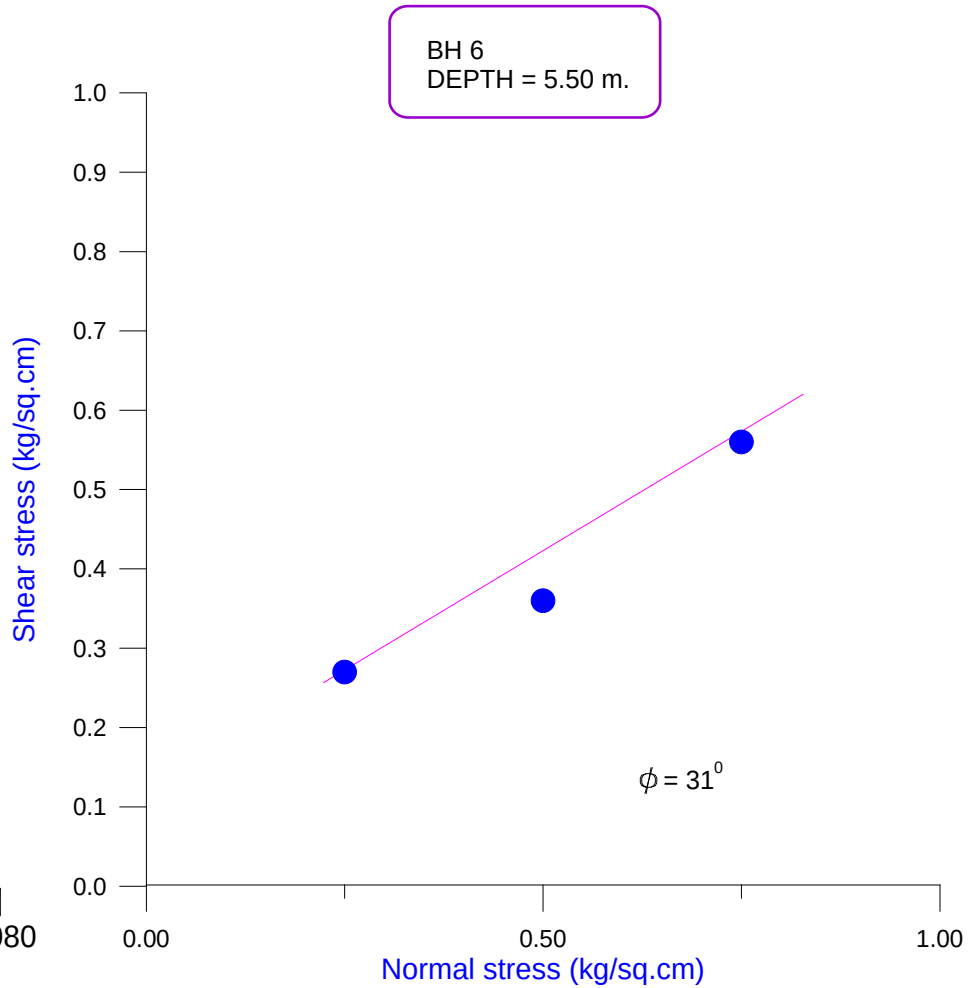
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

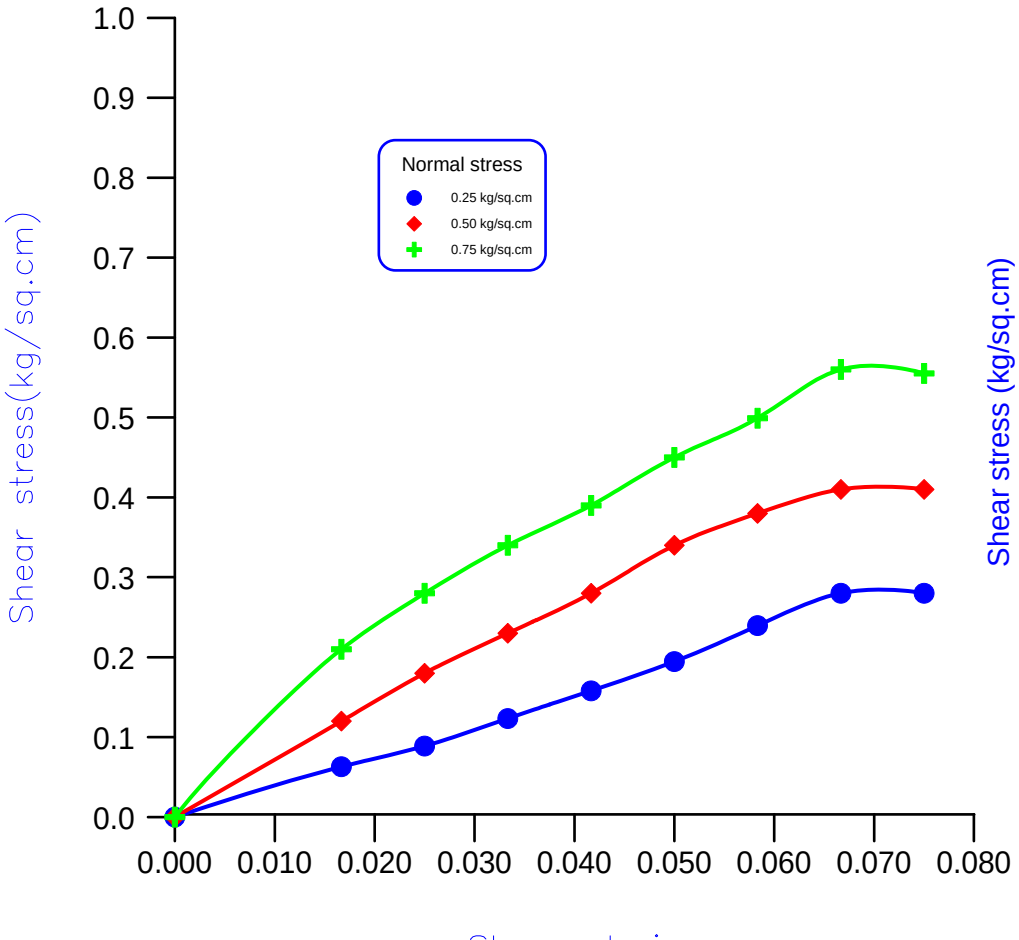
FIG- DS 6-1



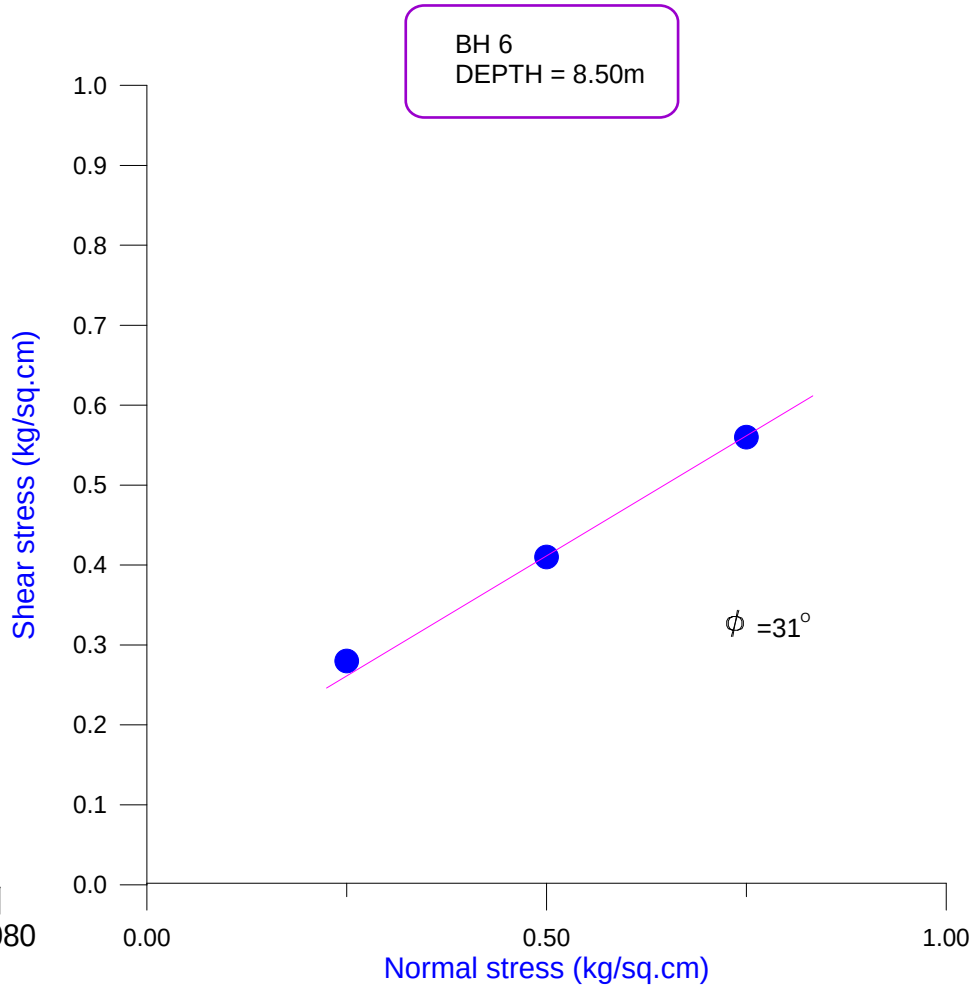
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



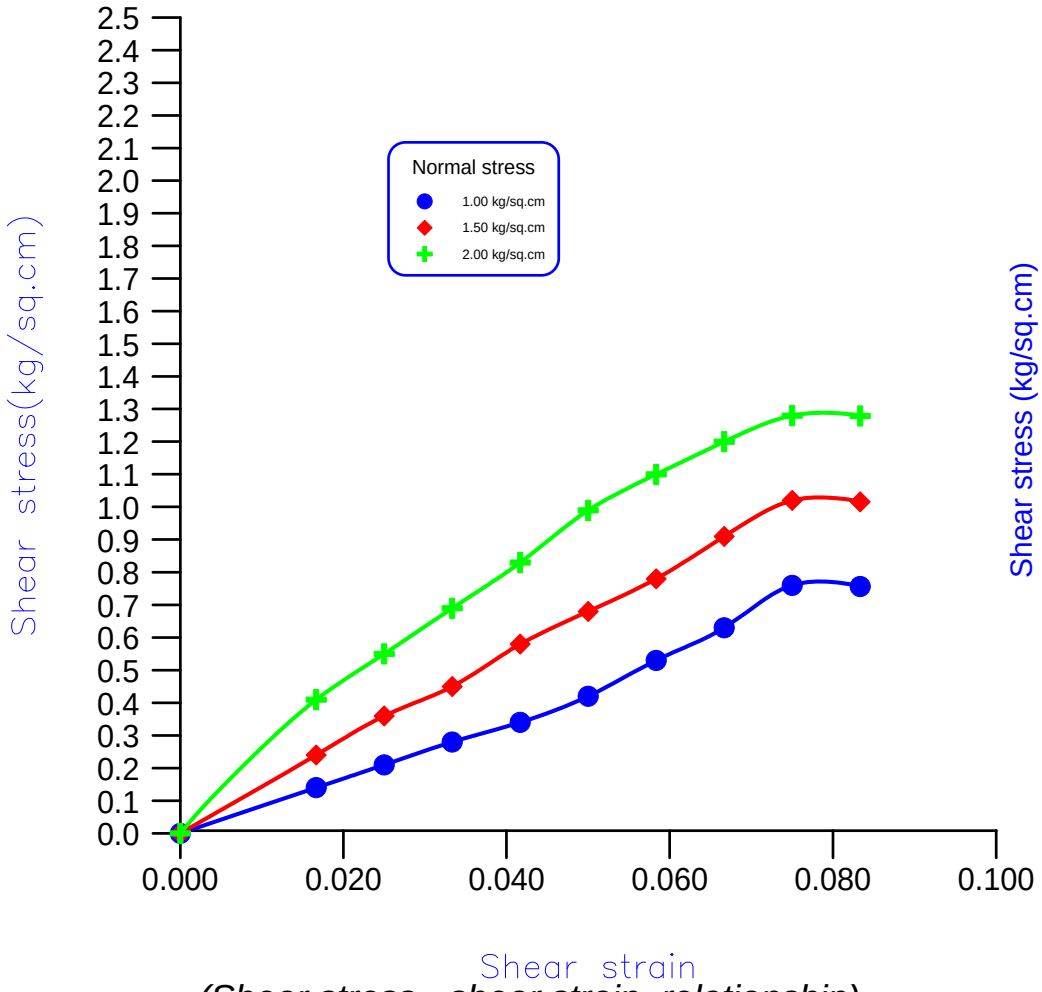
(Shear stress - shear strain relationship)



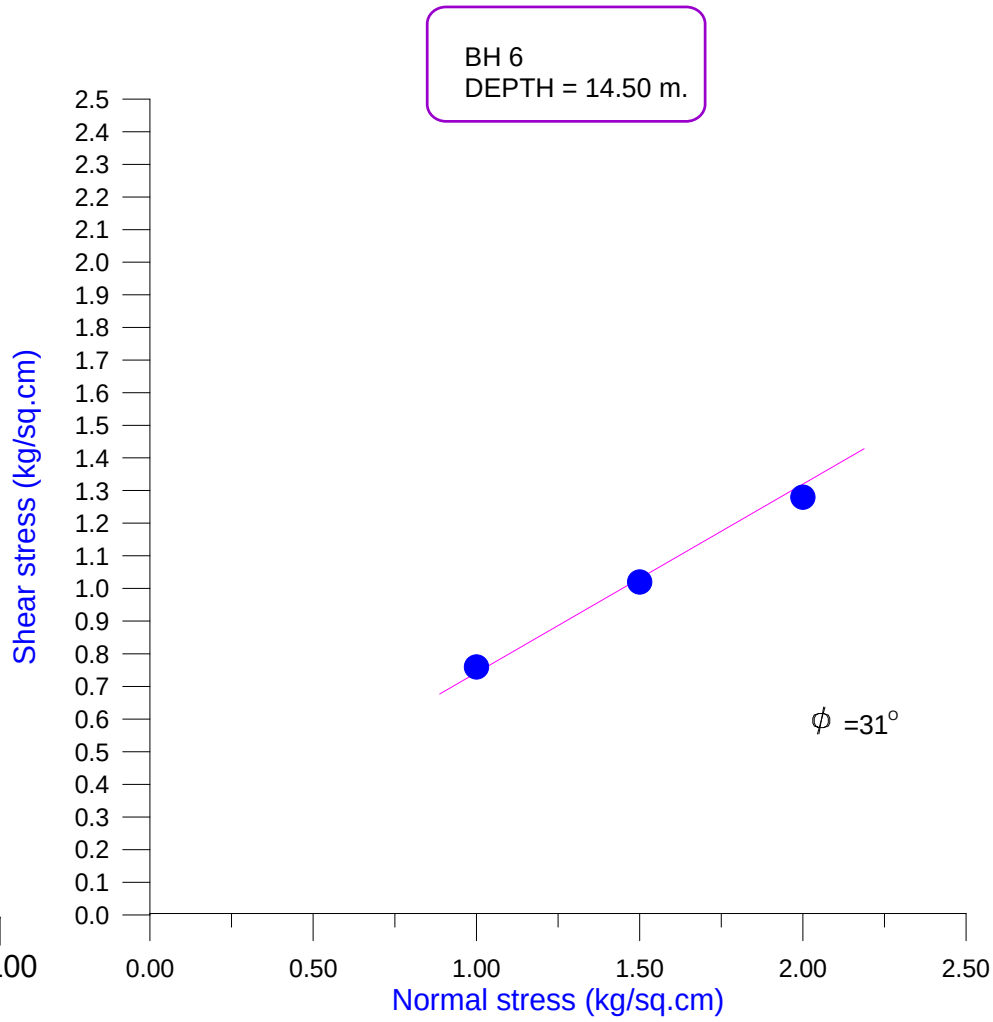
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

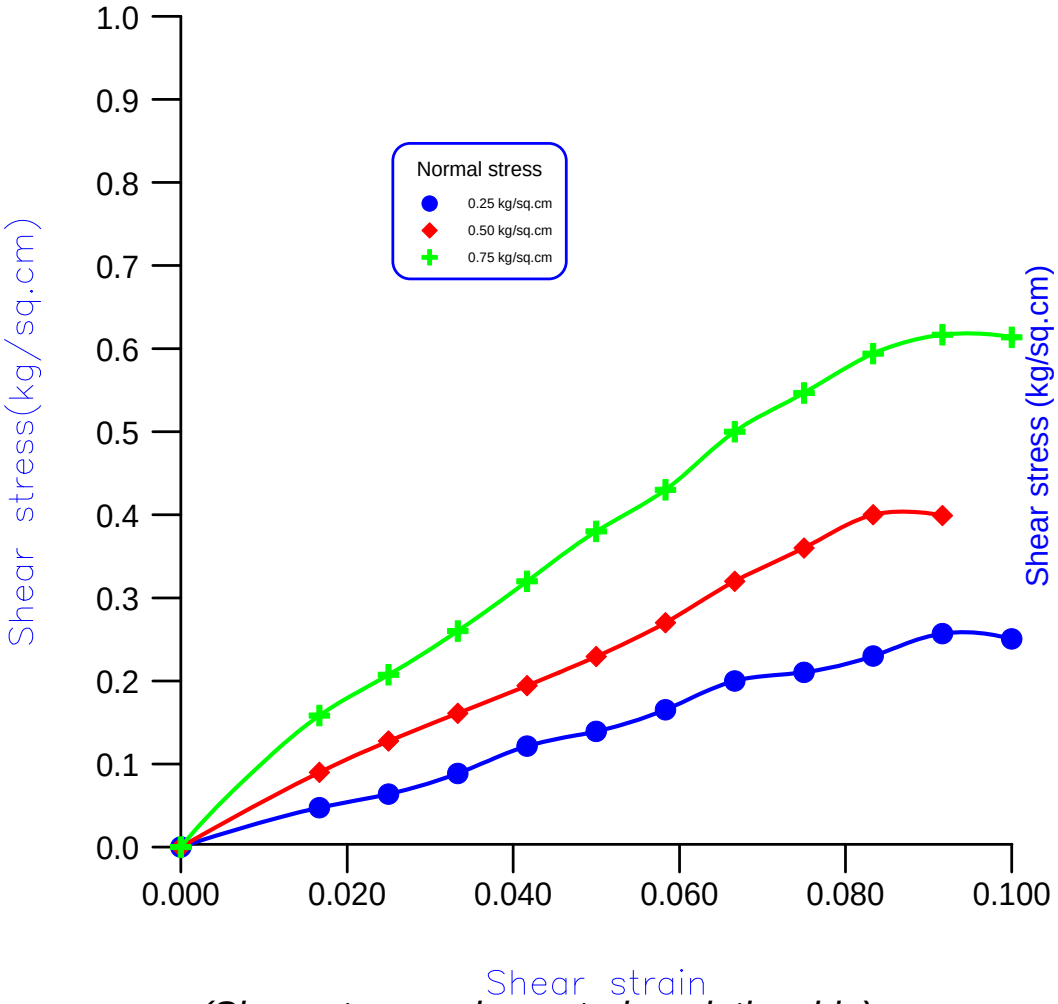
FIG- DS 6-3



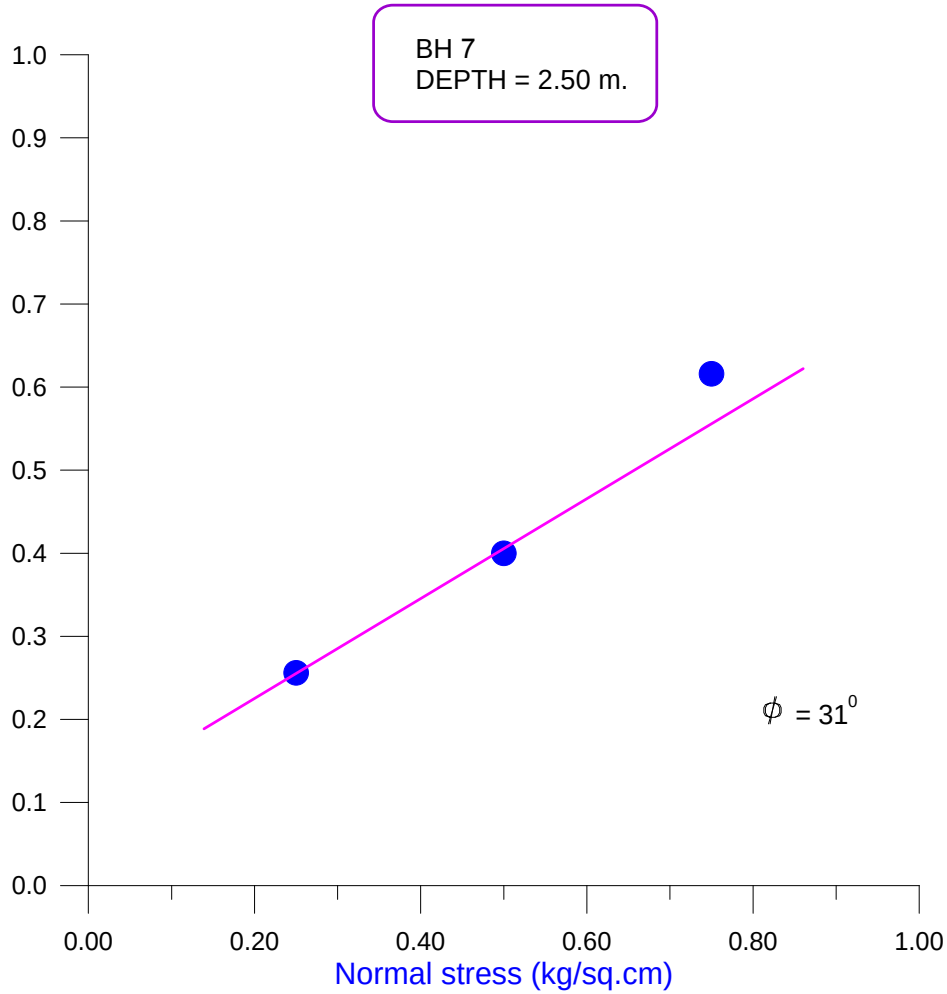
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



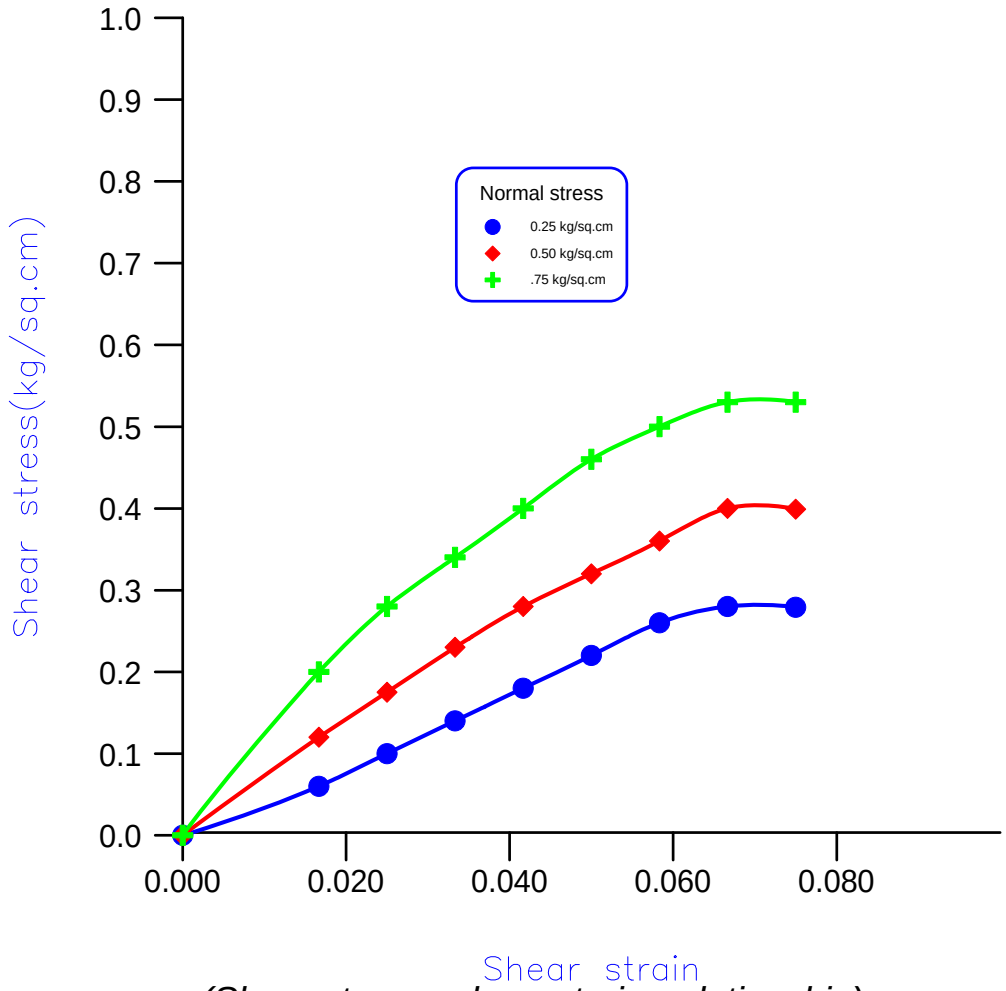
(Shear stress - shear strain relationship)



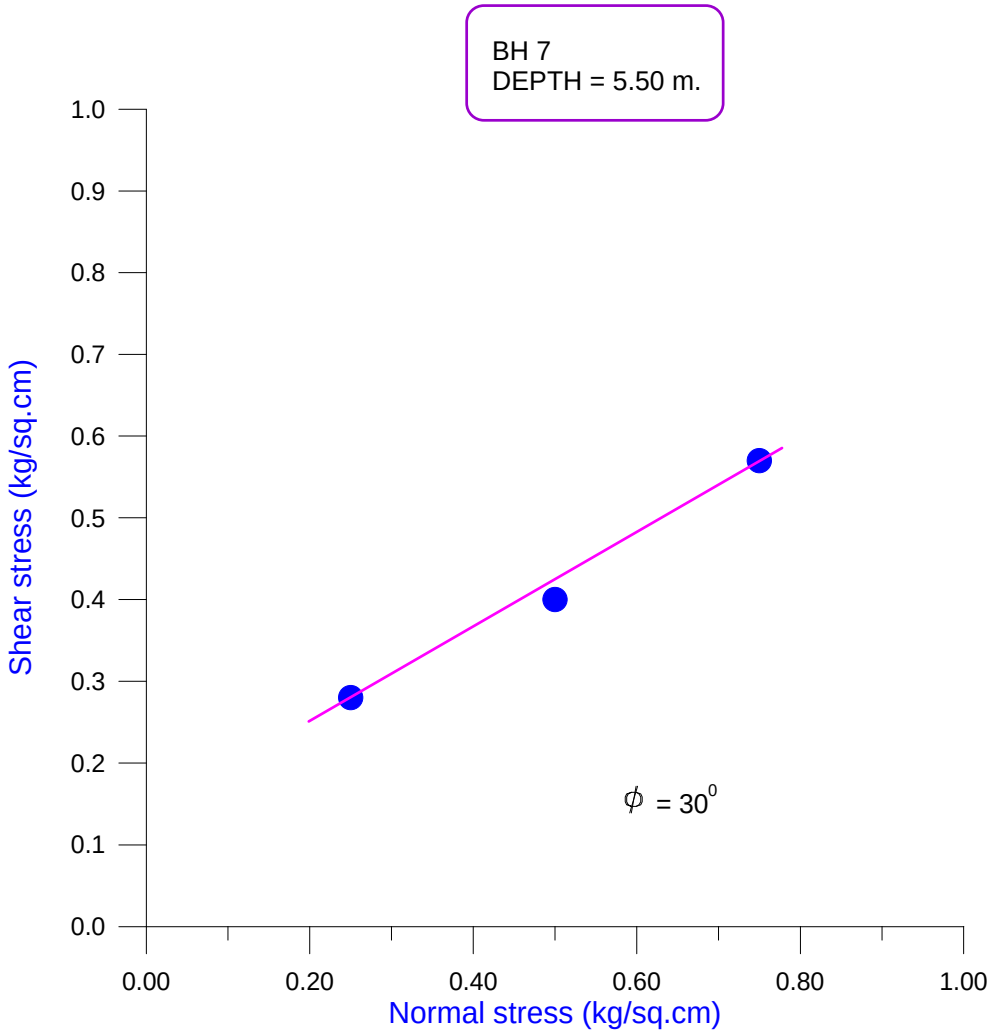
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 45-1



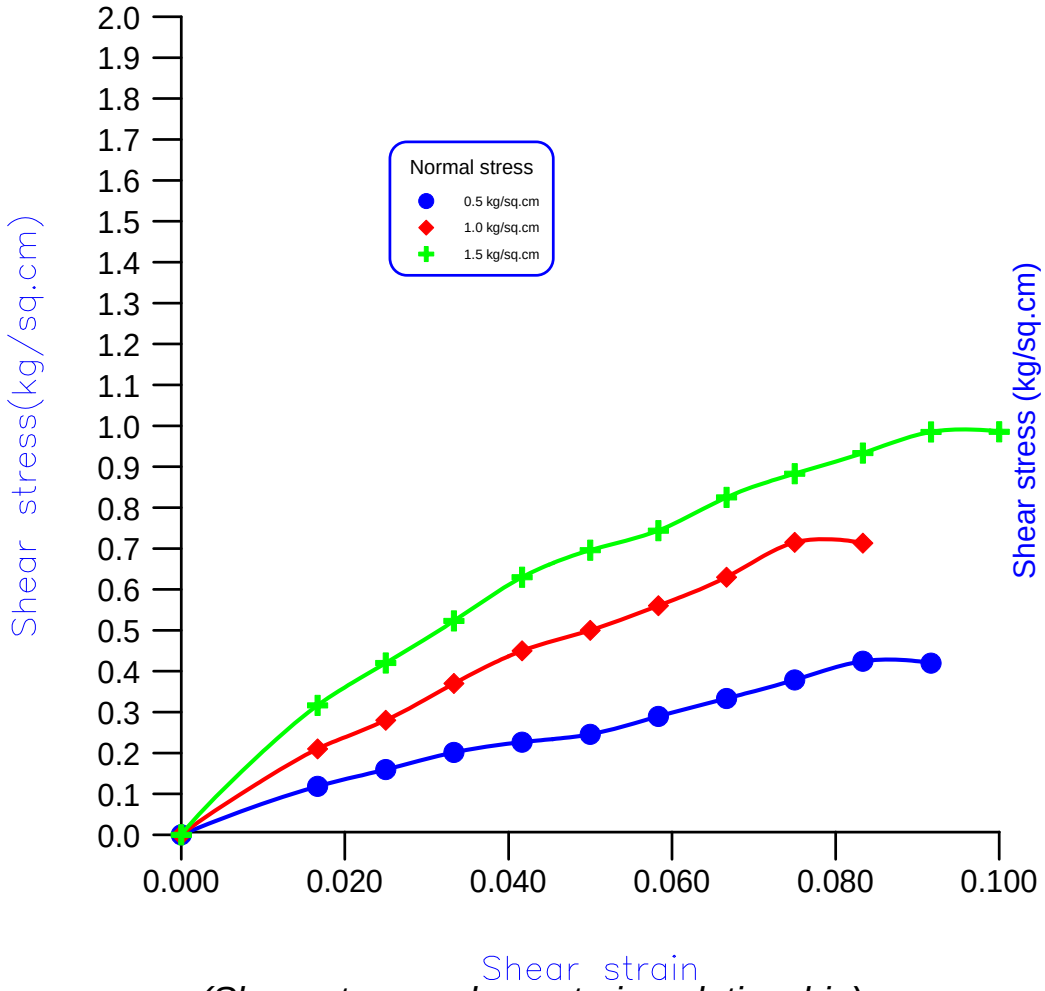
(Shear stress - shear strain relationship)



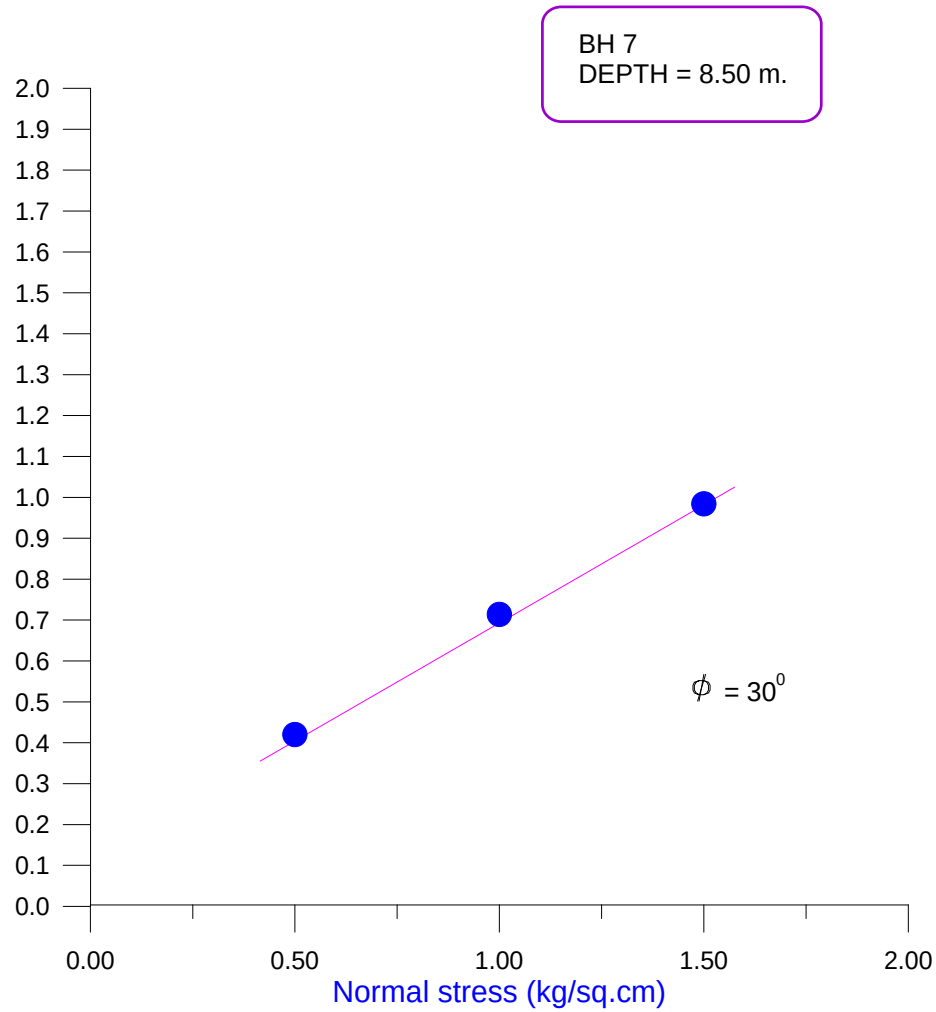
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

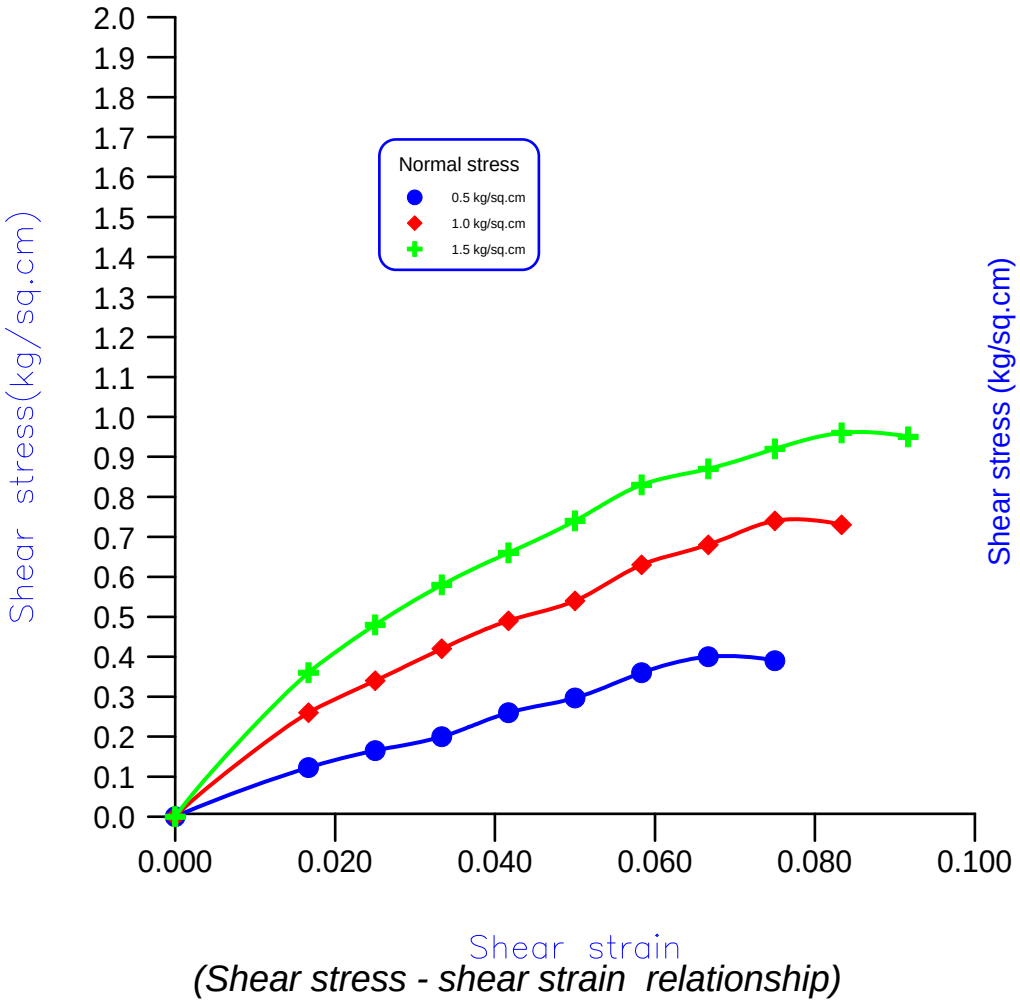
FIG- DS 7-2



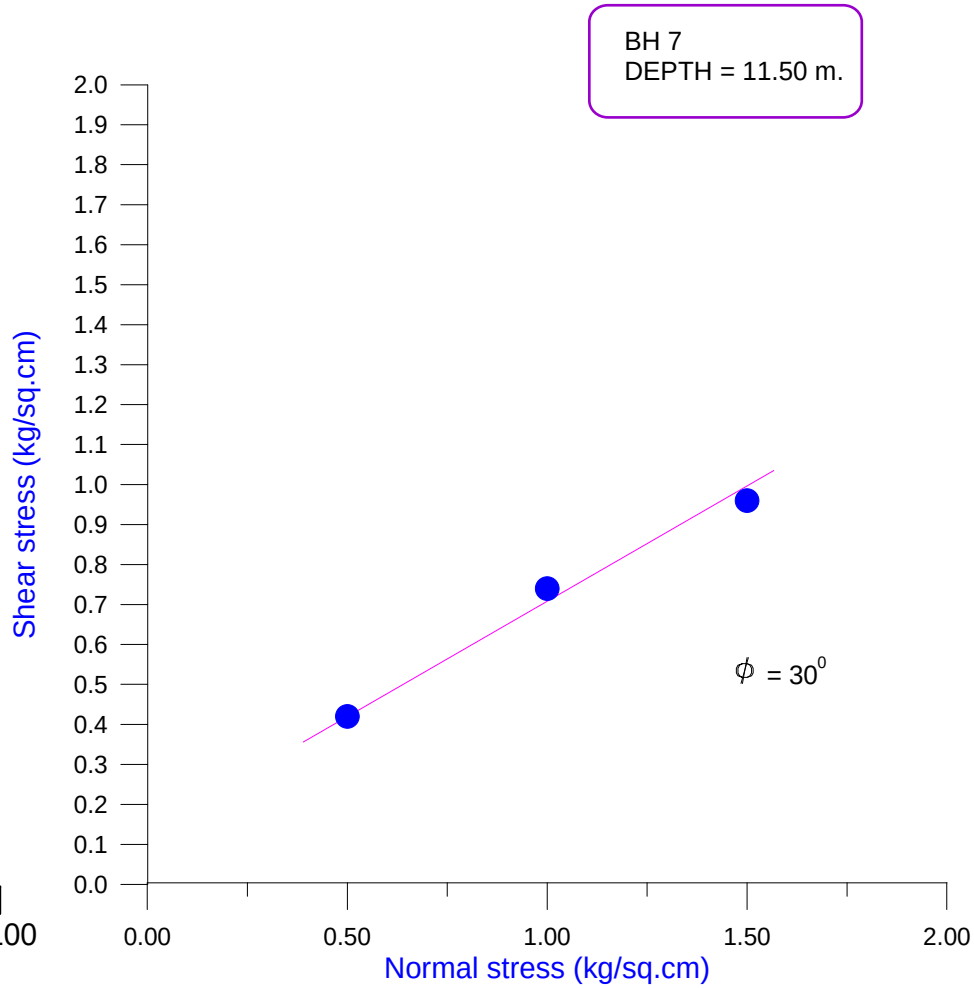
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



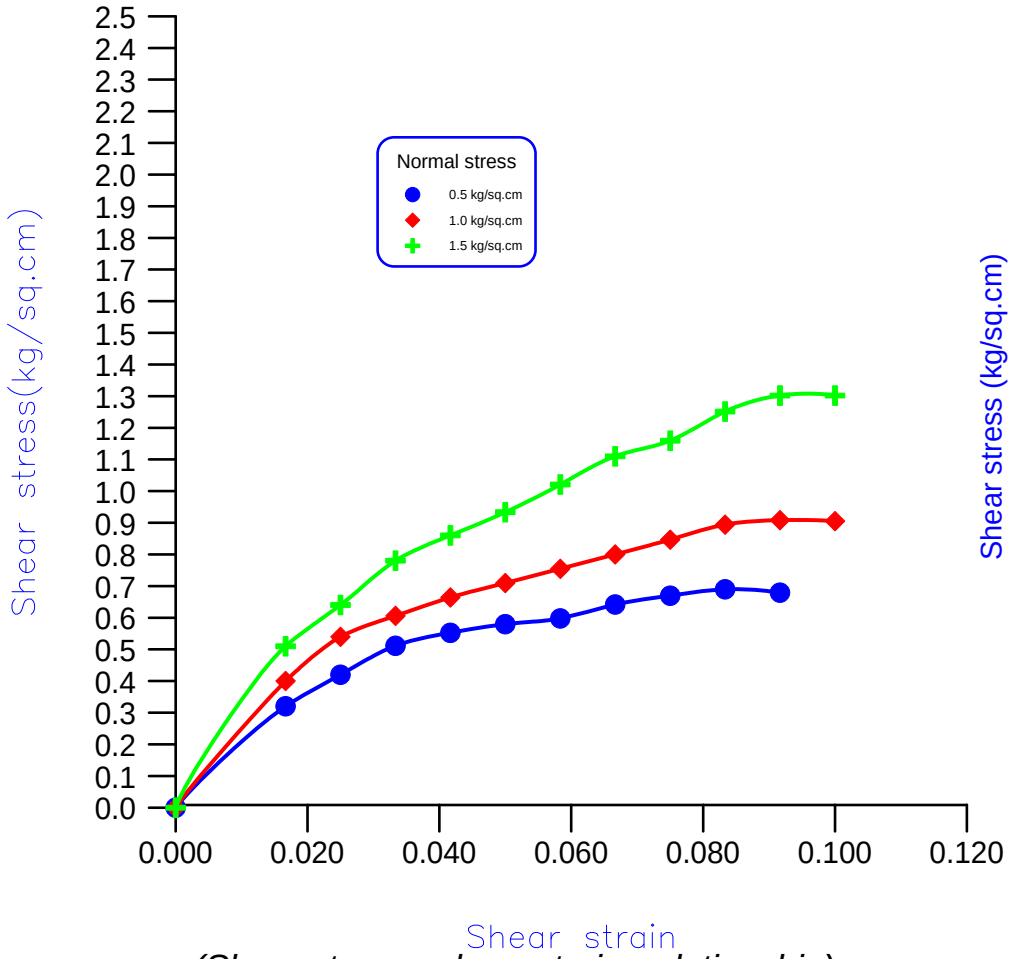
(Shear stress - shear strain relationship)



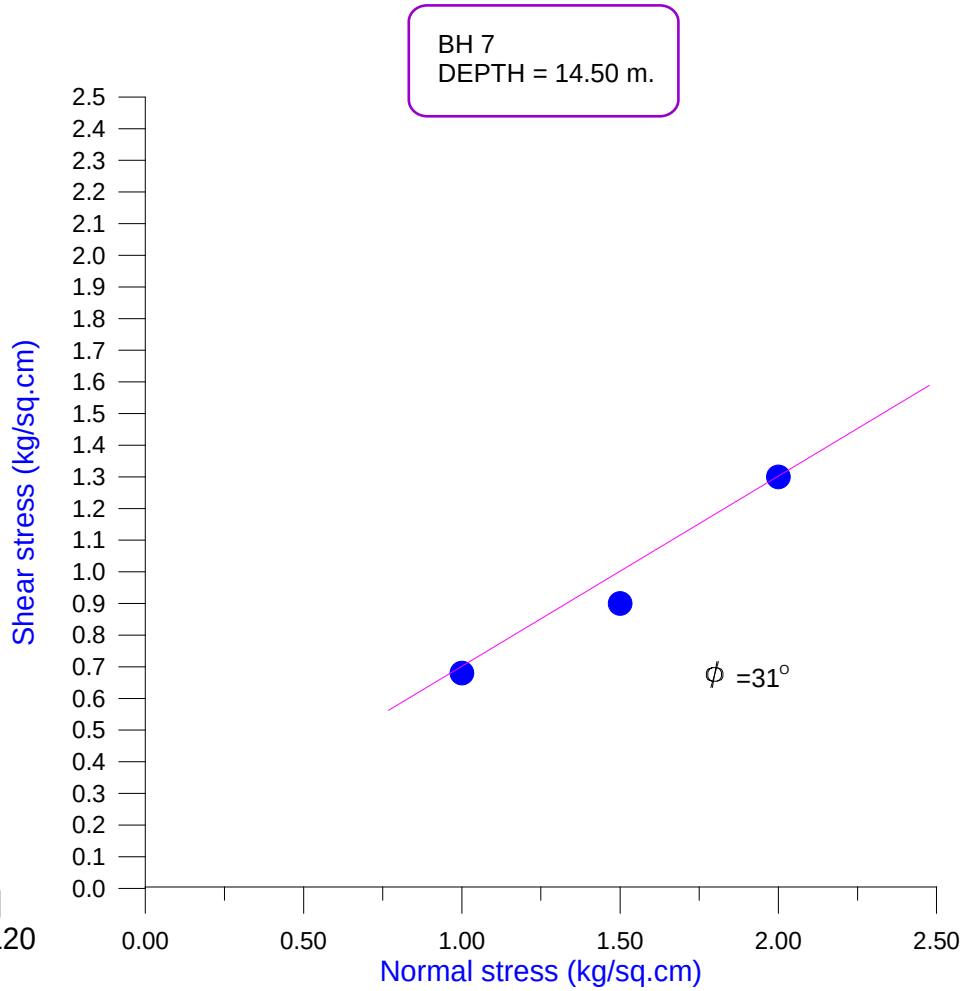
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

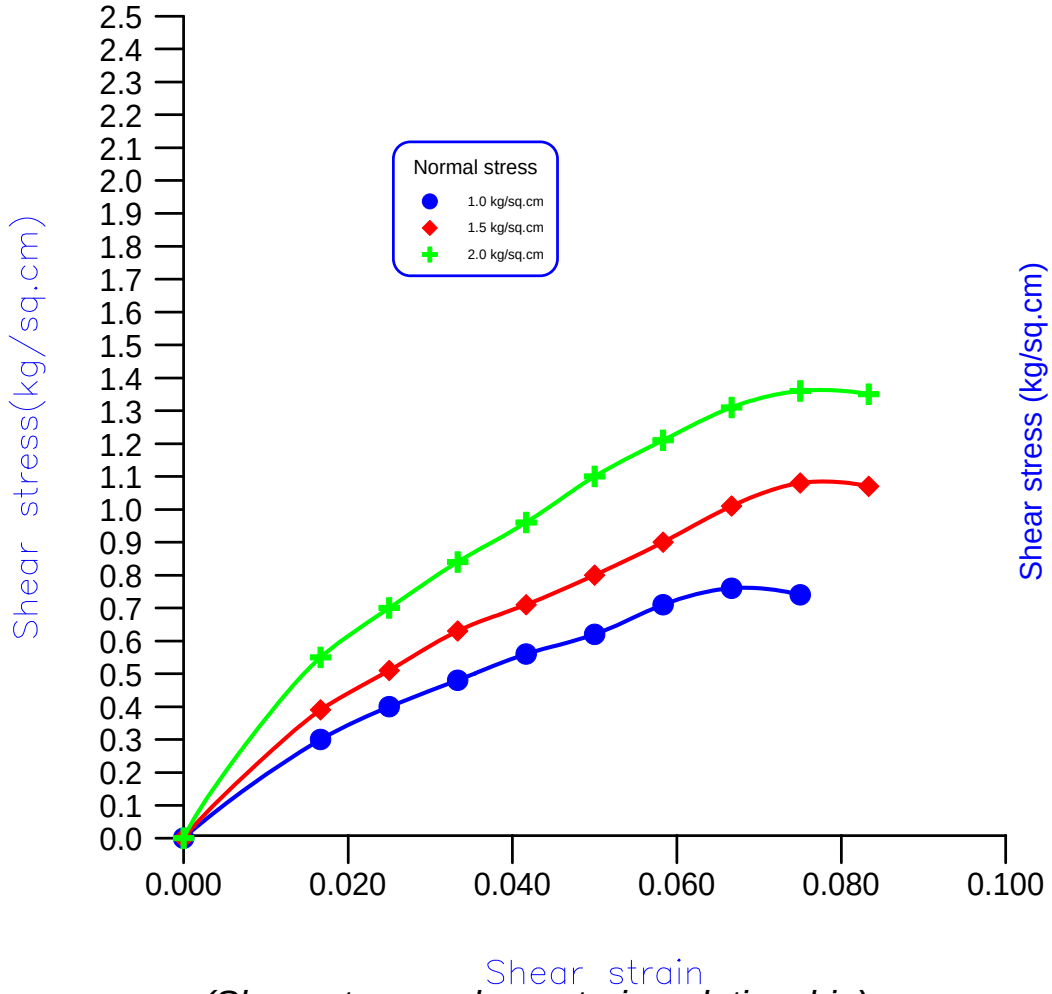
FIG- 7-4



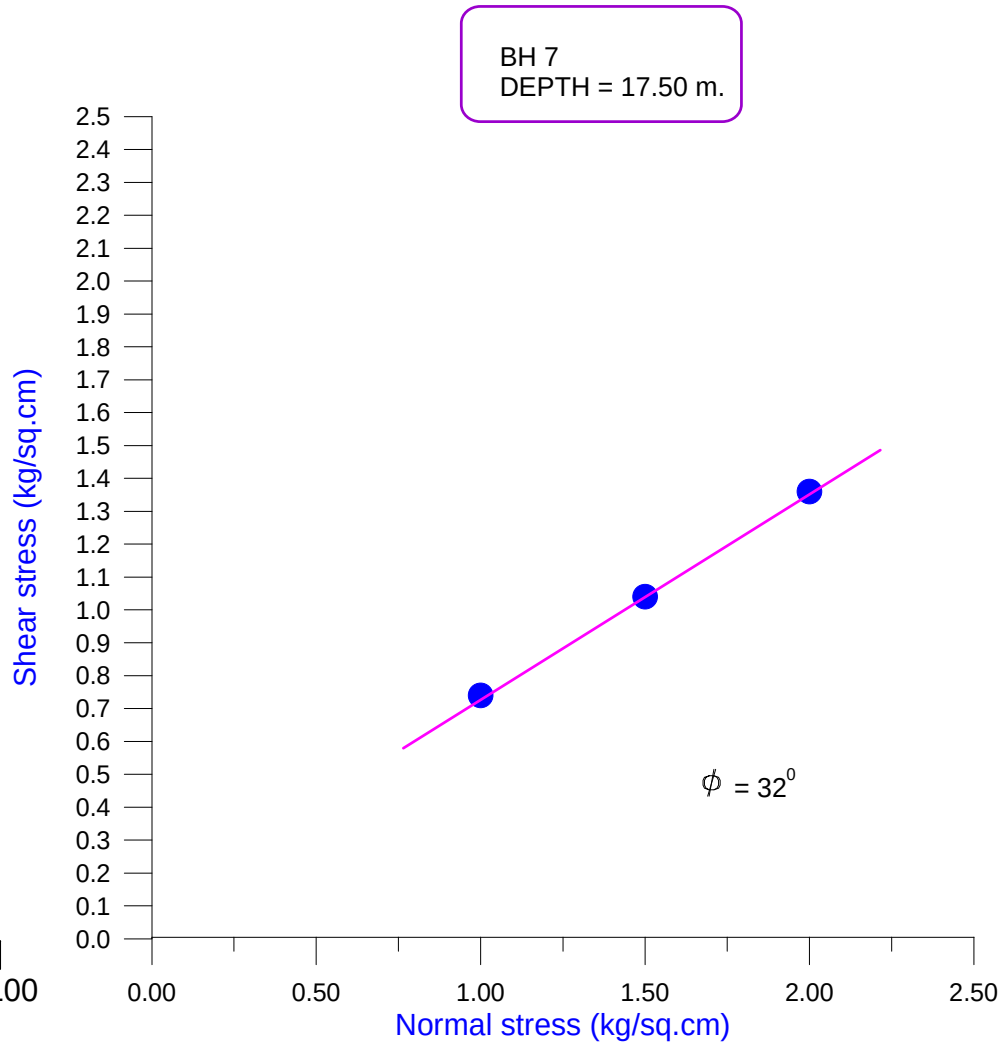
(Shear stress - shear strain relationship)



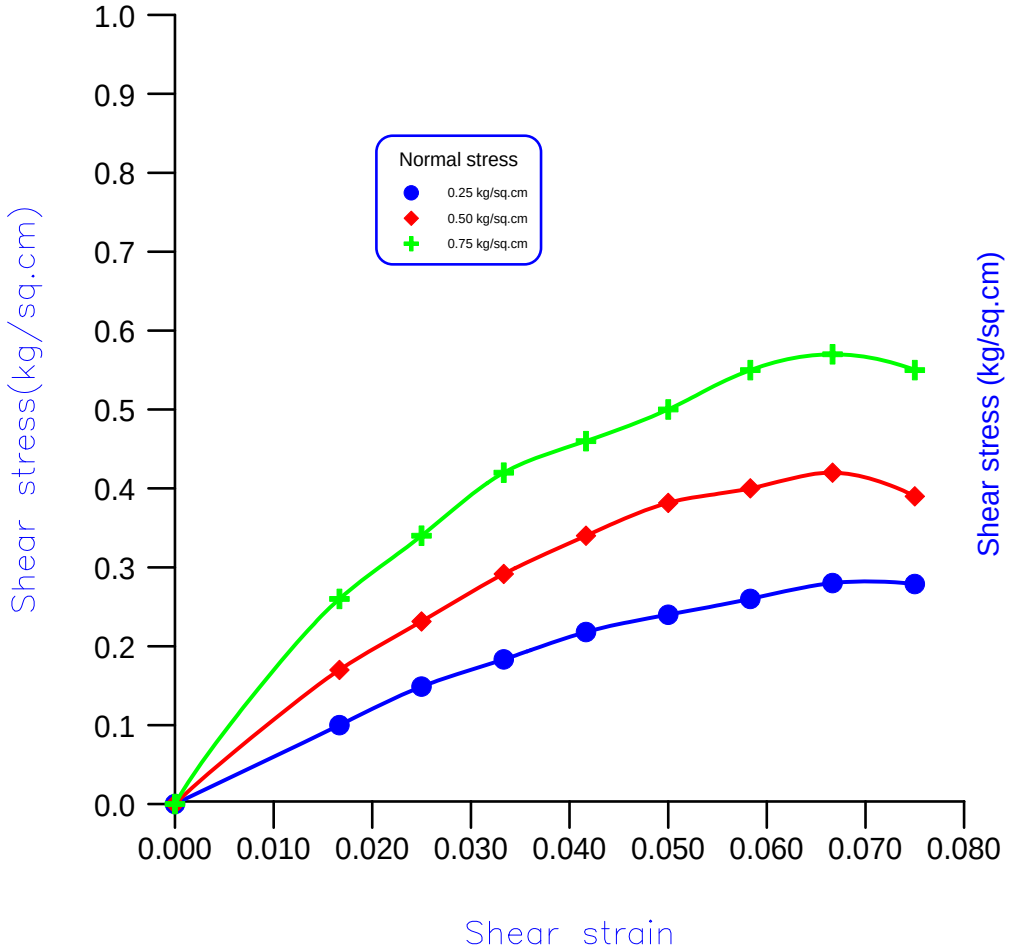
(Shear stress - Normal stress relationship)



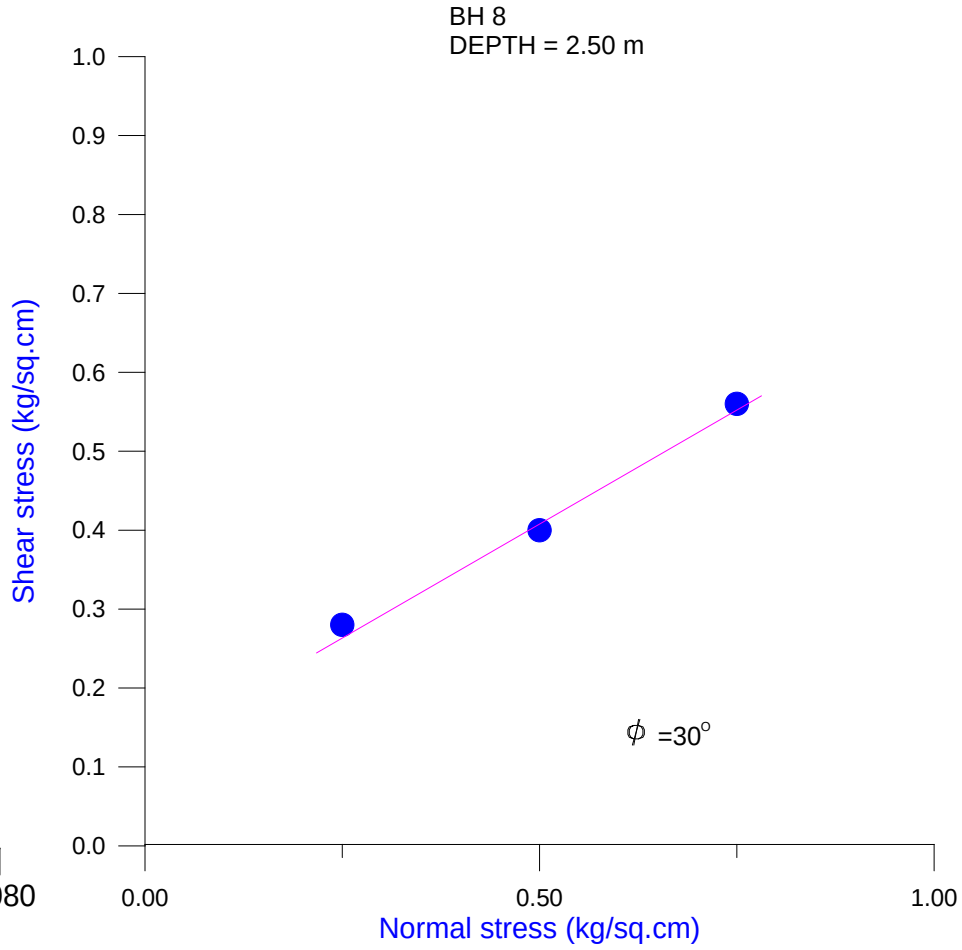
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



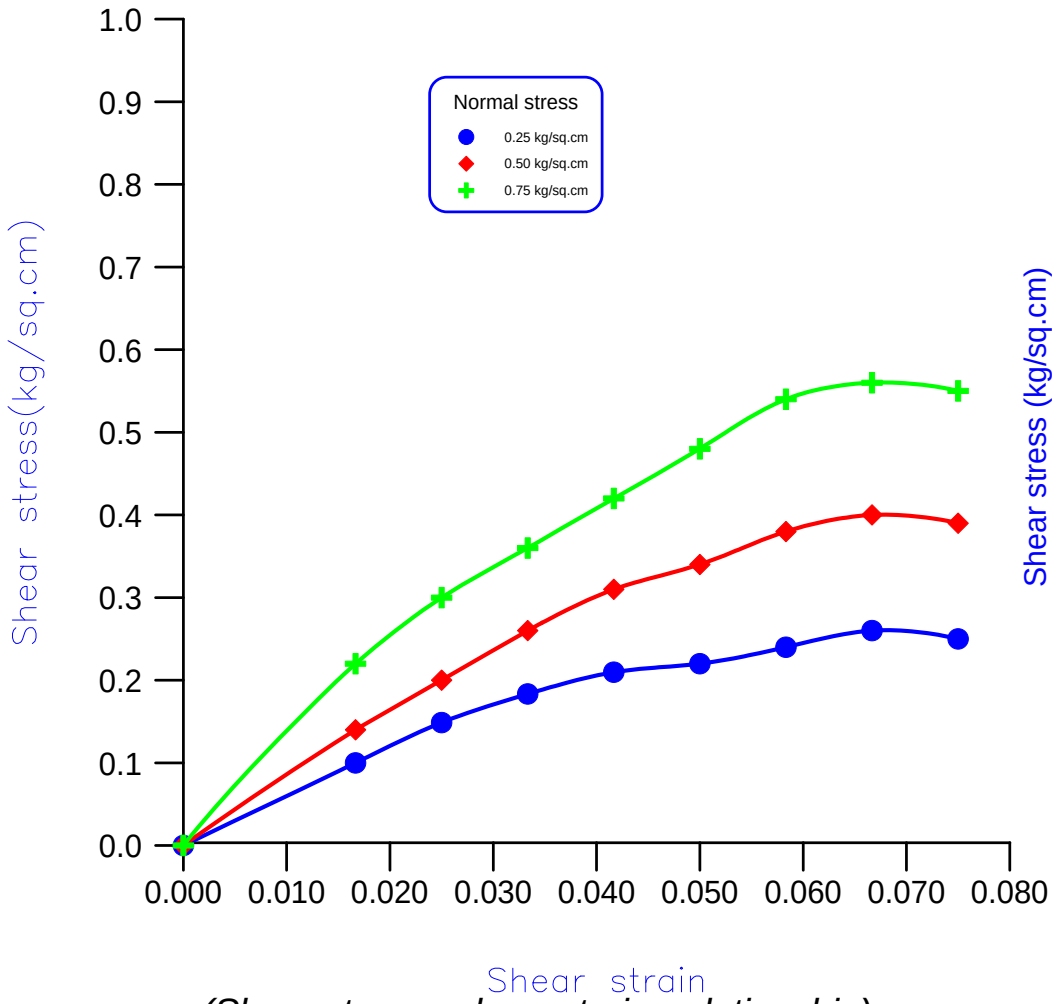
(Shear stress - shear strain relationship)



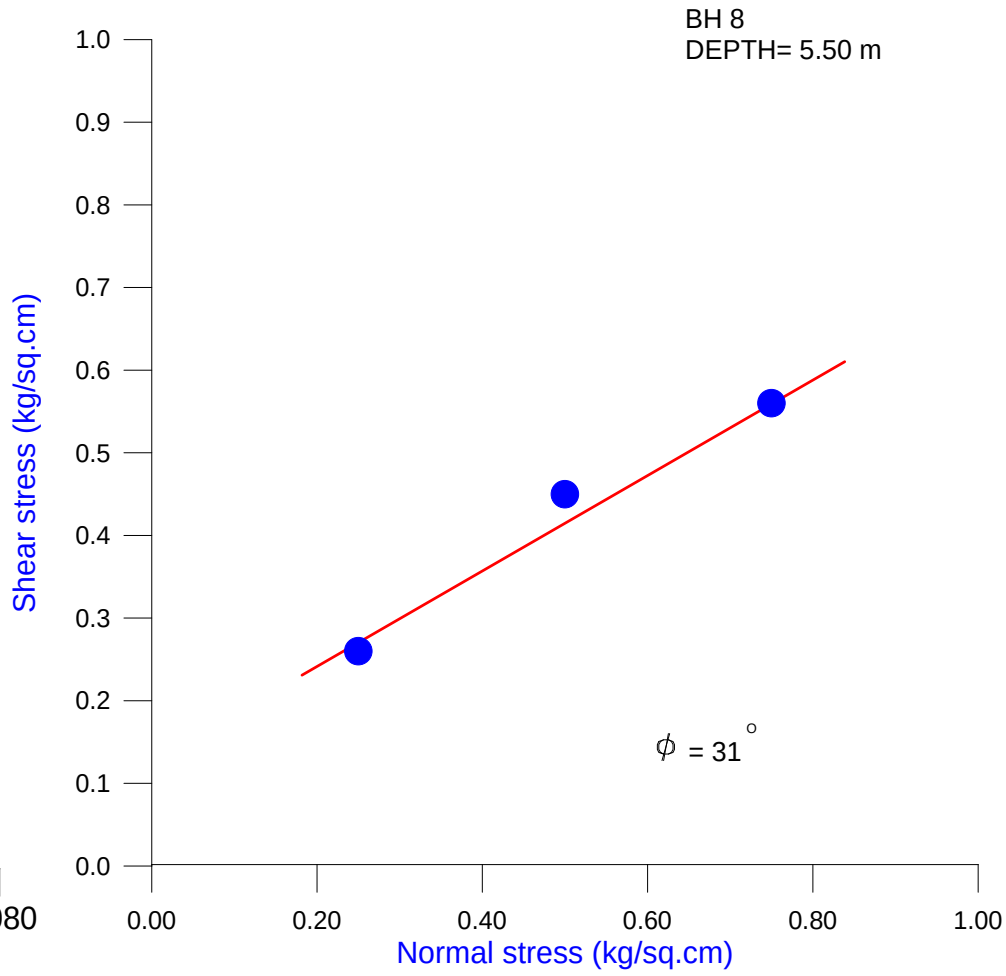
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 8-1



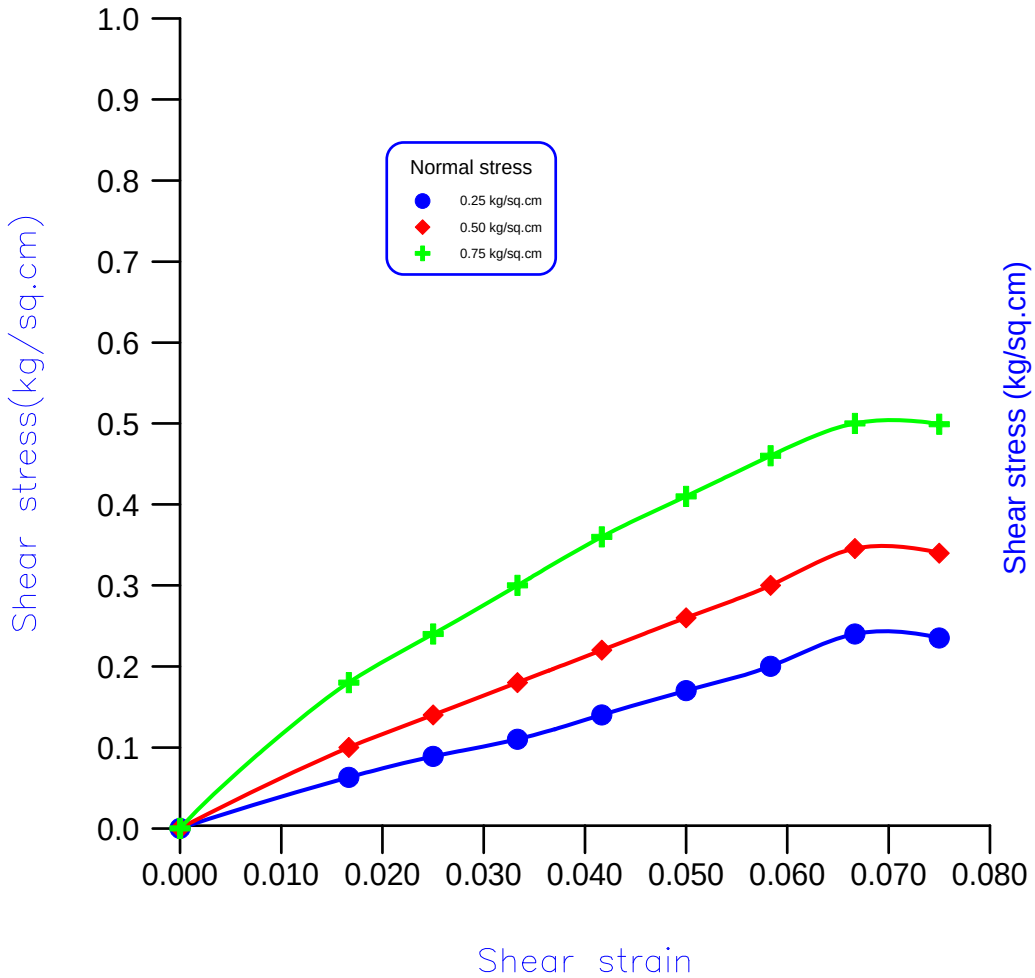
(Shear stress - shear strain relationship)



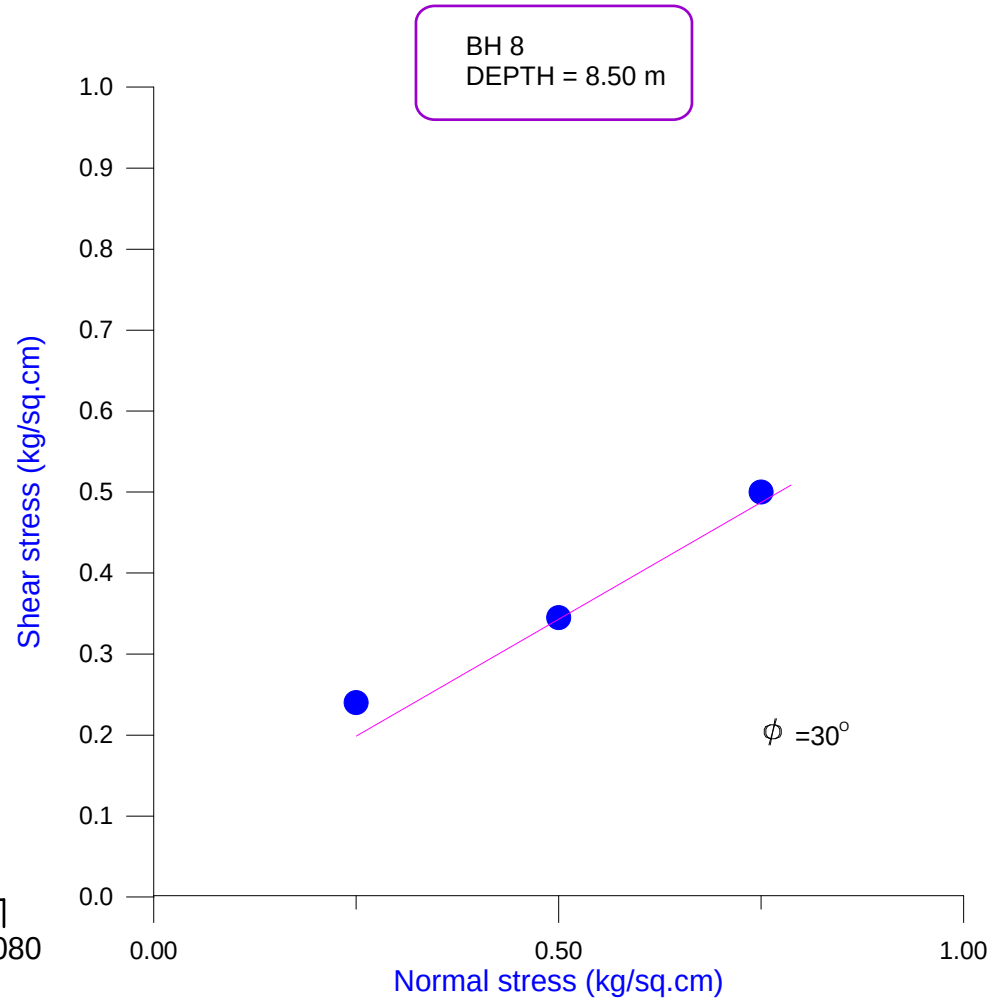
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 8-2



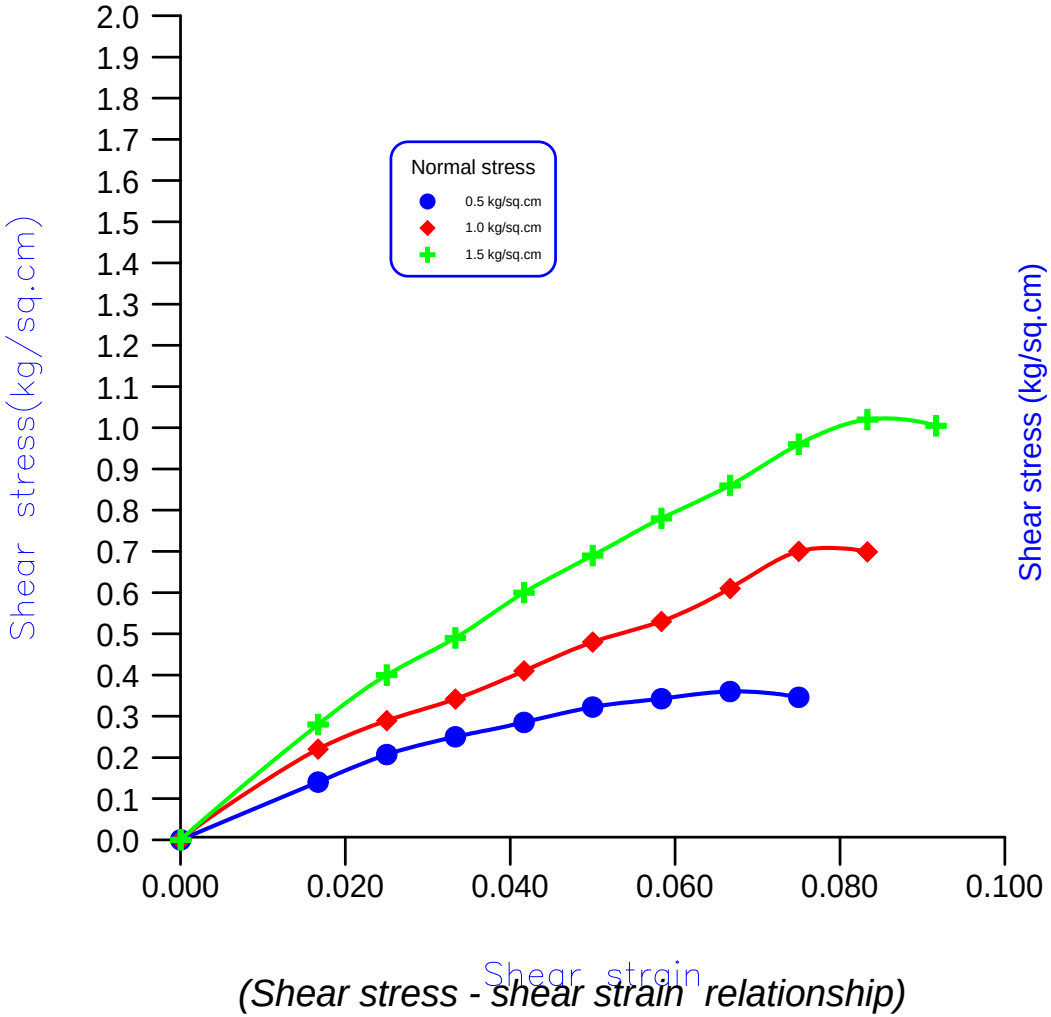
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)

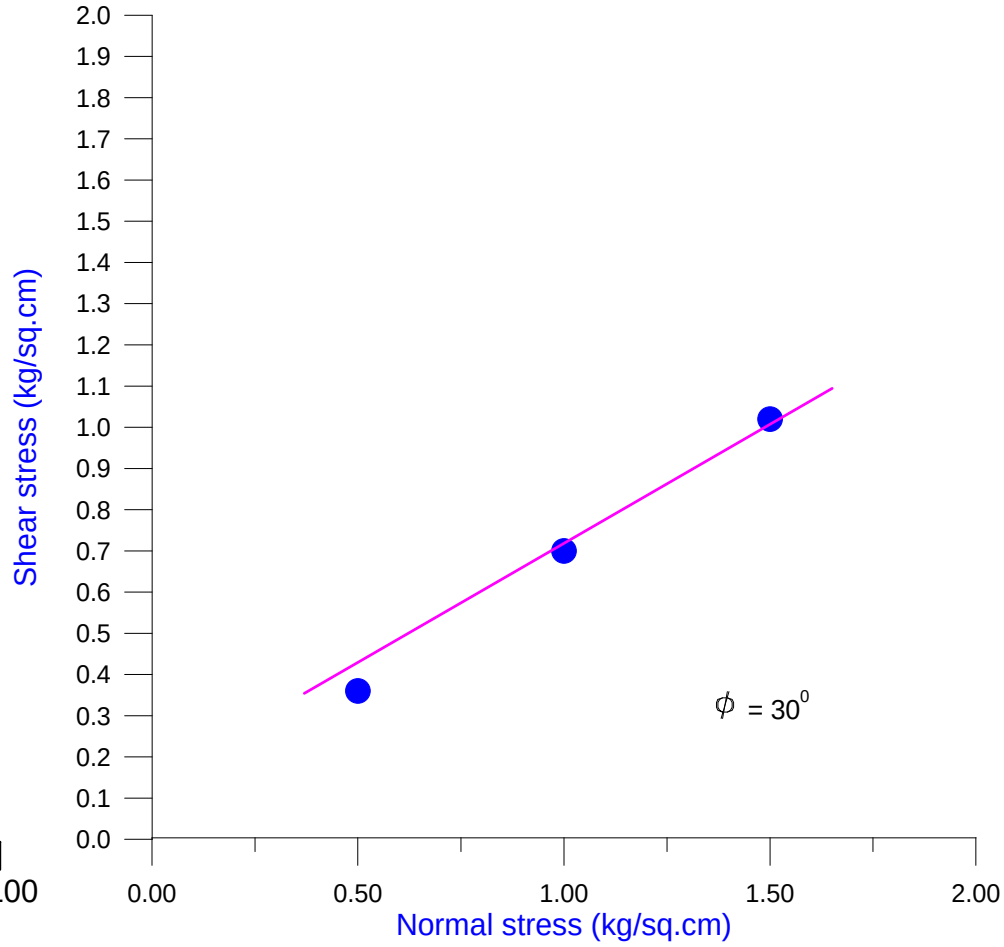
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 8-3



(Shear stress - shear strain relationship)

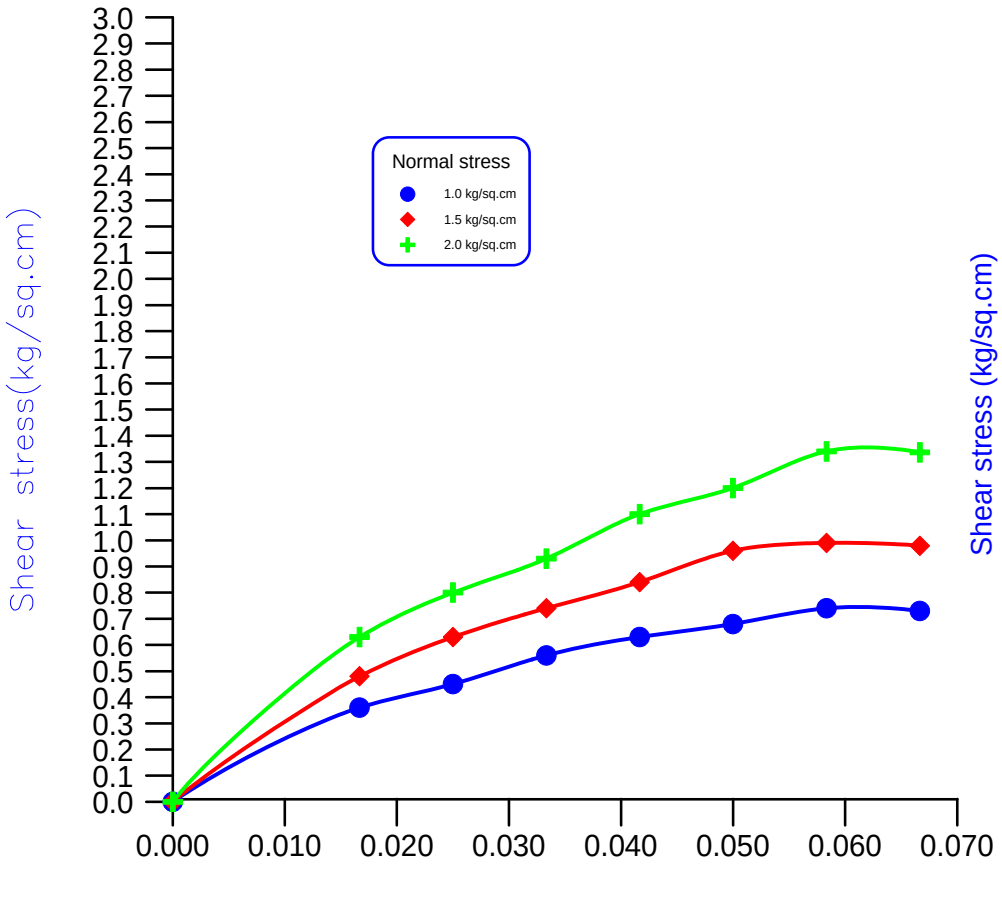
BH 8
DEPTH = 14.50 m.



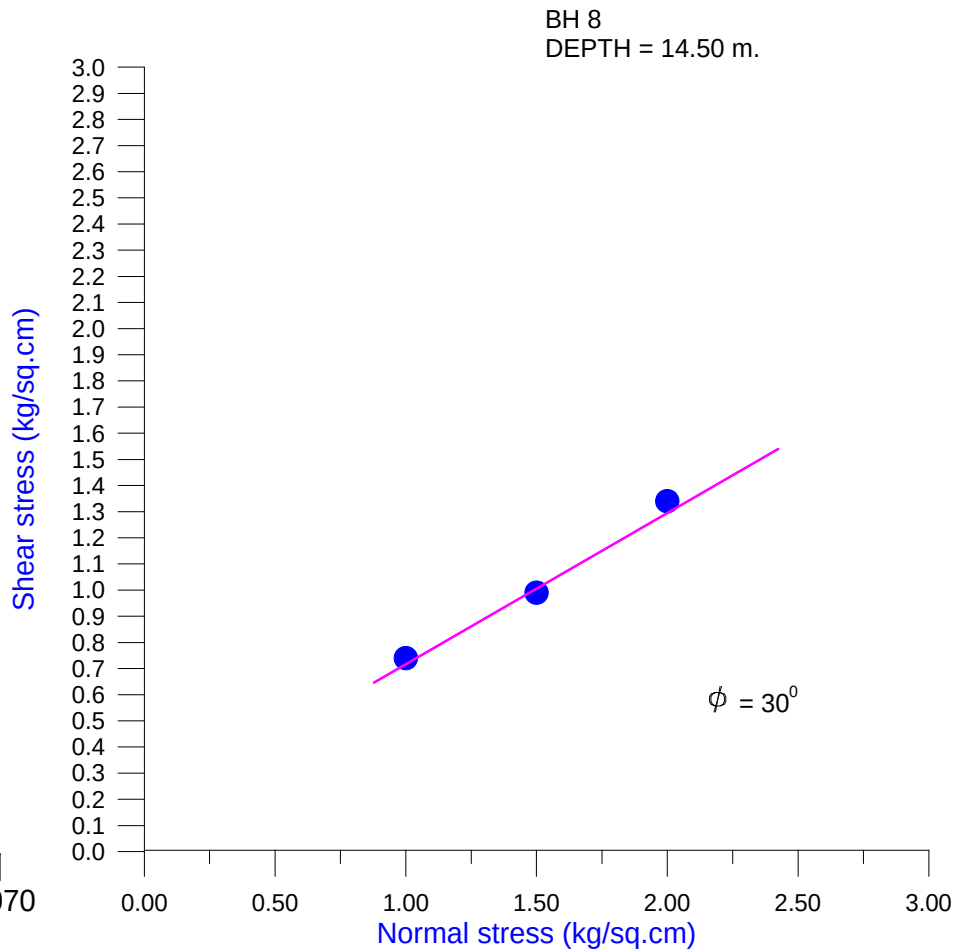
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 8-4



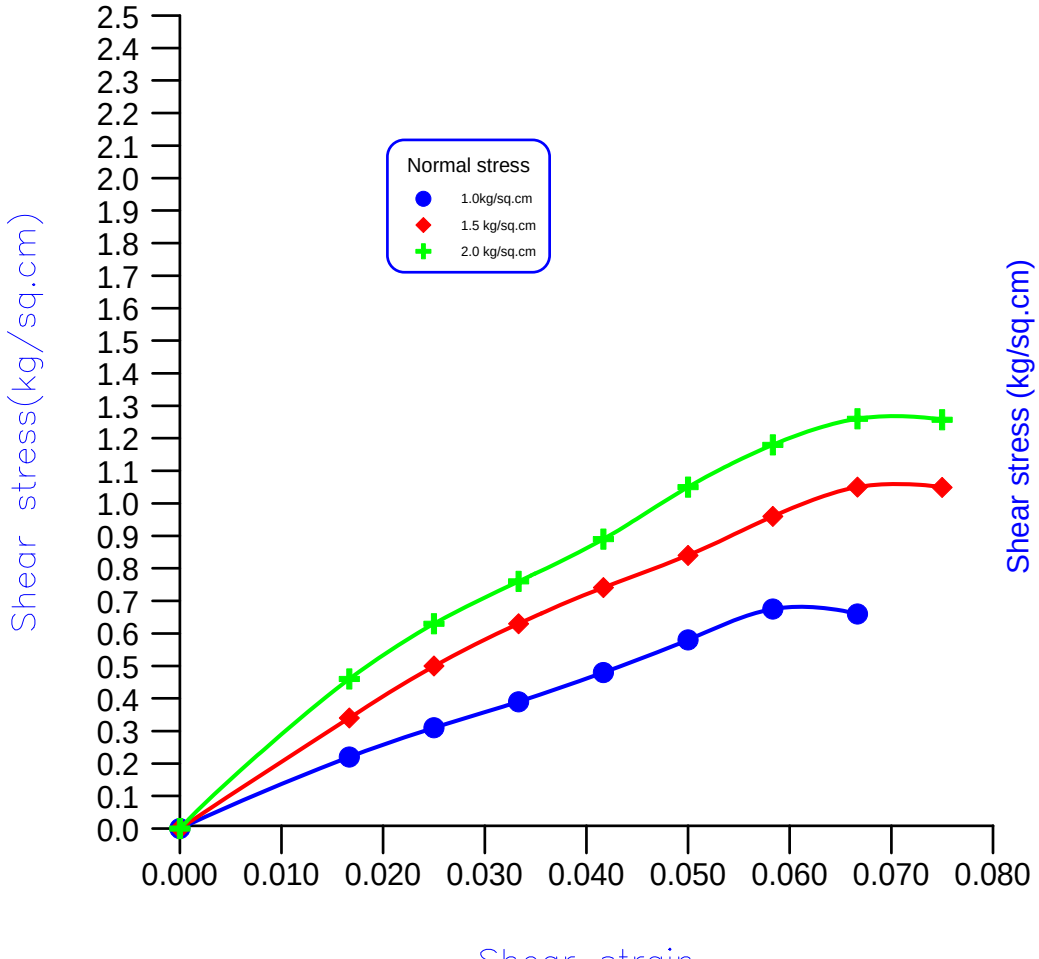
(Shear stress - shear strain relationship)



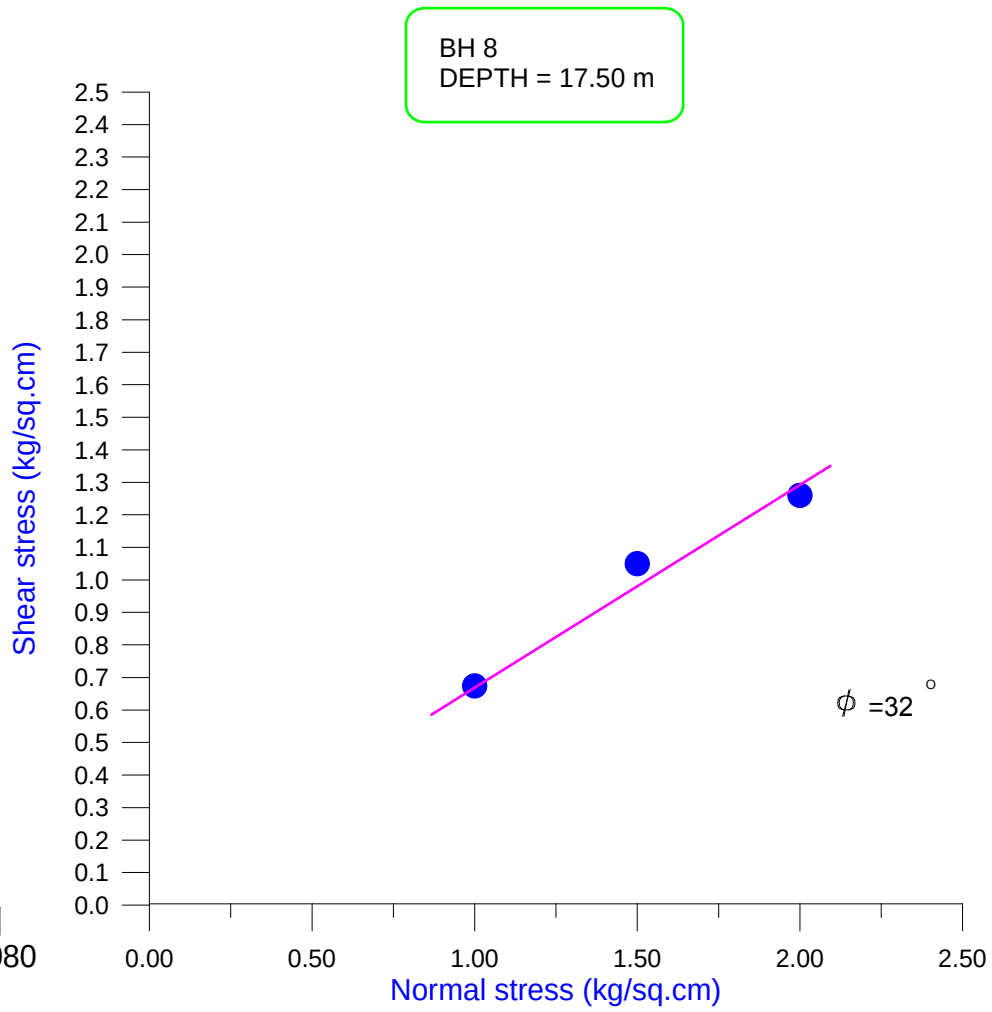
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 8-5



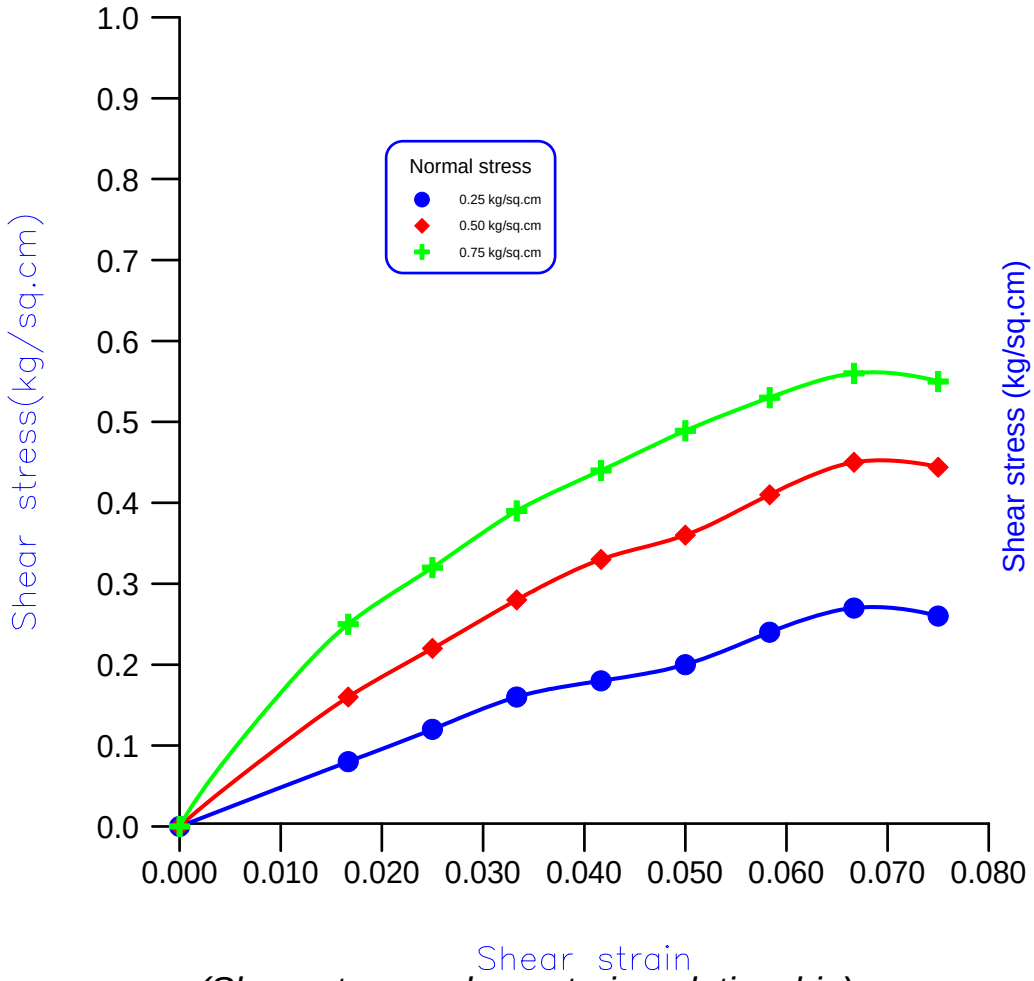
(Shear stress - shear strain relationship)



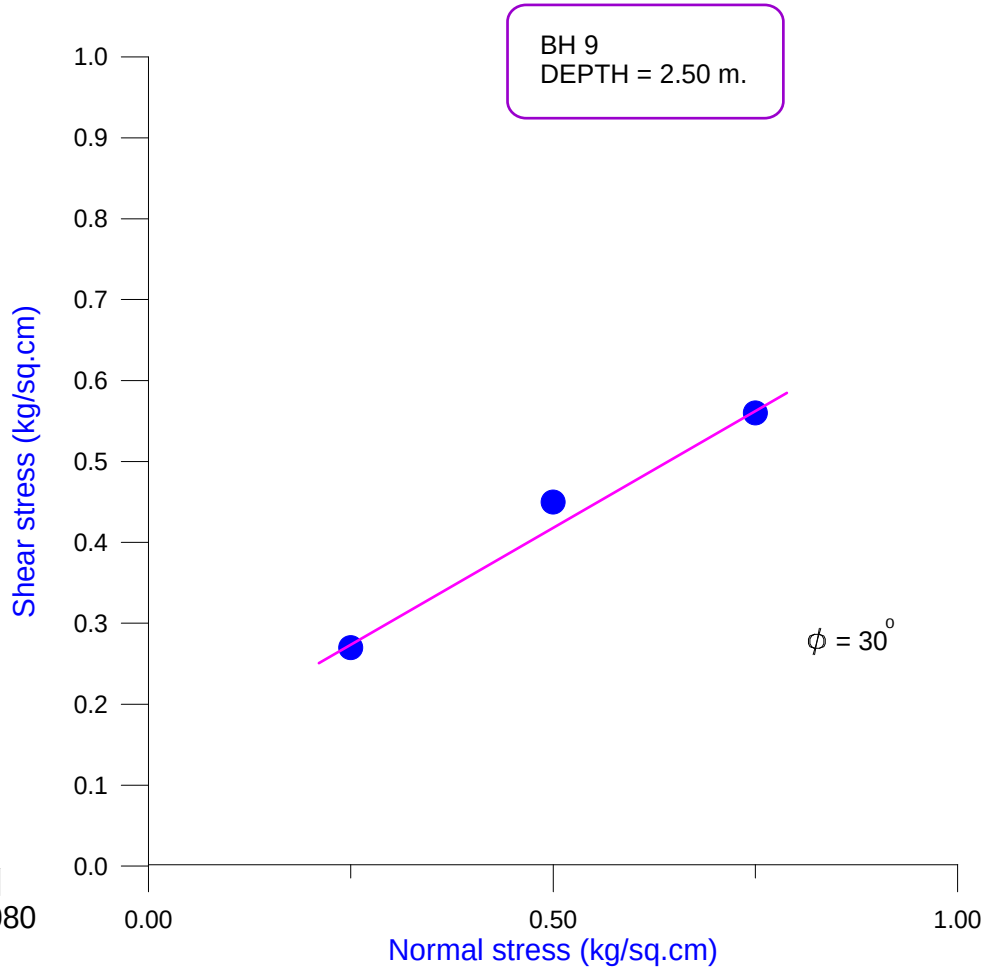
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

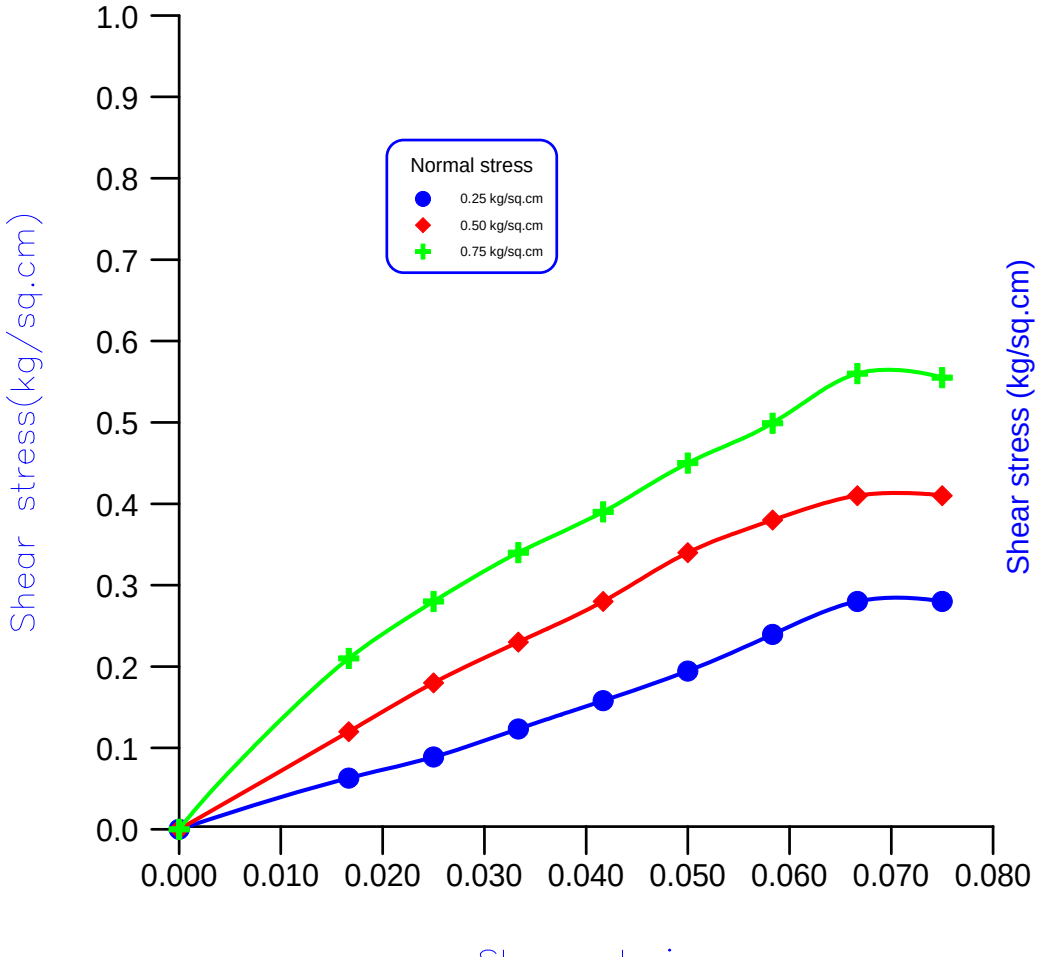
FIG- DS 8-6



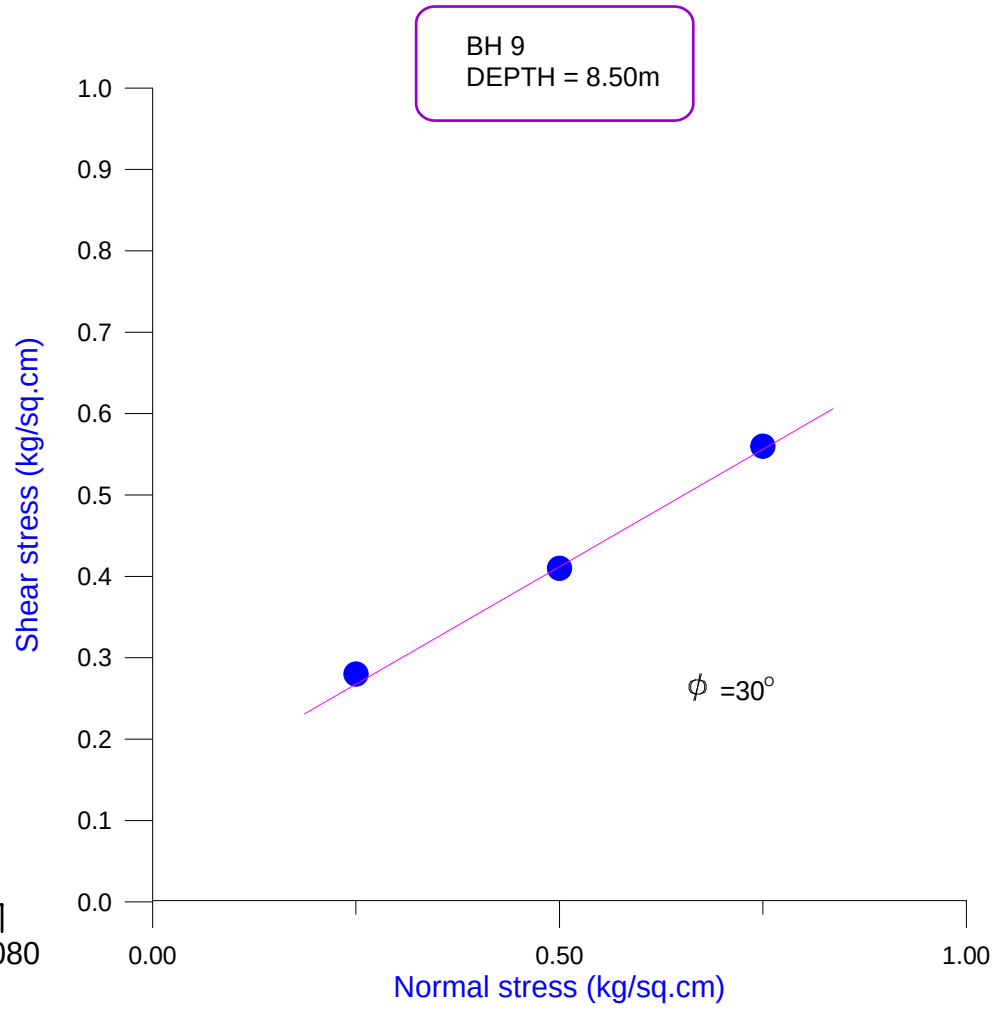
(Shear stress - shear strain relationship)



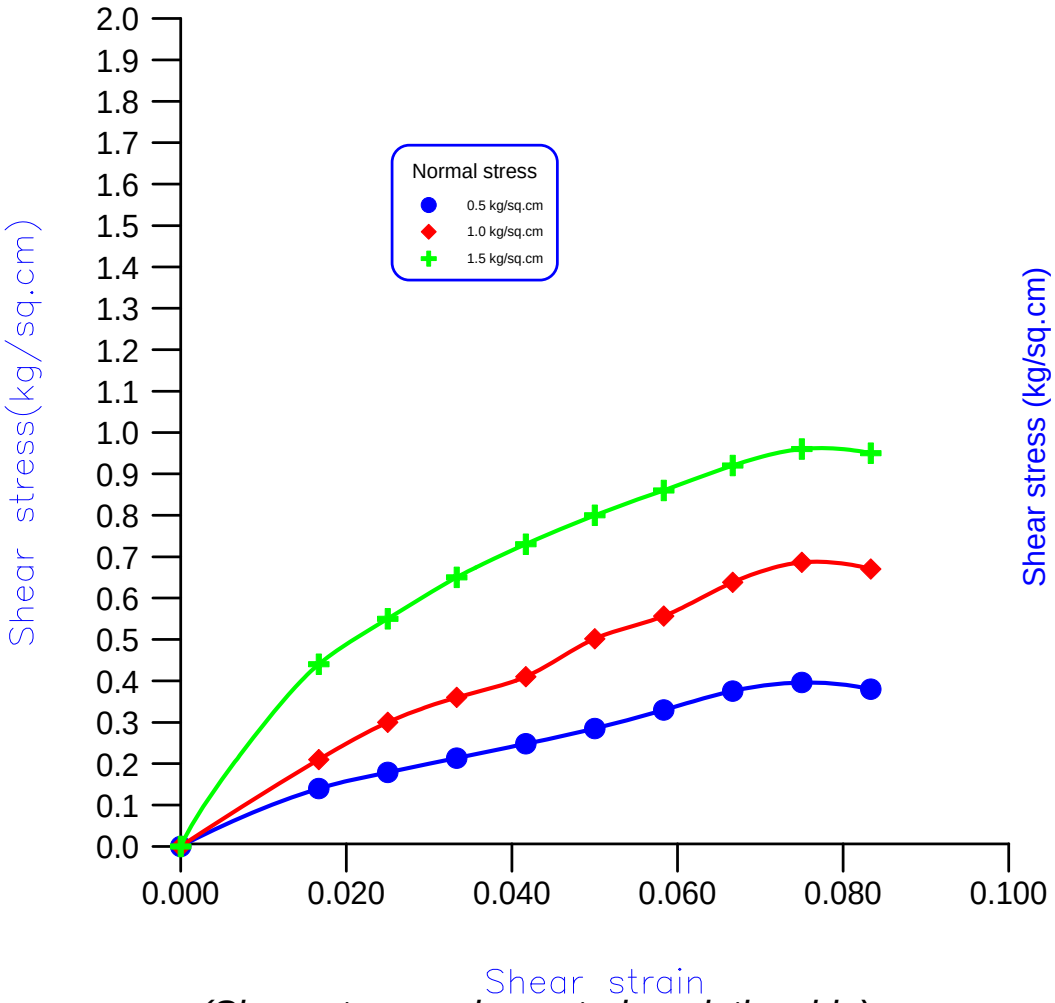
(Shear stress - Normal stress relationship)



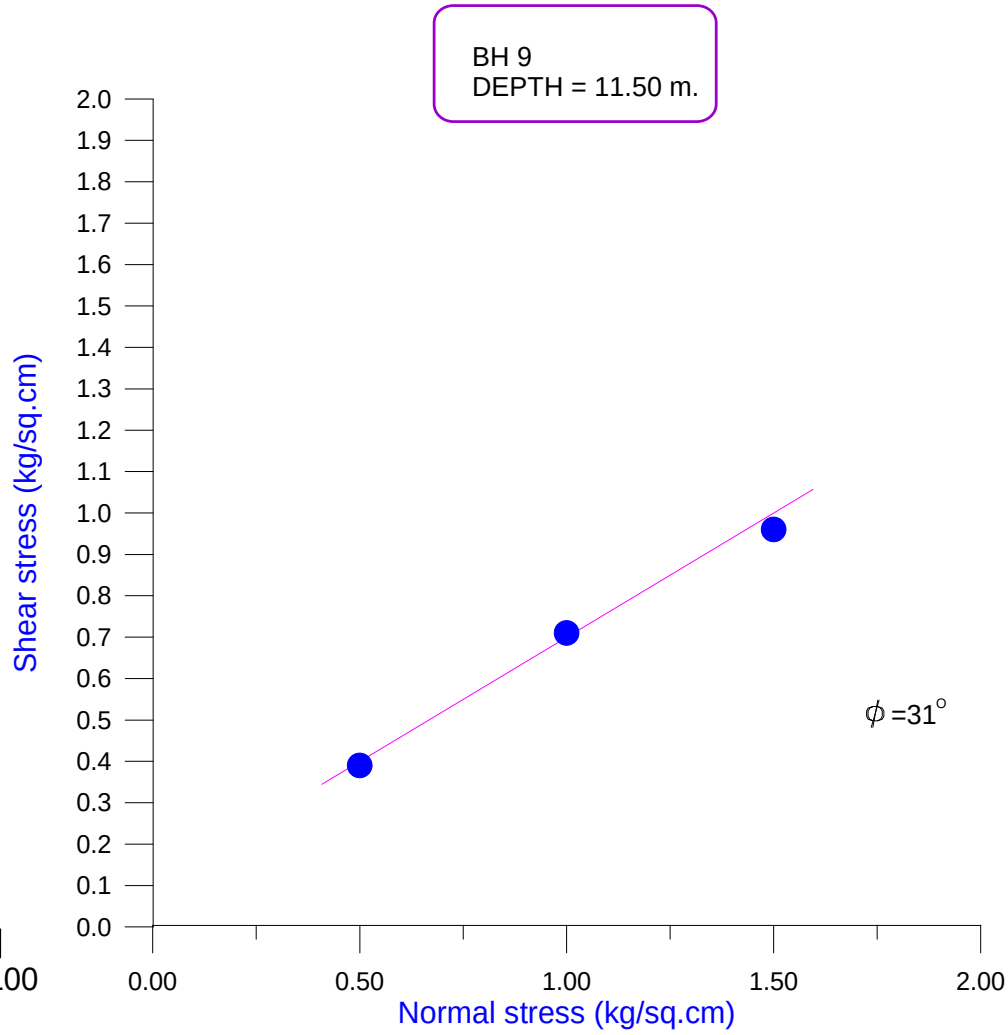
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



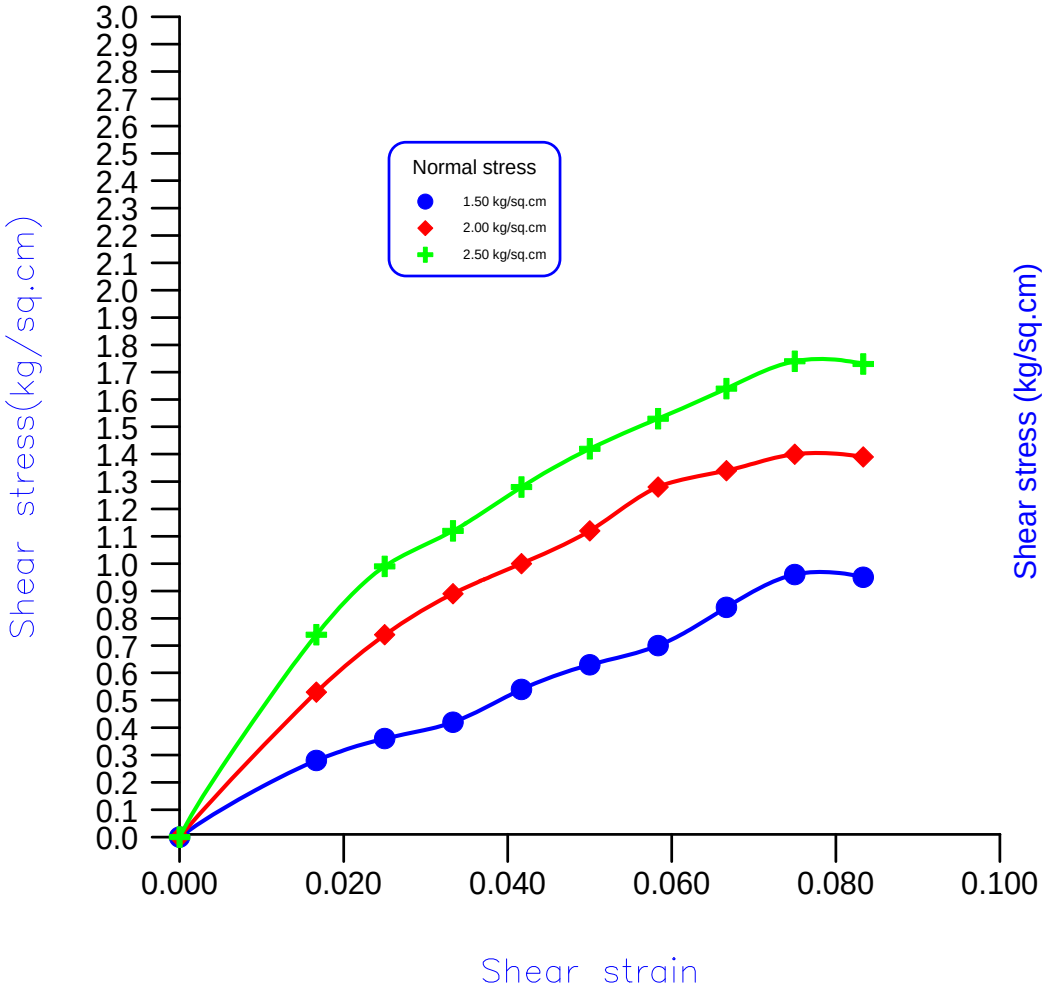
(Shear stress - shear strain relationship)



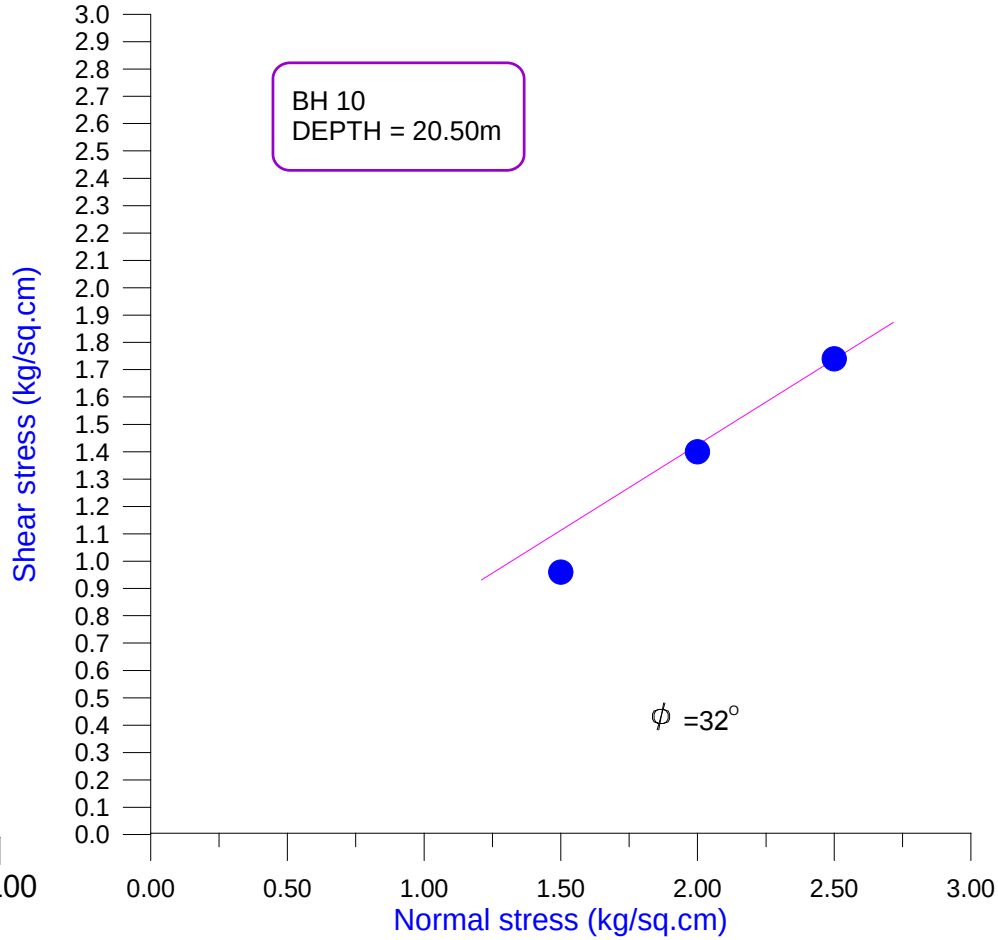
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

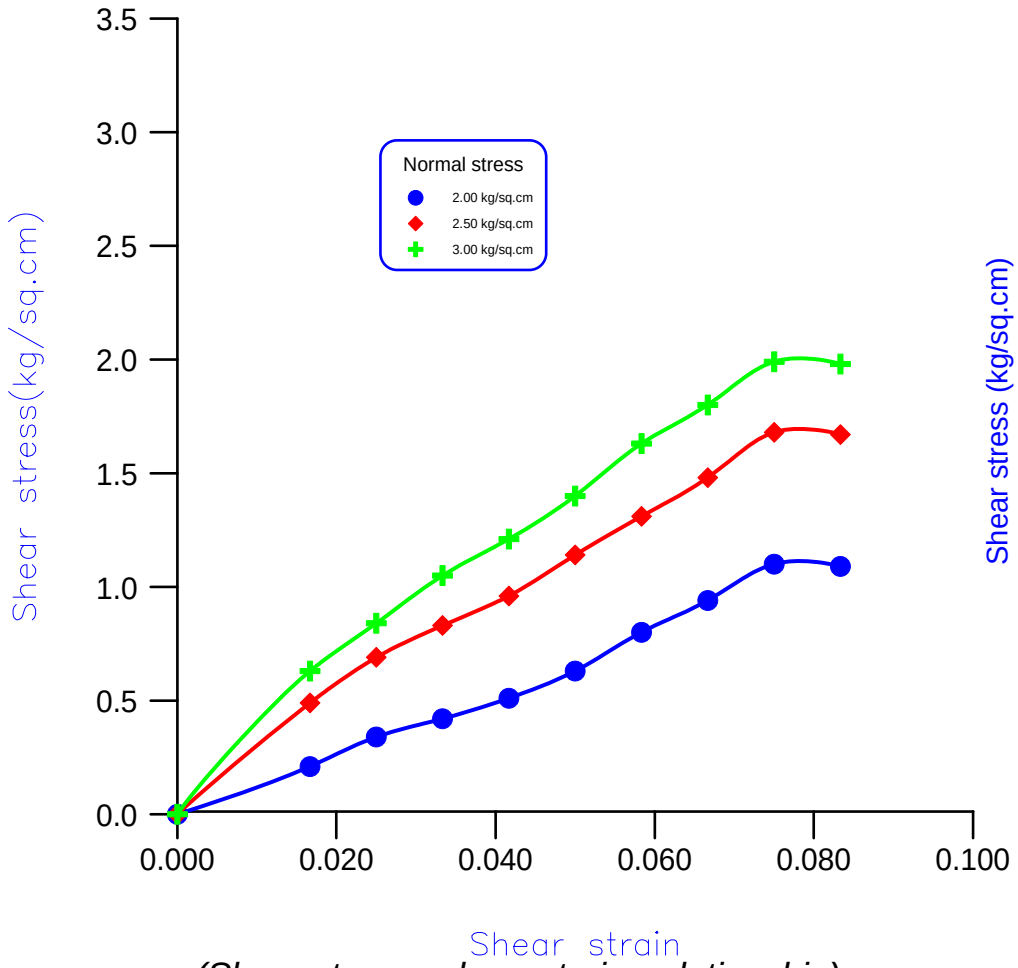
FIG- DS 9-4



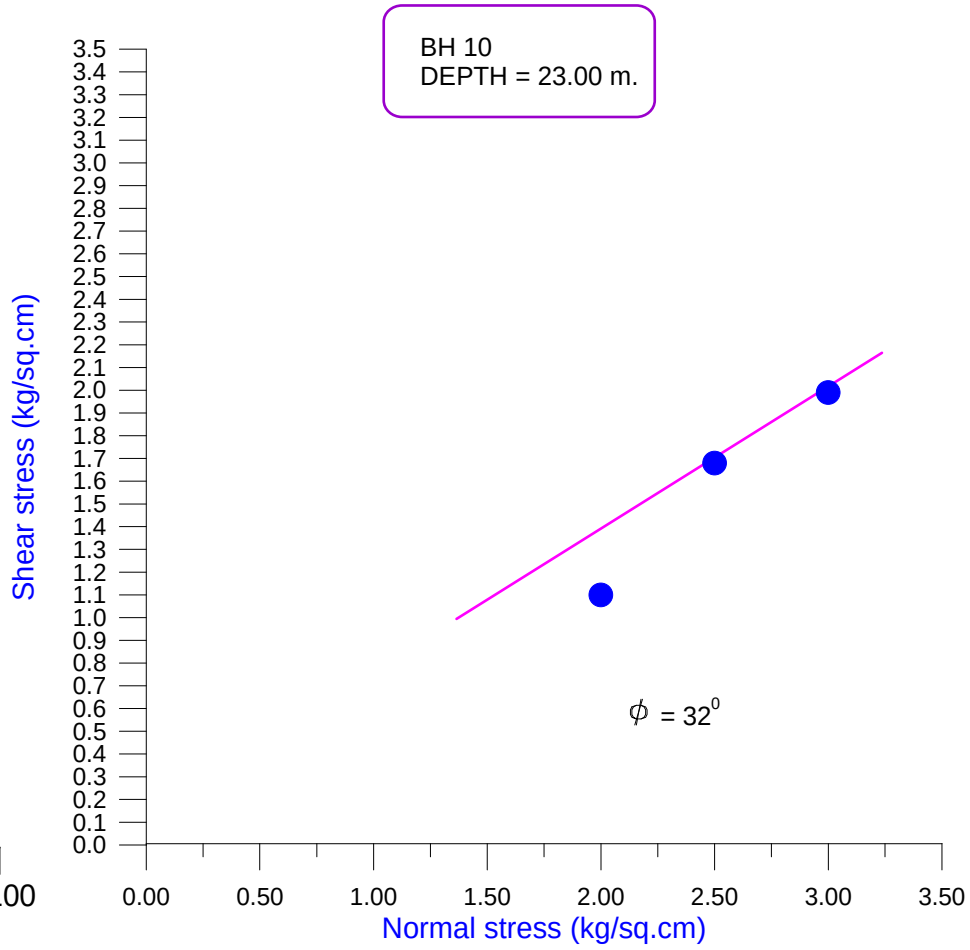
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



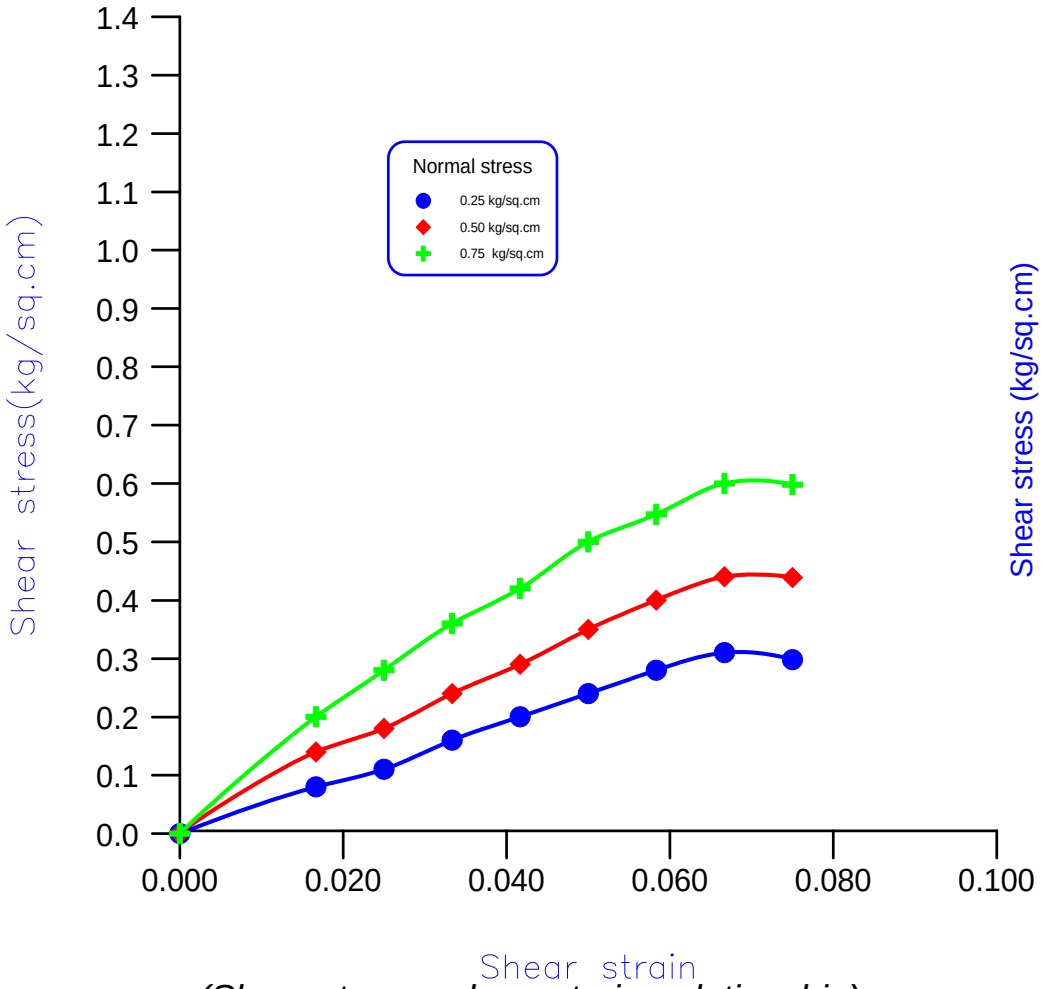
(Shear stress - shear strain relationship)



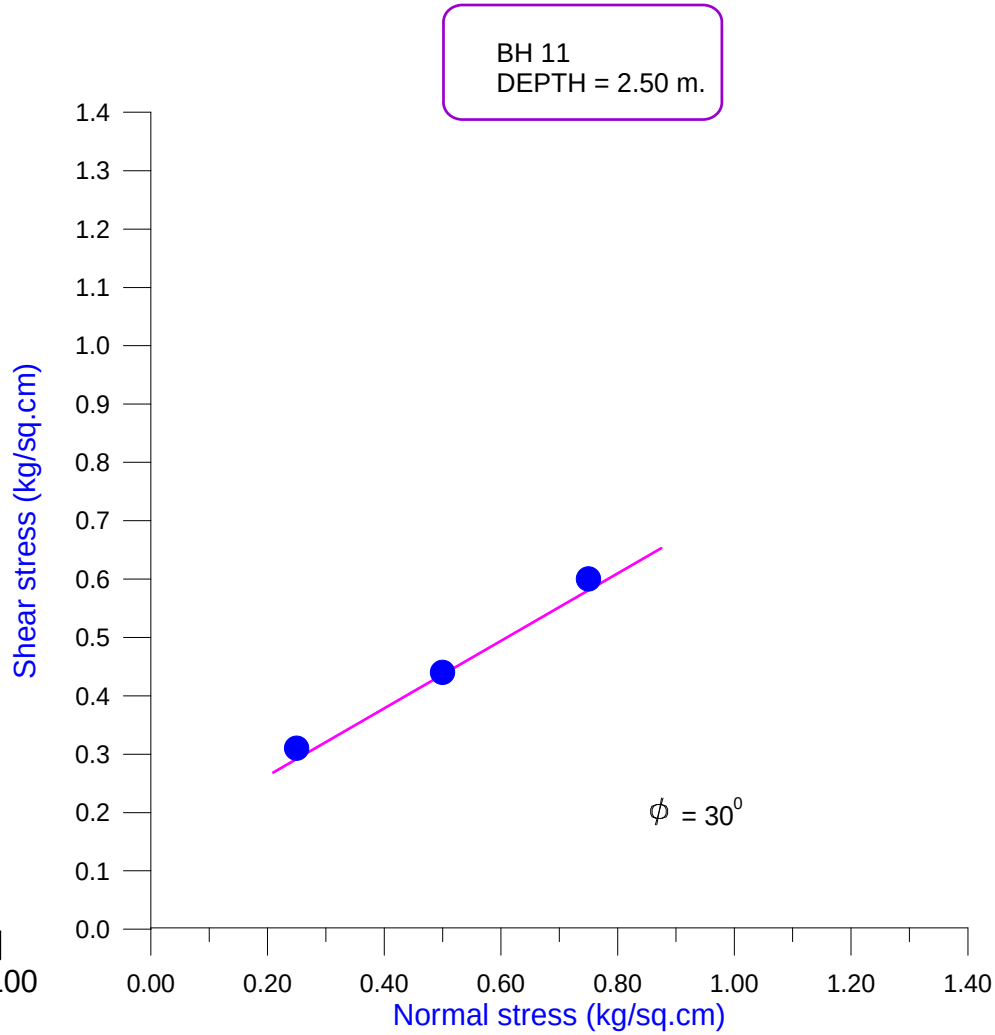
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 10-8



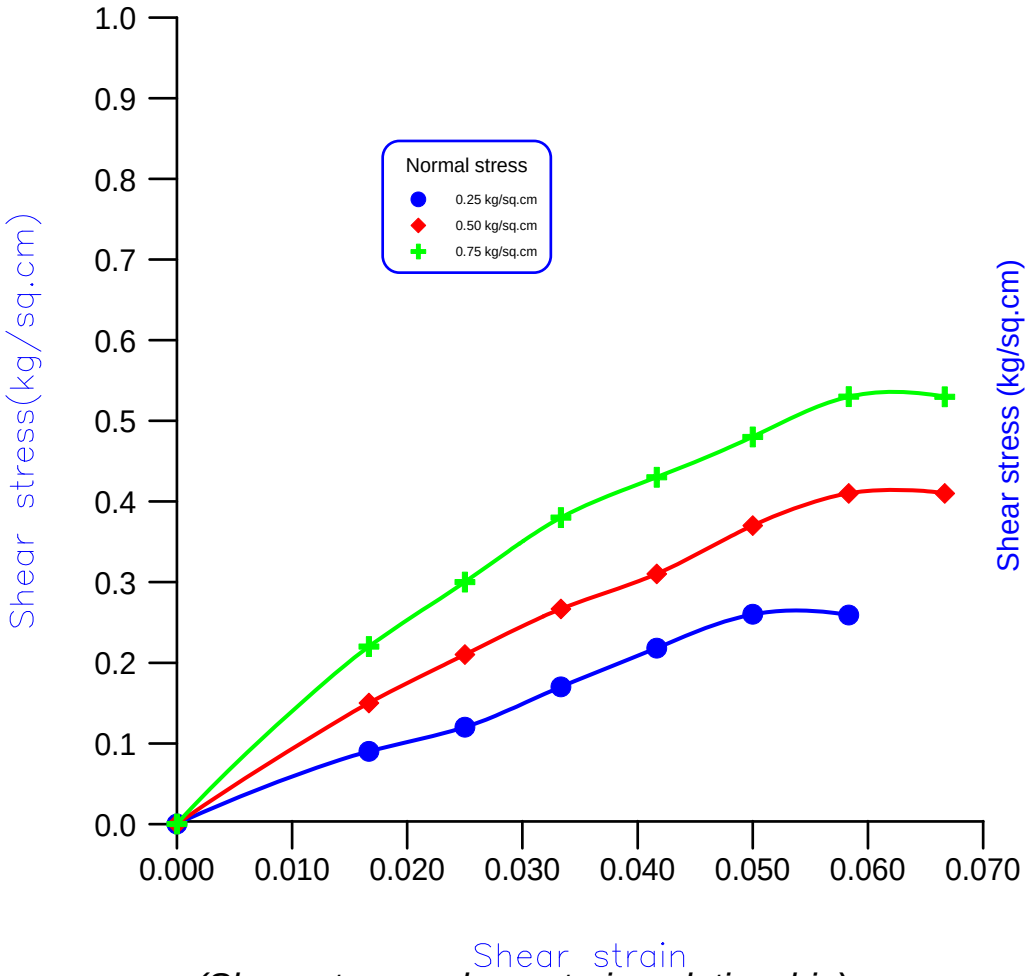
(Shear stress - shear strain relationship)



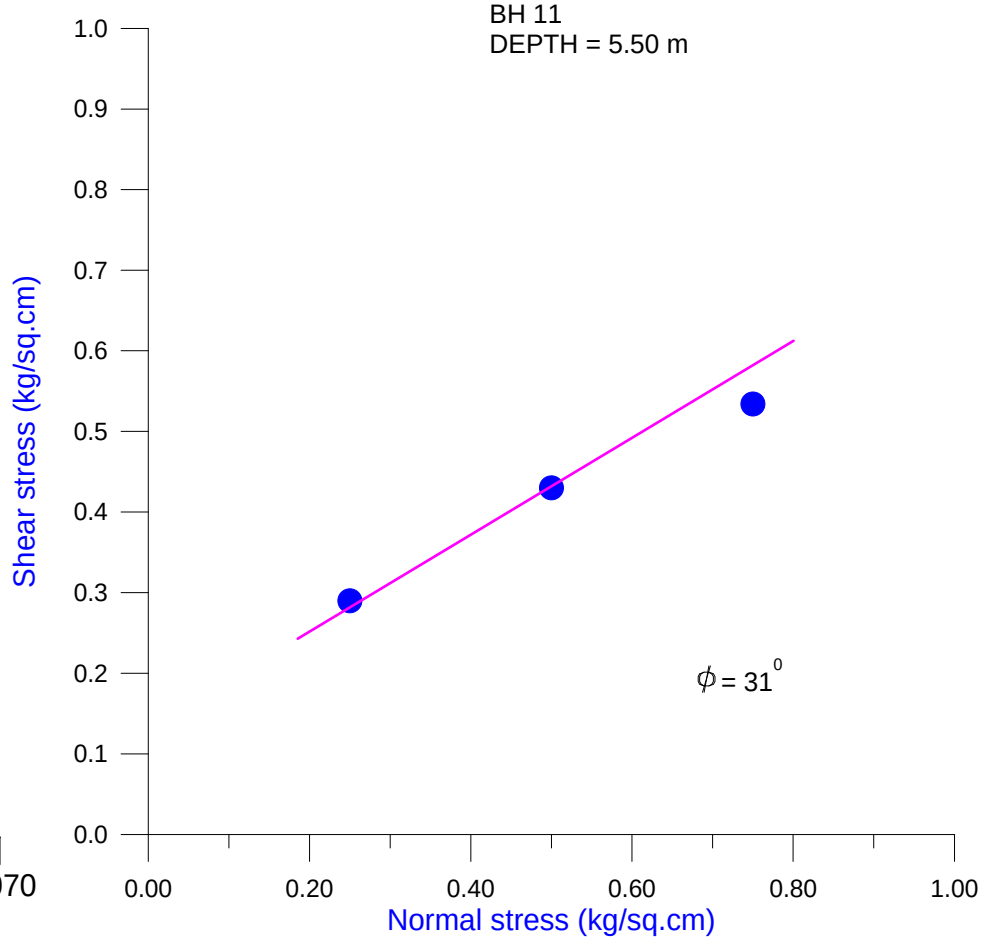
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 11-1



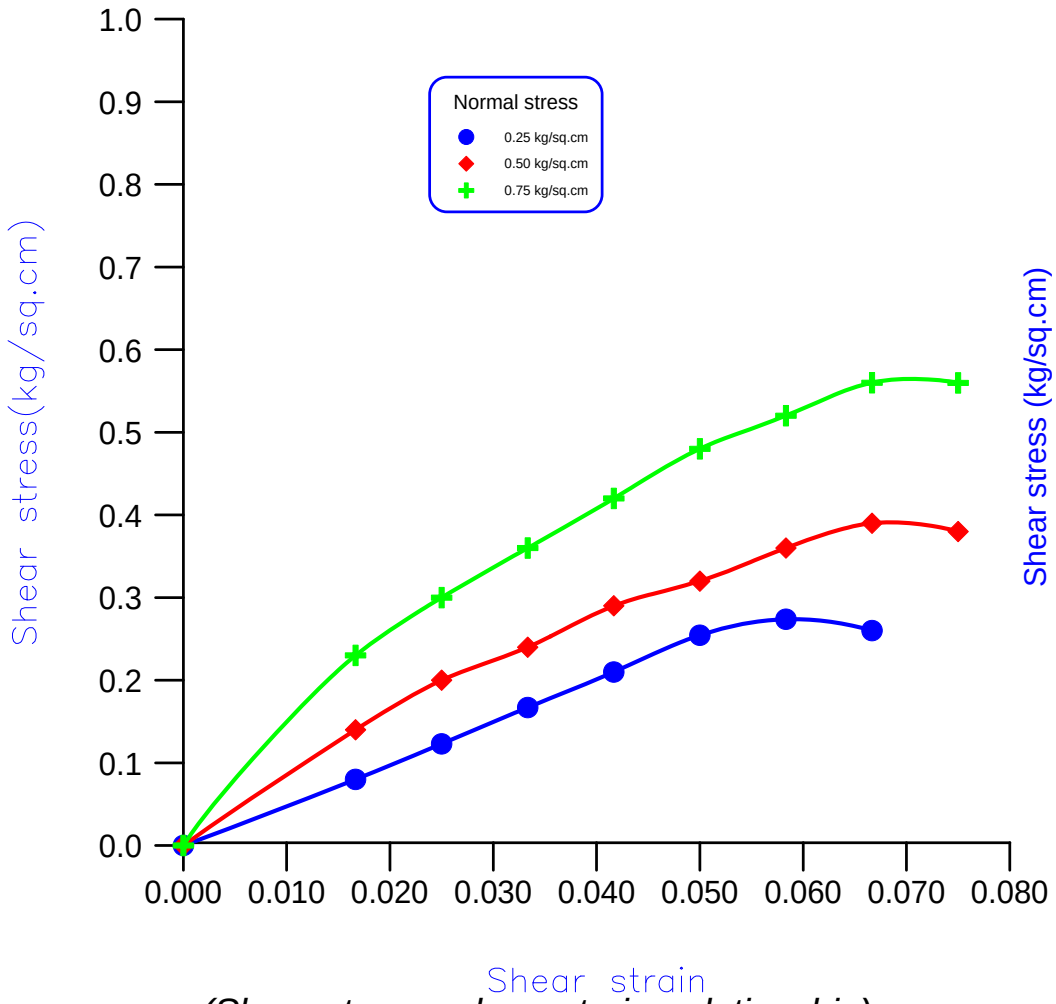
(Shear stress - shear strain relationship)



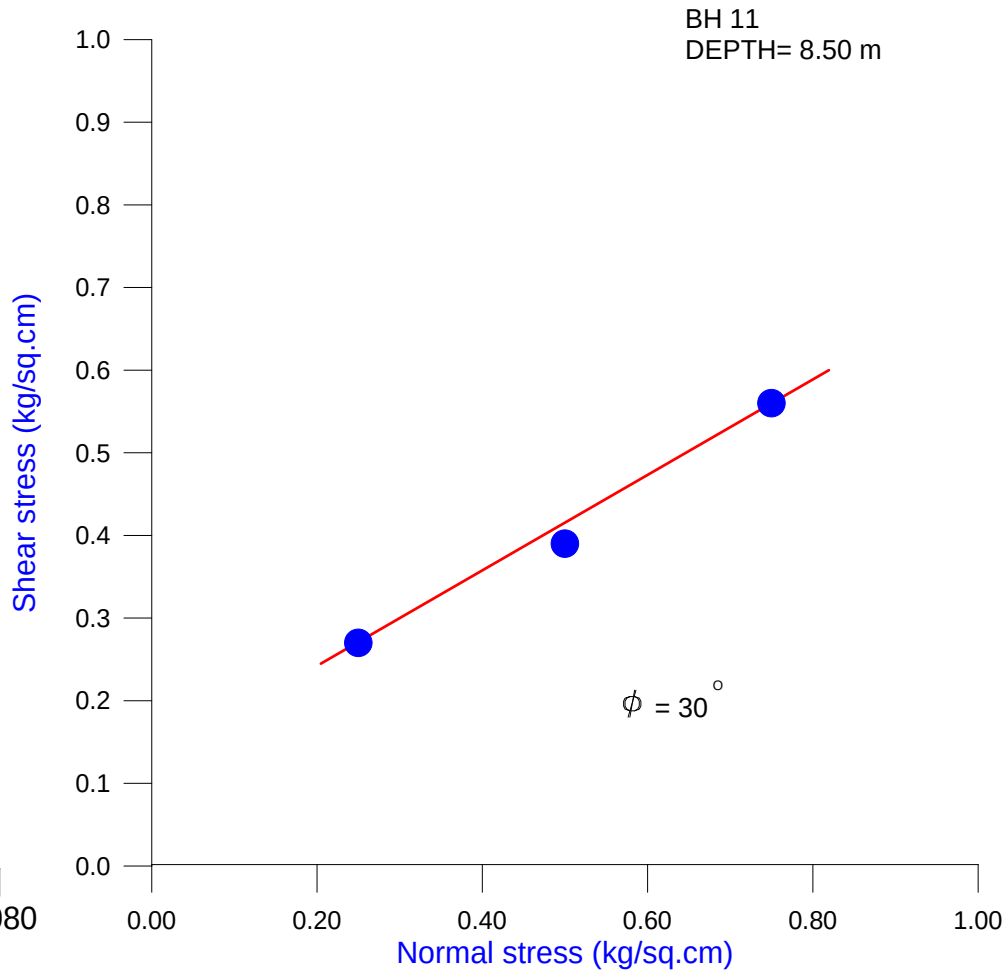
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 11-2



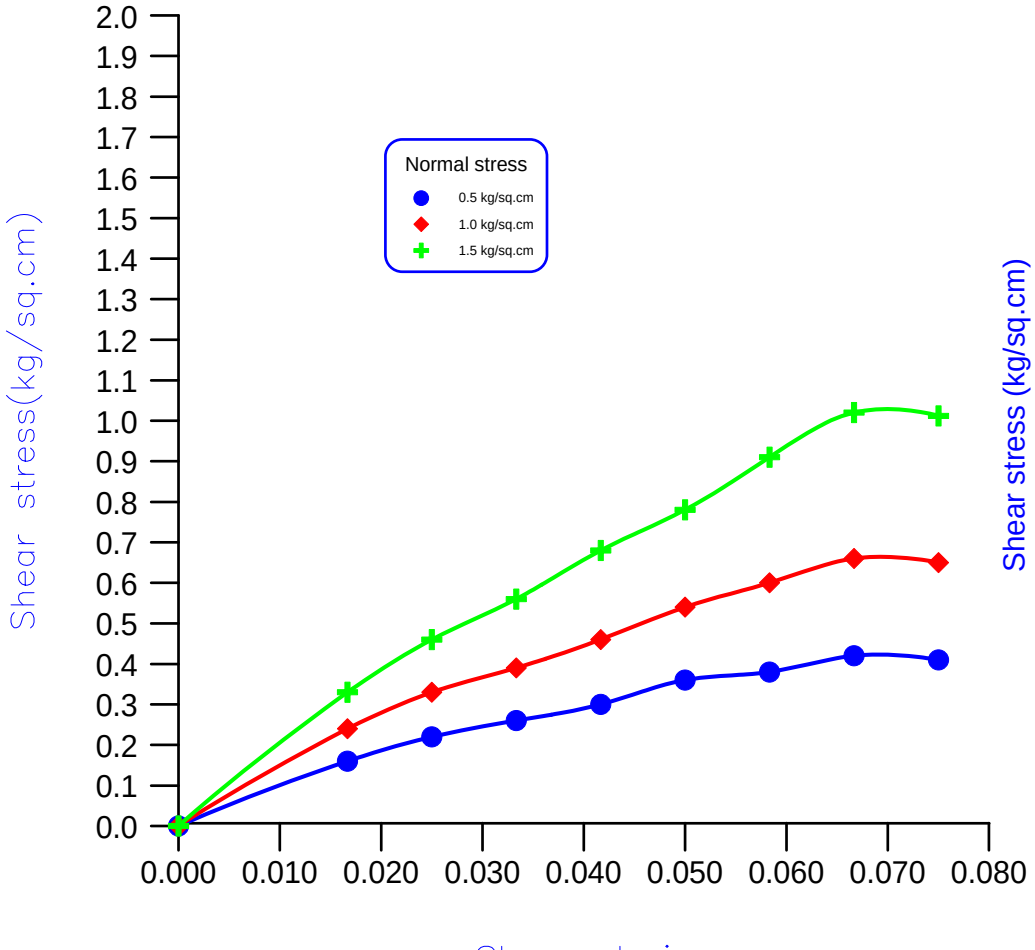
(Shear stress - shear strain relationship)



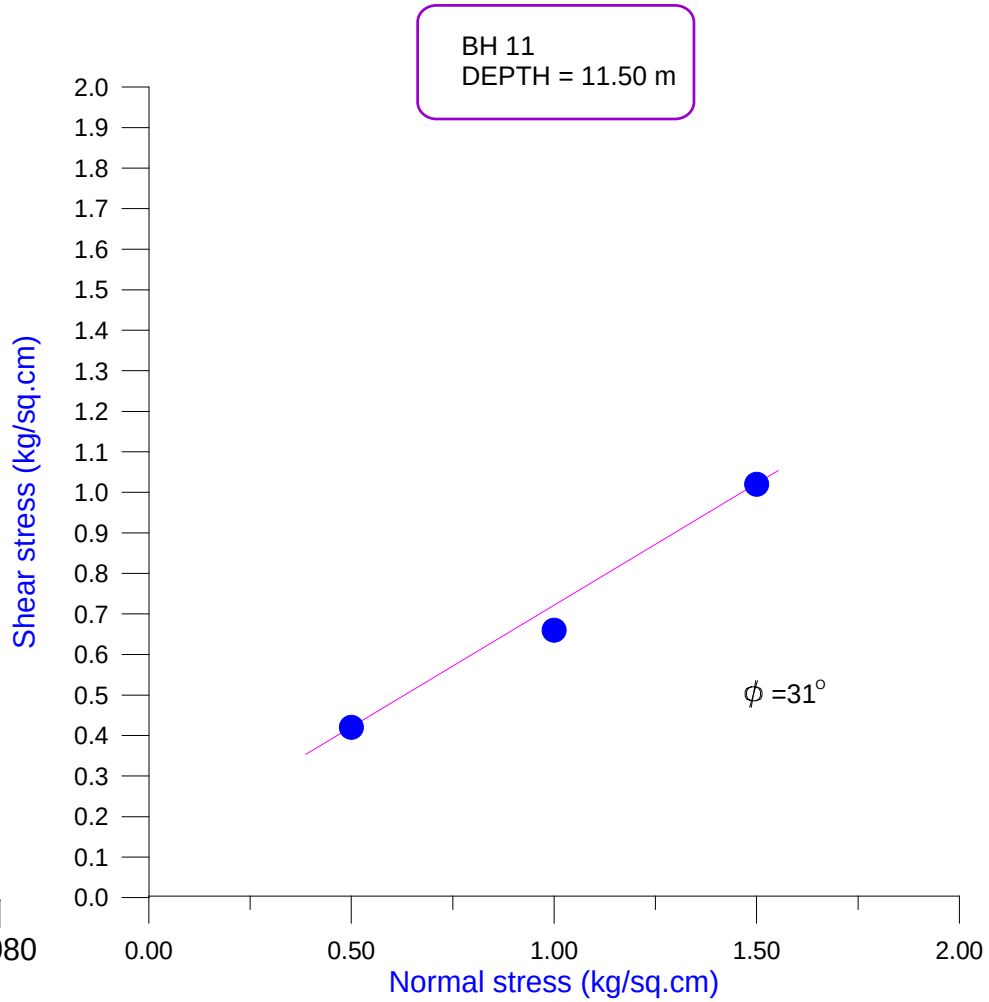
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 11-3



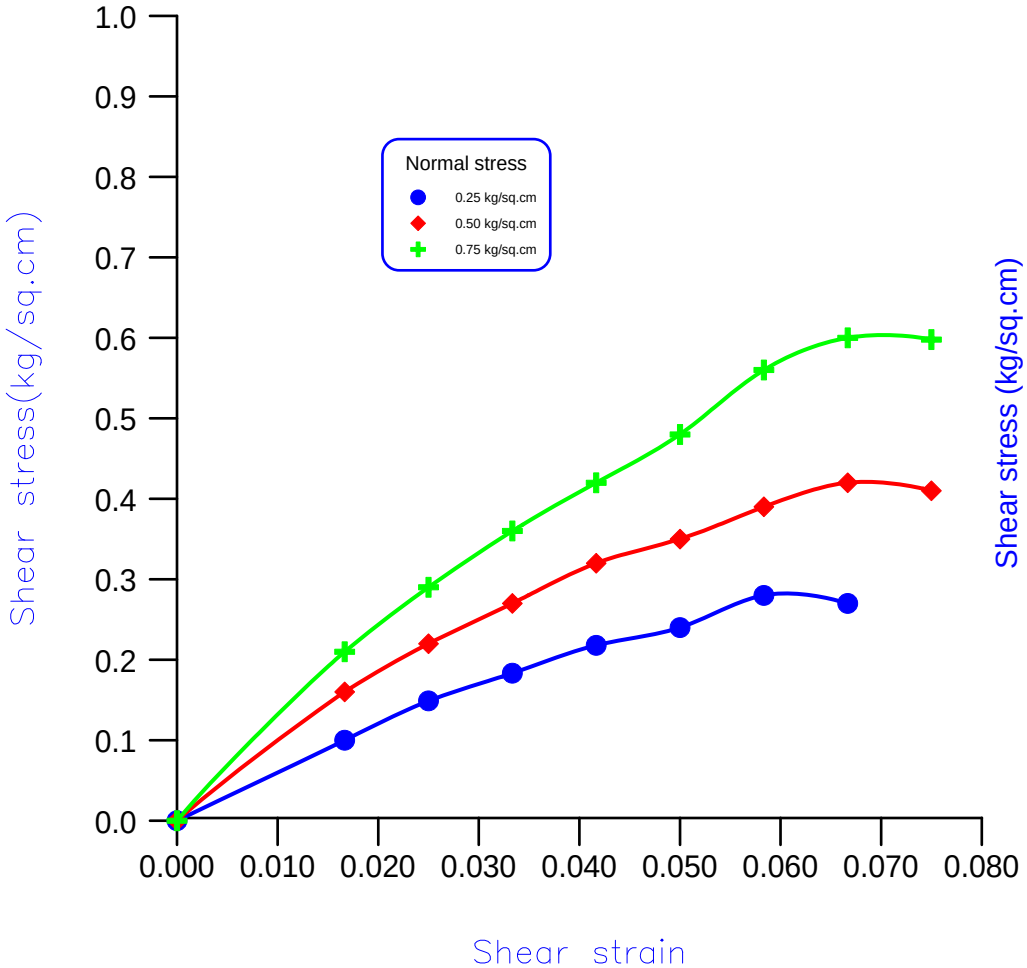
(Shear stress - shear strain relationship)



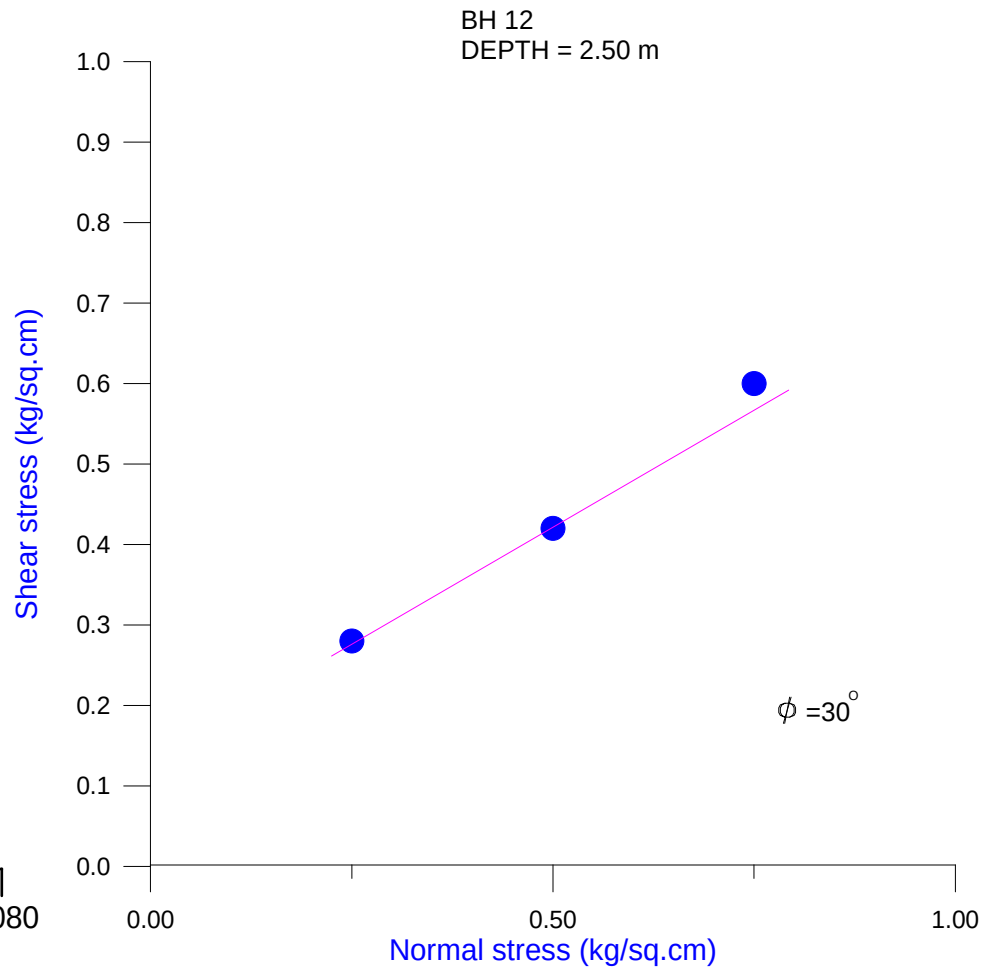
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 11-4



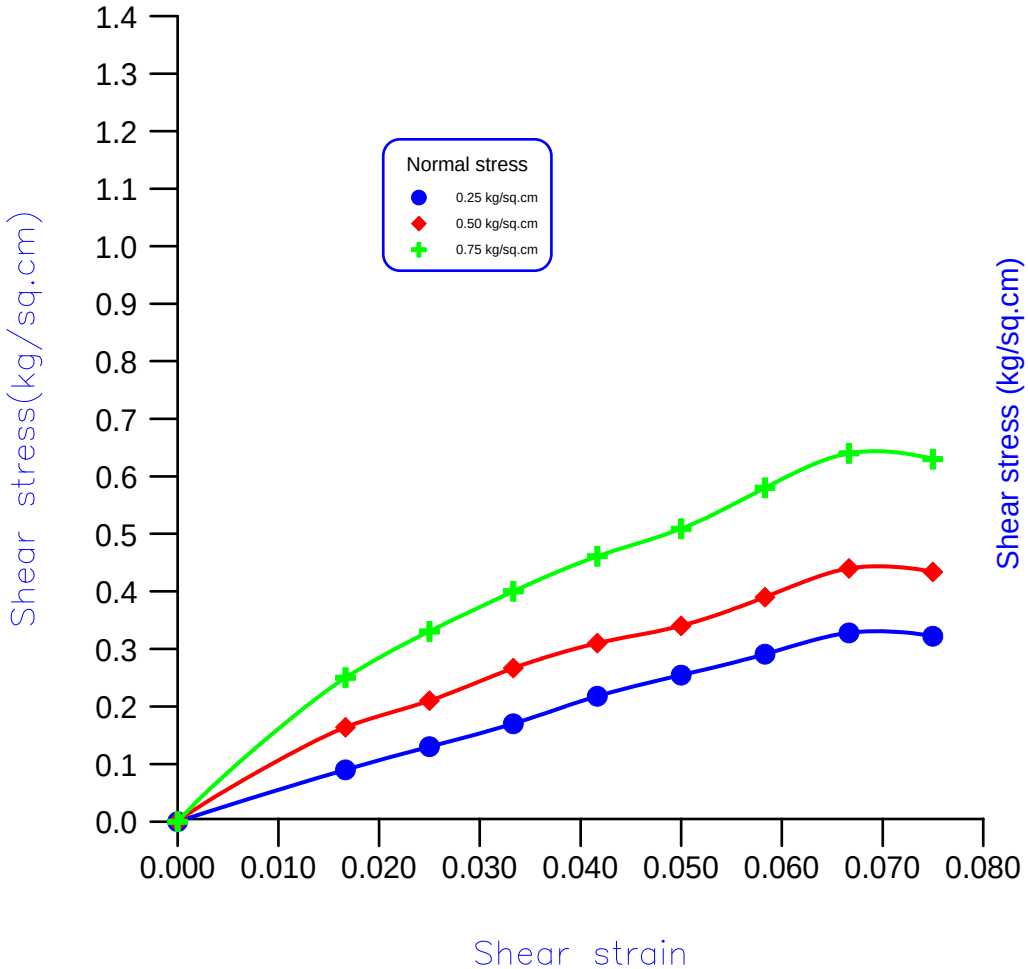
(Shear stress - shear strain relationship)



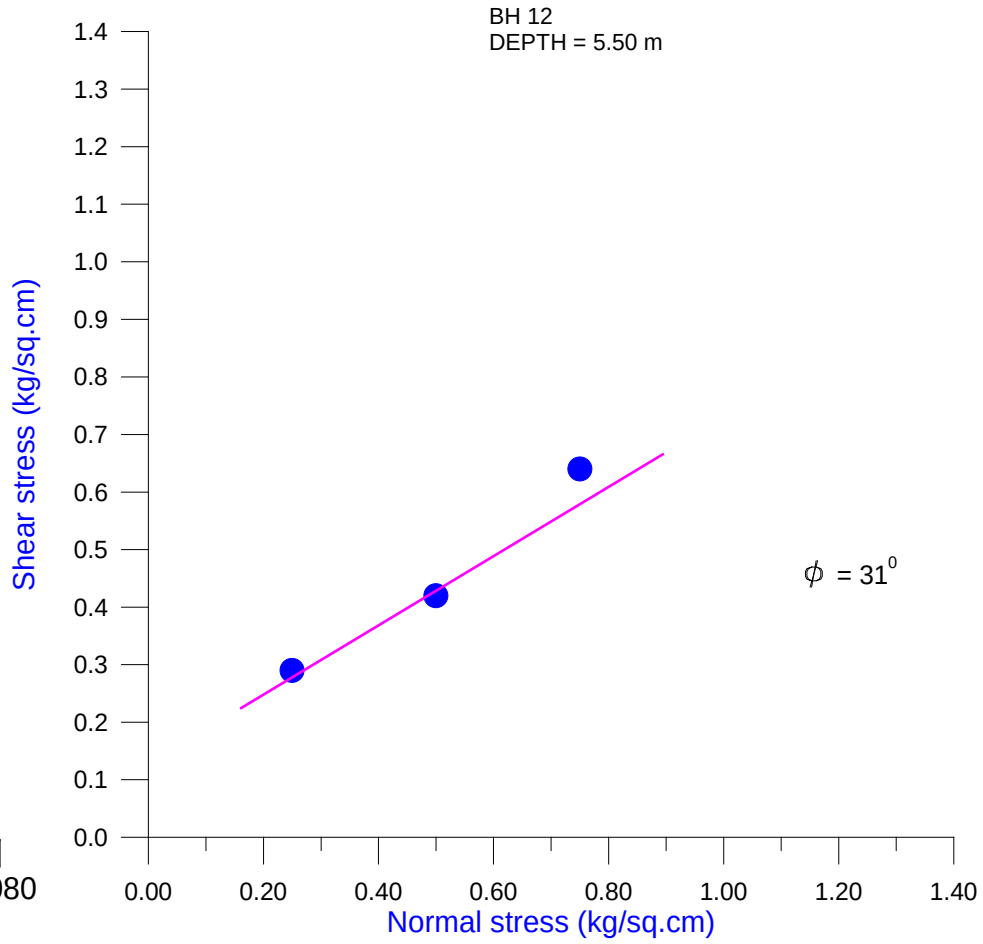
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 12-1



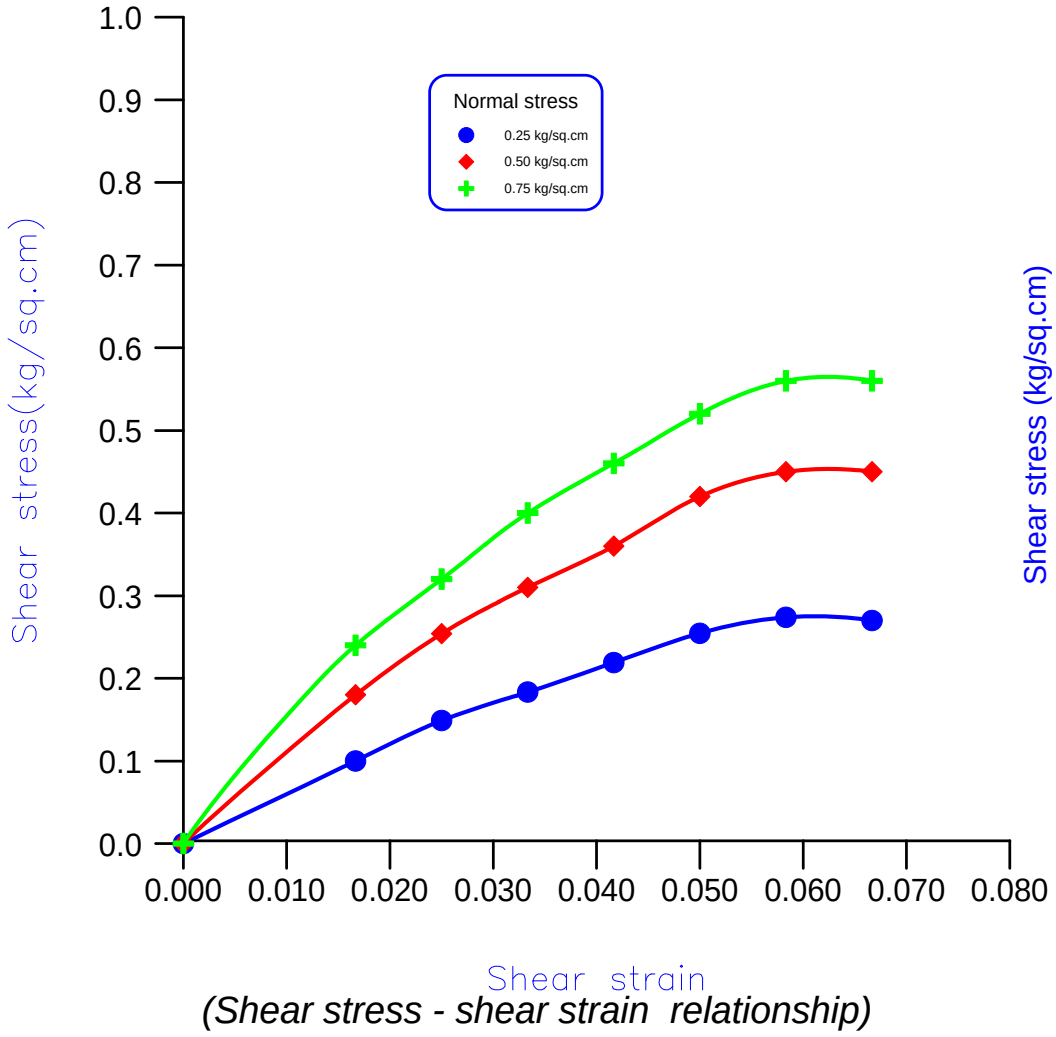
(Shear stress - shear strain relationship)



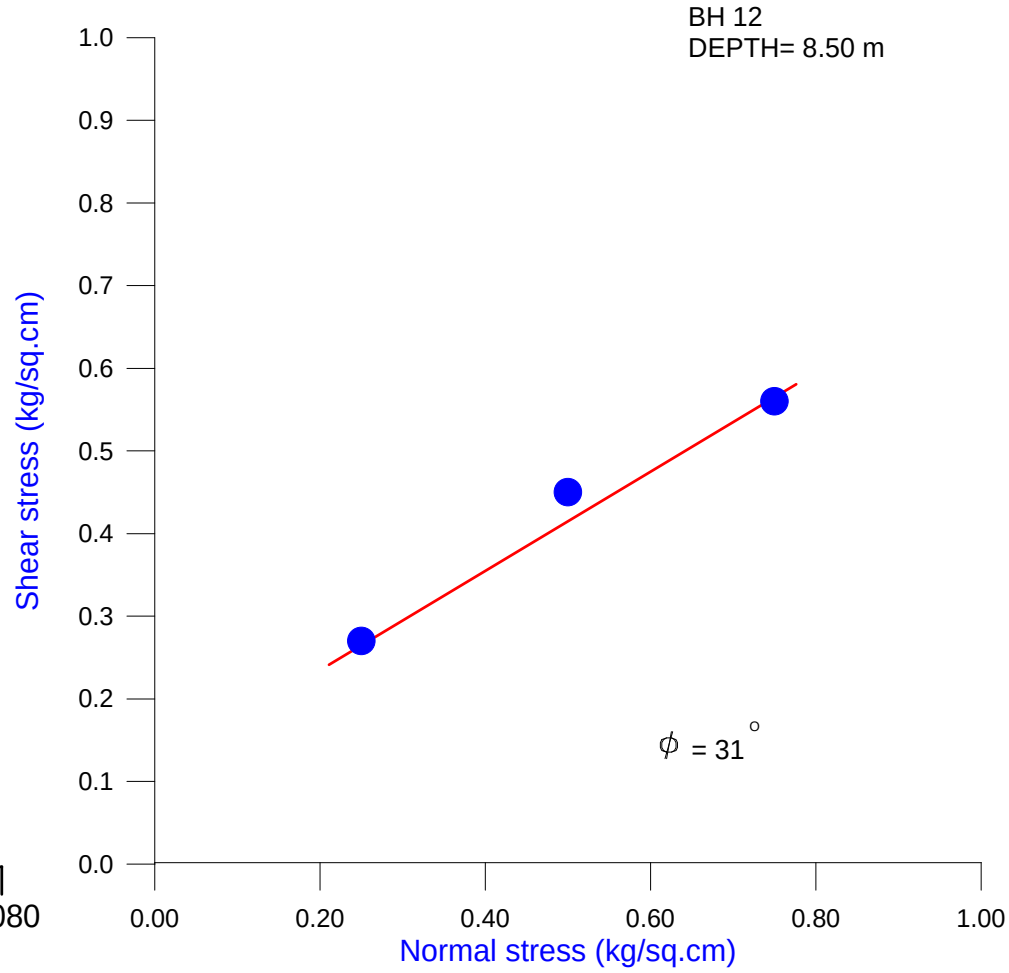
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 12-2



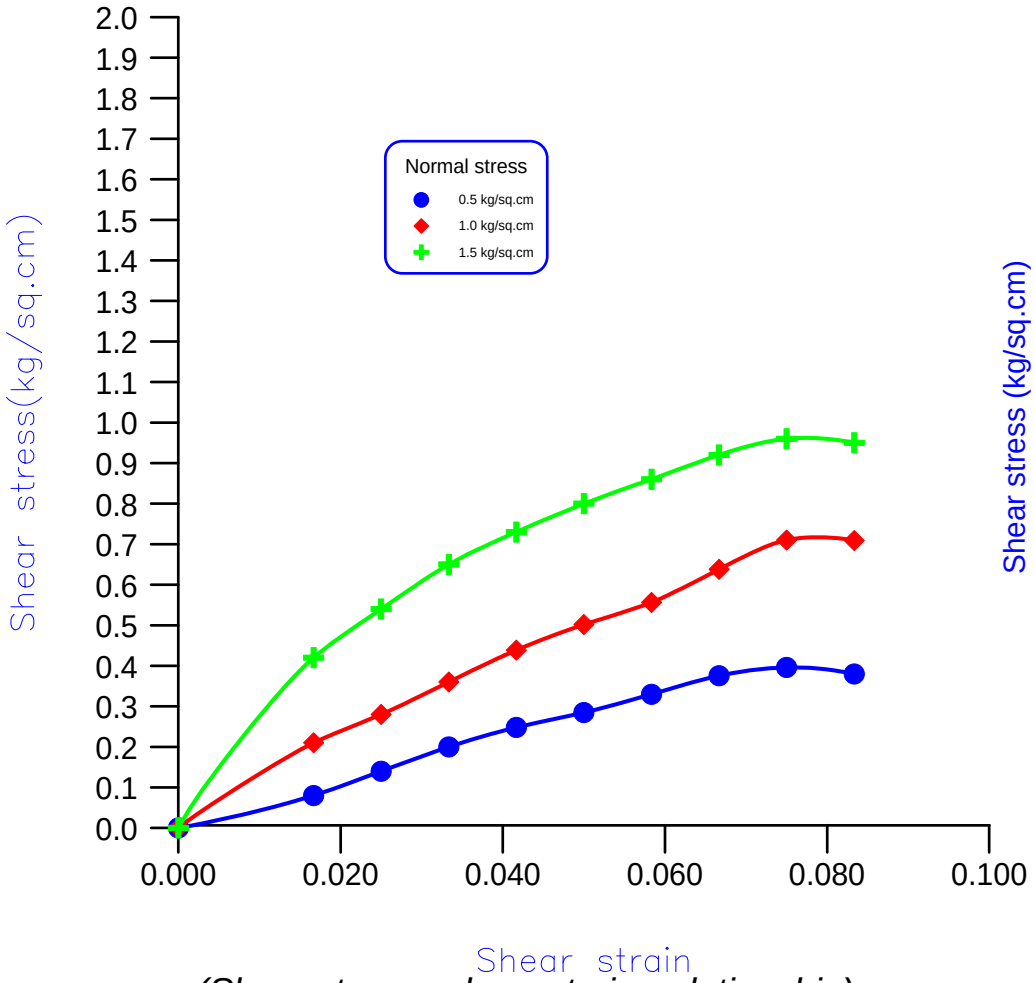
(Shear stress - shear strain relationship)



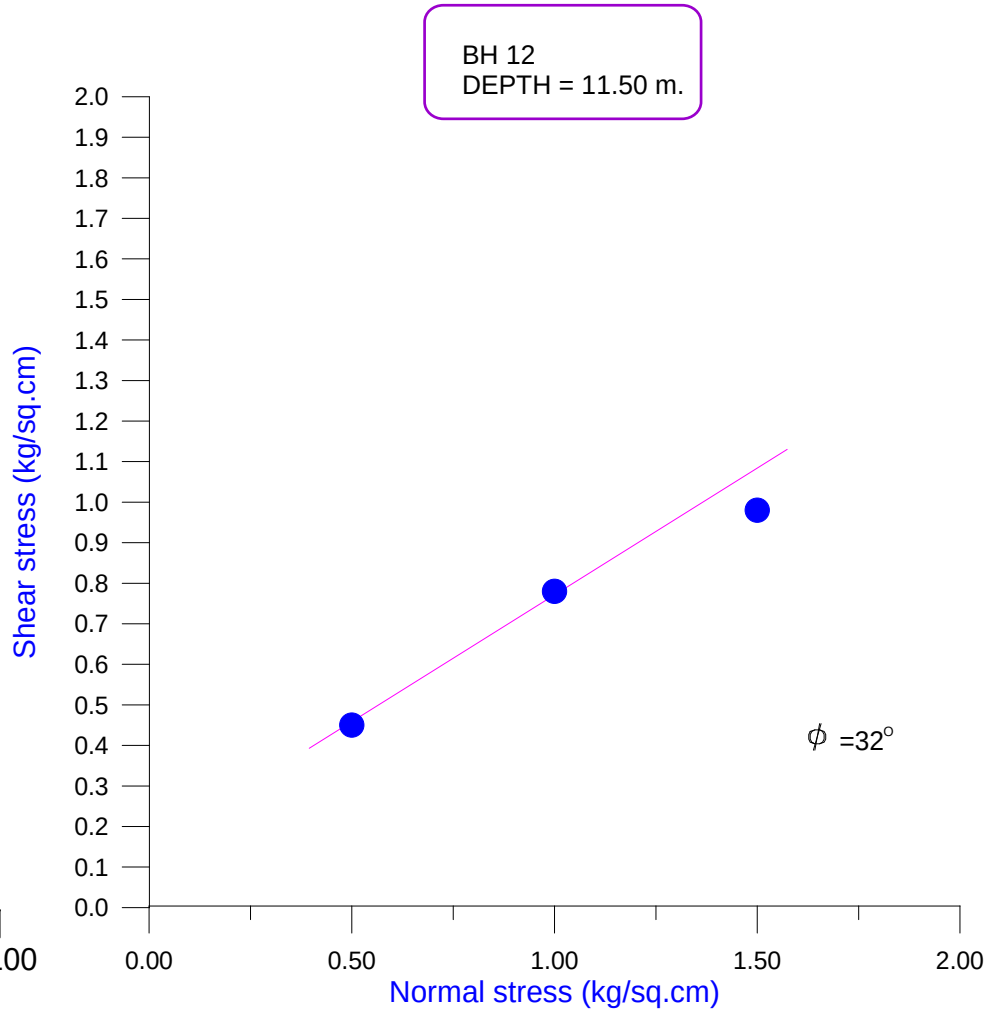
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 12-3



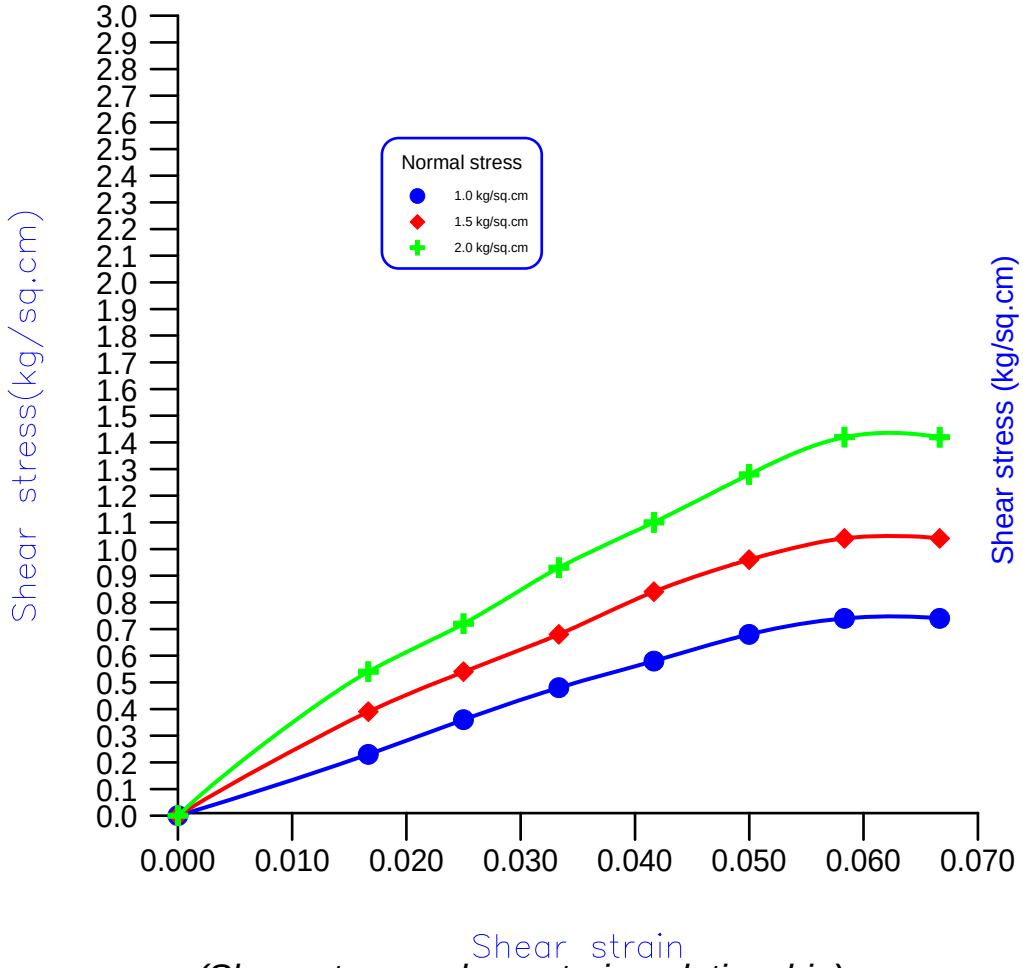
(Shear stress - shear strain relationship)



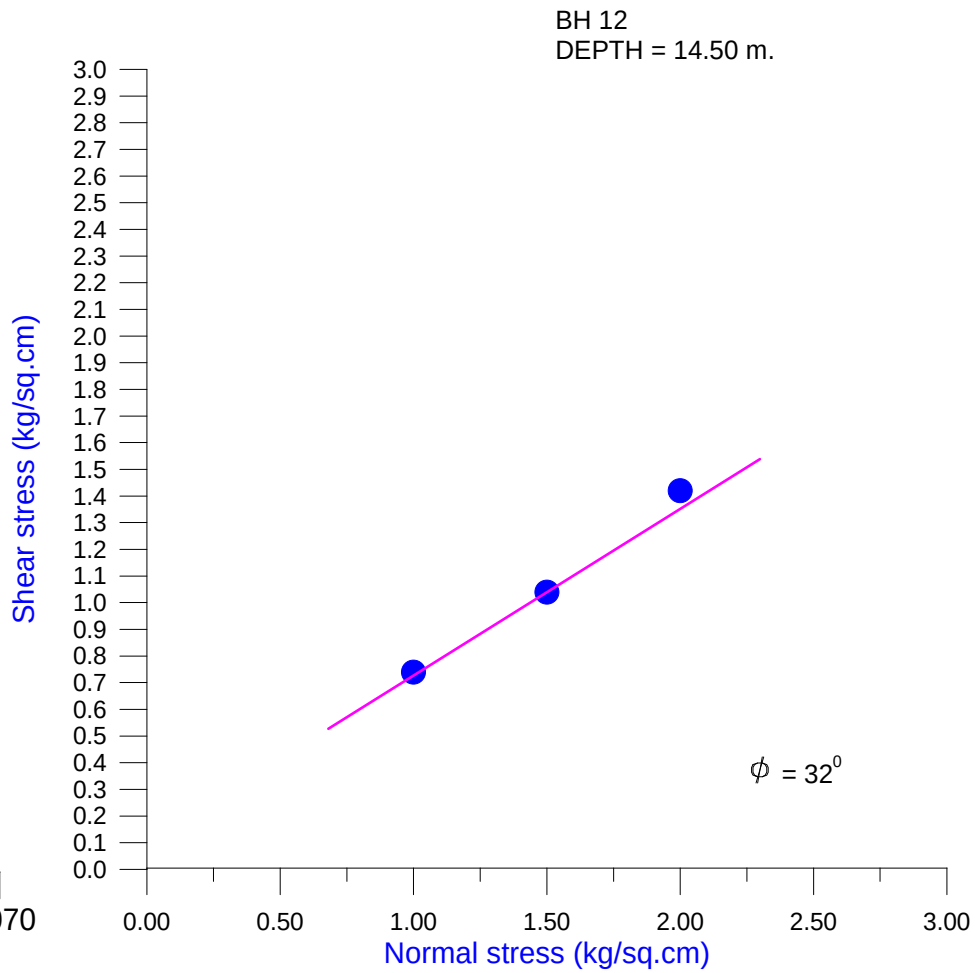
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 12-4



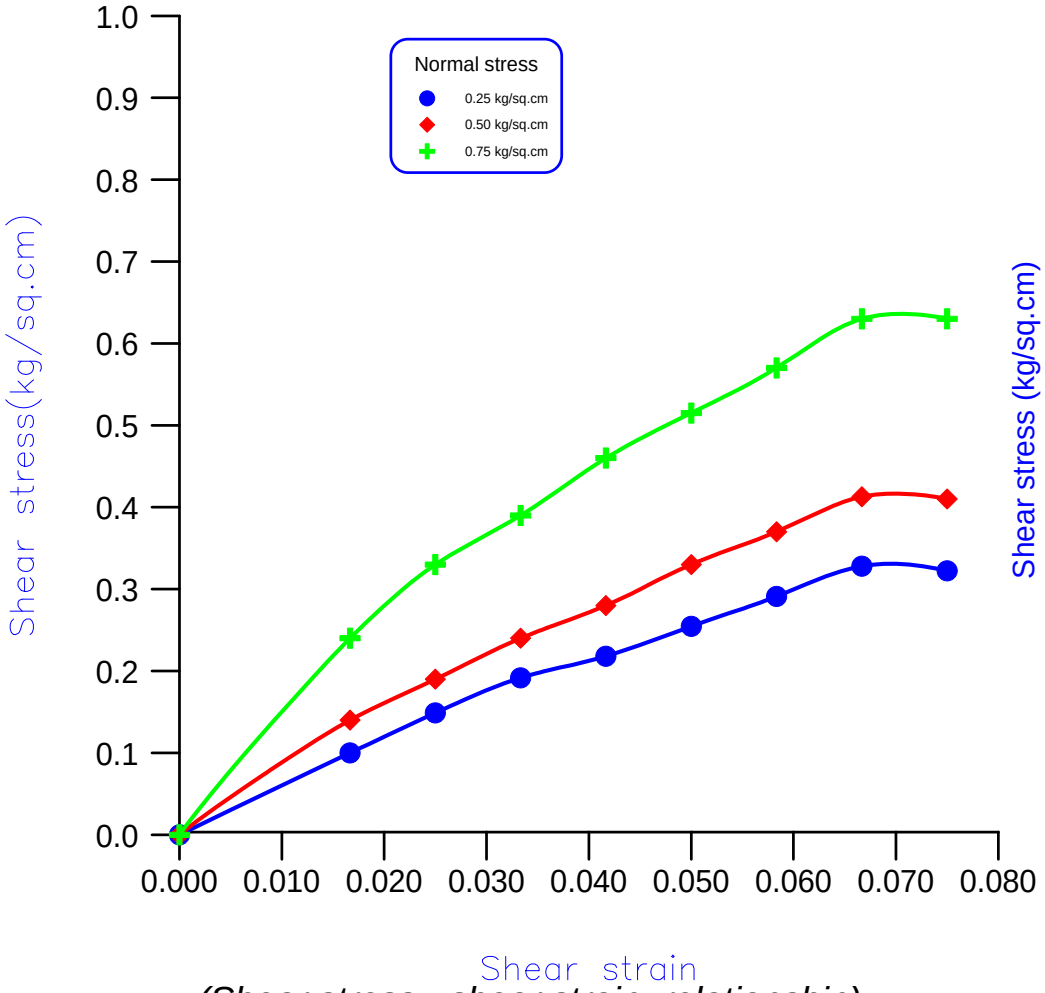
(Shear stress - shear strain relationship)



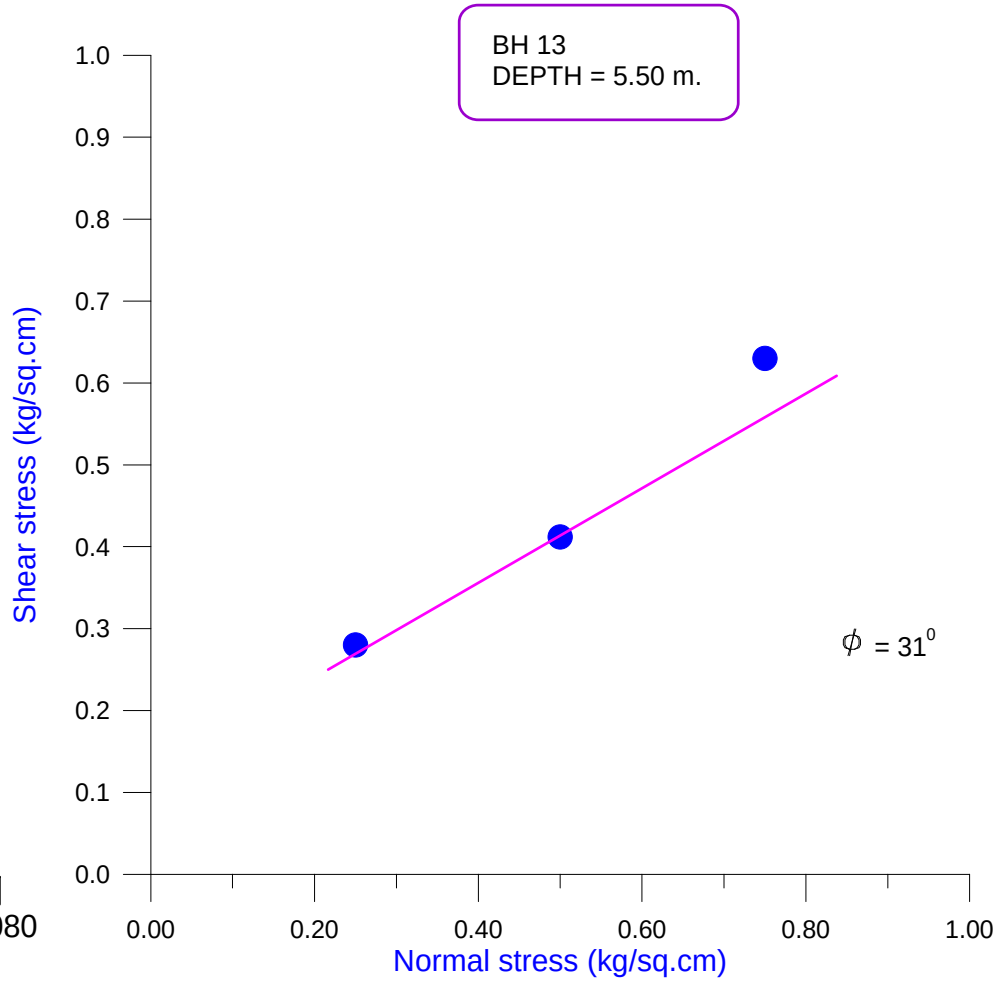
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 12-5



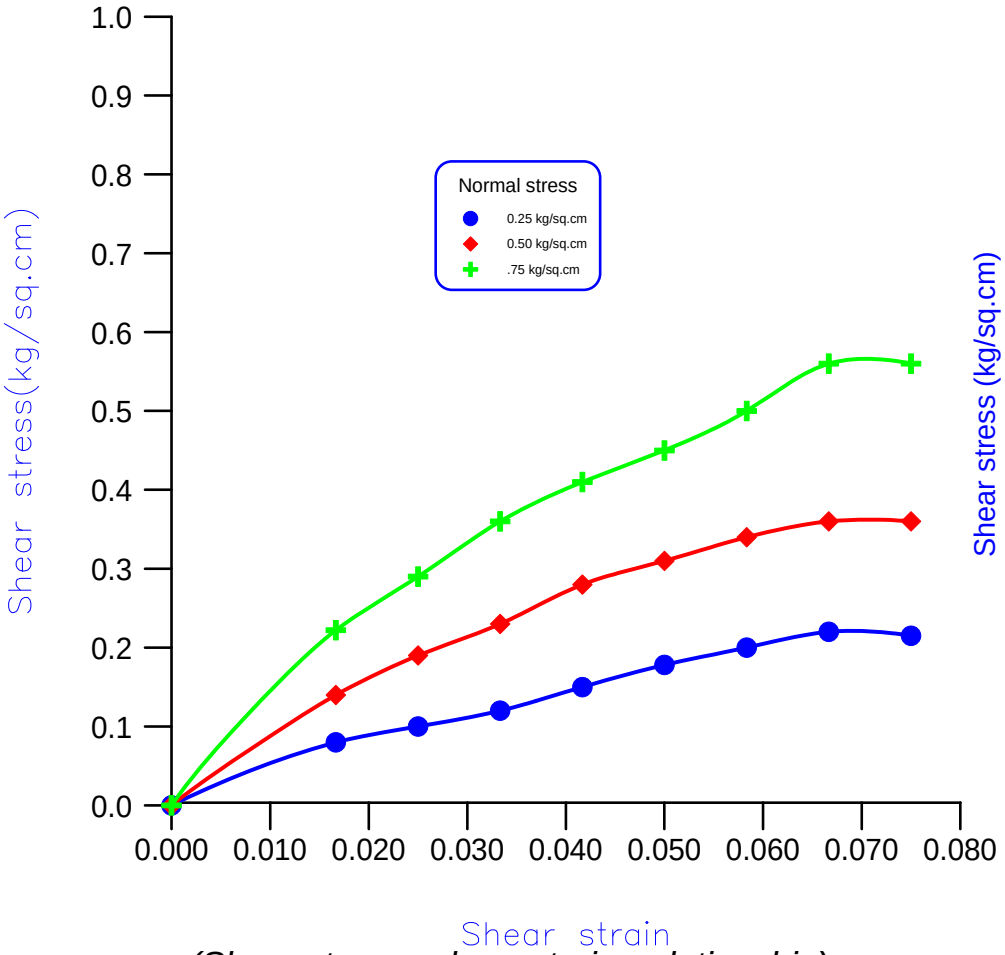
(Shear stress - shear strain relationship)



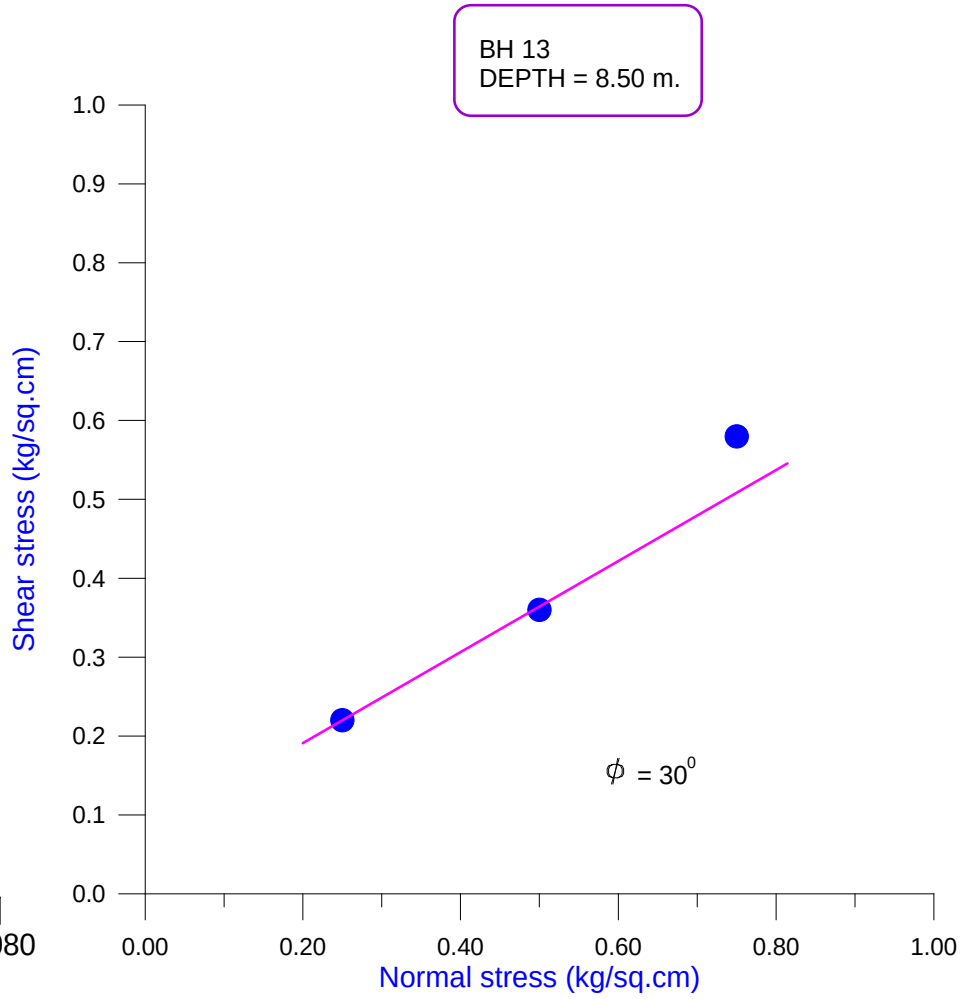
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 13-1



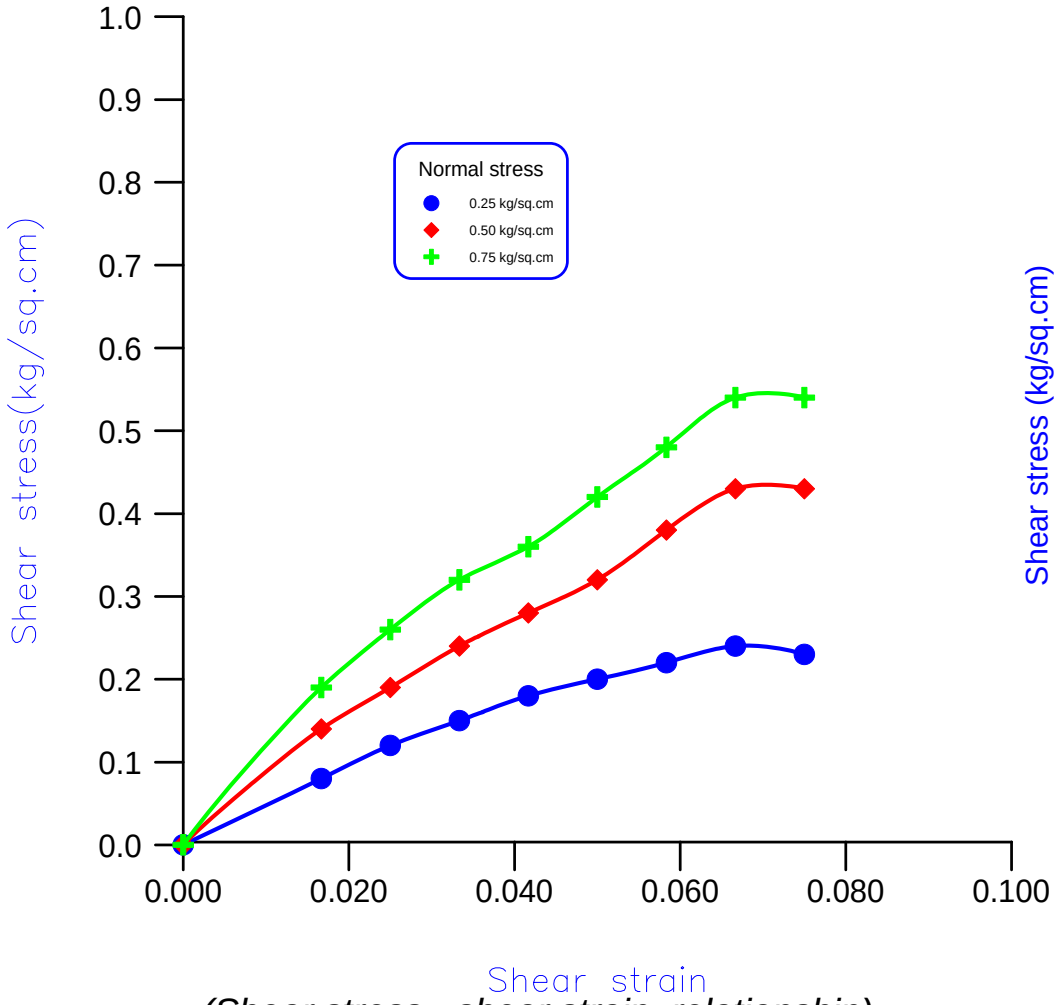
(Shear stress - shear strain relationship)



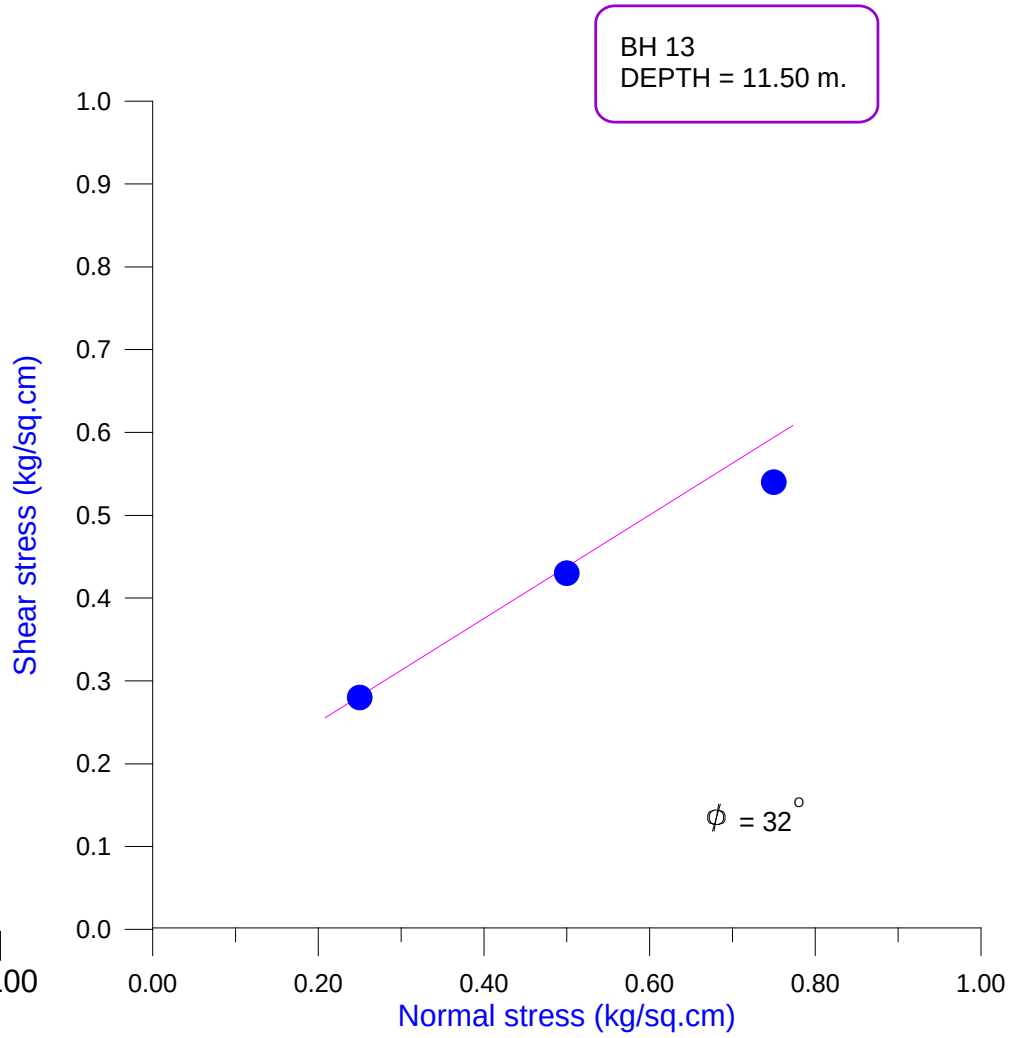
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 13-3



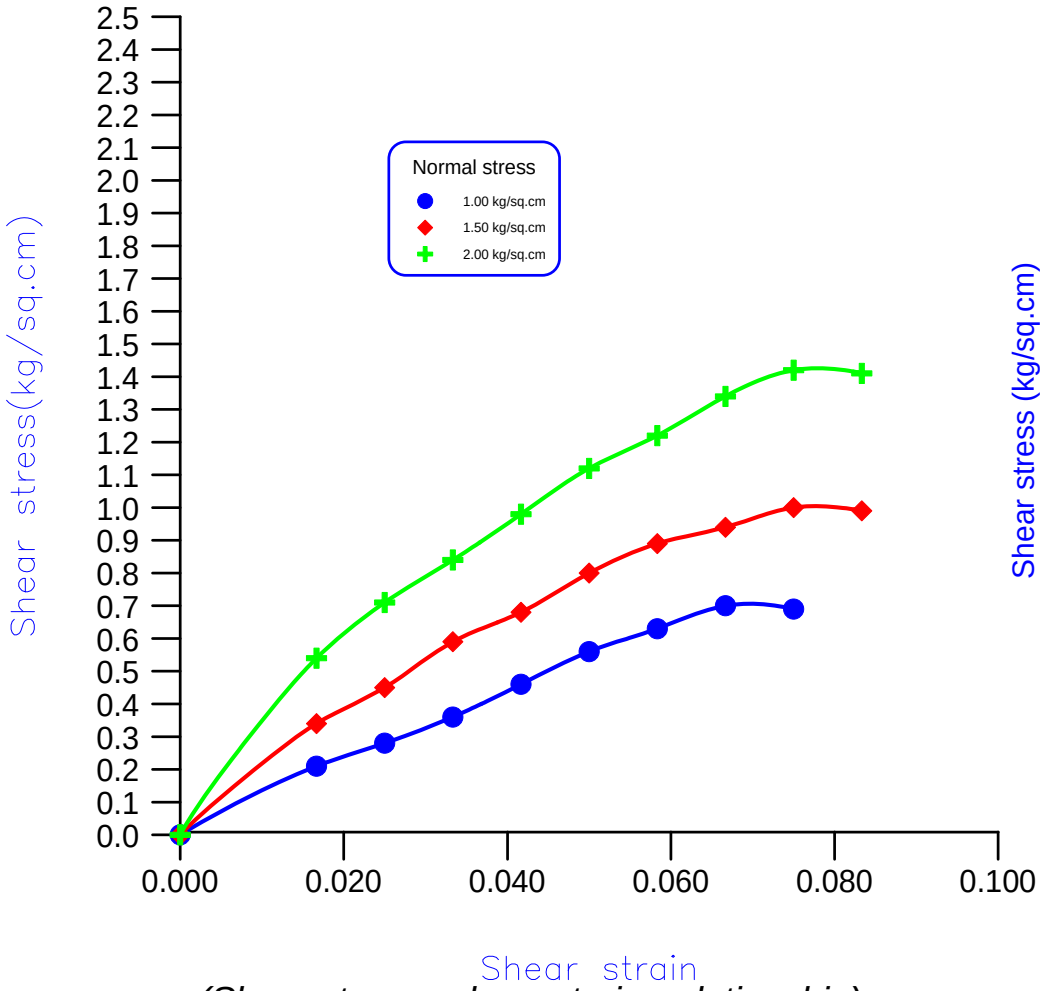
(Shear stress - shear strain relationship)



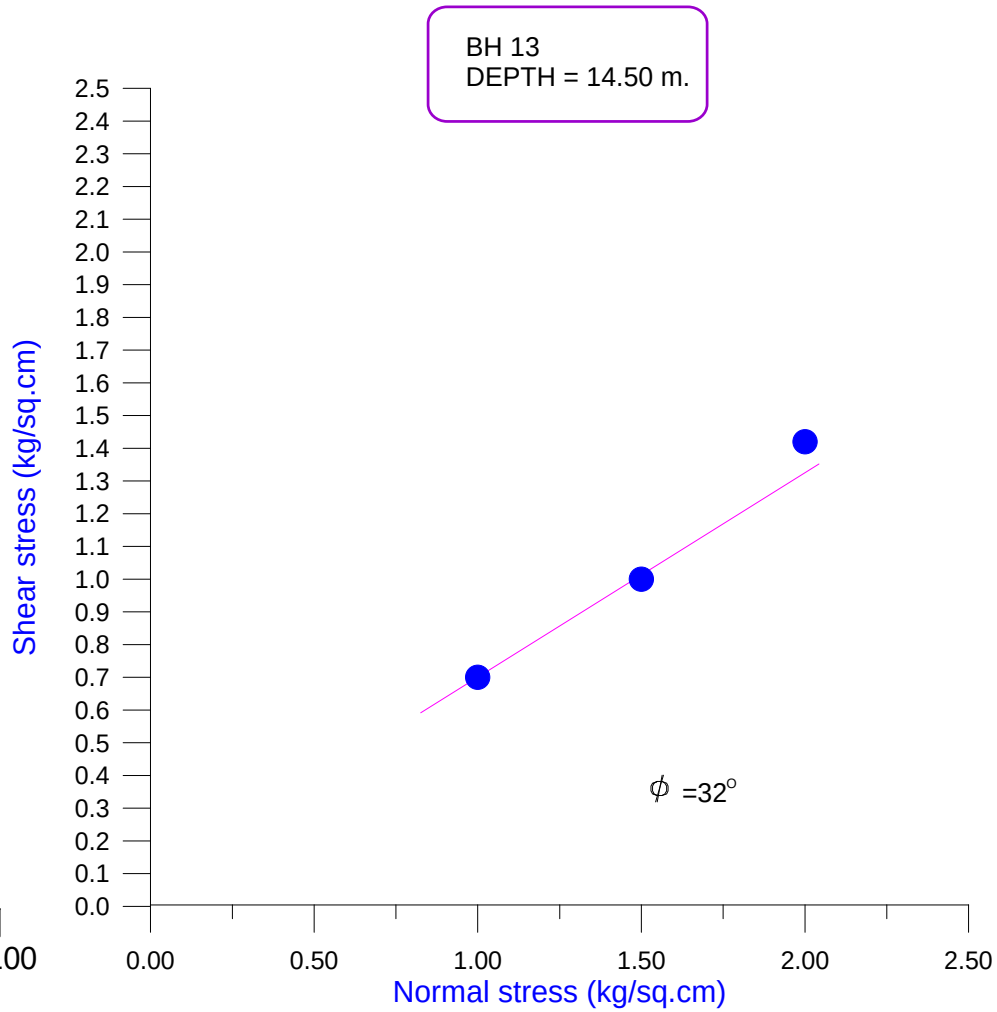
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

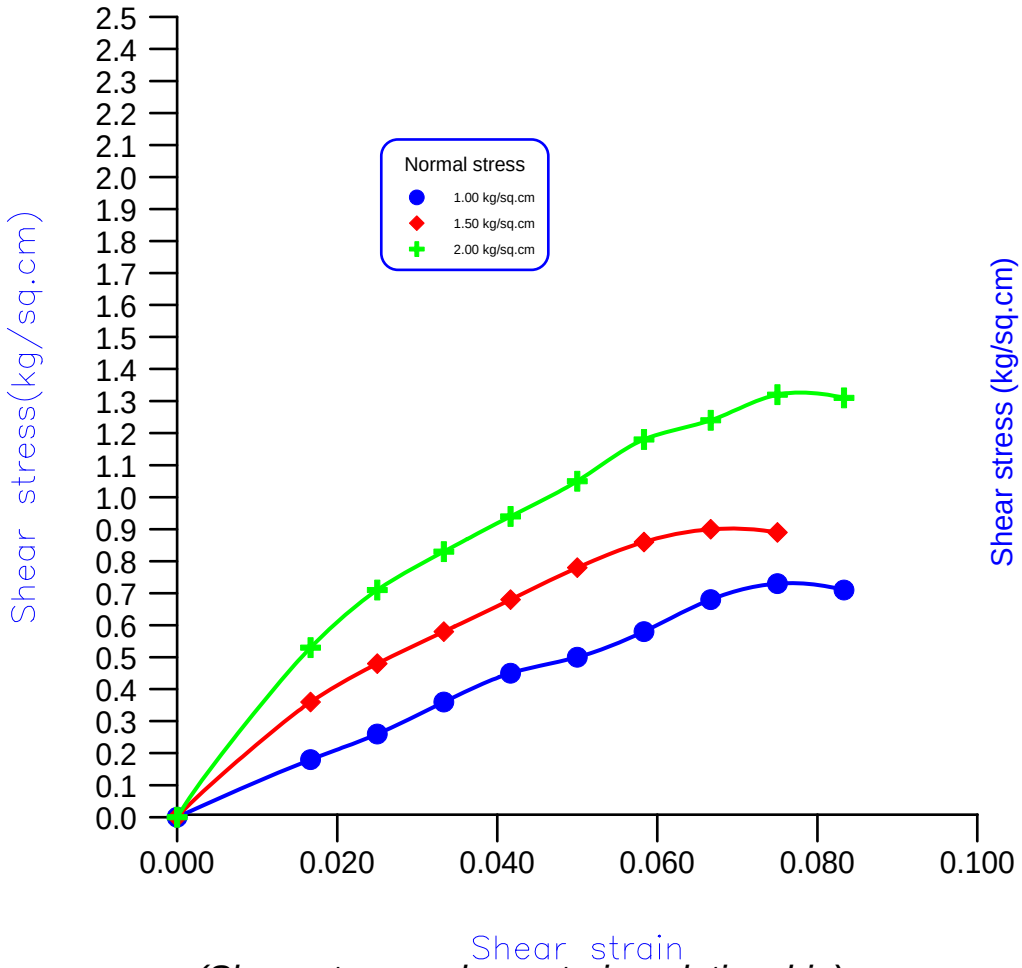
FIG- DS 13-4



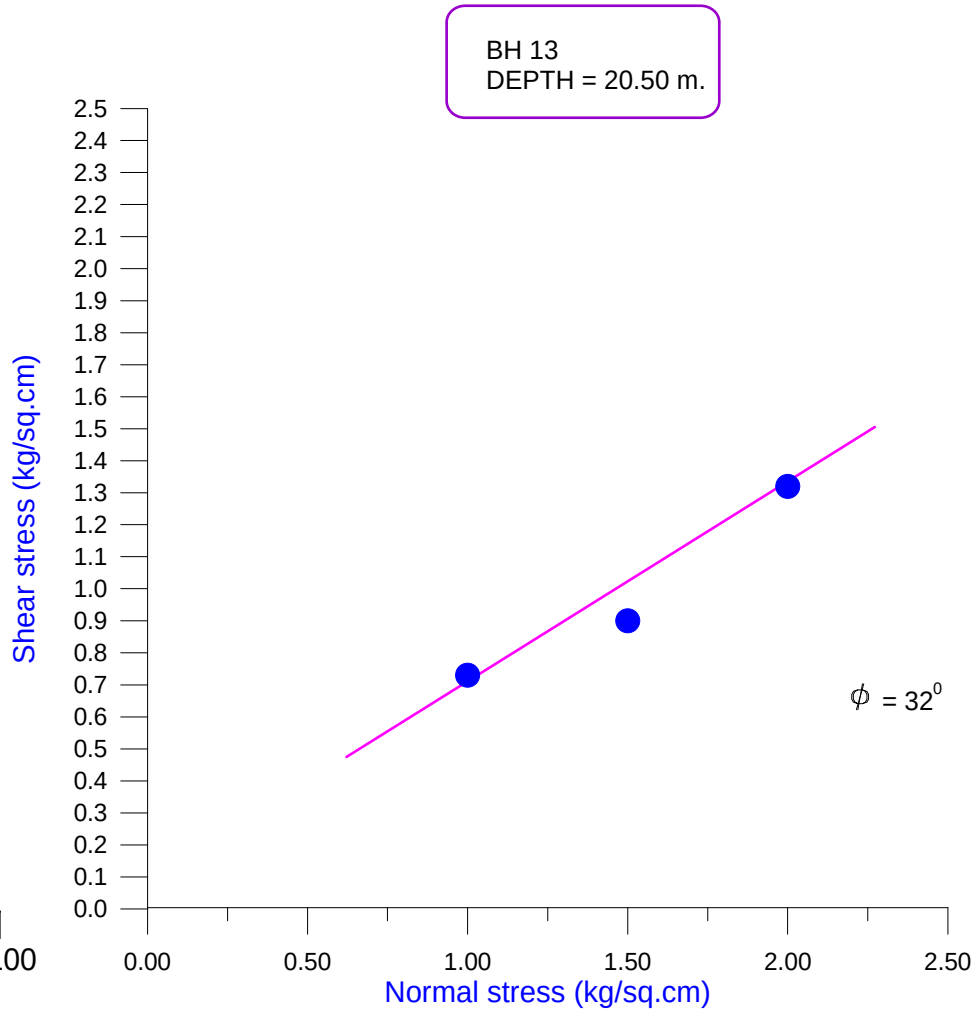
(Shear stress - shear strain relationship)



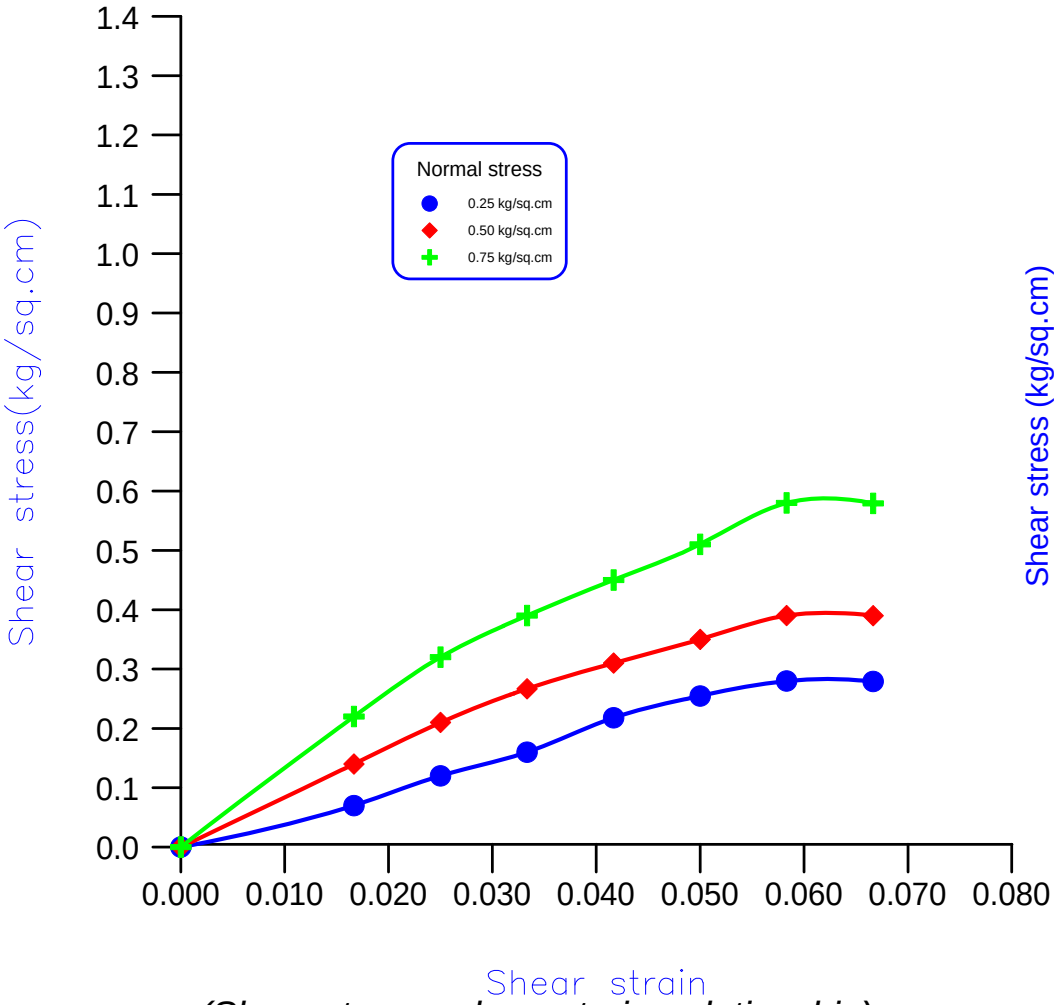
(Shear stress - Normal stress relationship)



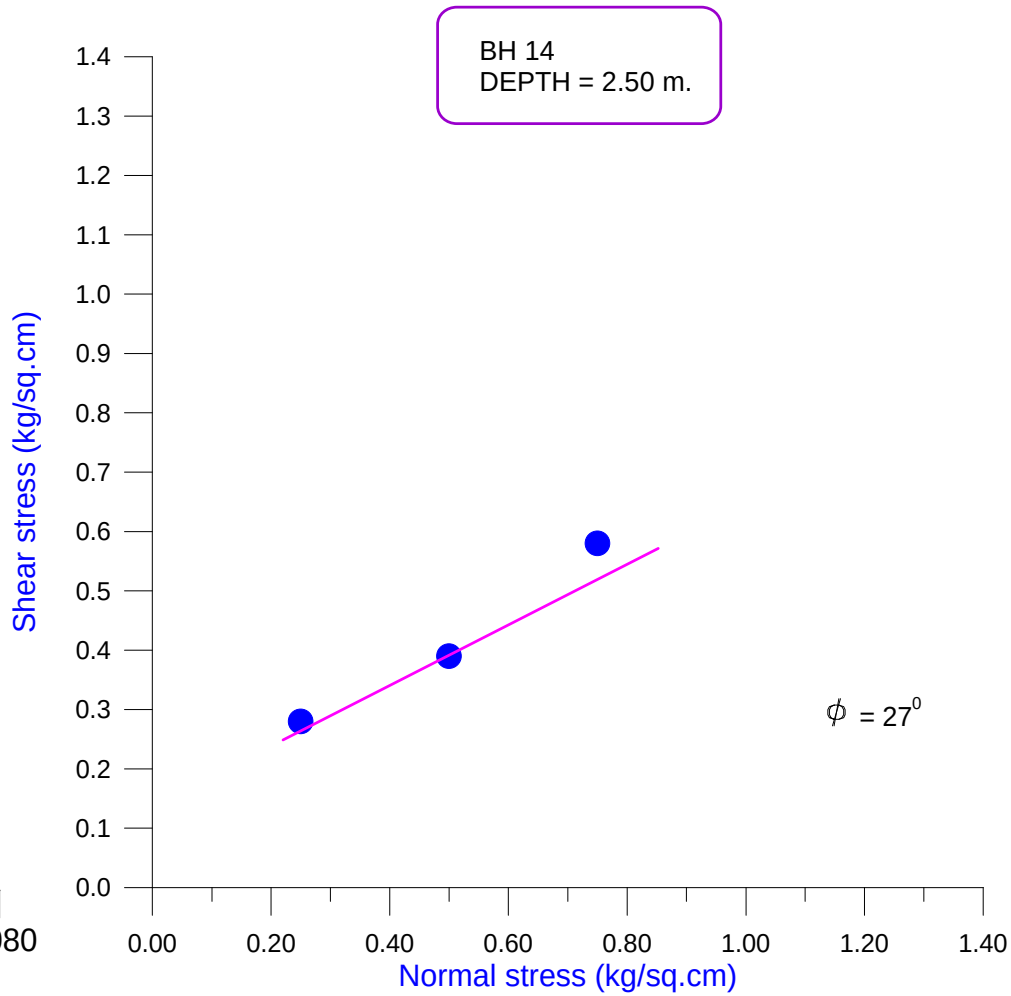
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



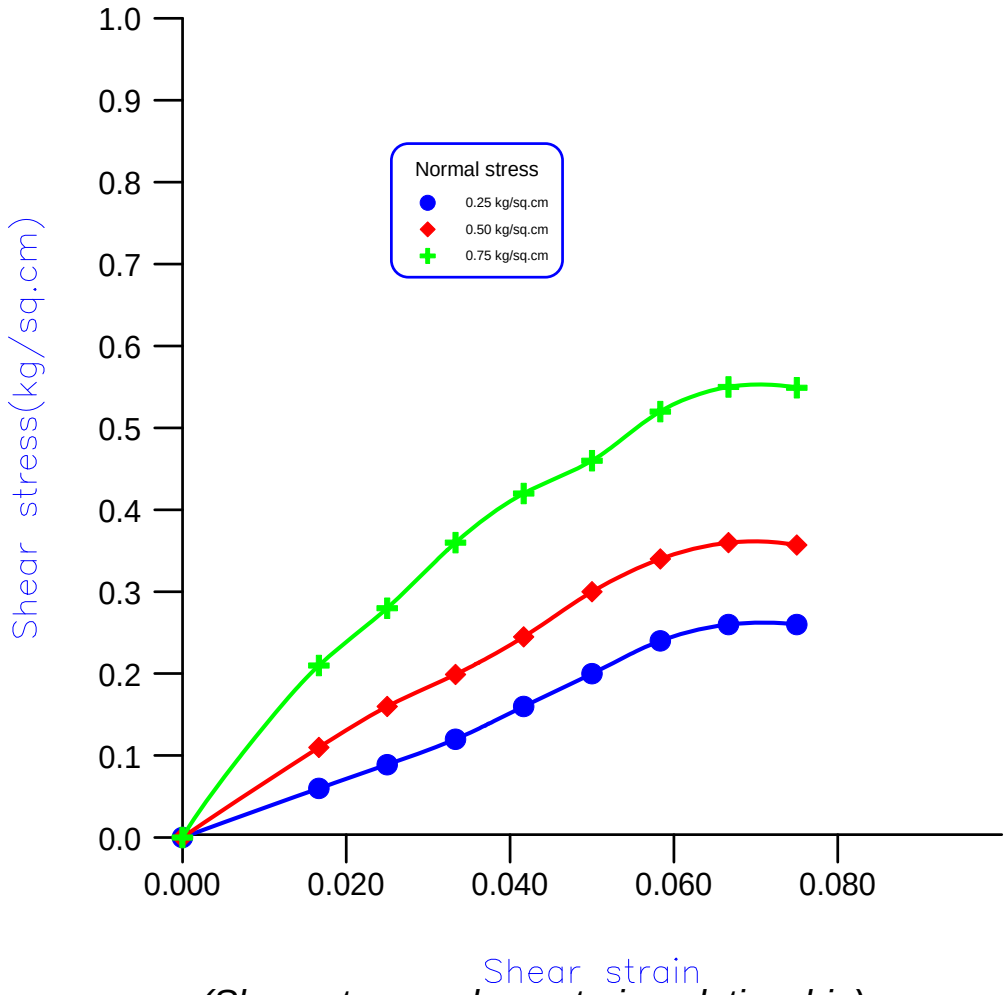
(Shear stress - shear strain relationship)



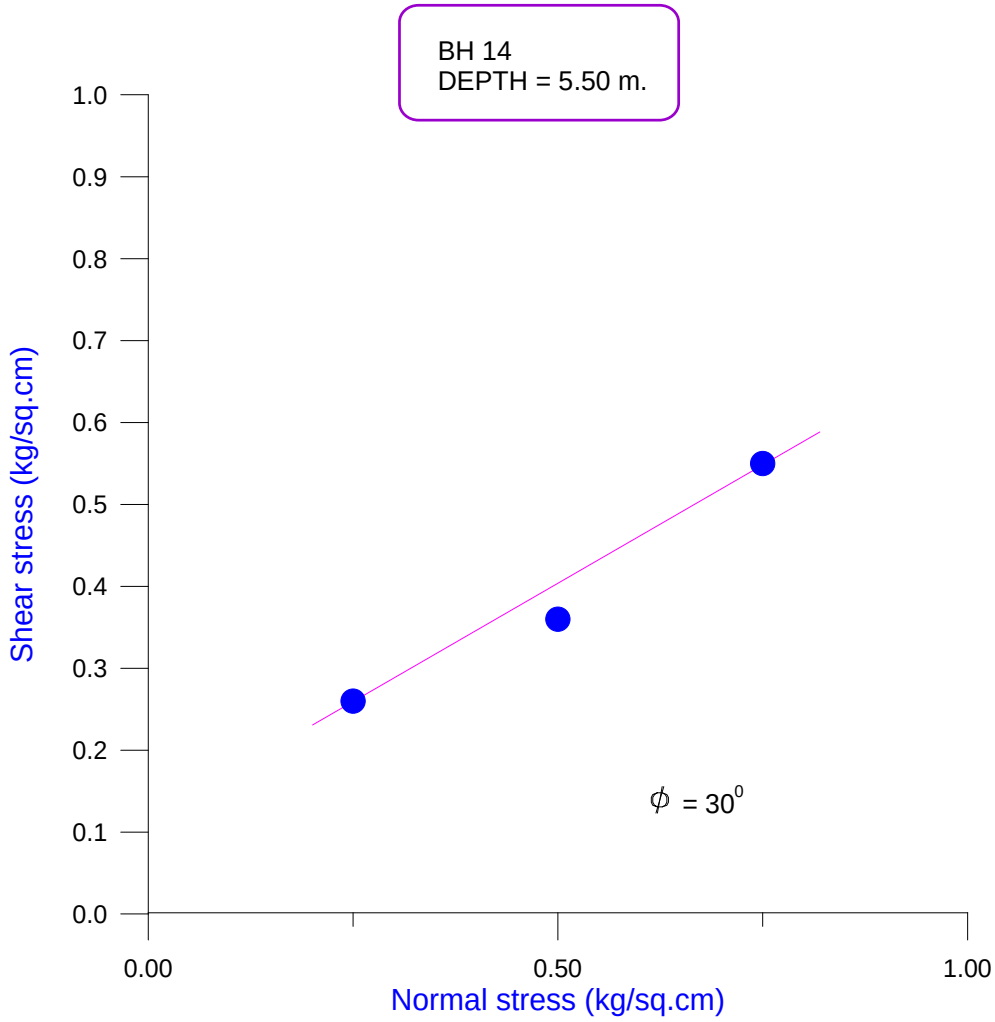
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 14-1



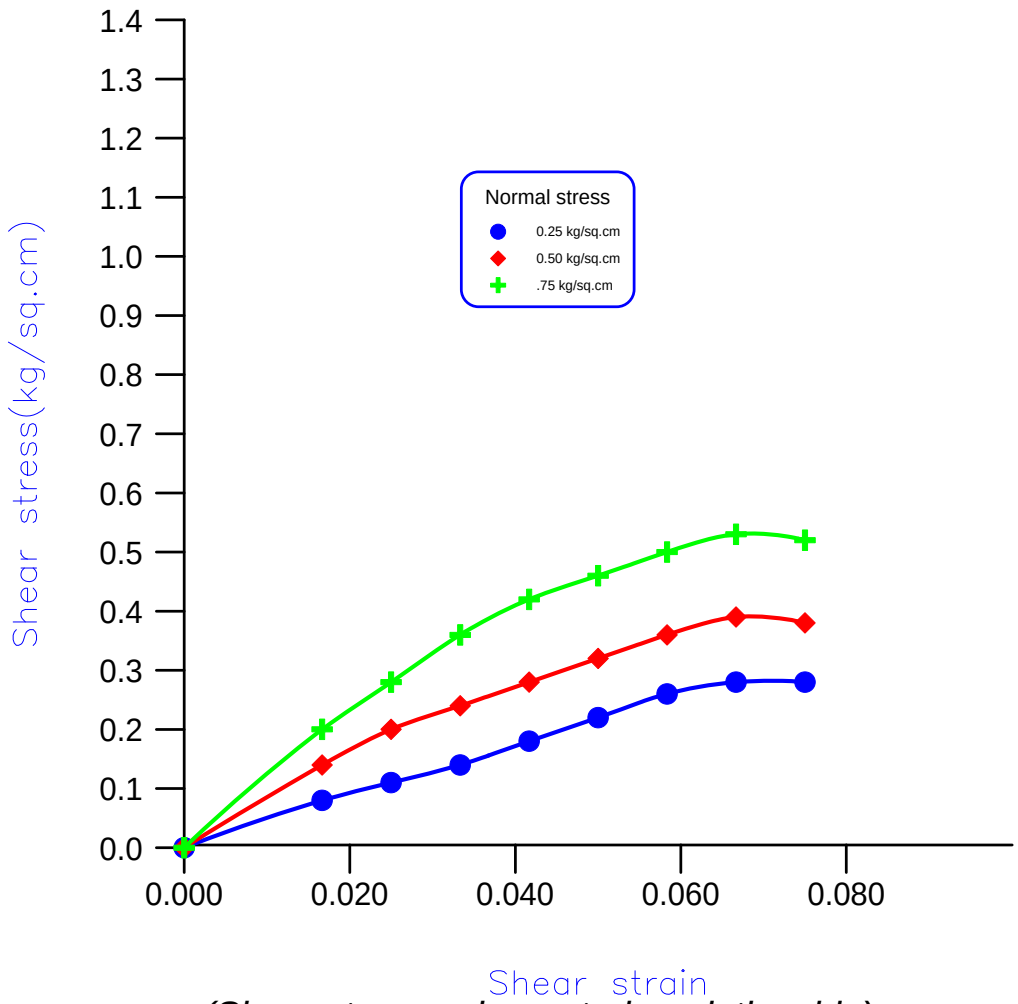
(Shear stress - shear strain relationship)



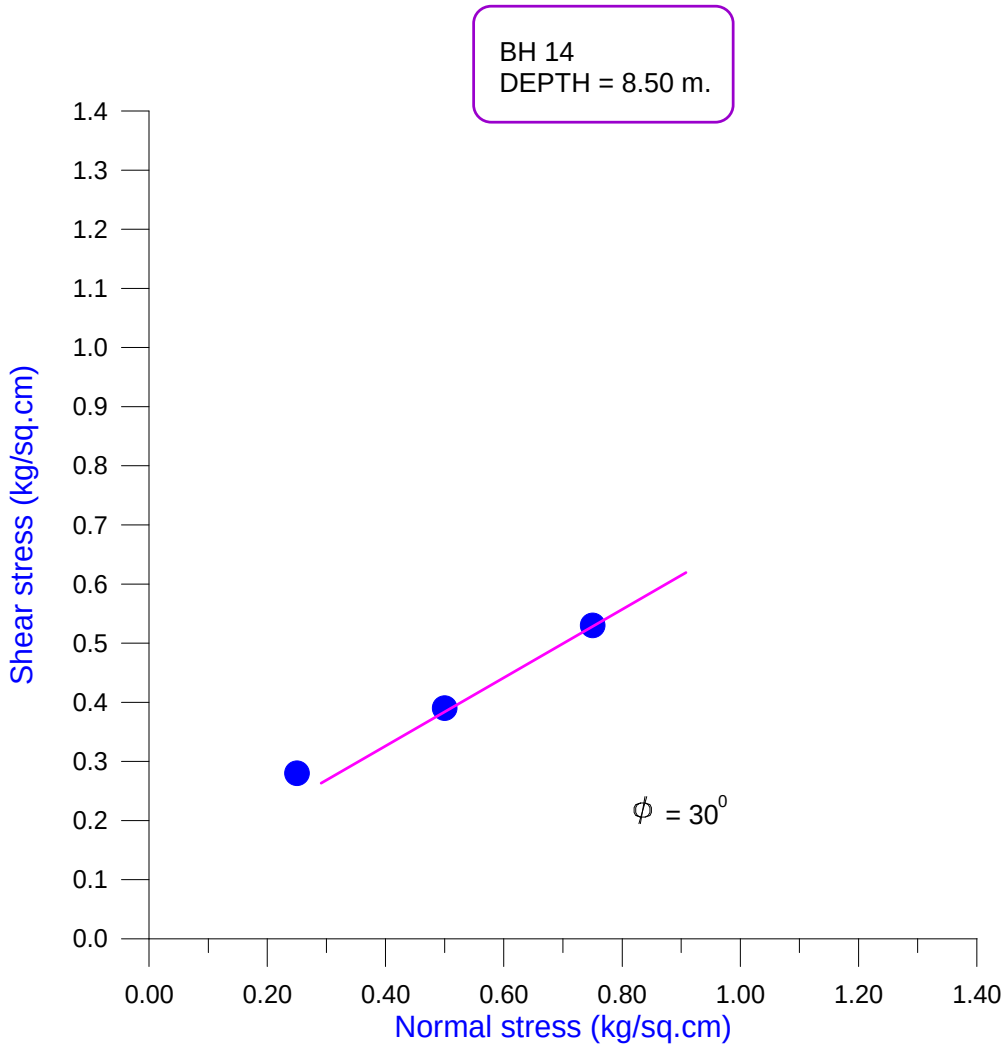
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

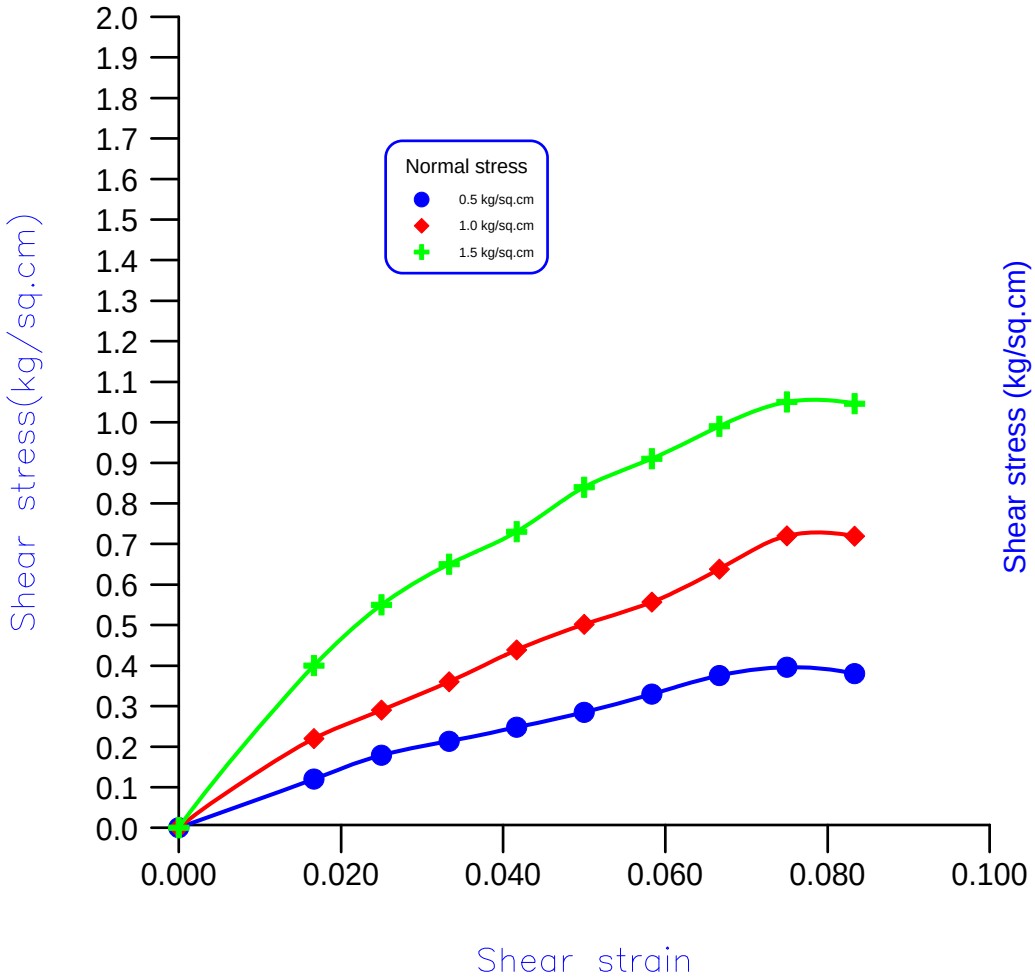
FIG- DS 14-2



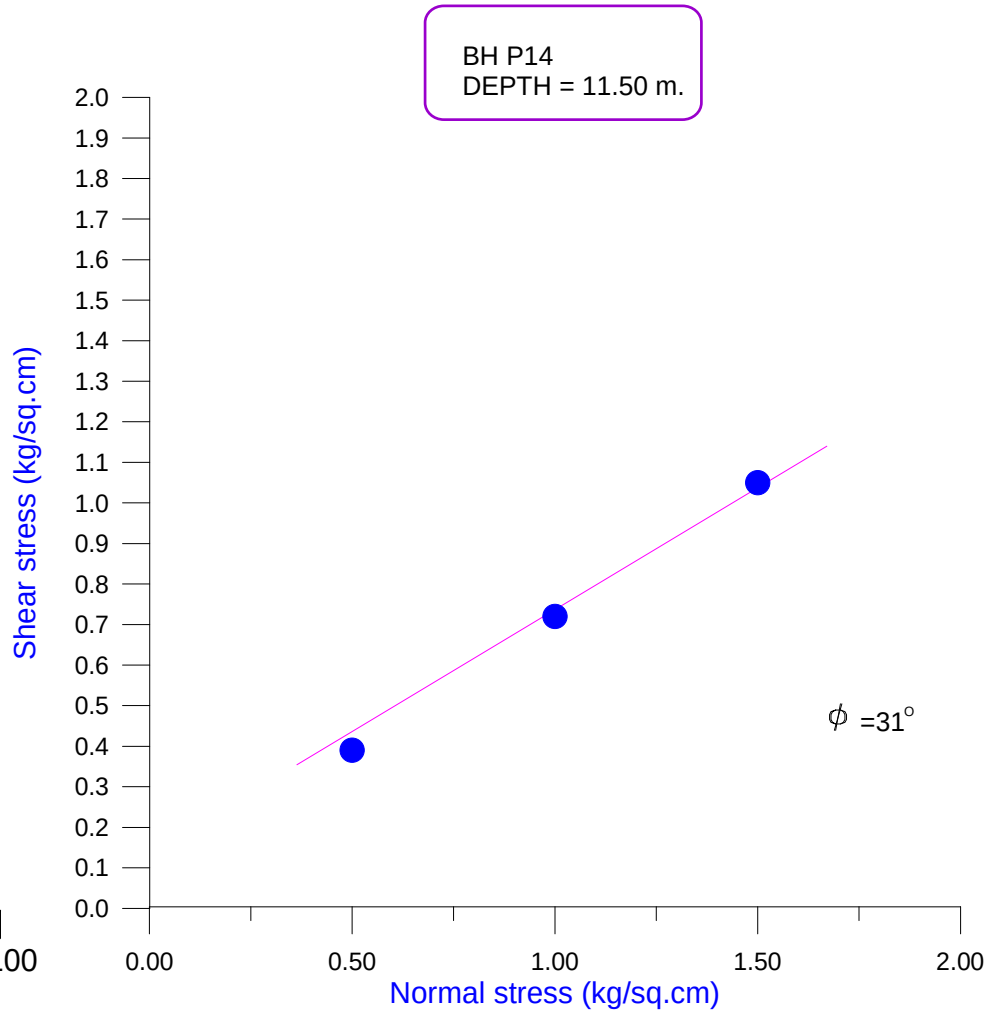
(Shear stress - shear strain relationship)



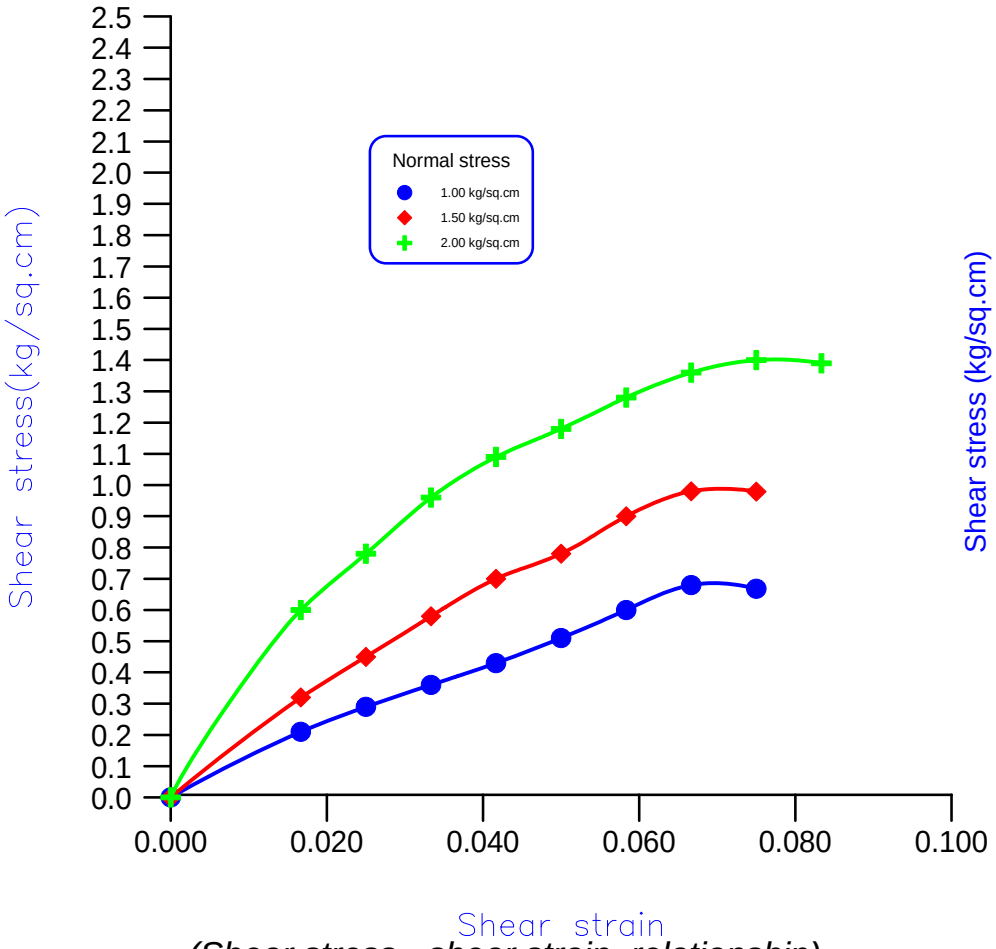
(Shear stress - Normal stress relationship)



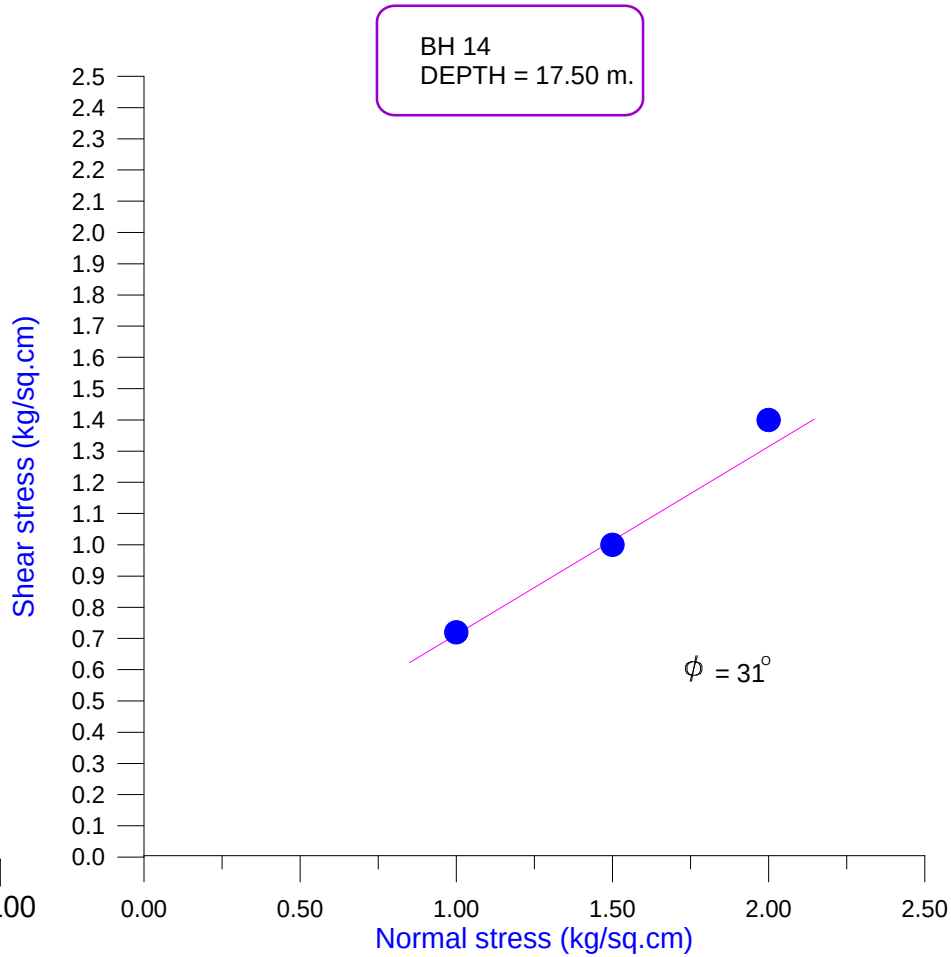
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



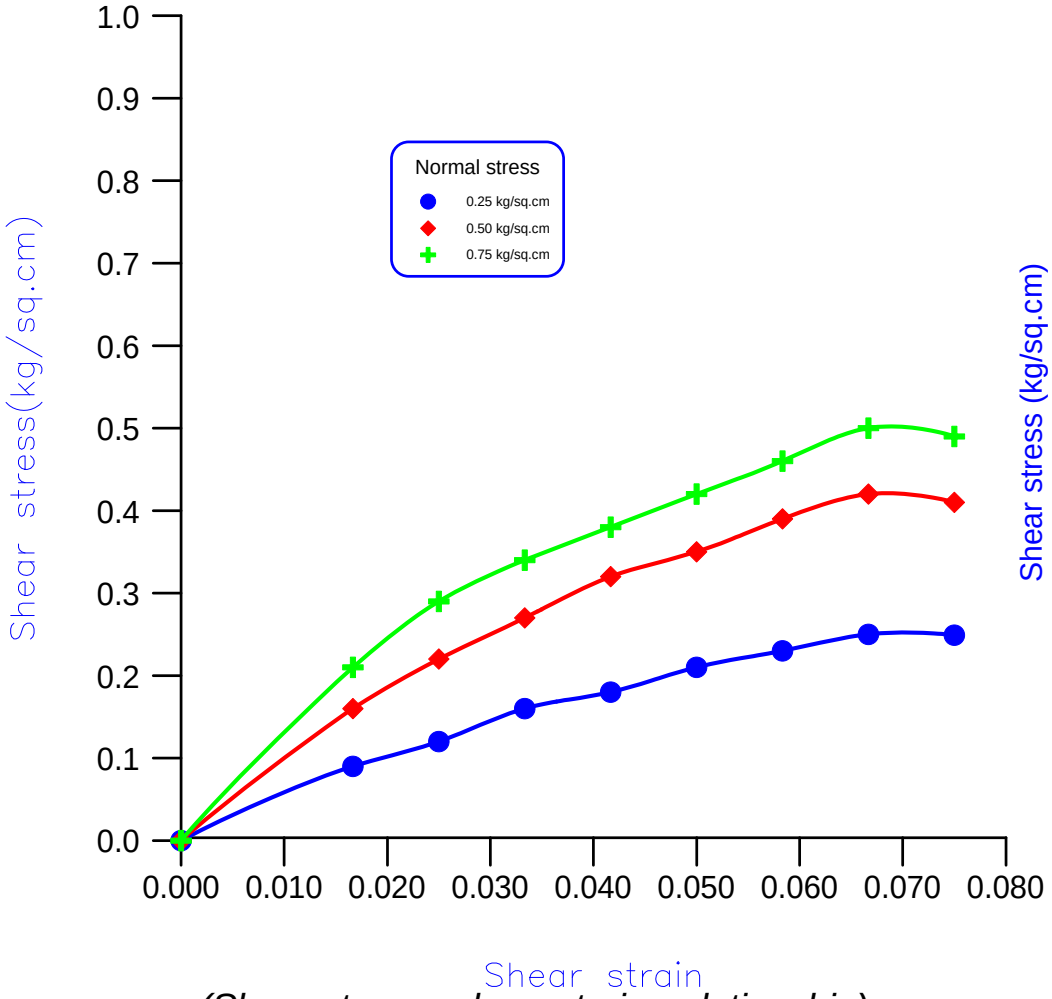
(Shear stress - shear strain relationship)



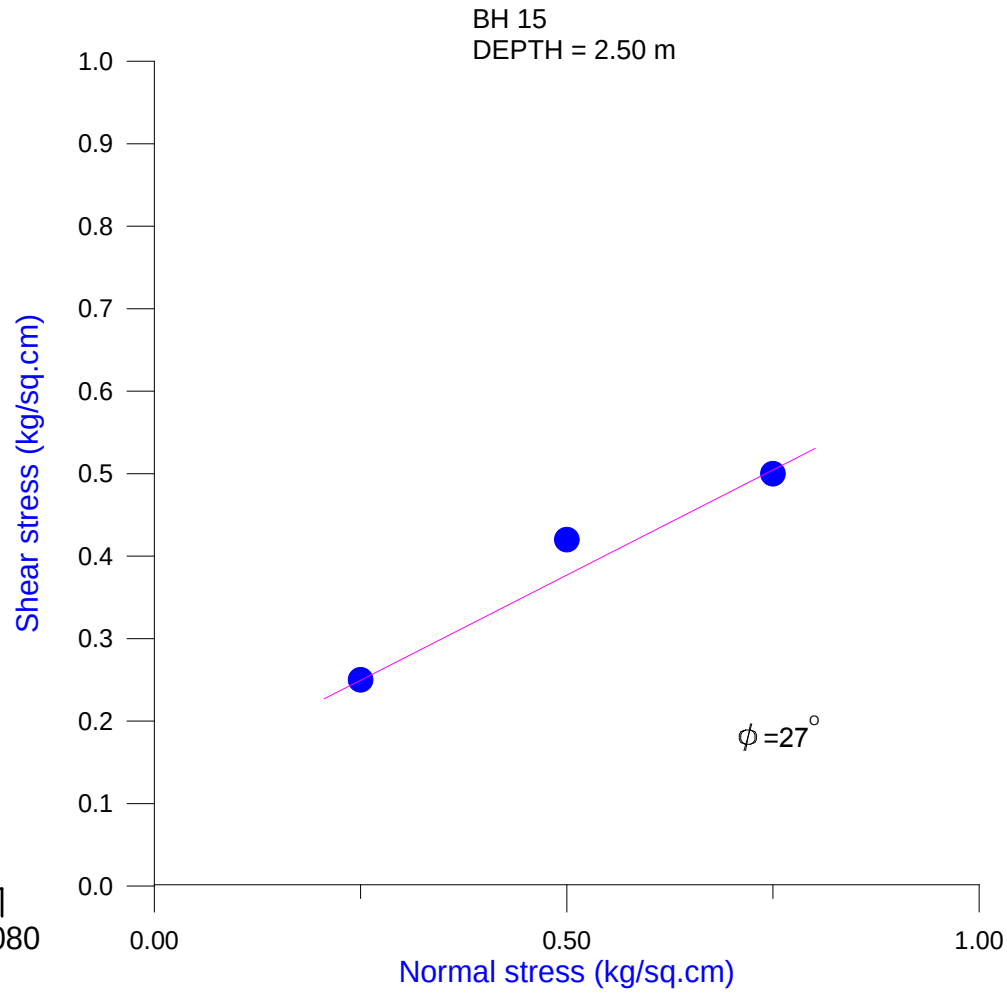
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 14-5



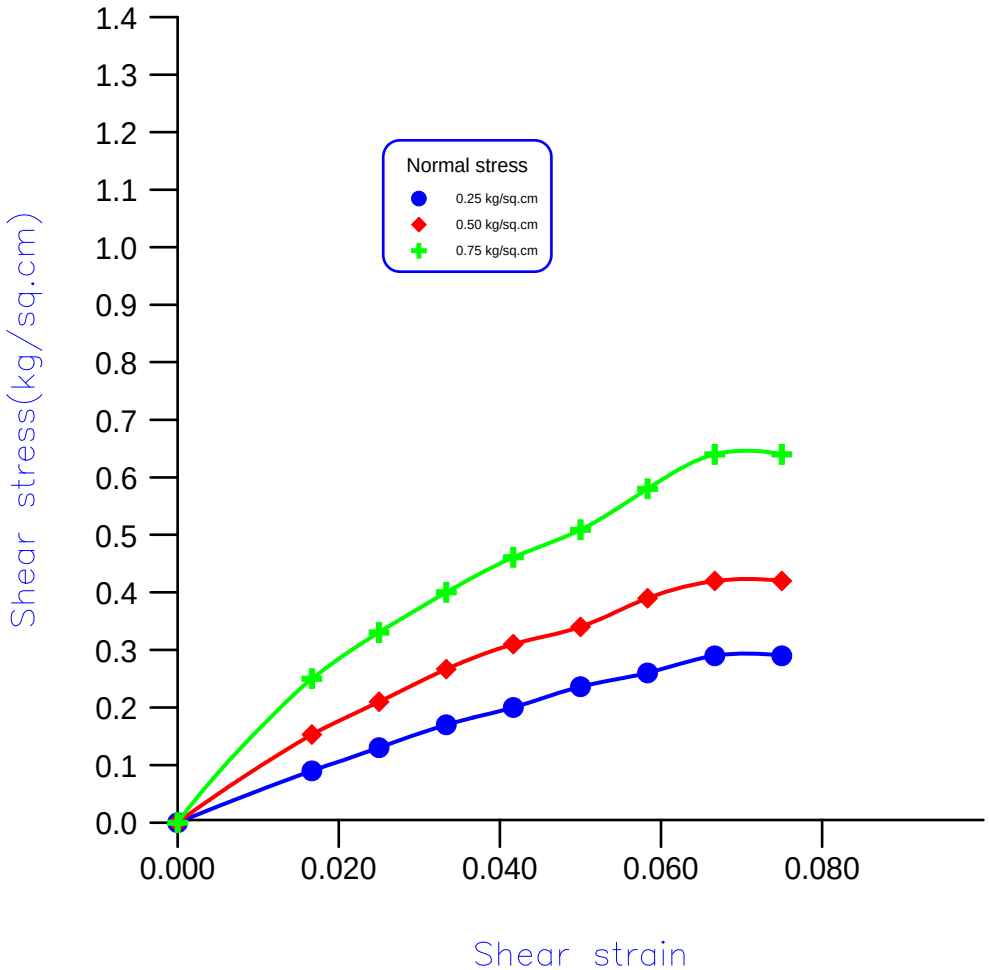
(Shear stress - shear strain relationship)



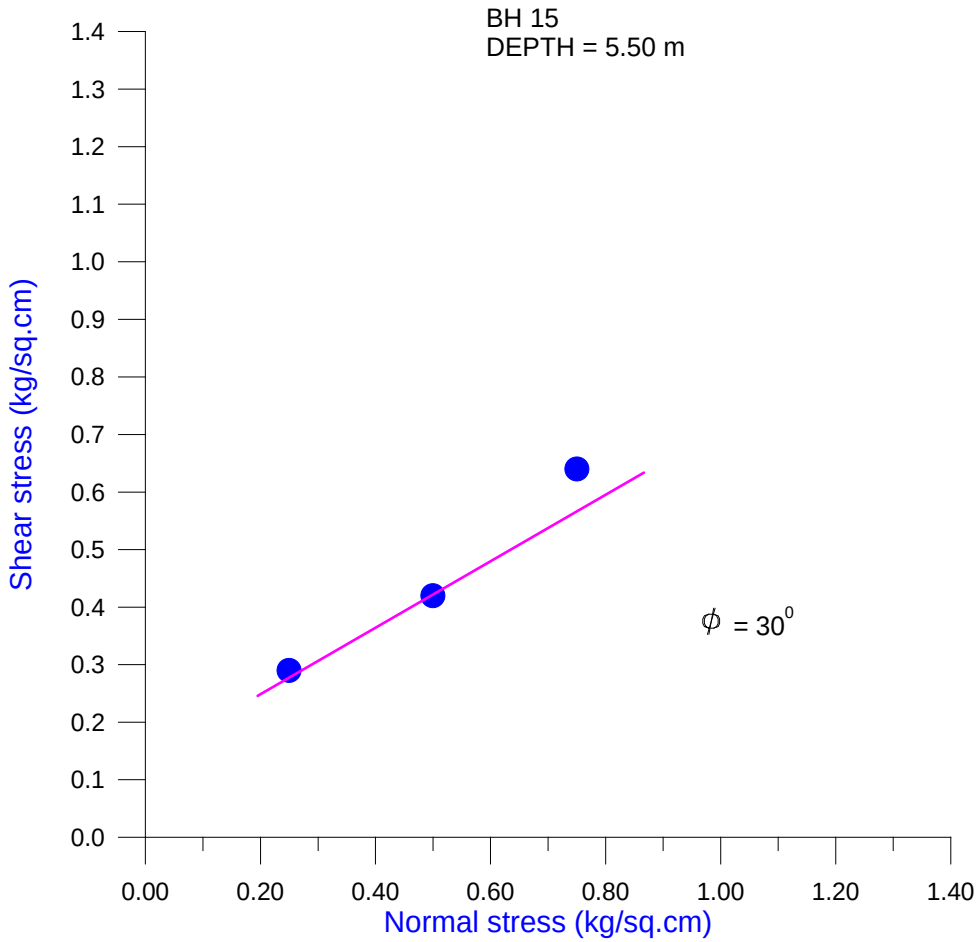
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 15-1



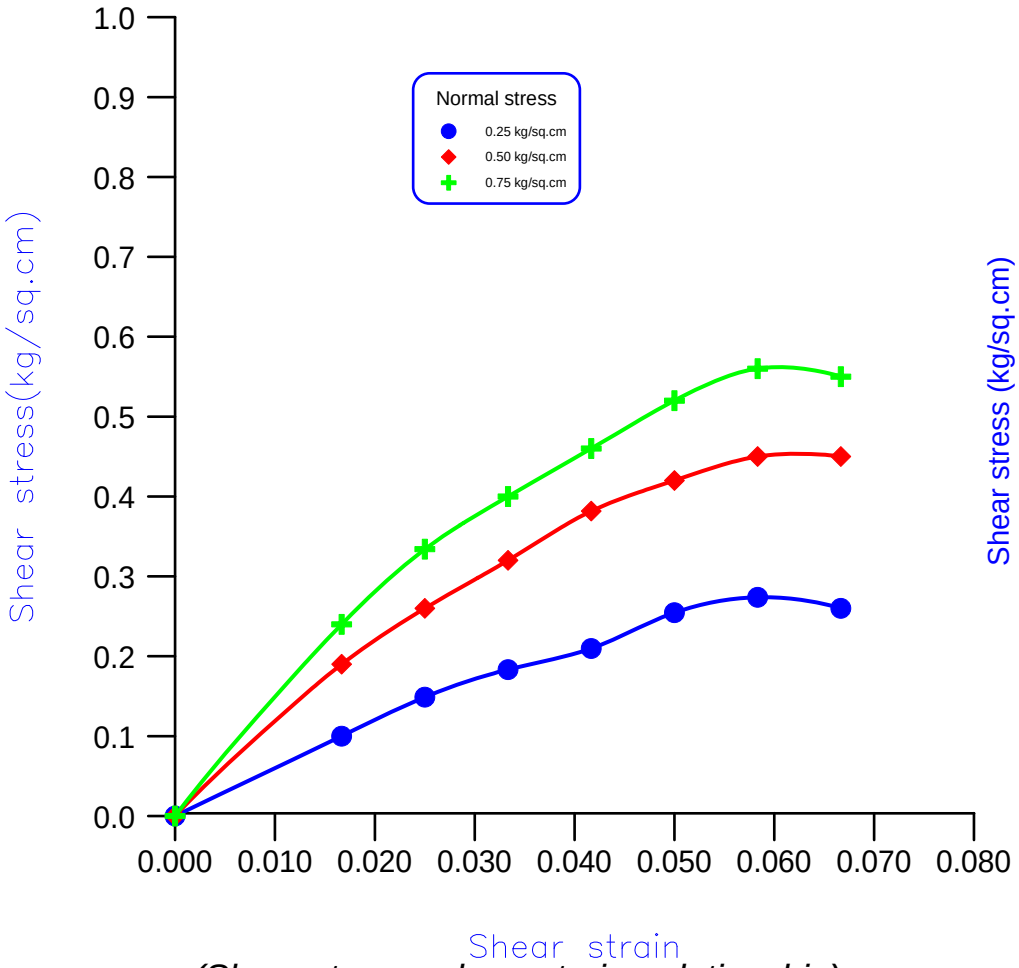
(Shear stress - shear strain relationship)



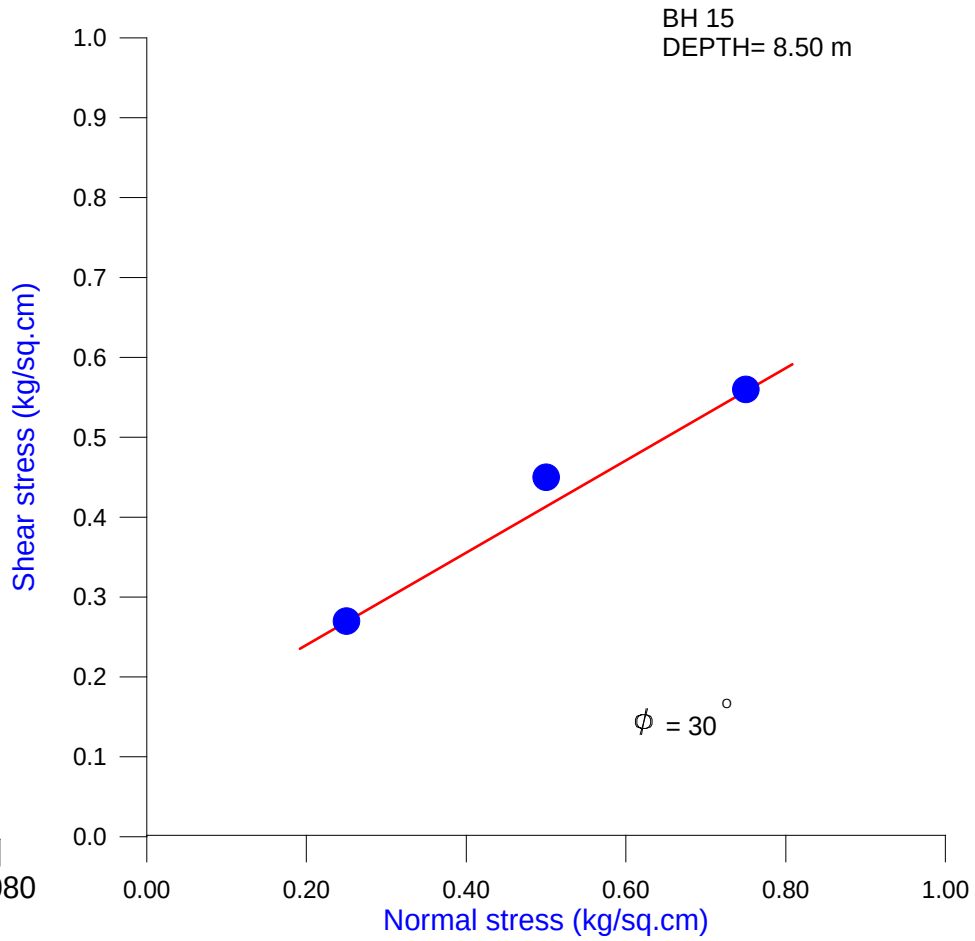
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 15-2



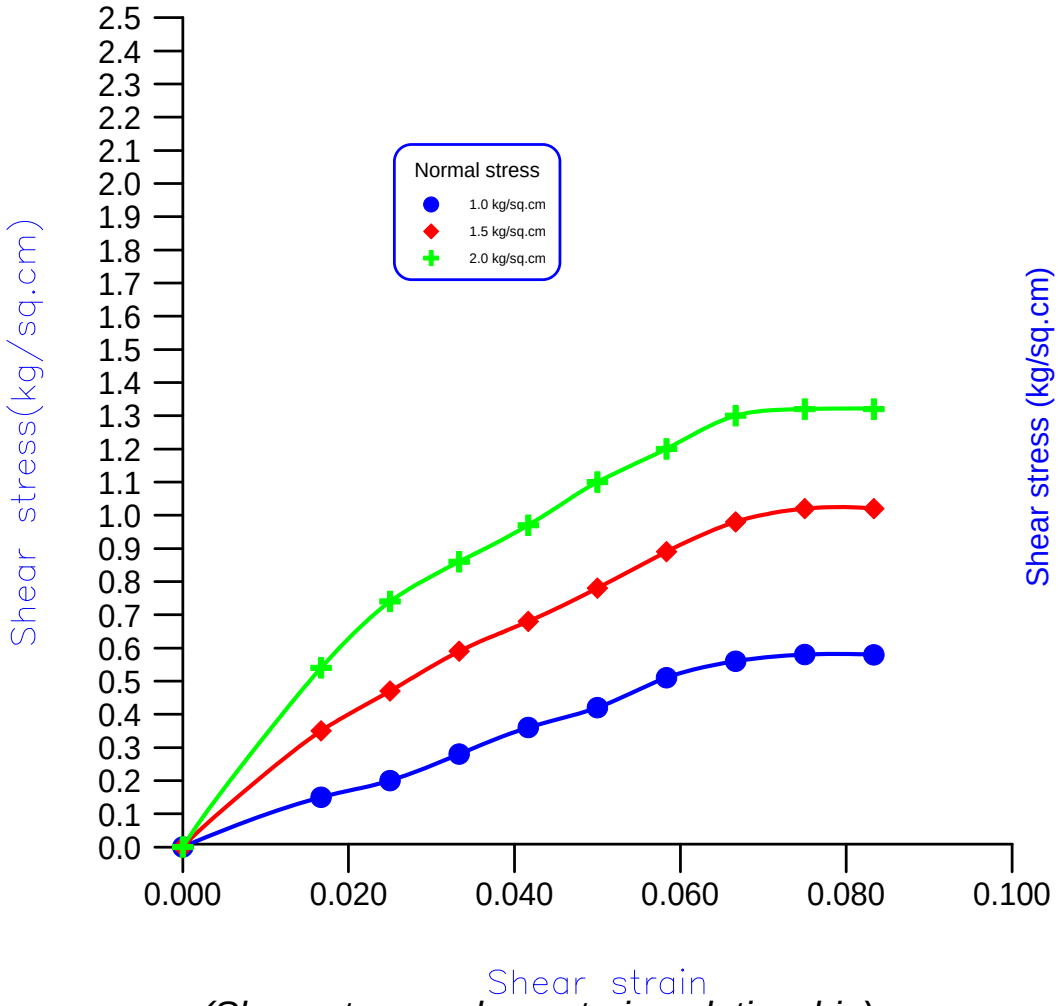
(Shear stress - shear strain relationship)



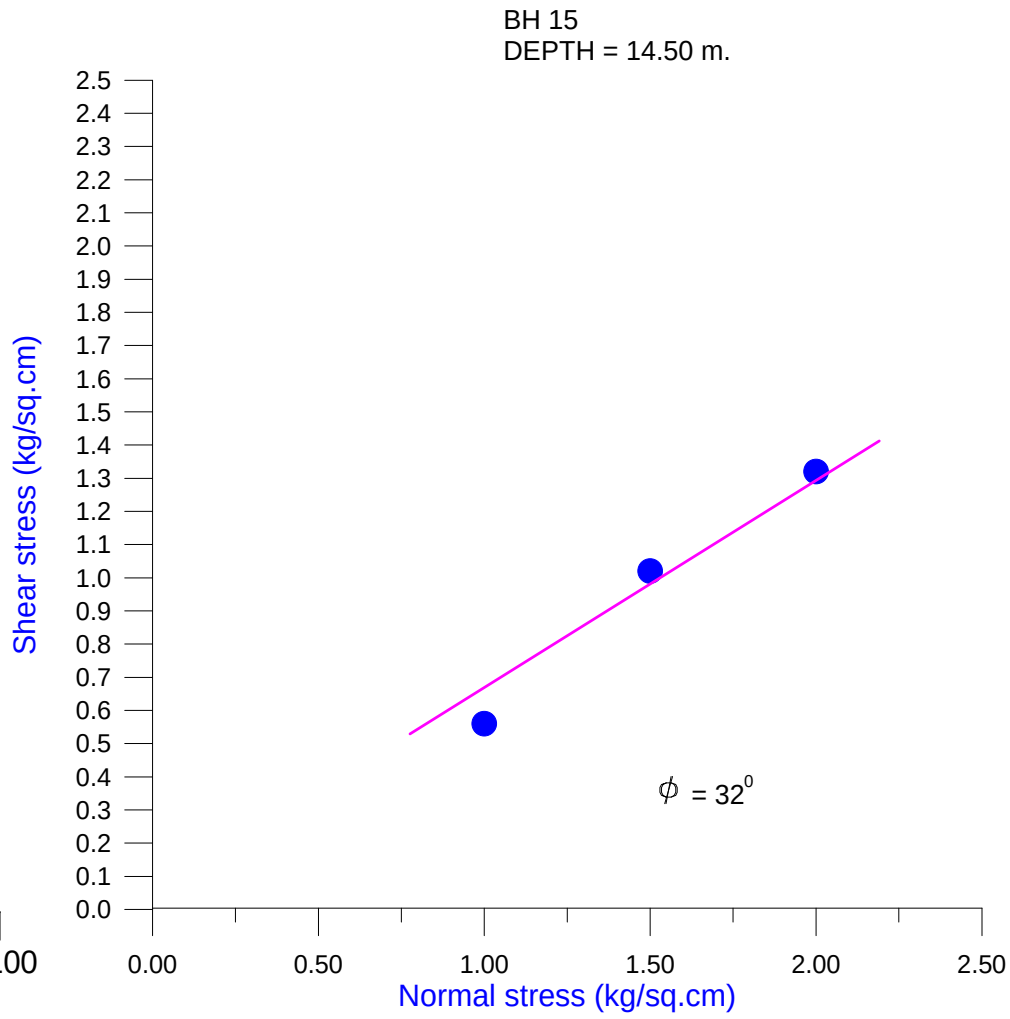
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 15-3



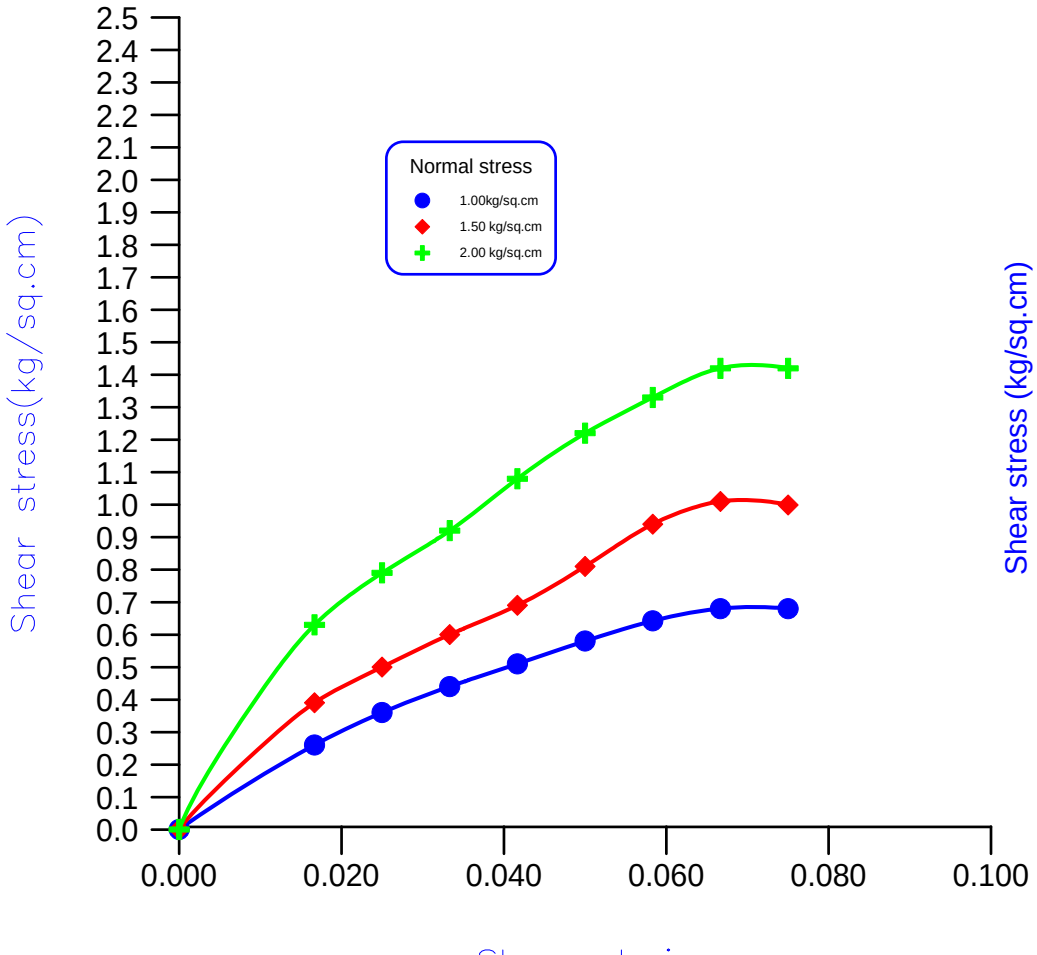
(Shear stress - shear strain relationship)



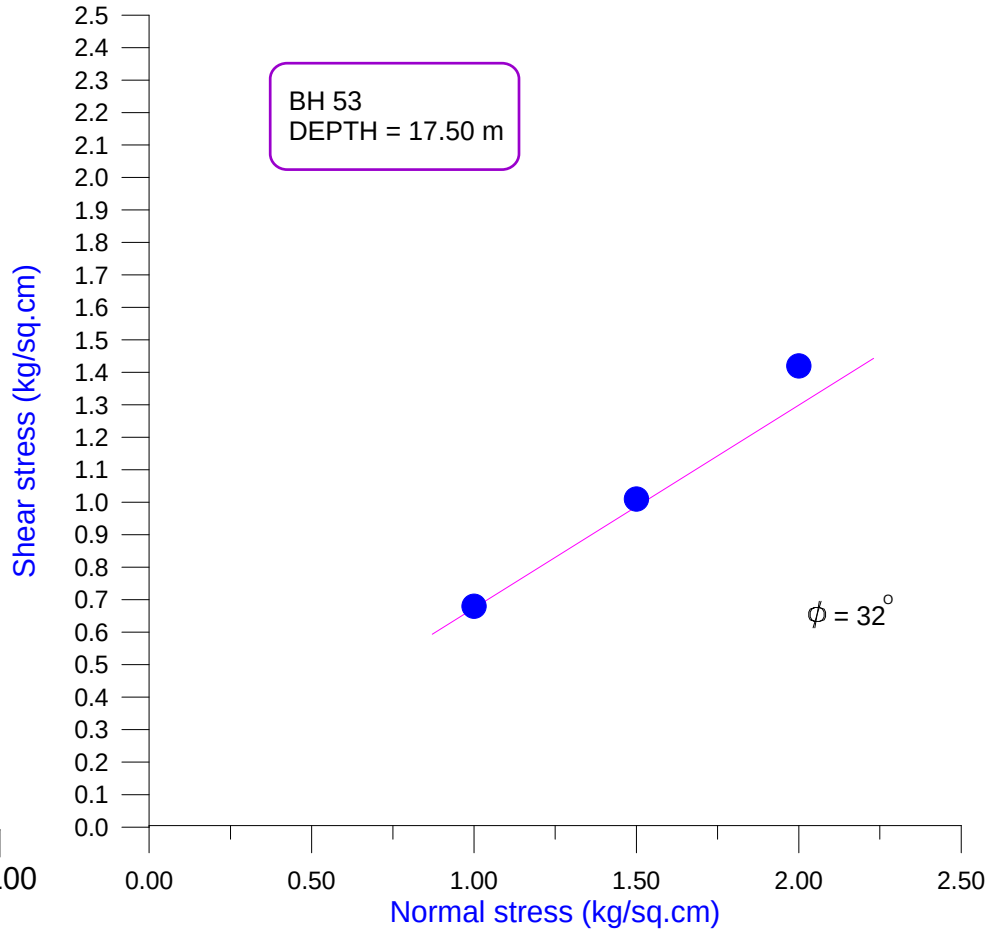
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

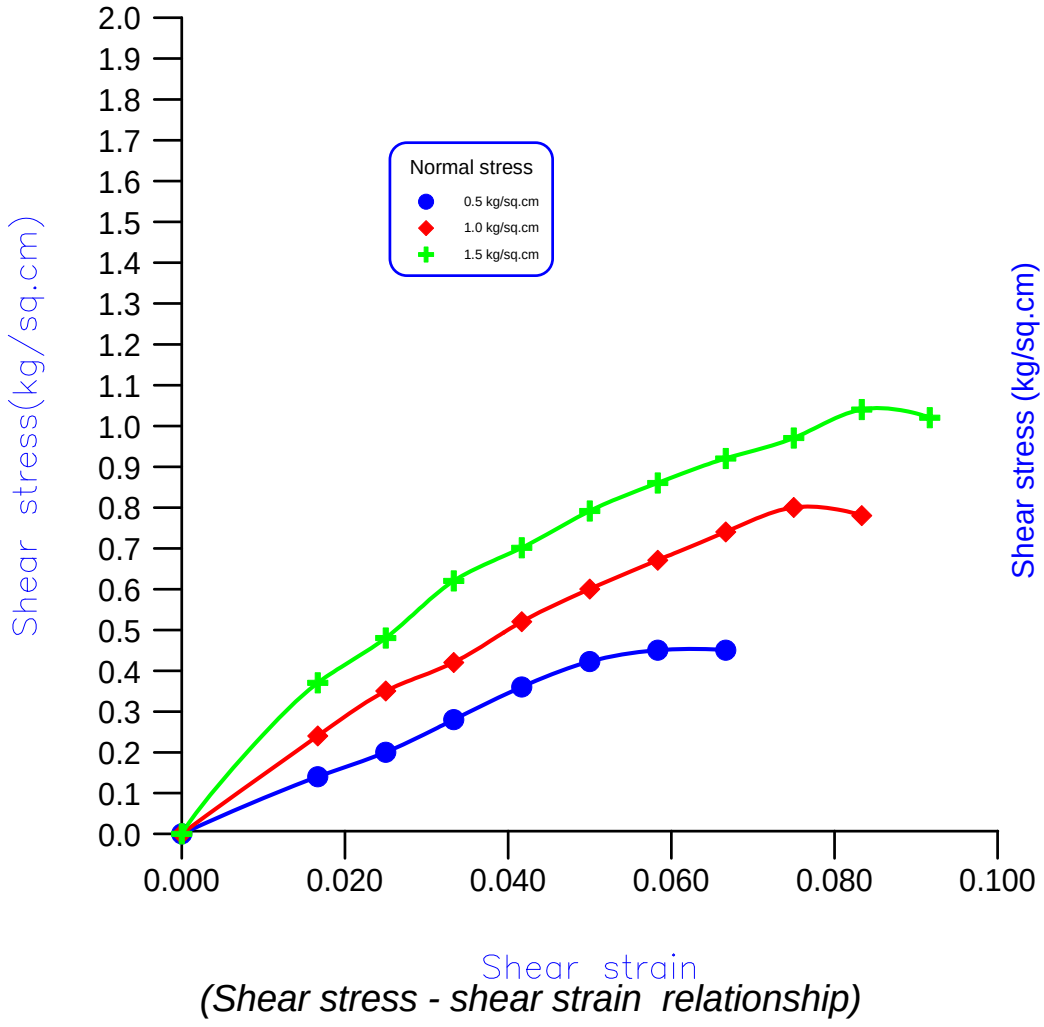
FIG- DS 15-5



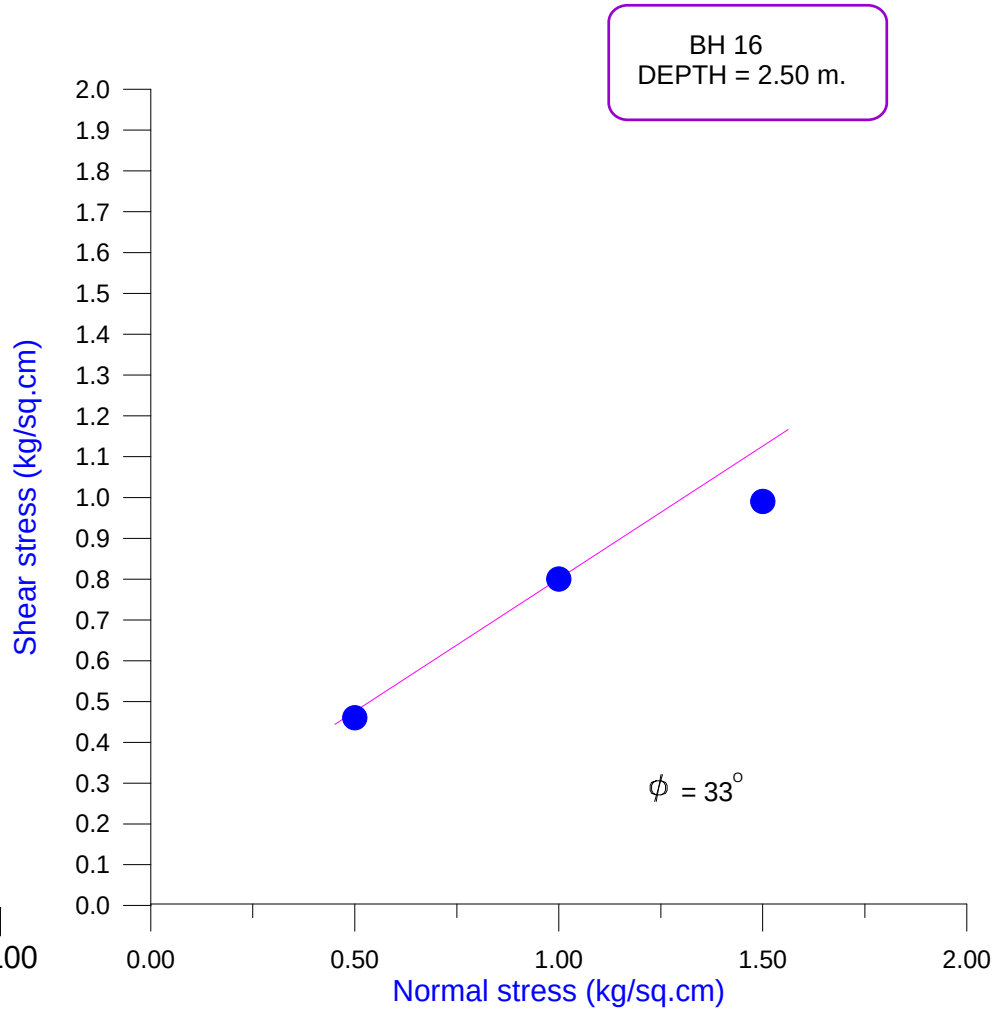
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



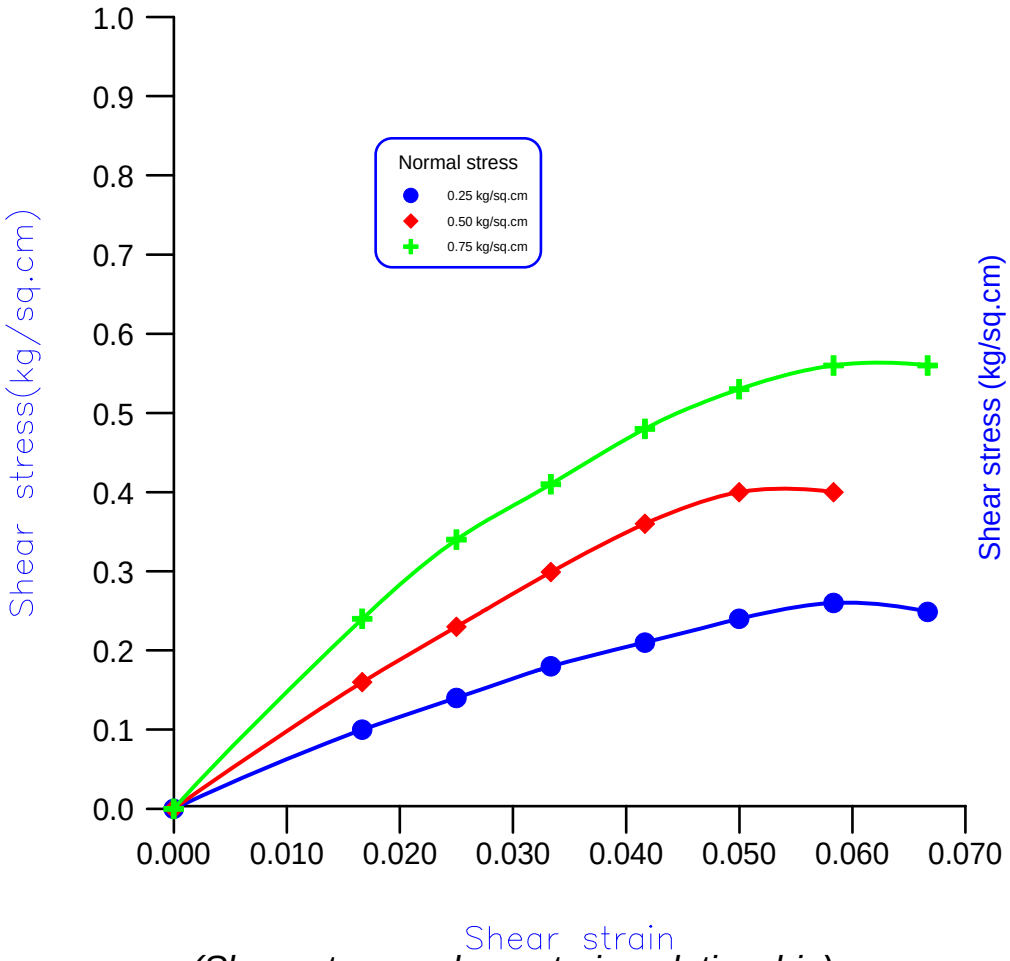
(Shear stress - shear strain relationship)



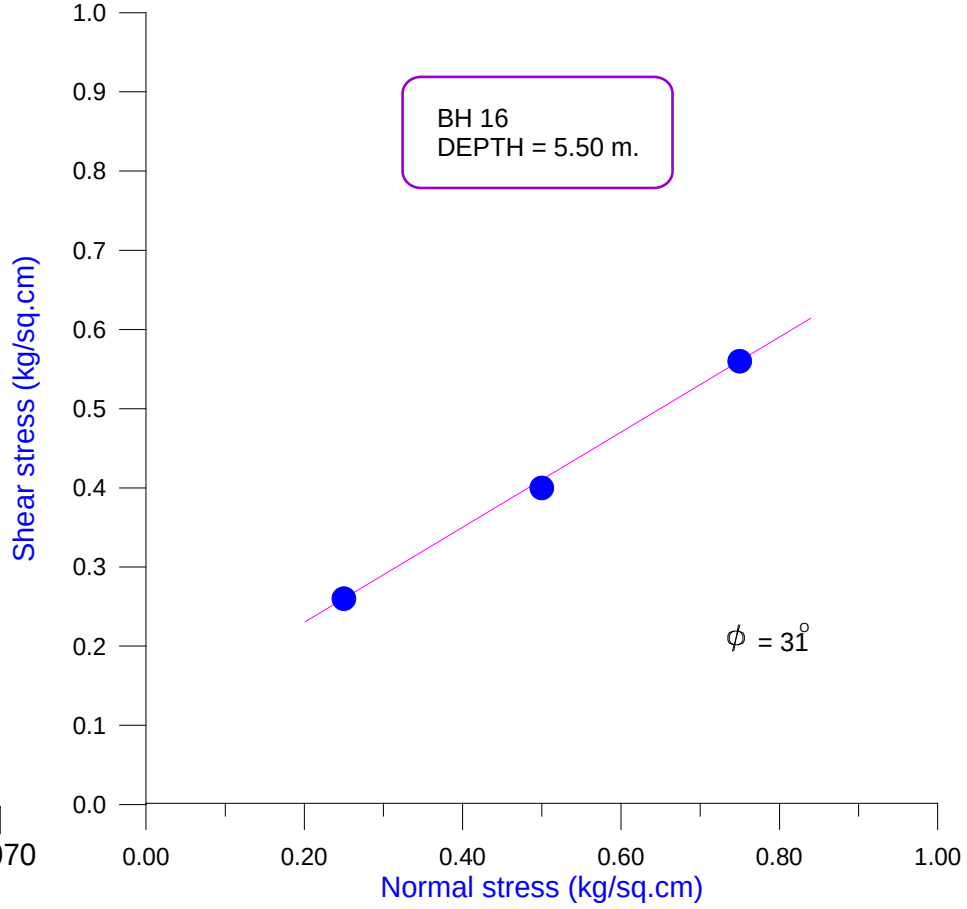
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 16-1



(Shear stress - shear strain relationship)

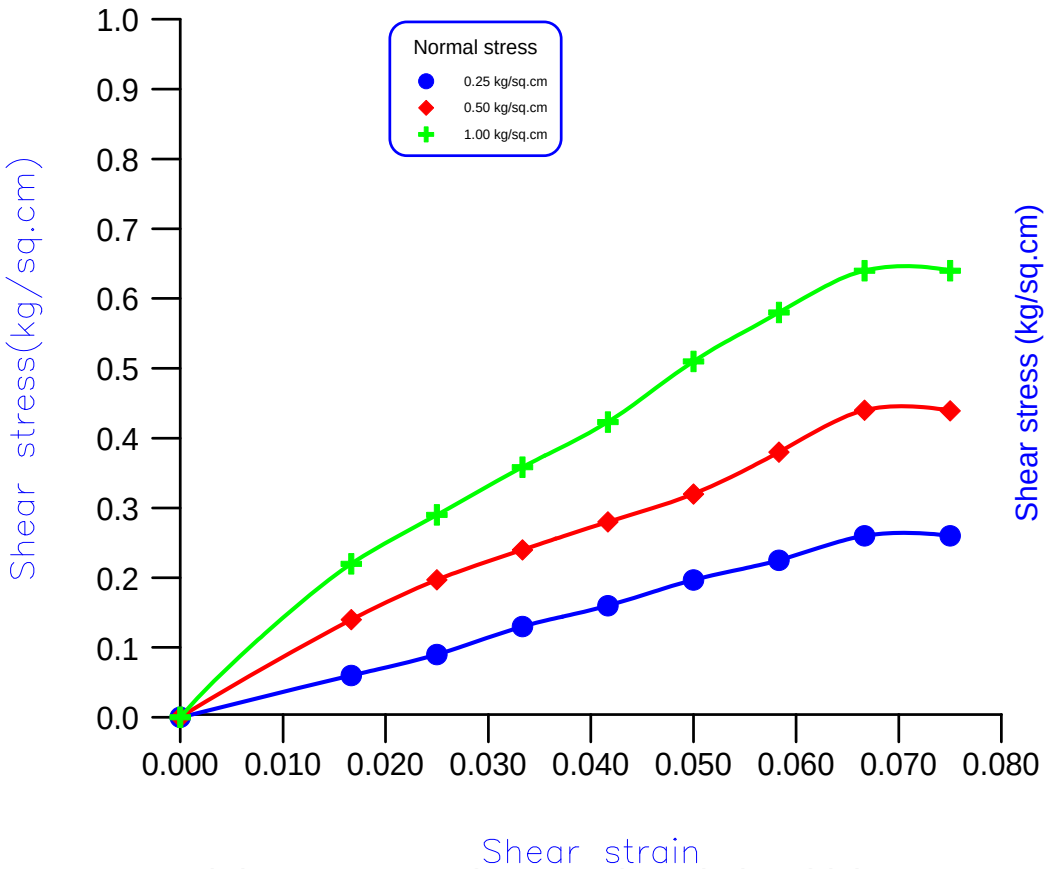


(Shear stress - Normal stress relationship)

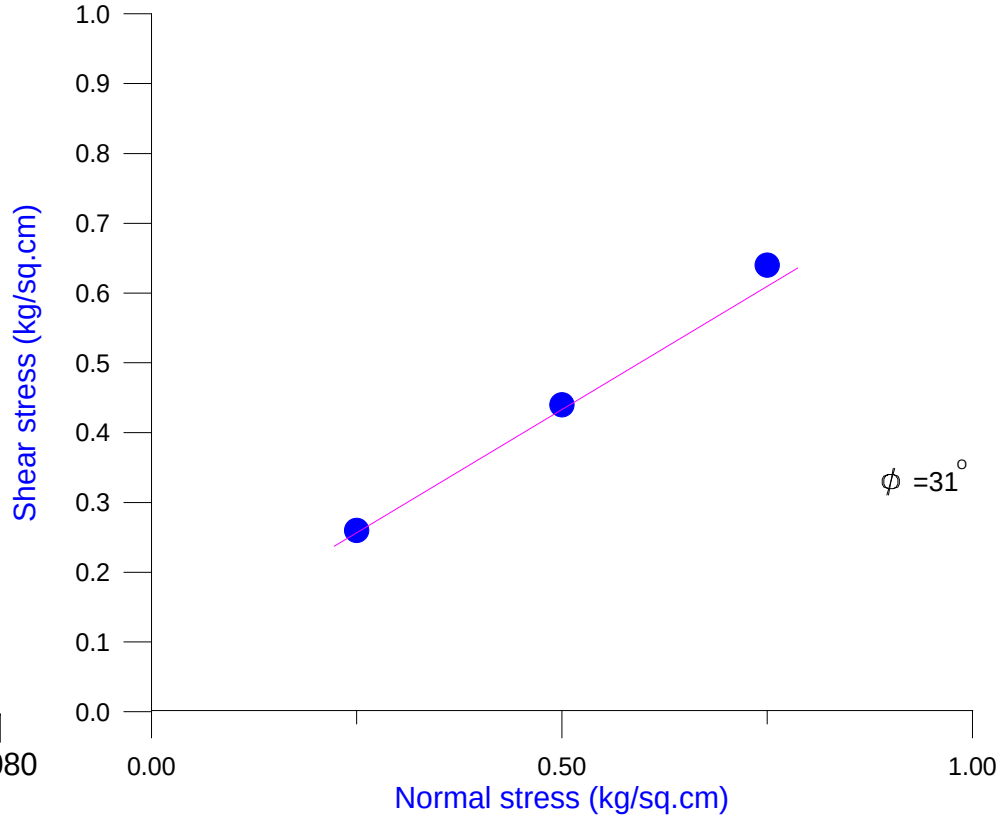
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 16-2

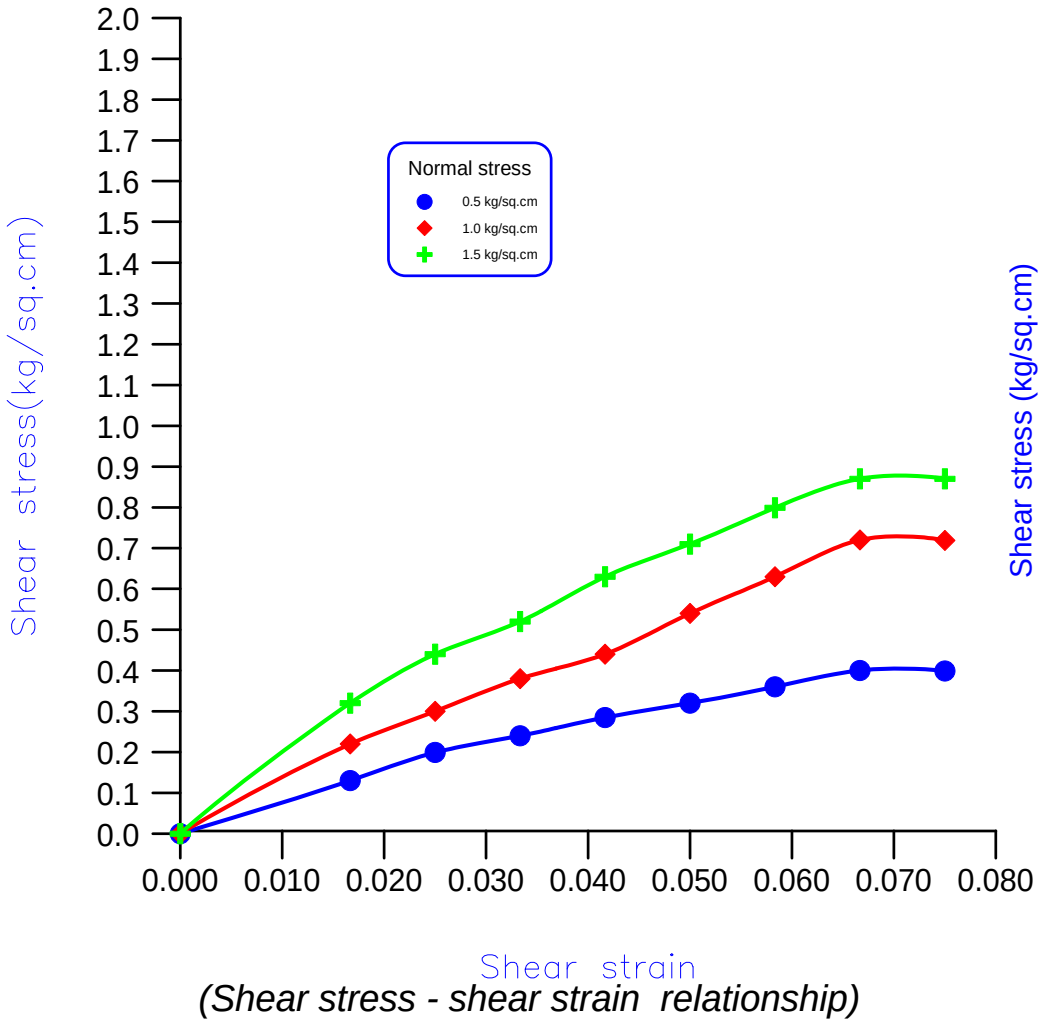
BH 16
DEPTH = 8.50 m.



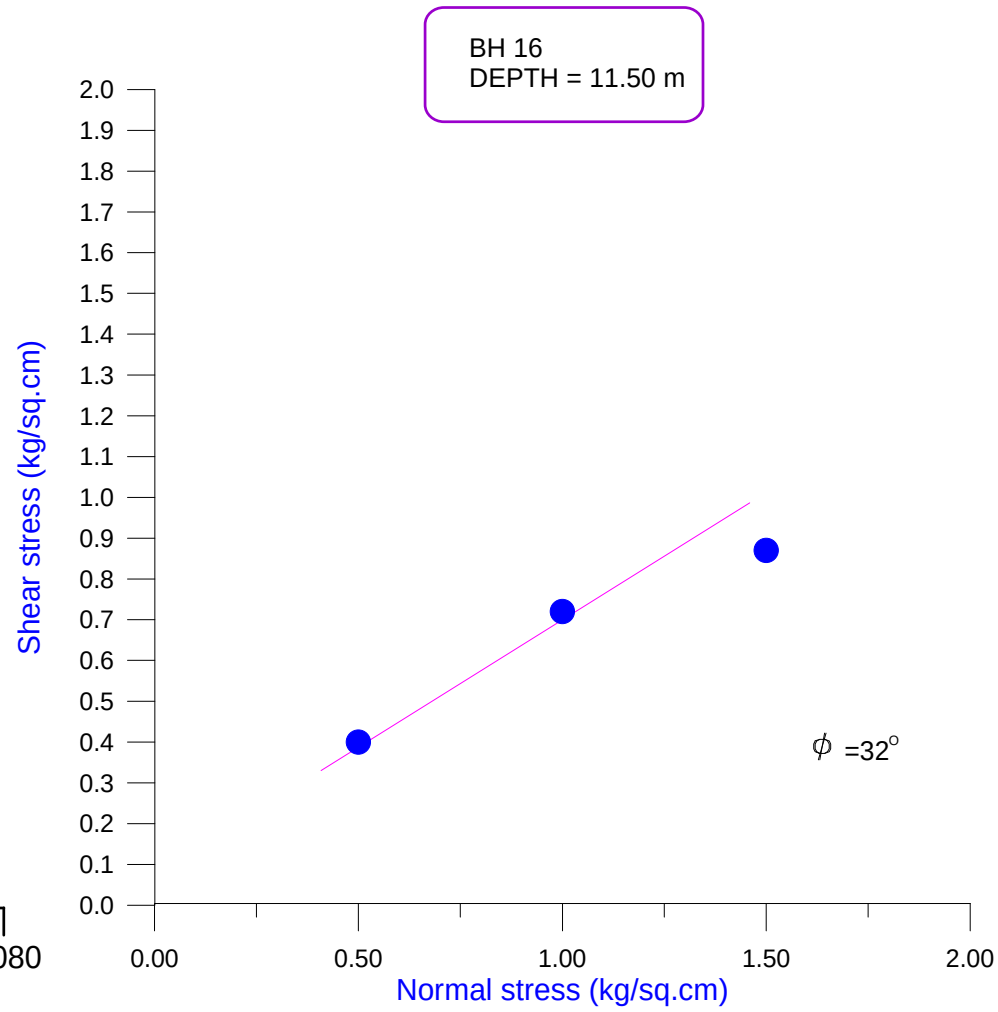
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



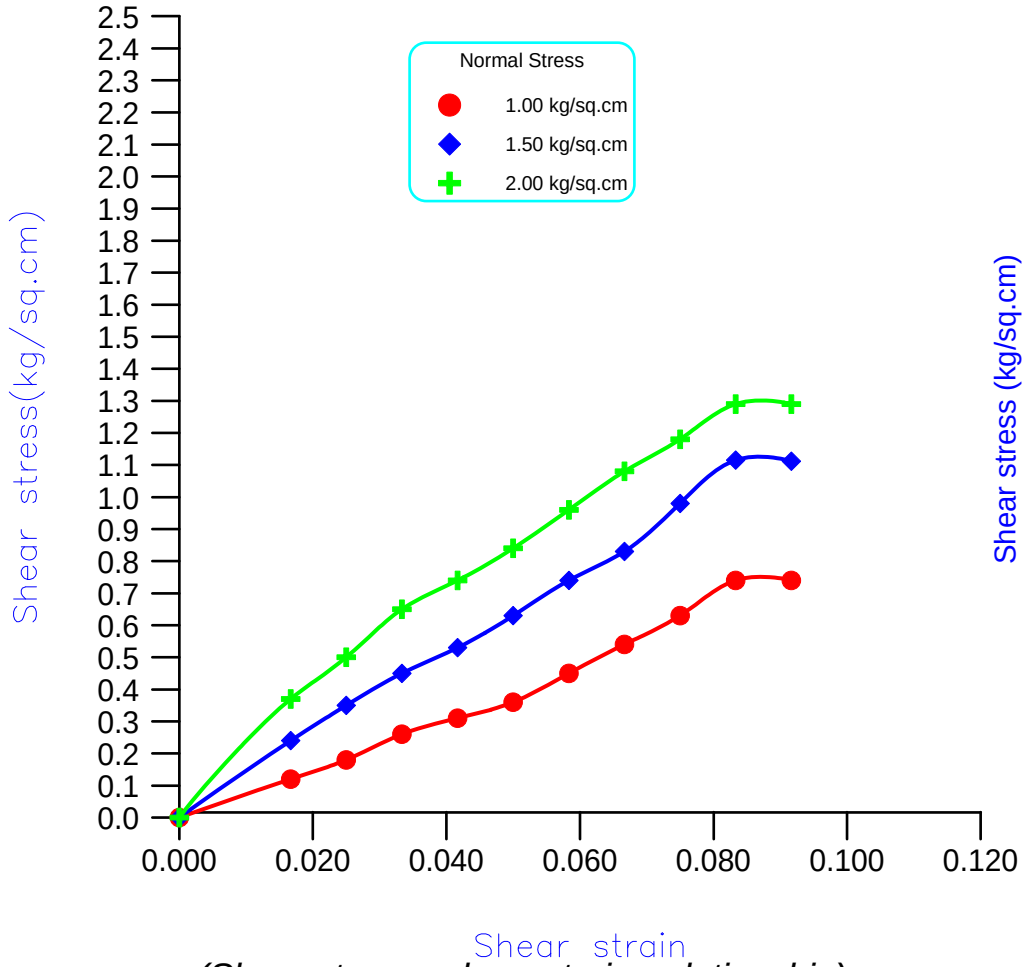
(Shear stress - shear strain relationship)



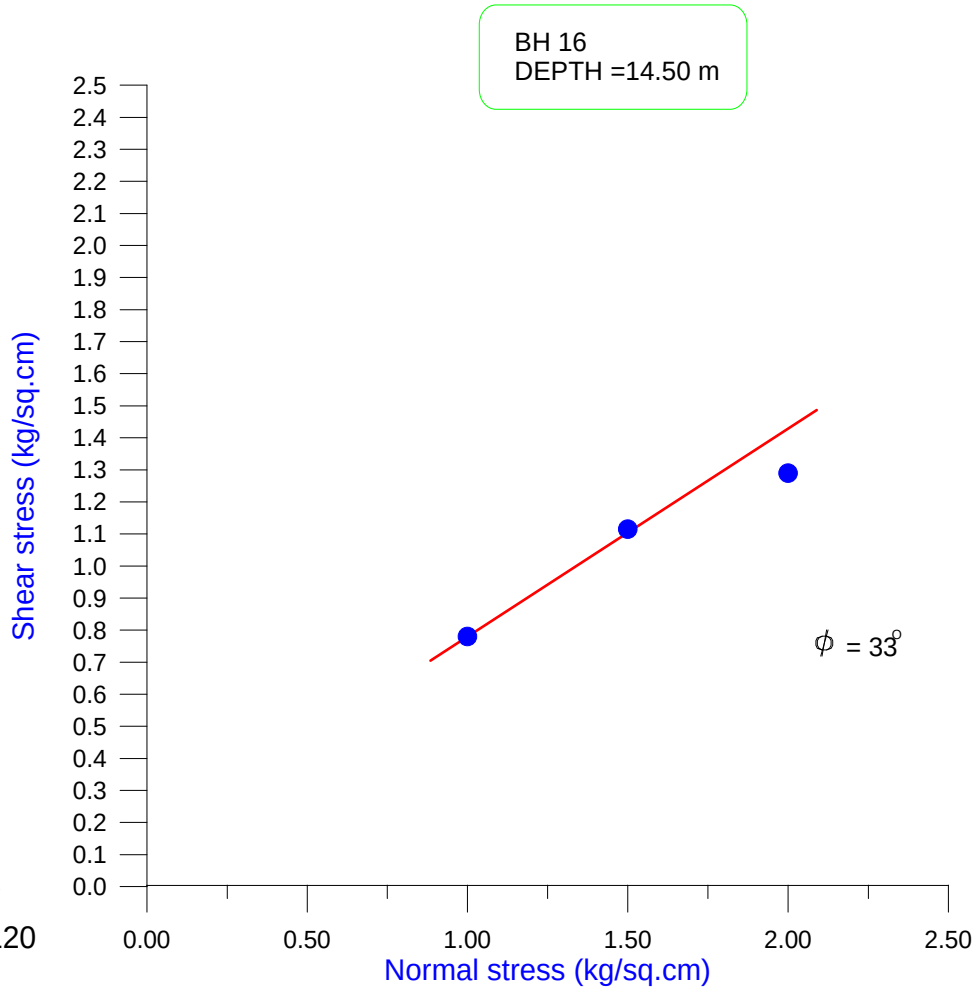
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 16-4



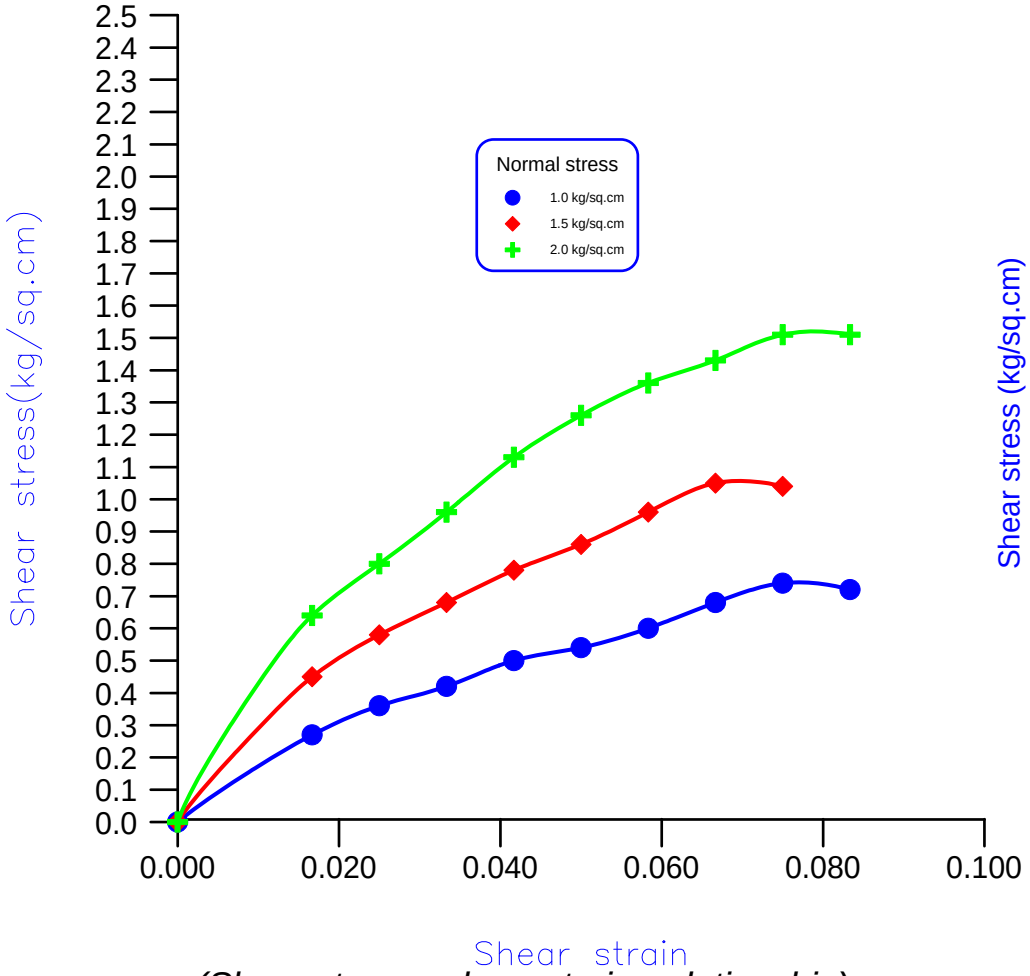
(Shear stress - shear strain relationship)



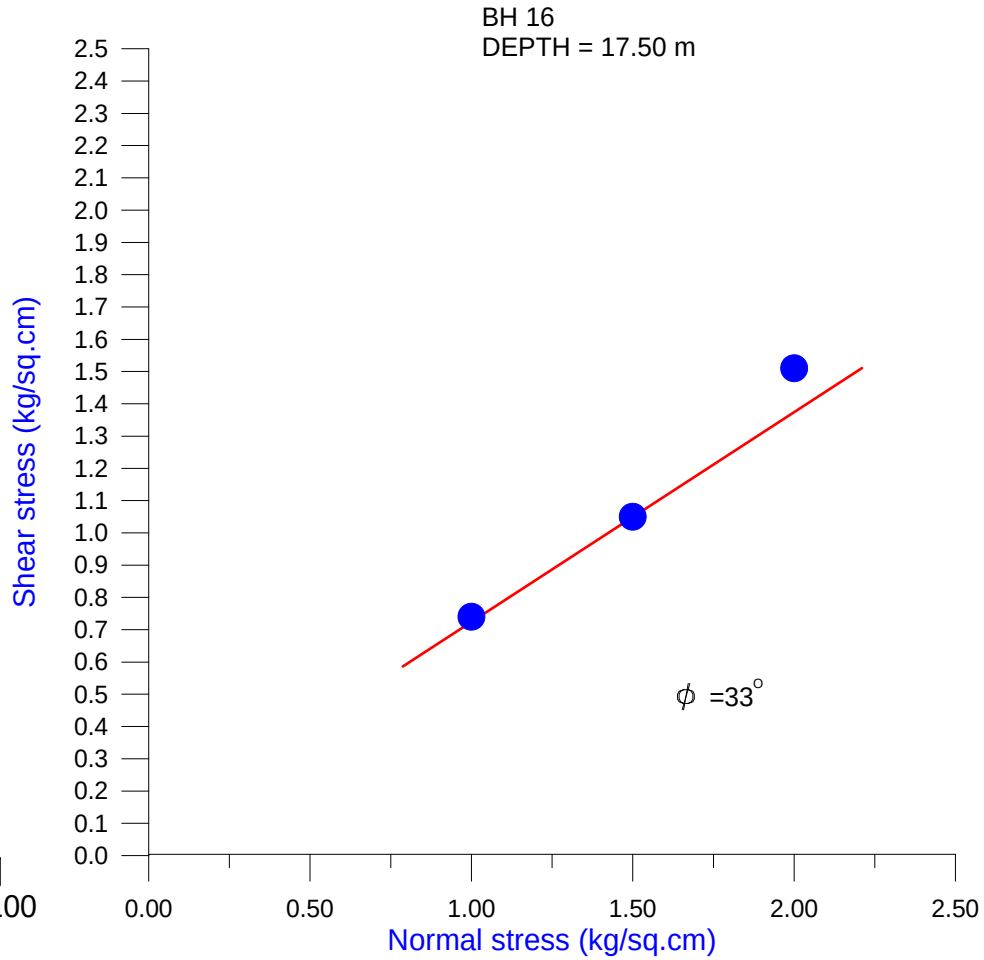
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 16-5



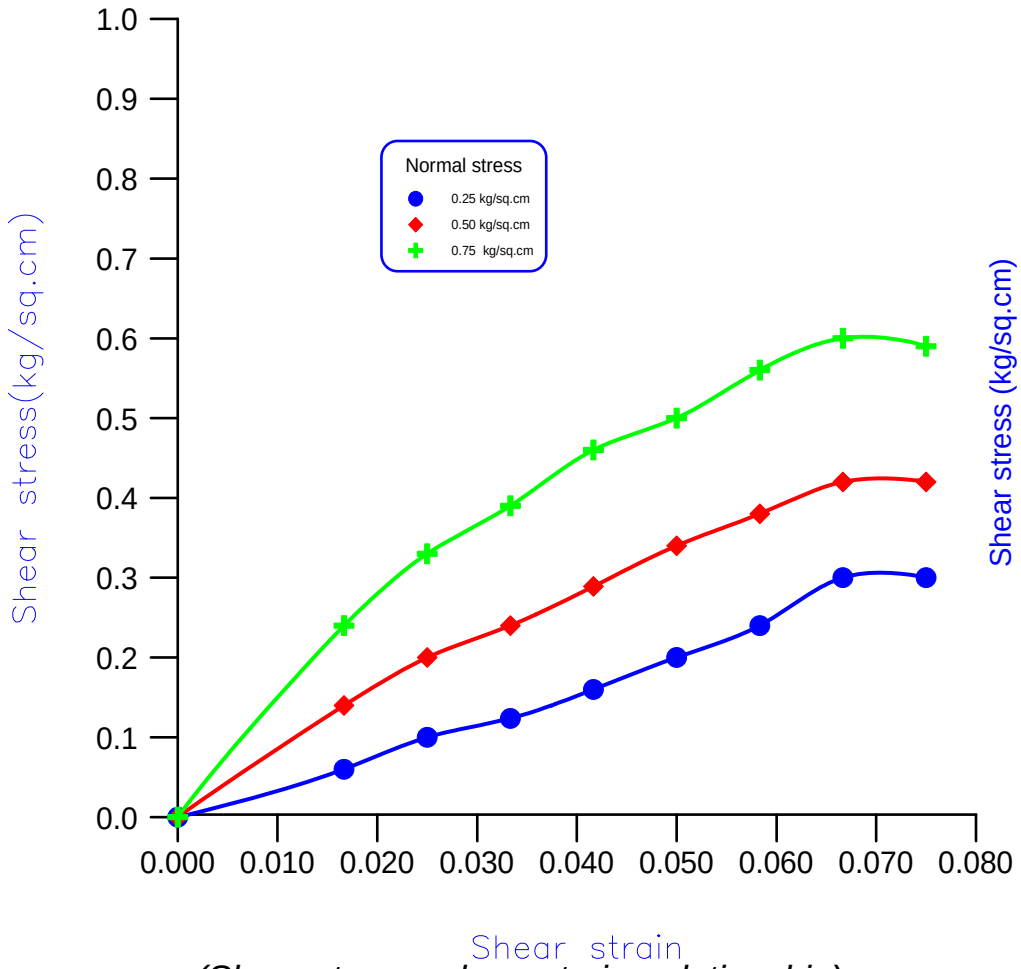
(Shear stress - shear strain relationship)



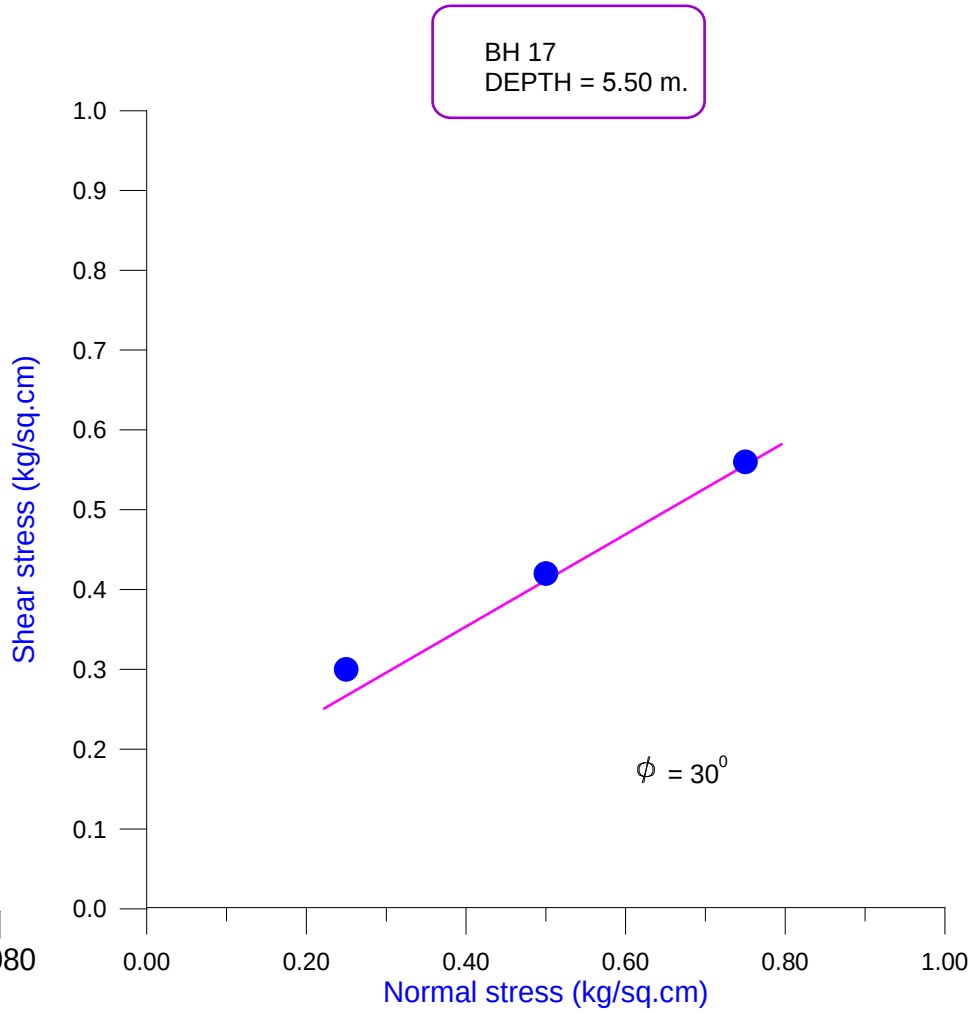
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 16-6



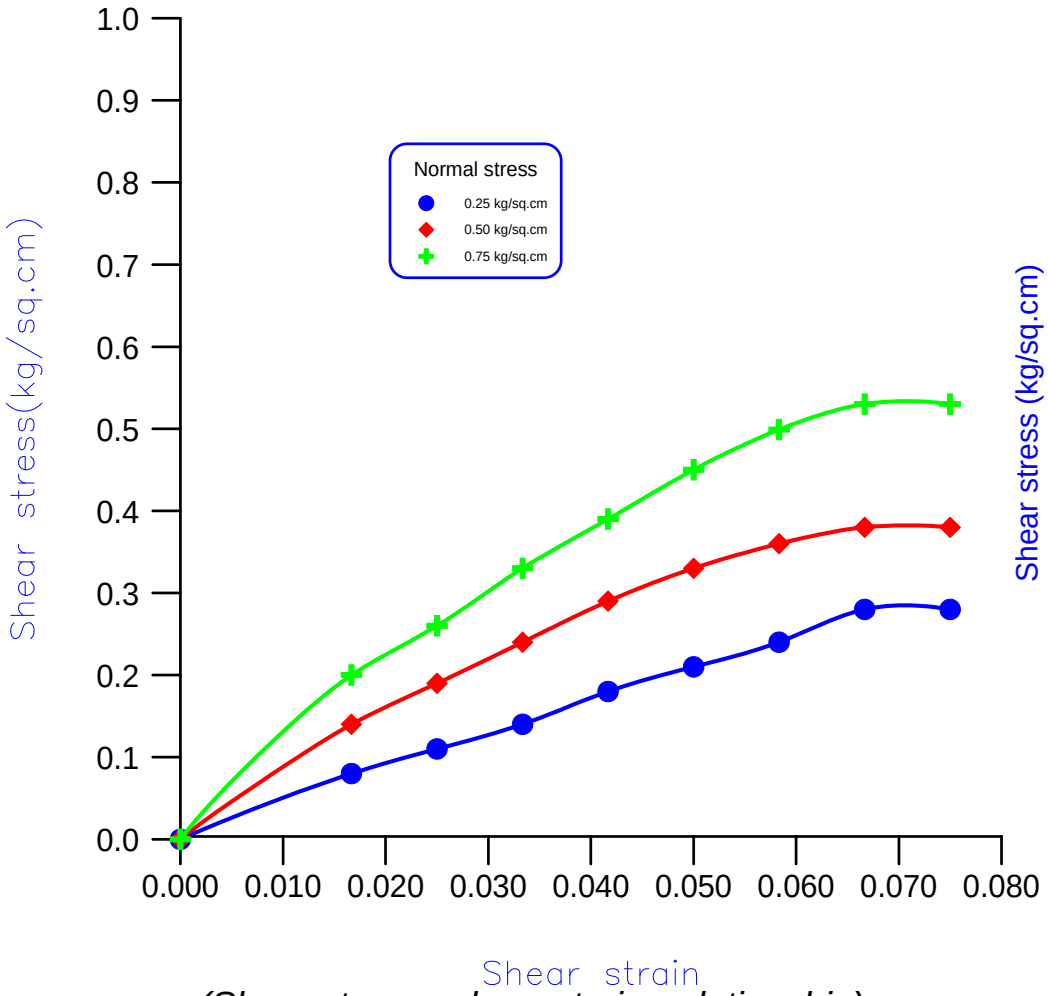
(Shear stress - shear strain relationship)



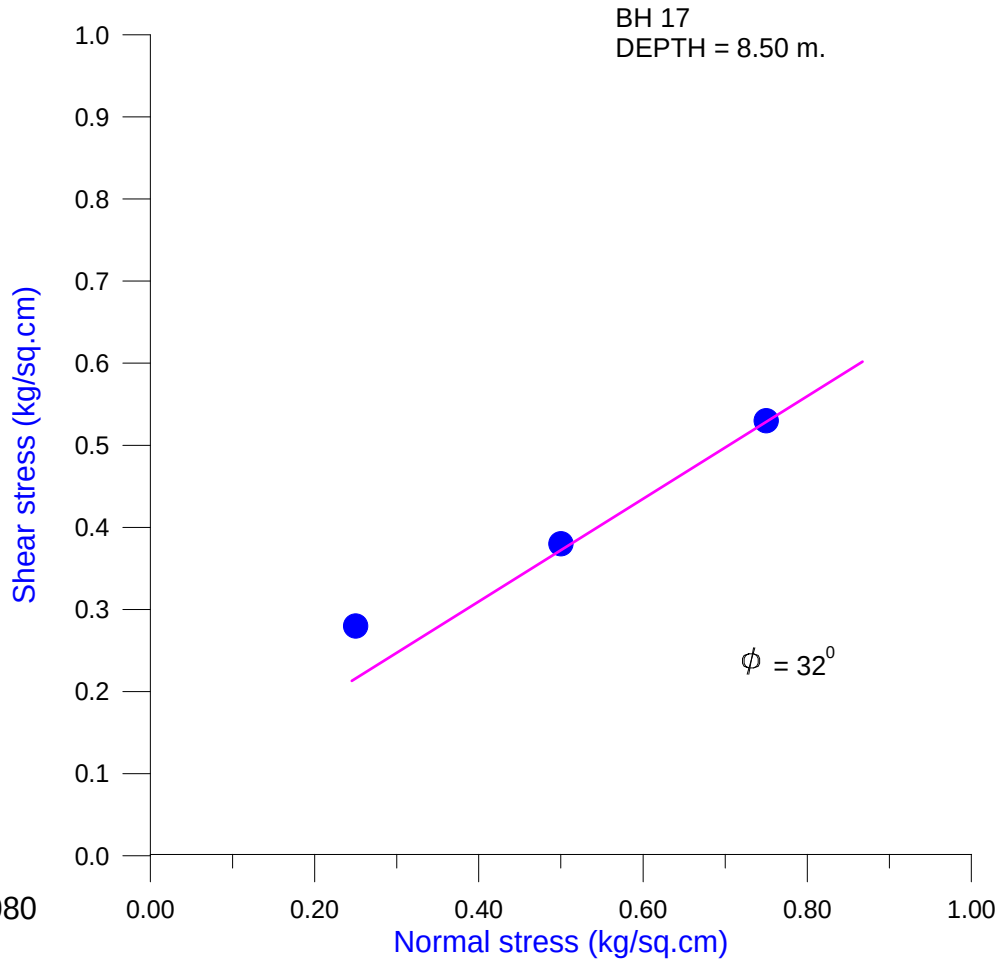
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 17-1



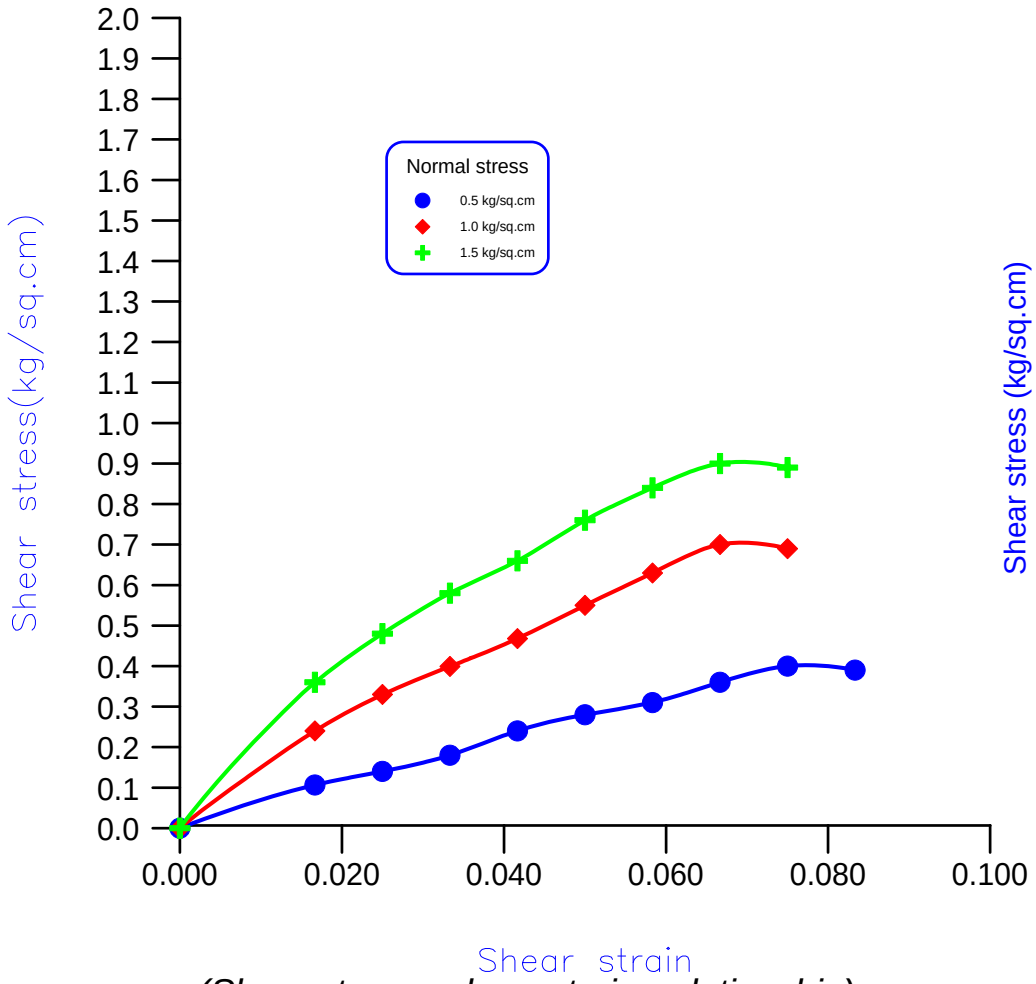
(Shear stress - shear strain relationship)



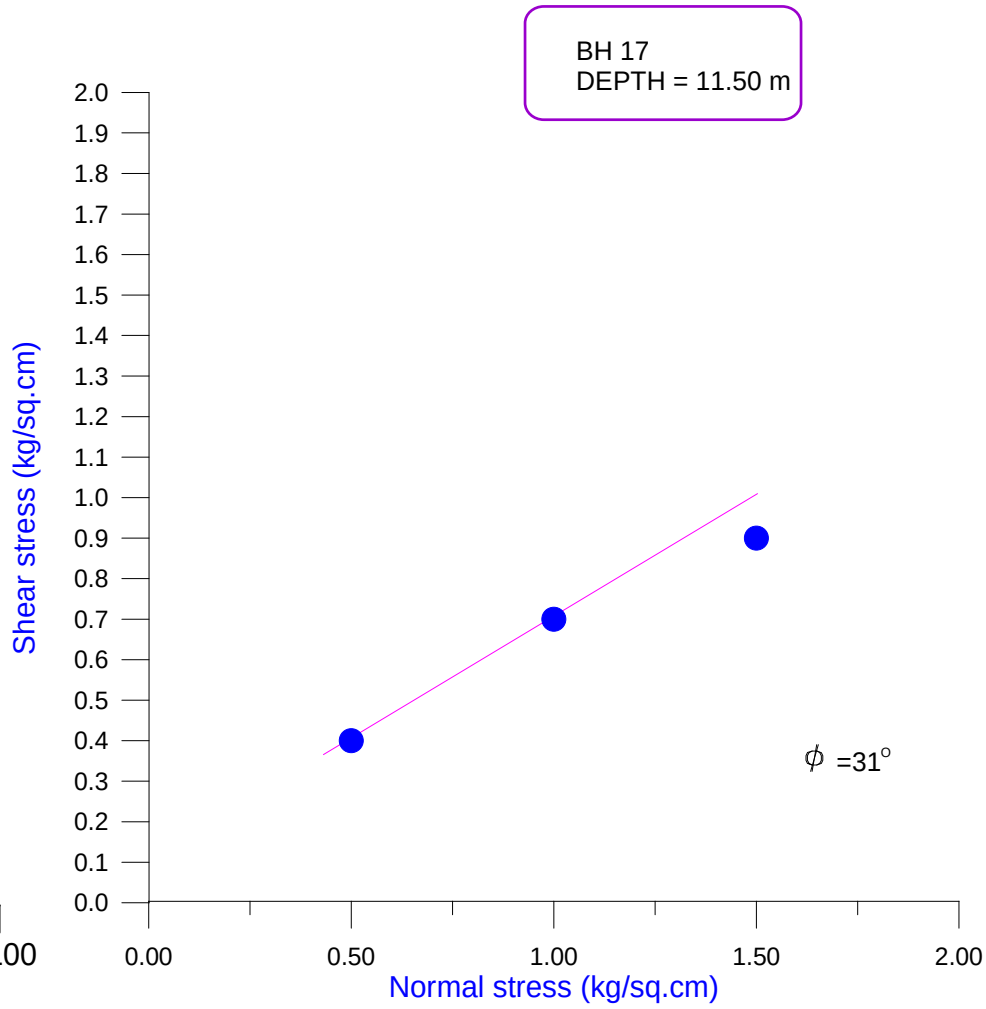
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 17-2



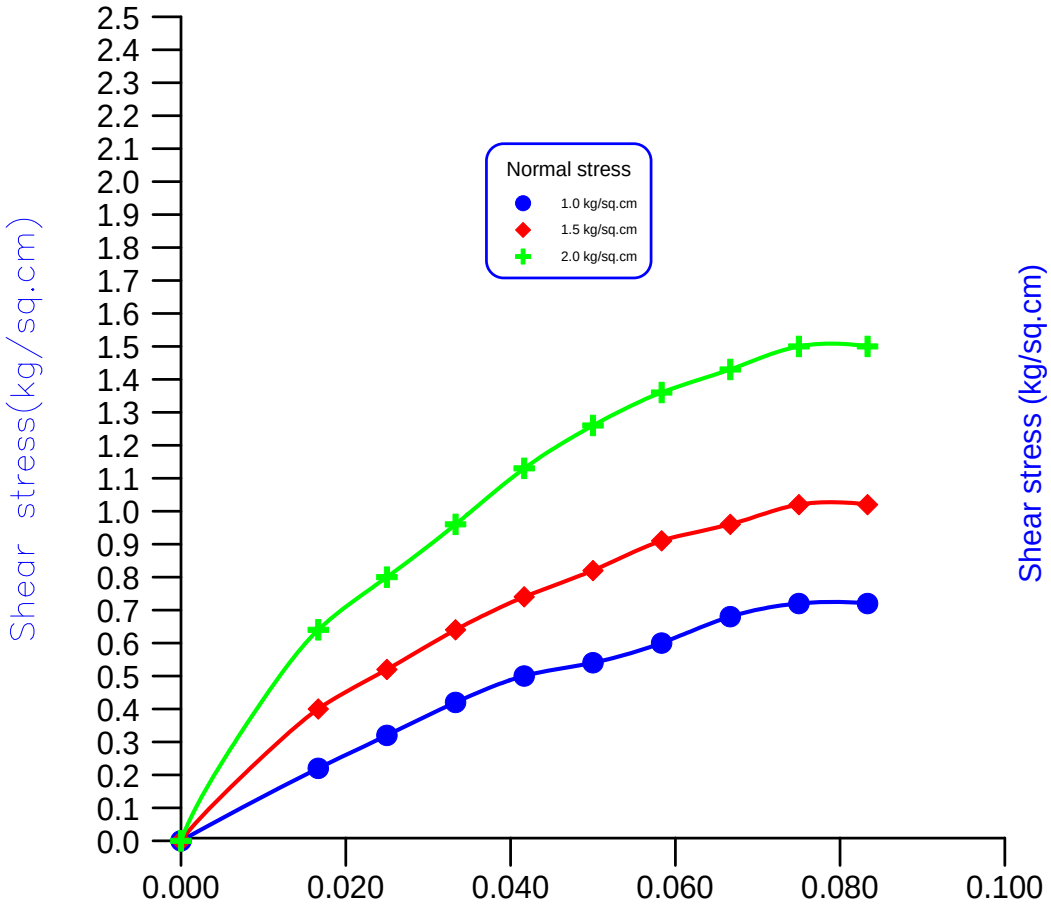
(Shear stress - shear strain relationship)



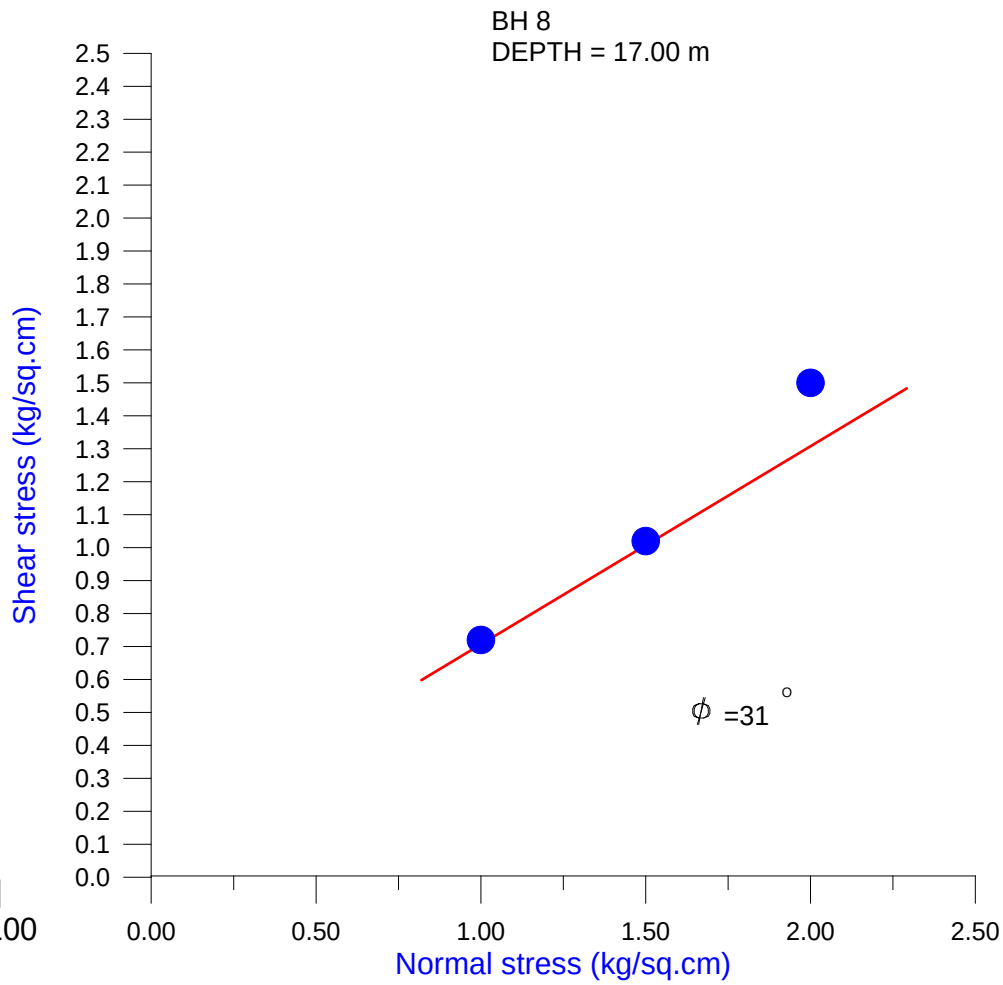
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

FIG- DS 17-3



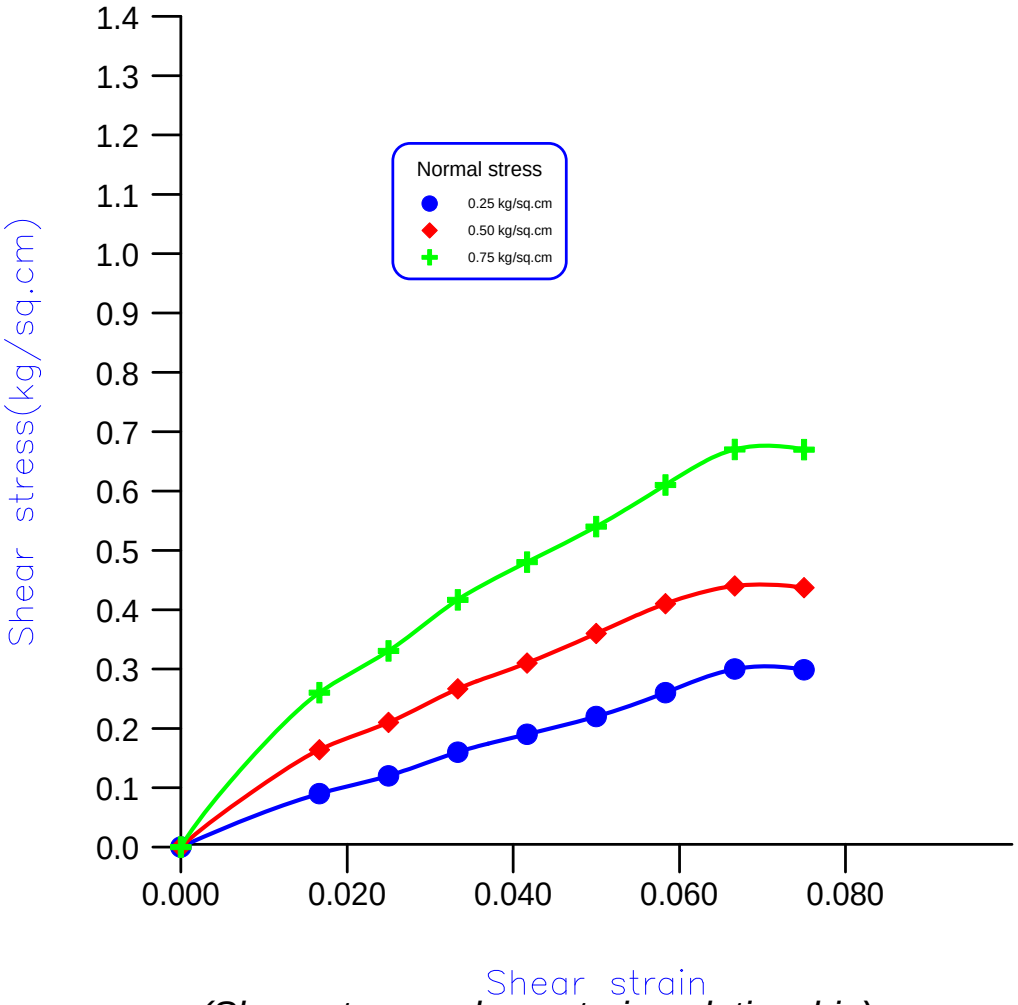
(Shear stress - shear strain relationship)



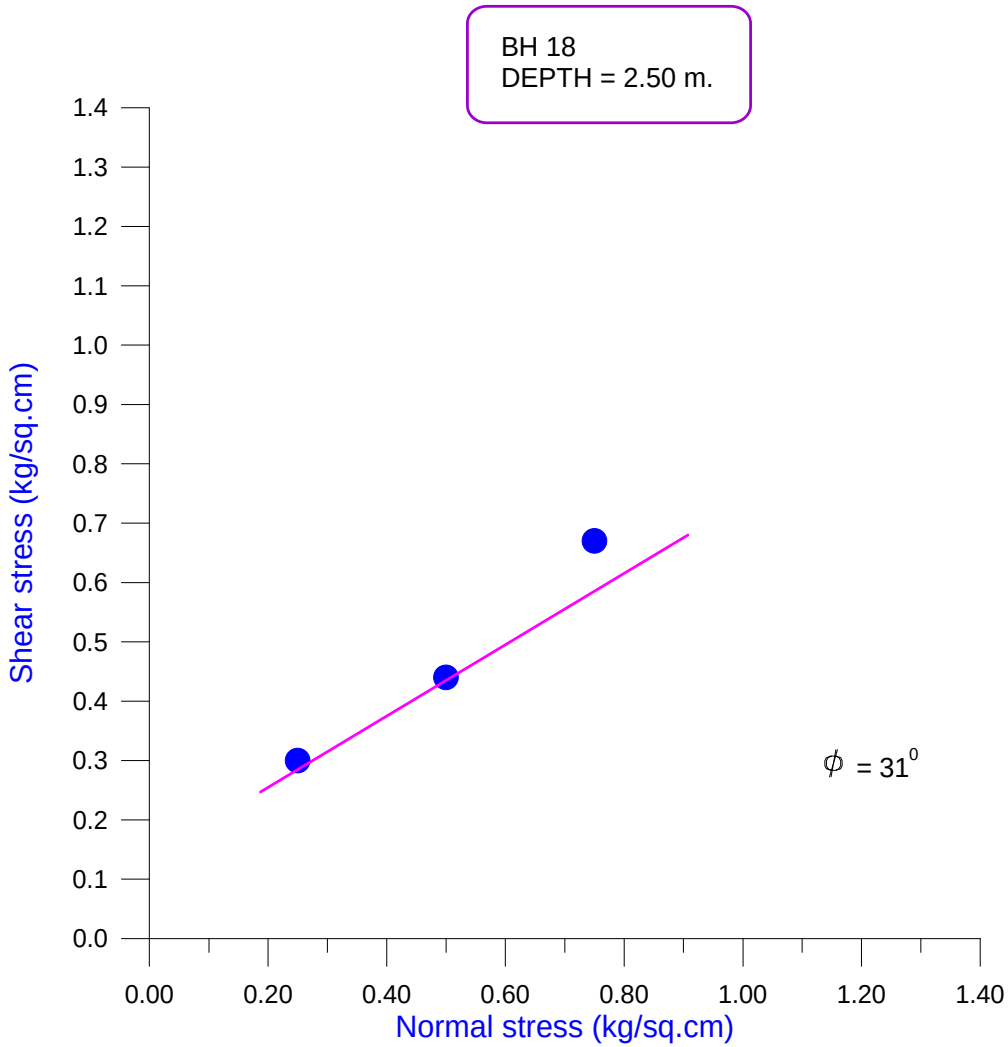
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

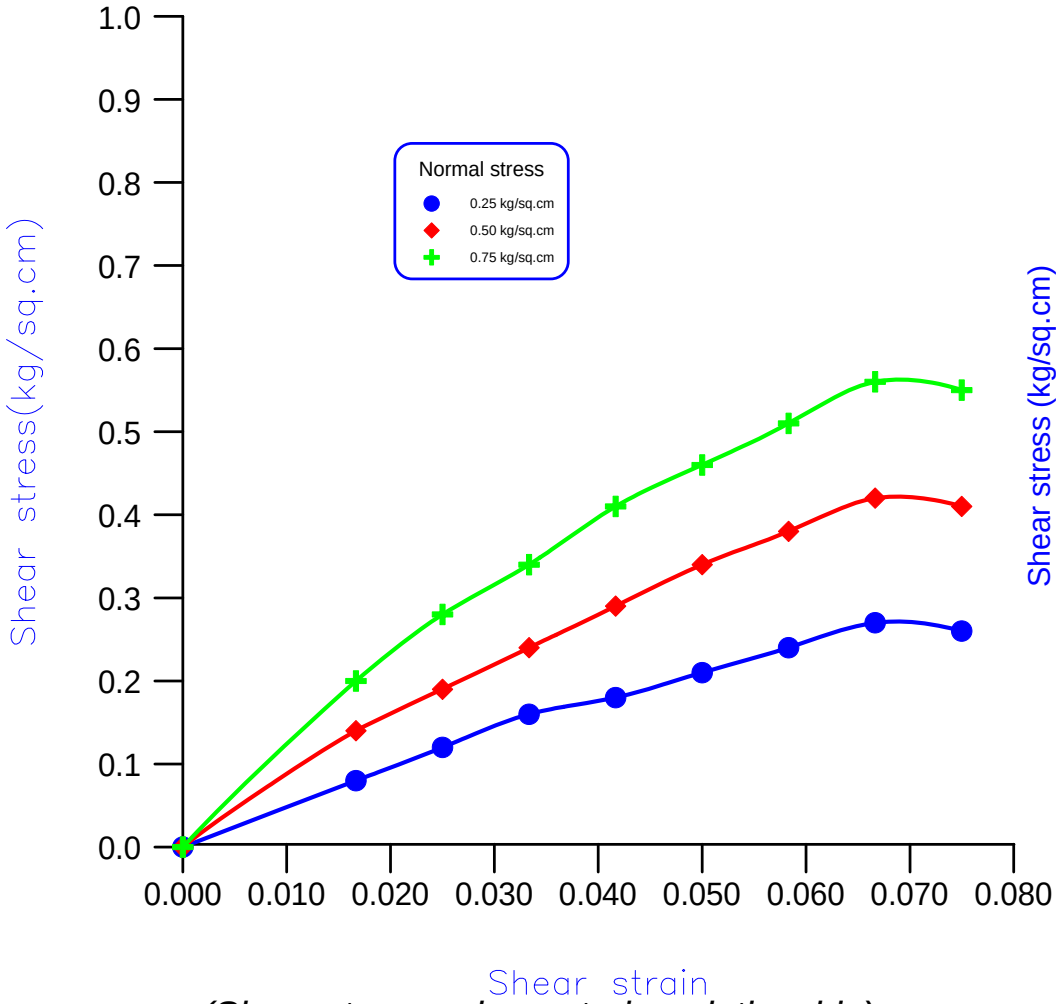
FIG- DS 17-5



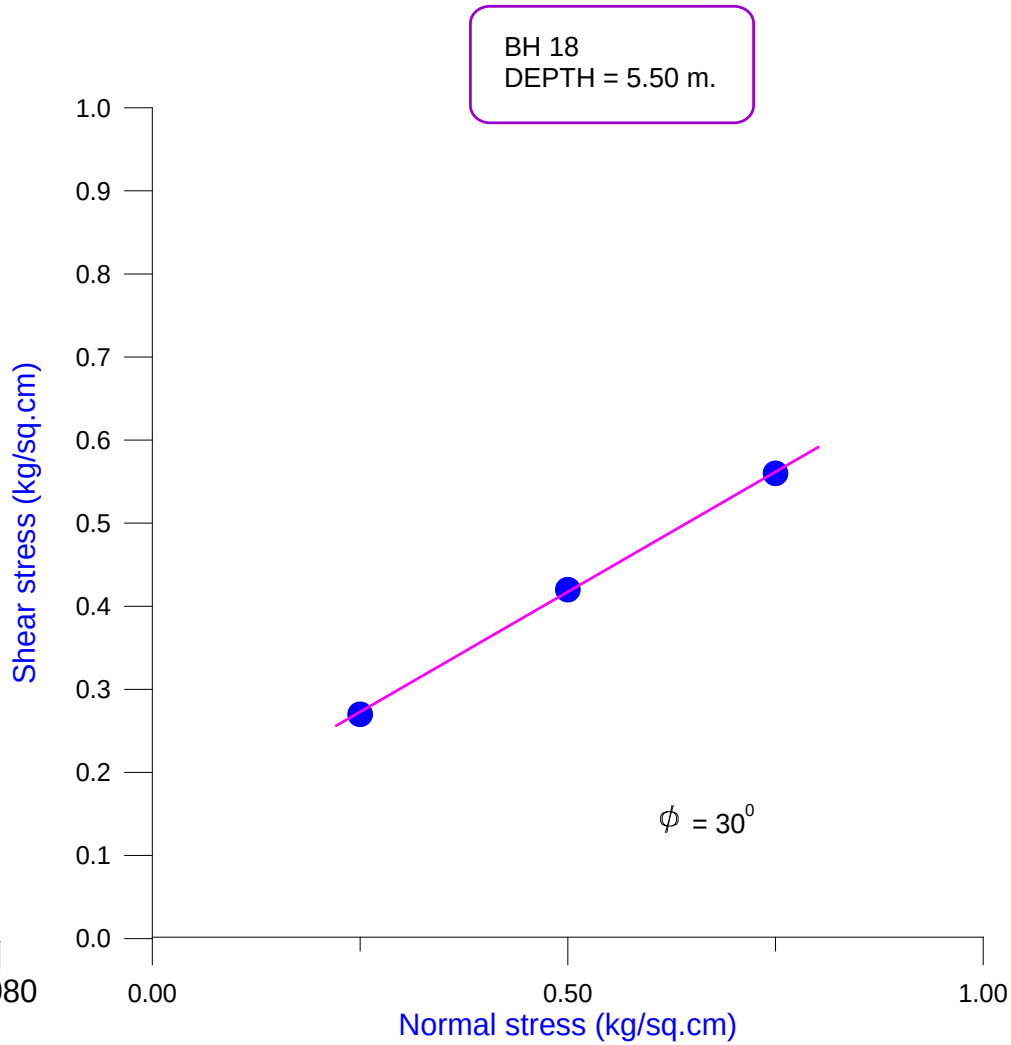
(Shear stress - shear strain relationship)



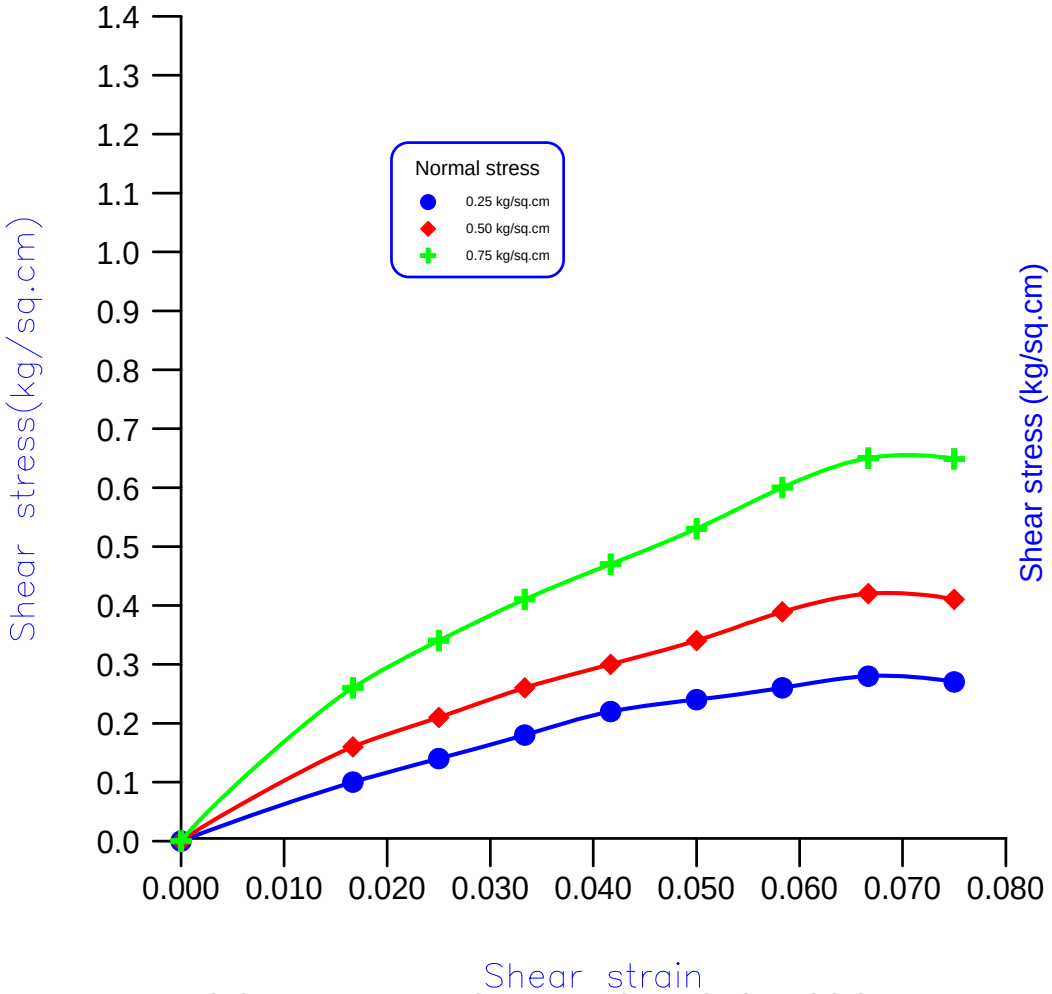
(Shear stress - Normal stress relationship)



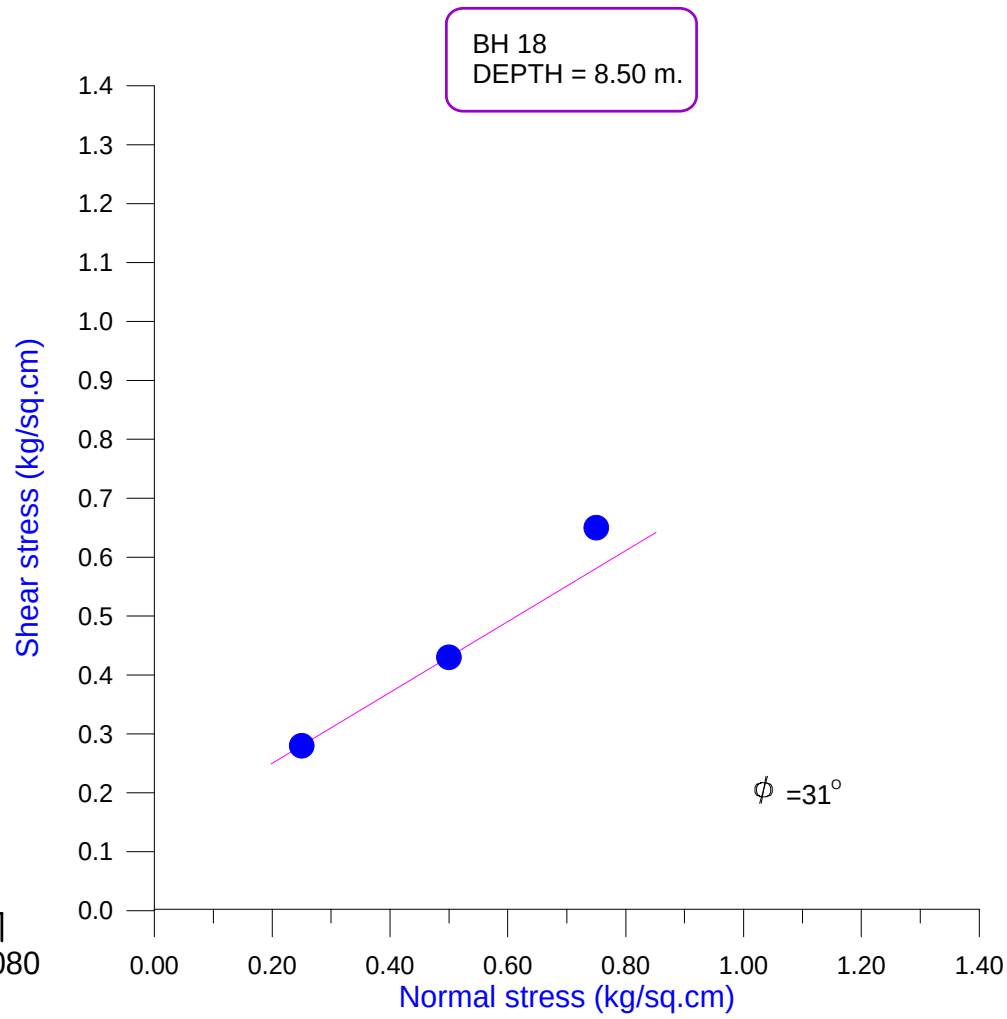
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



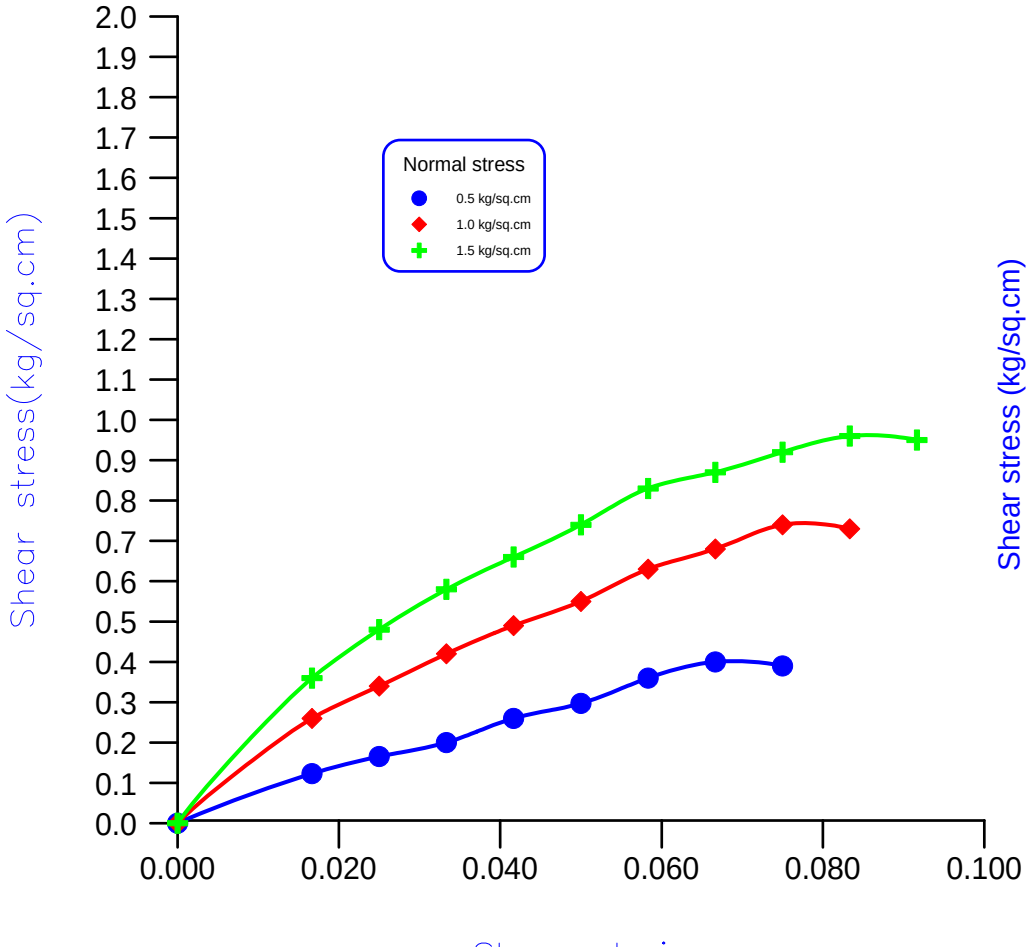
(Shear stress - shear strain relationship)



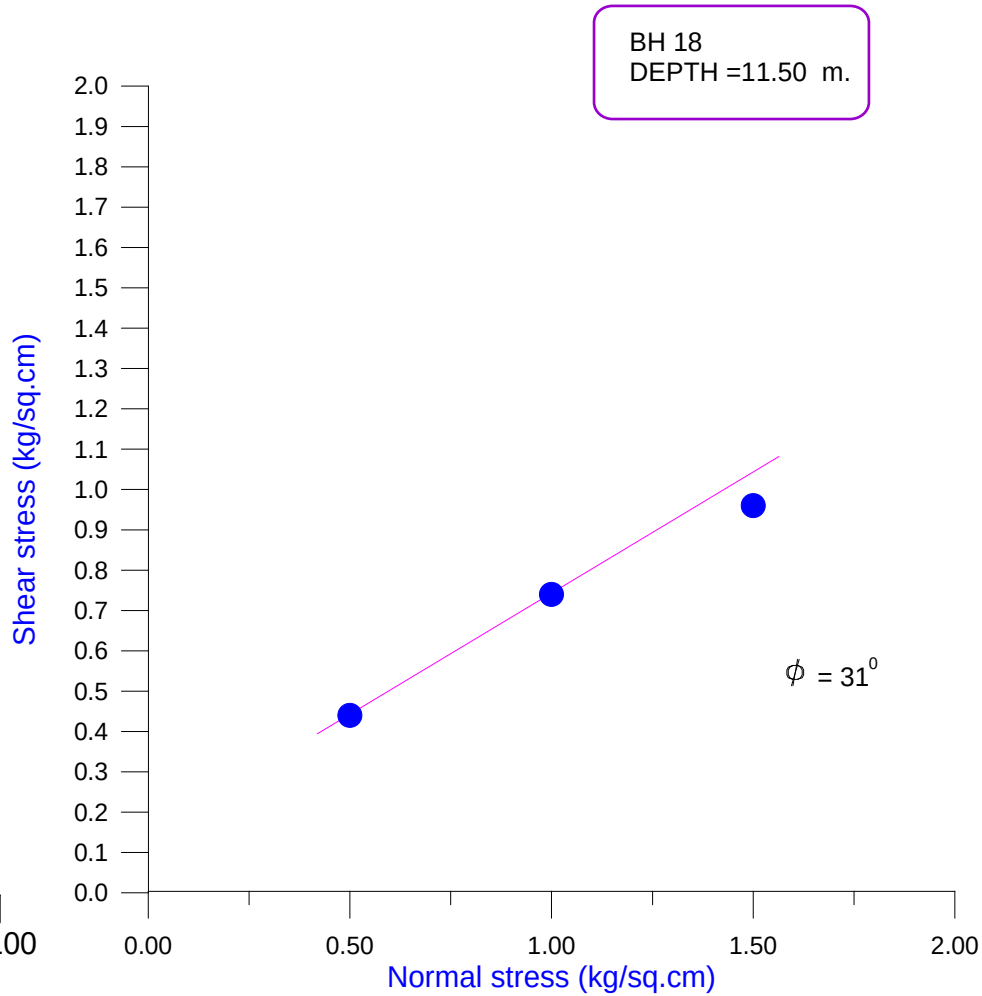
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 18-3



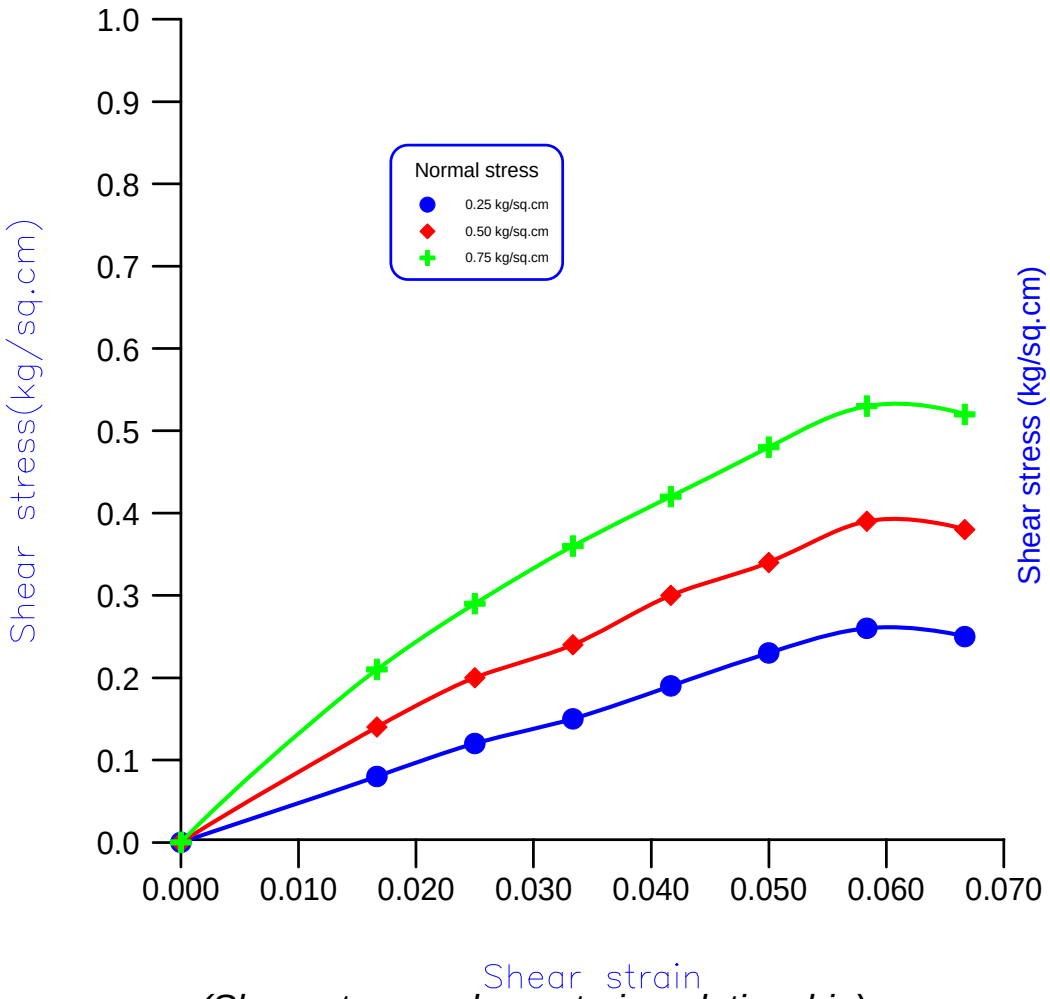
(Shear stress - shear strain relationship)



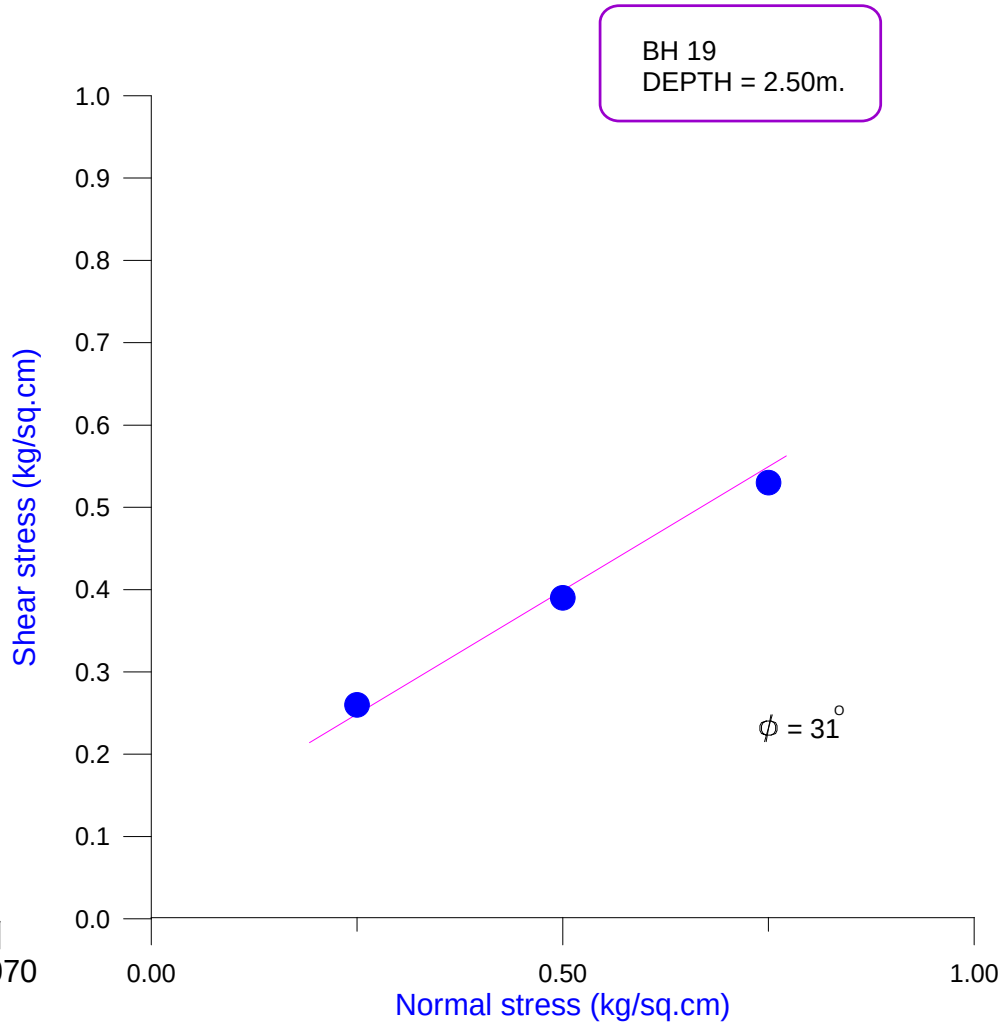
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

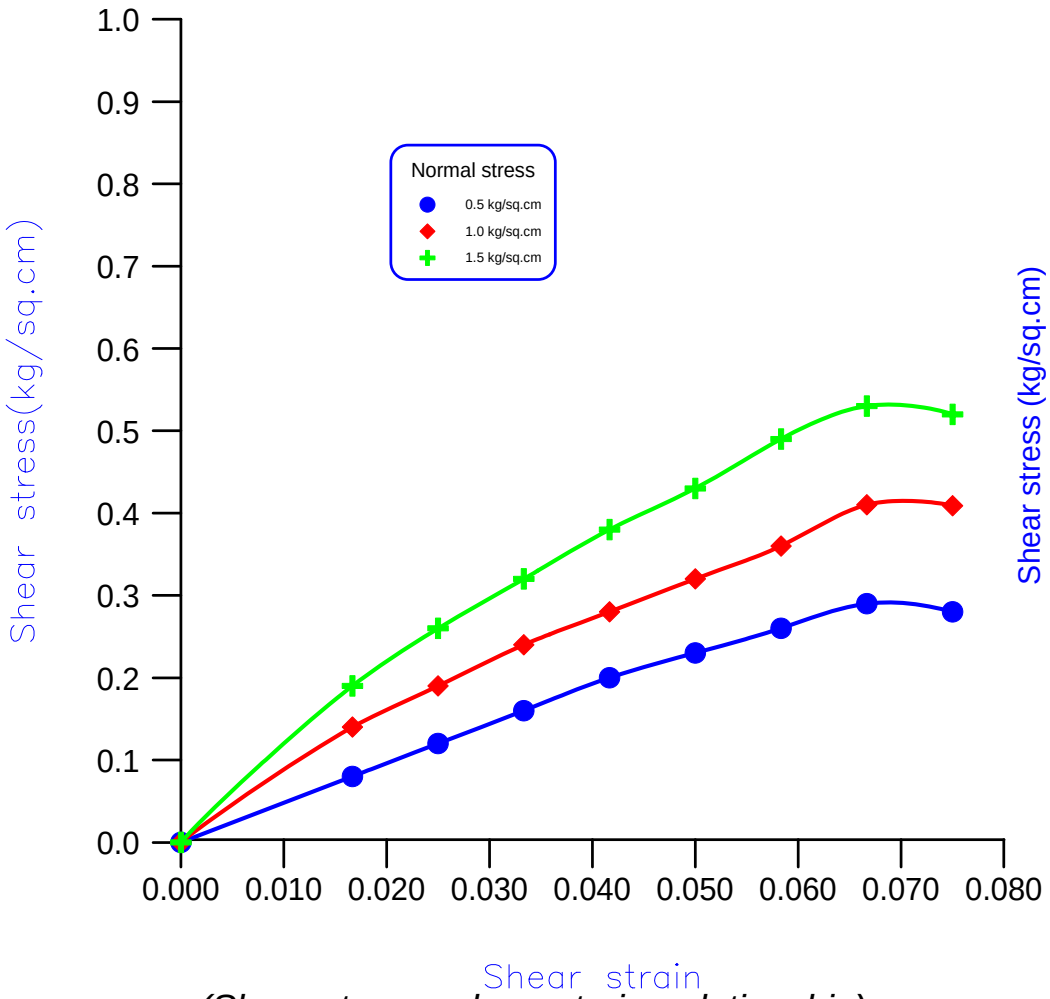
FIG- 18-4



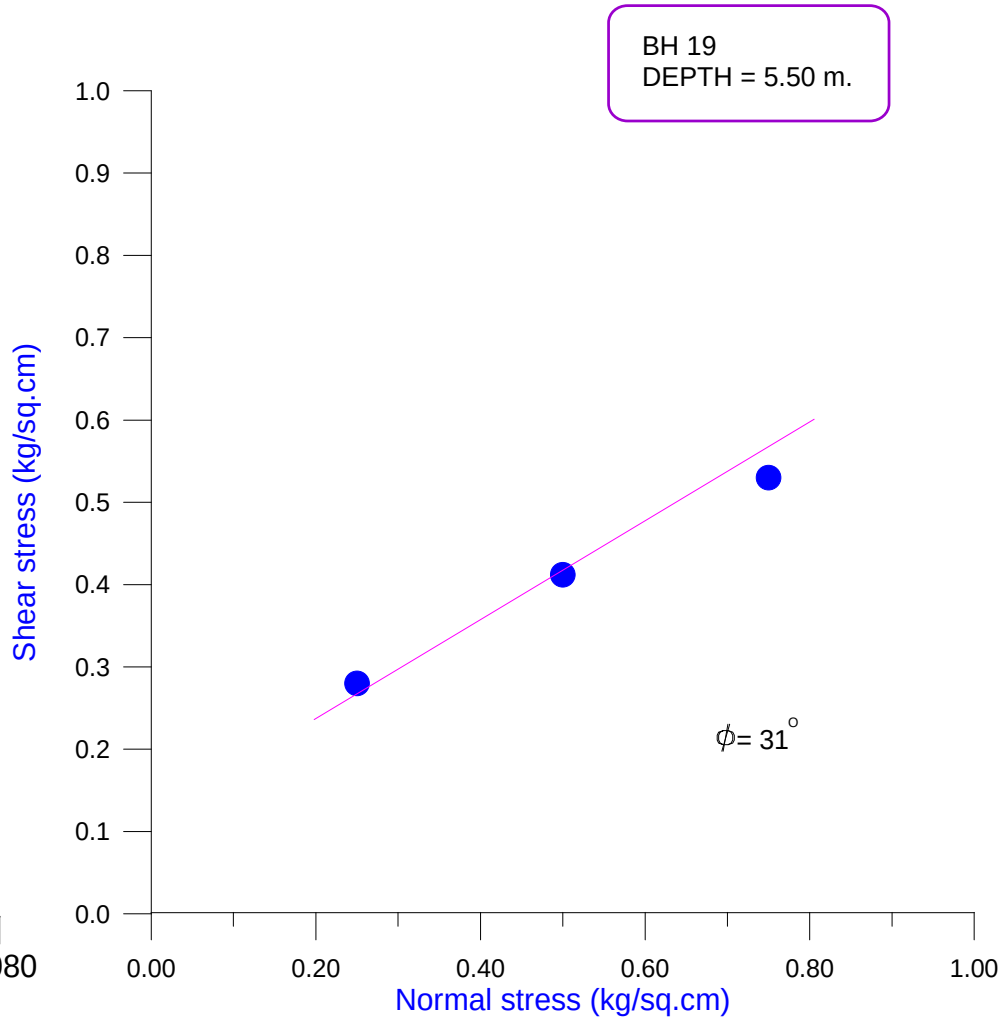
(Shear stress - shear strain relationship)



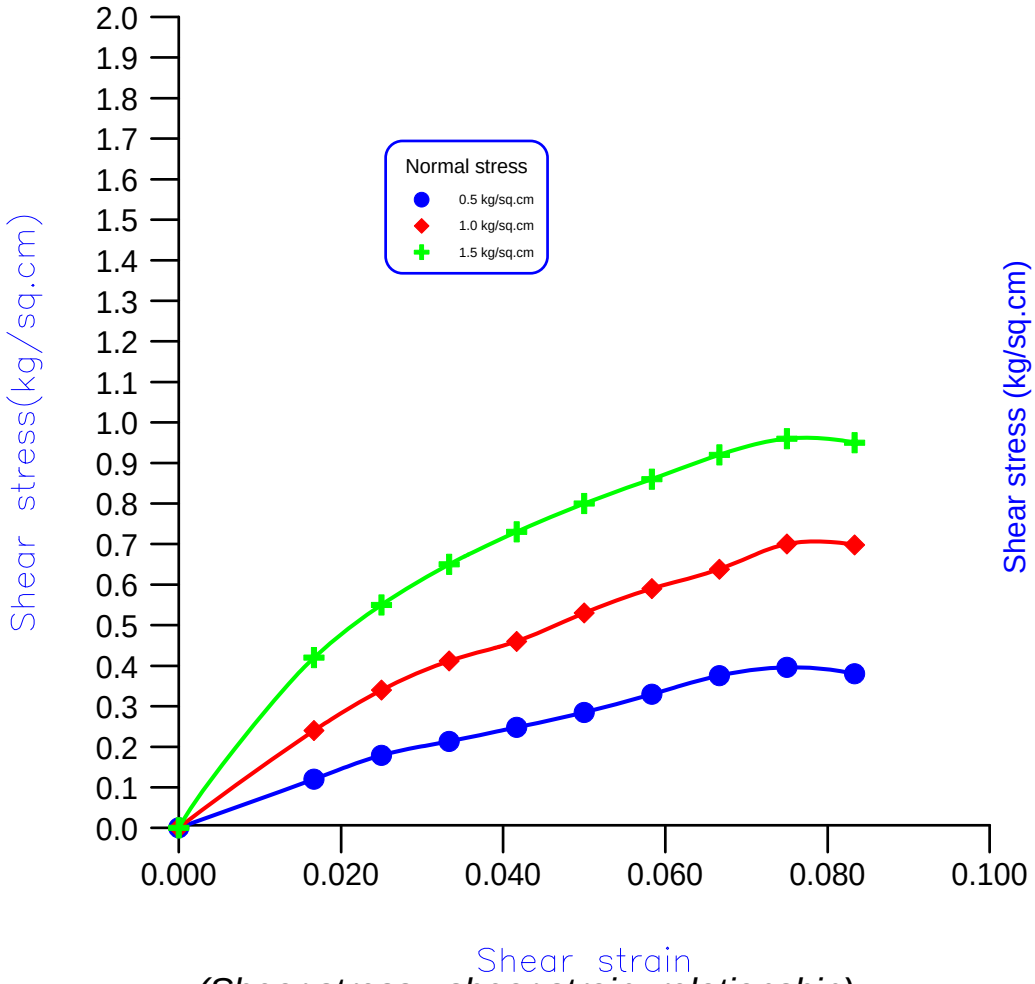
(Shear stress - Normal stress relationship)



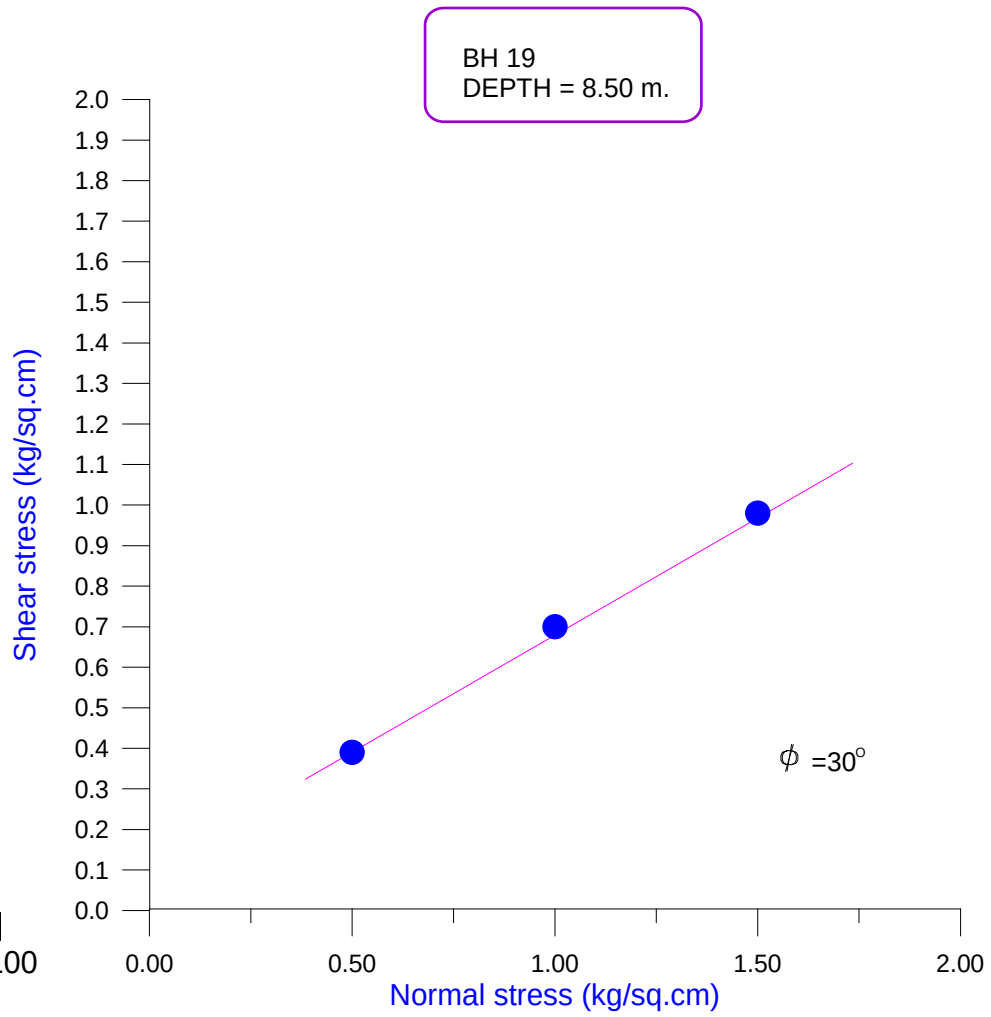
(Shear stress - shear strain relationship)



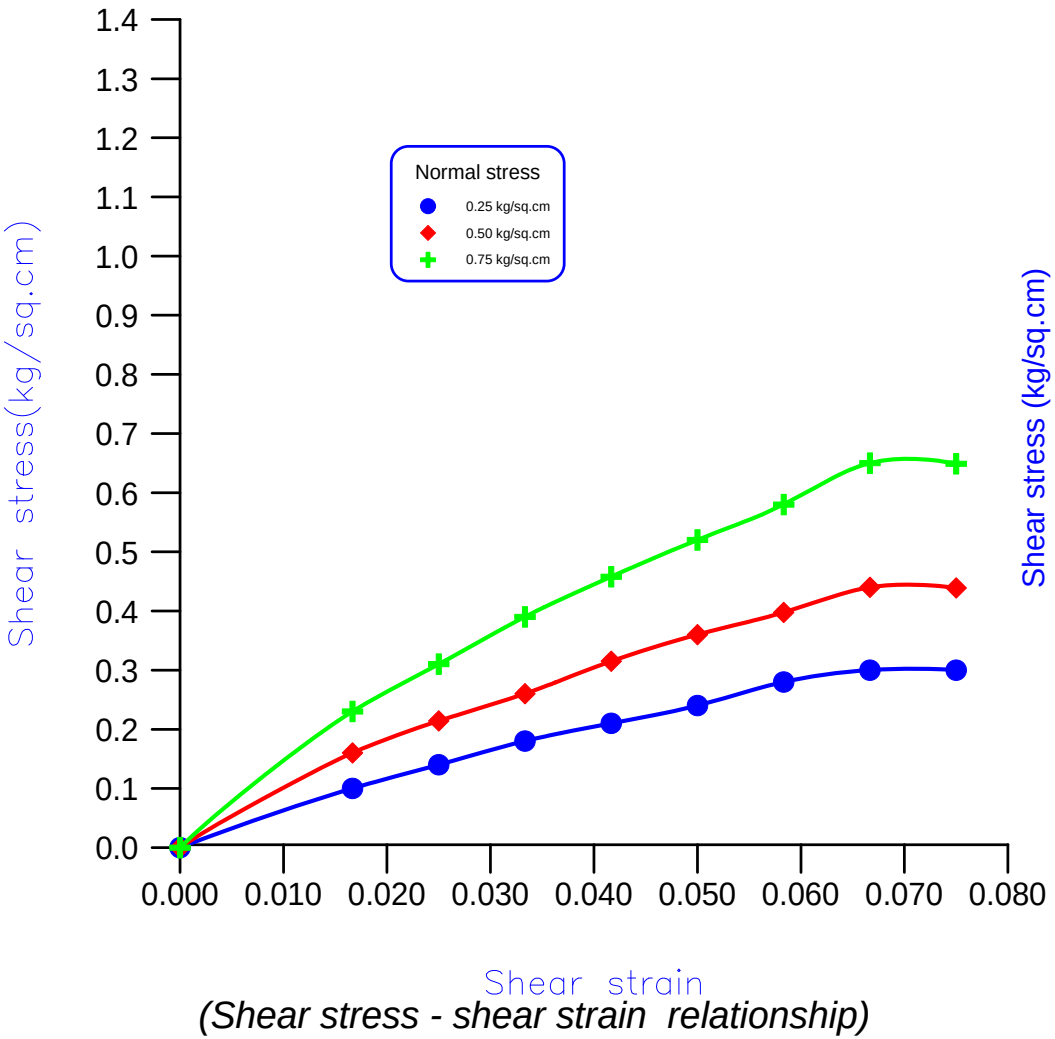
(Shear stress - Normal stress relationship)



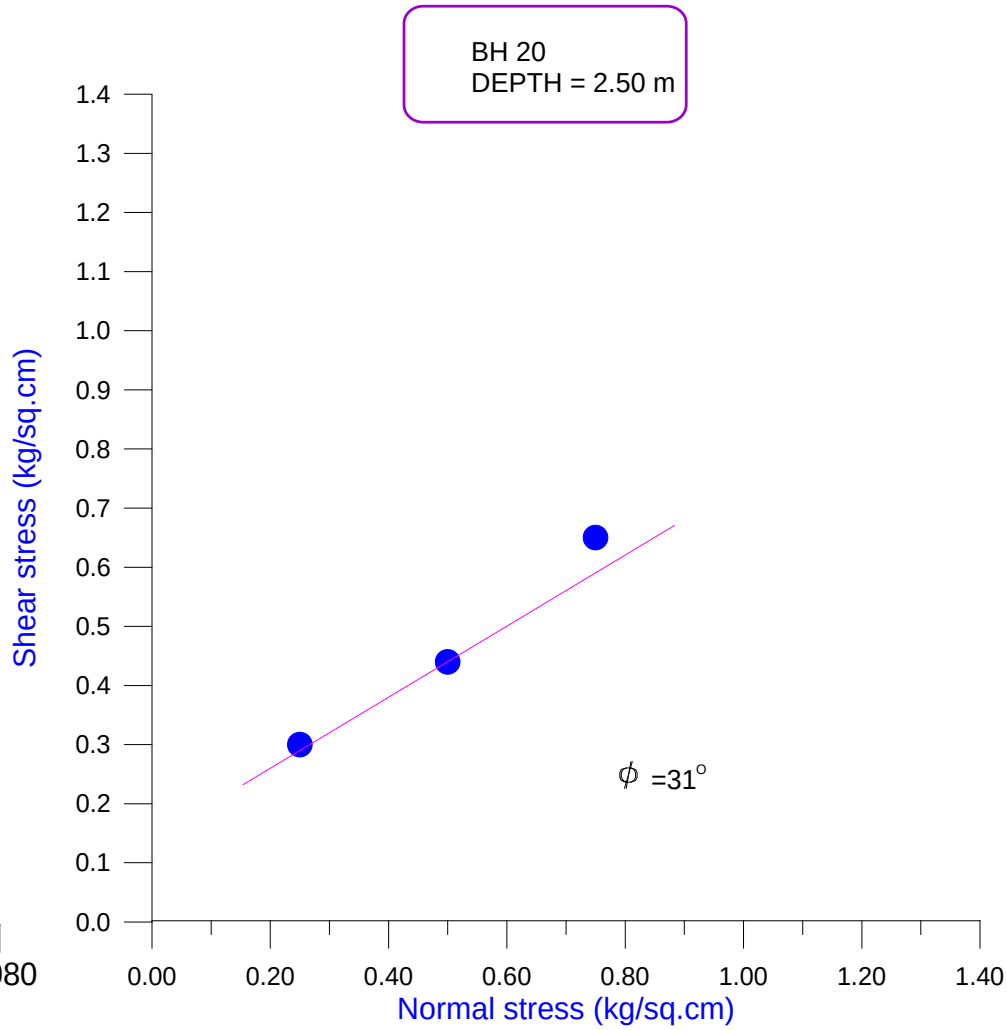
(Shear stress - shear strain relationship)



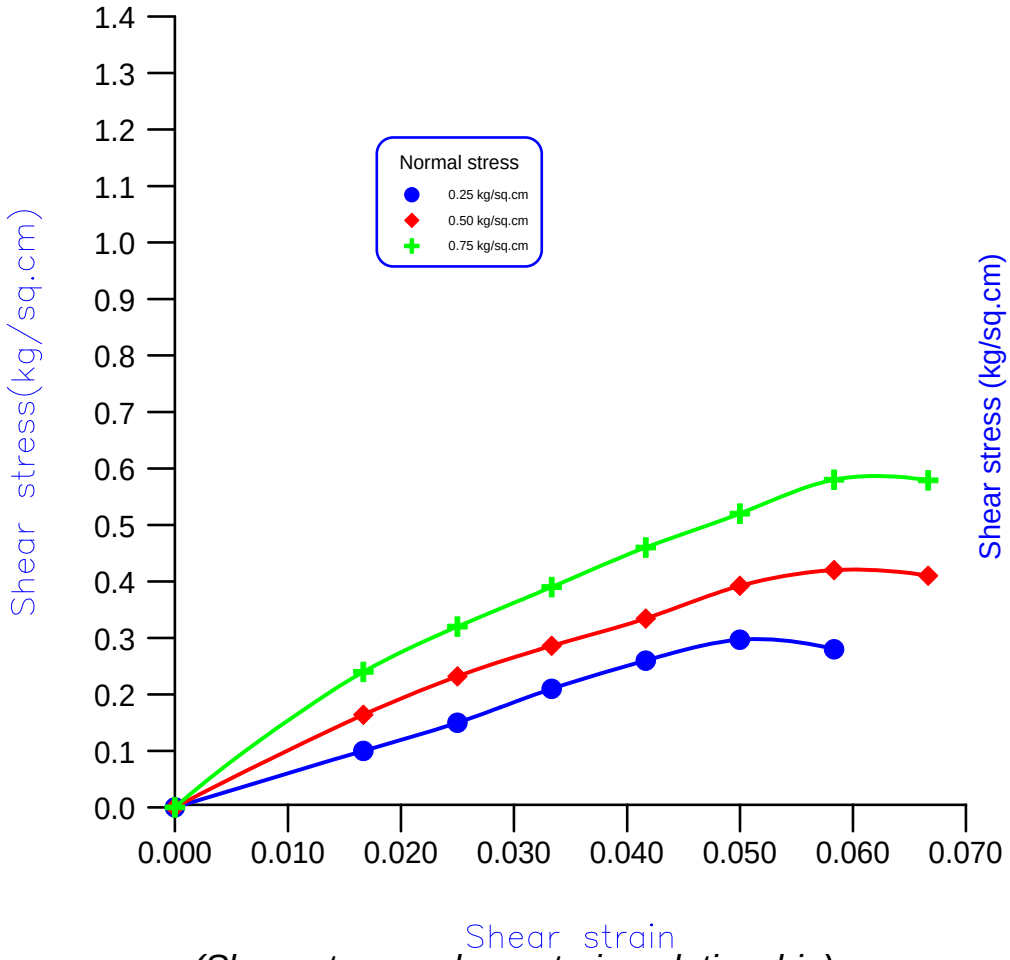
(Shear stress - Normal stress relationship)



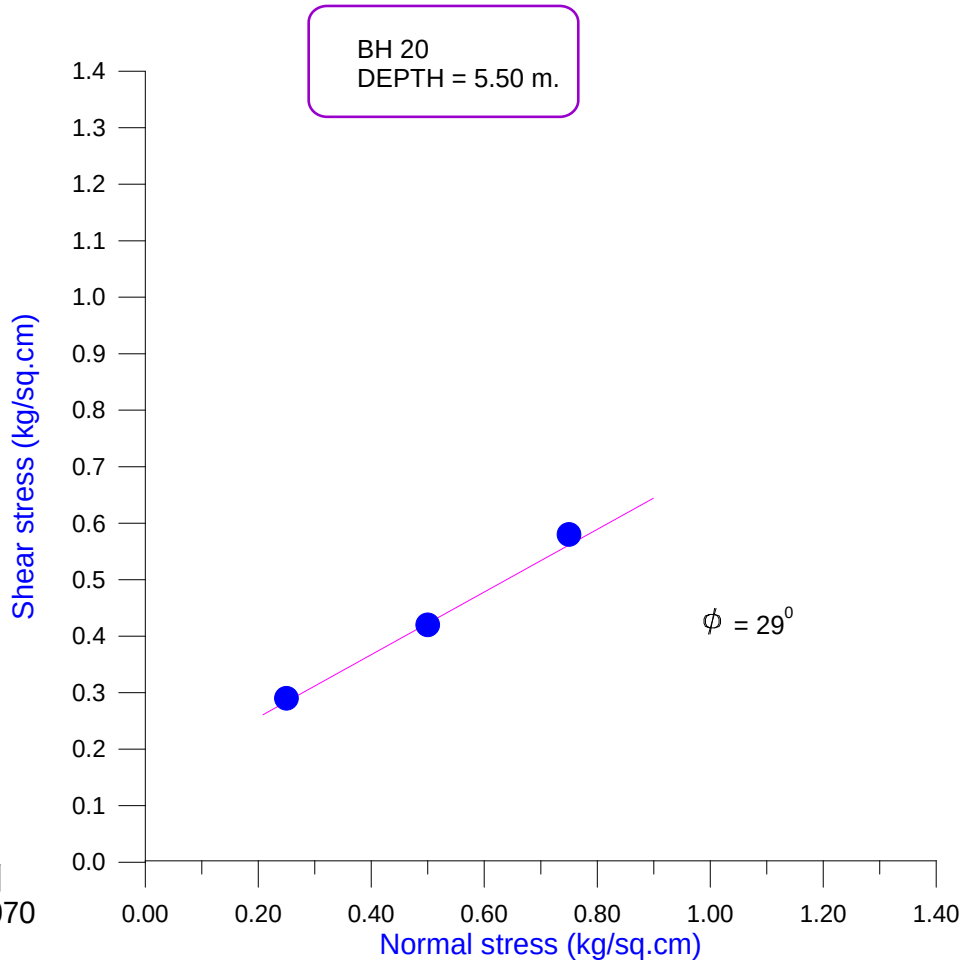
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



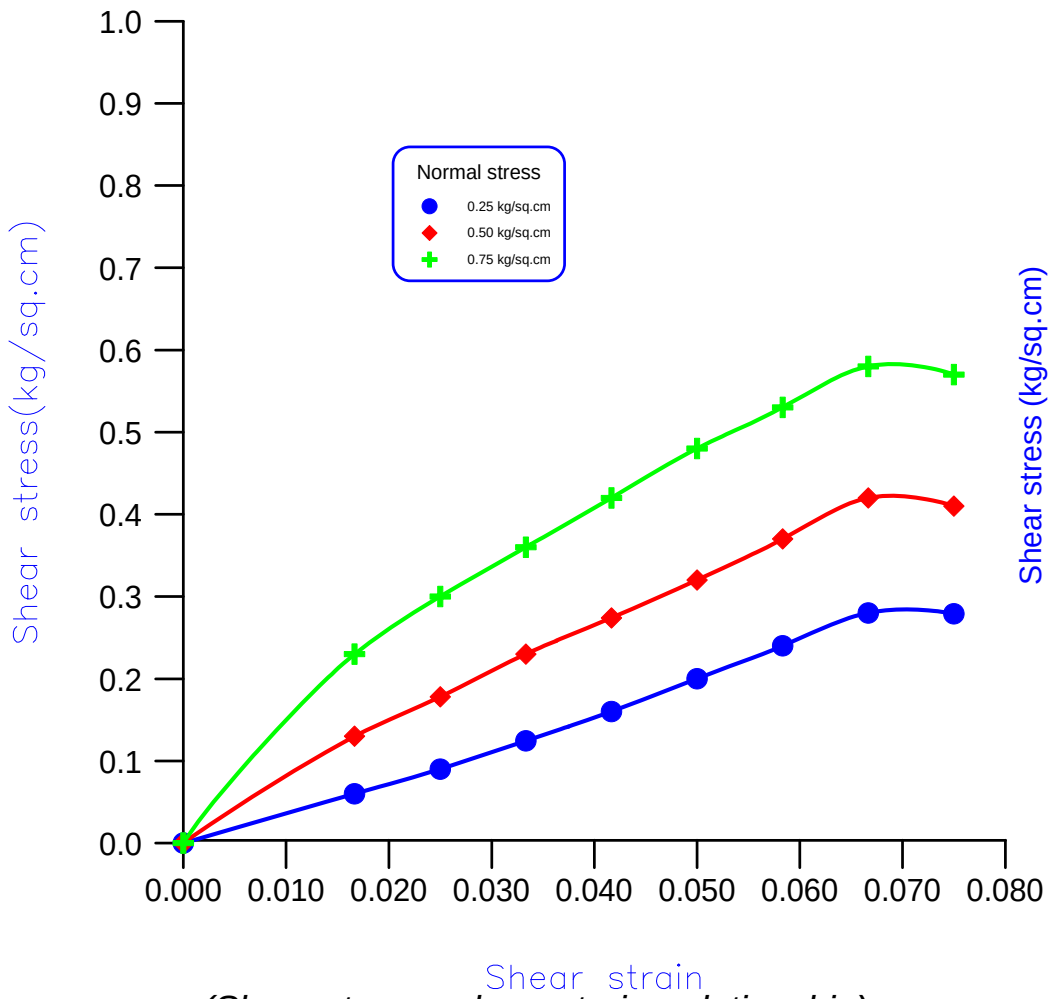
(Shear stress - shear strain relationship)



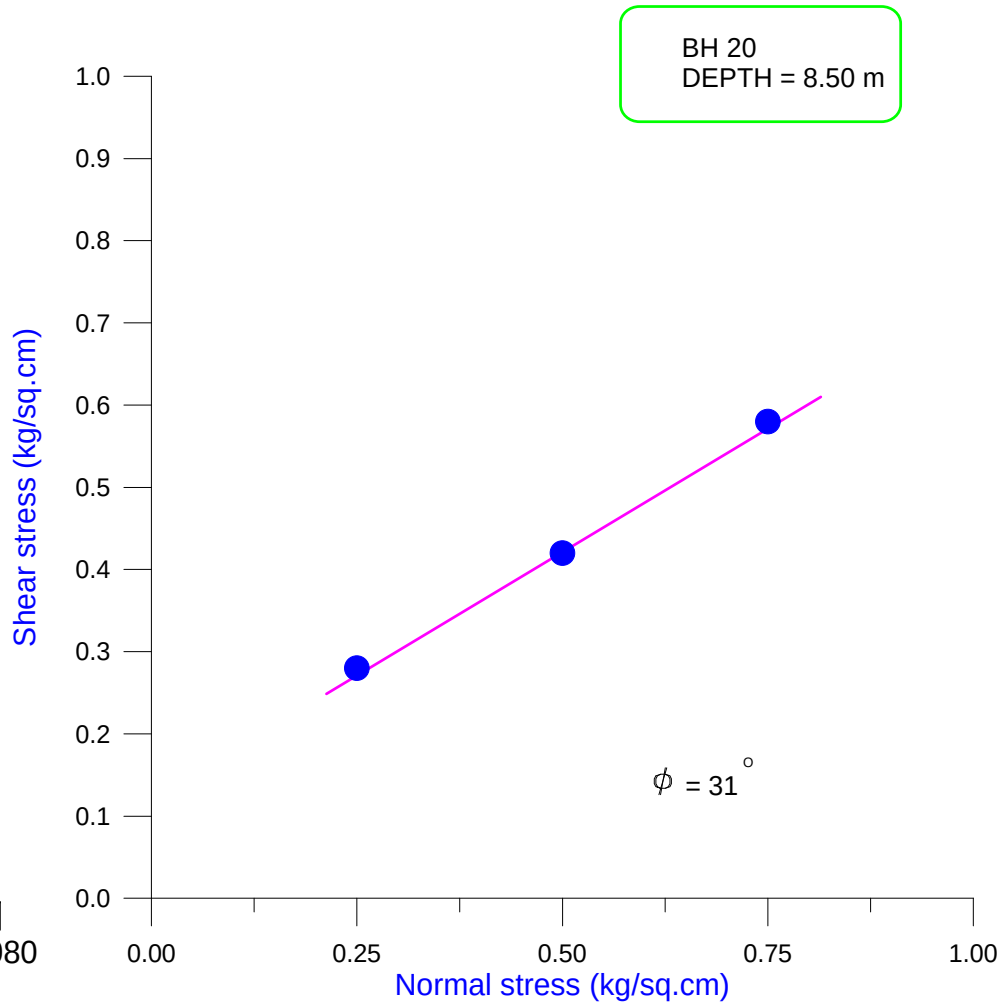
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

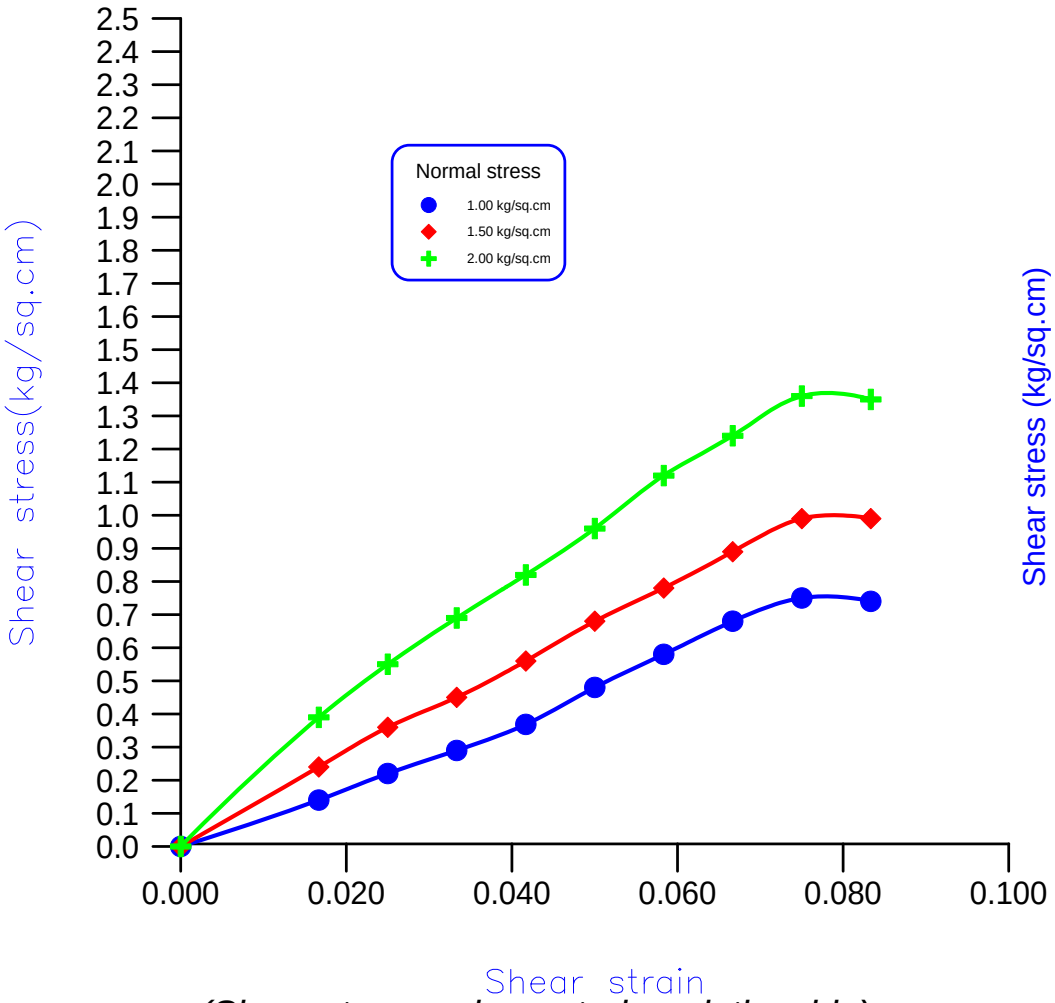
FIG- DS 20-2



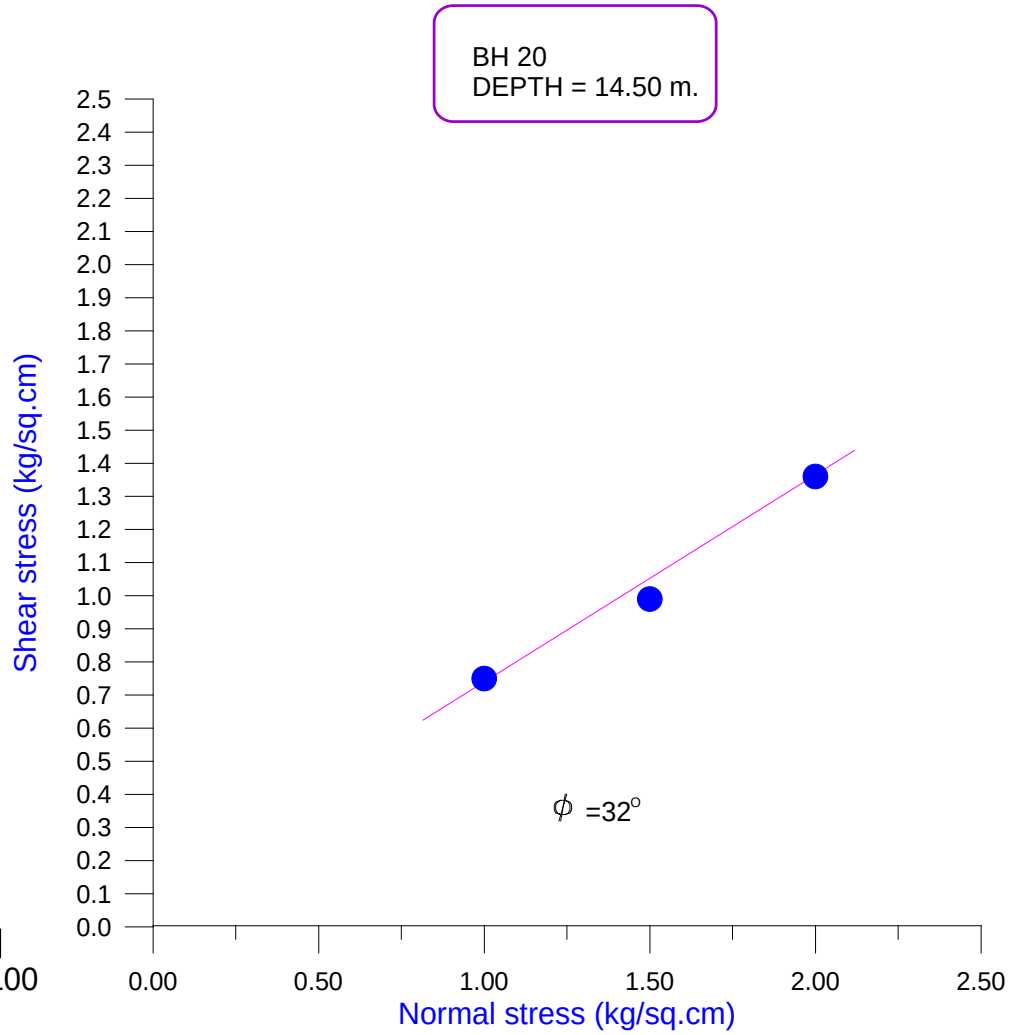
(Shear stress - shear strain relationship)



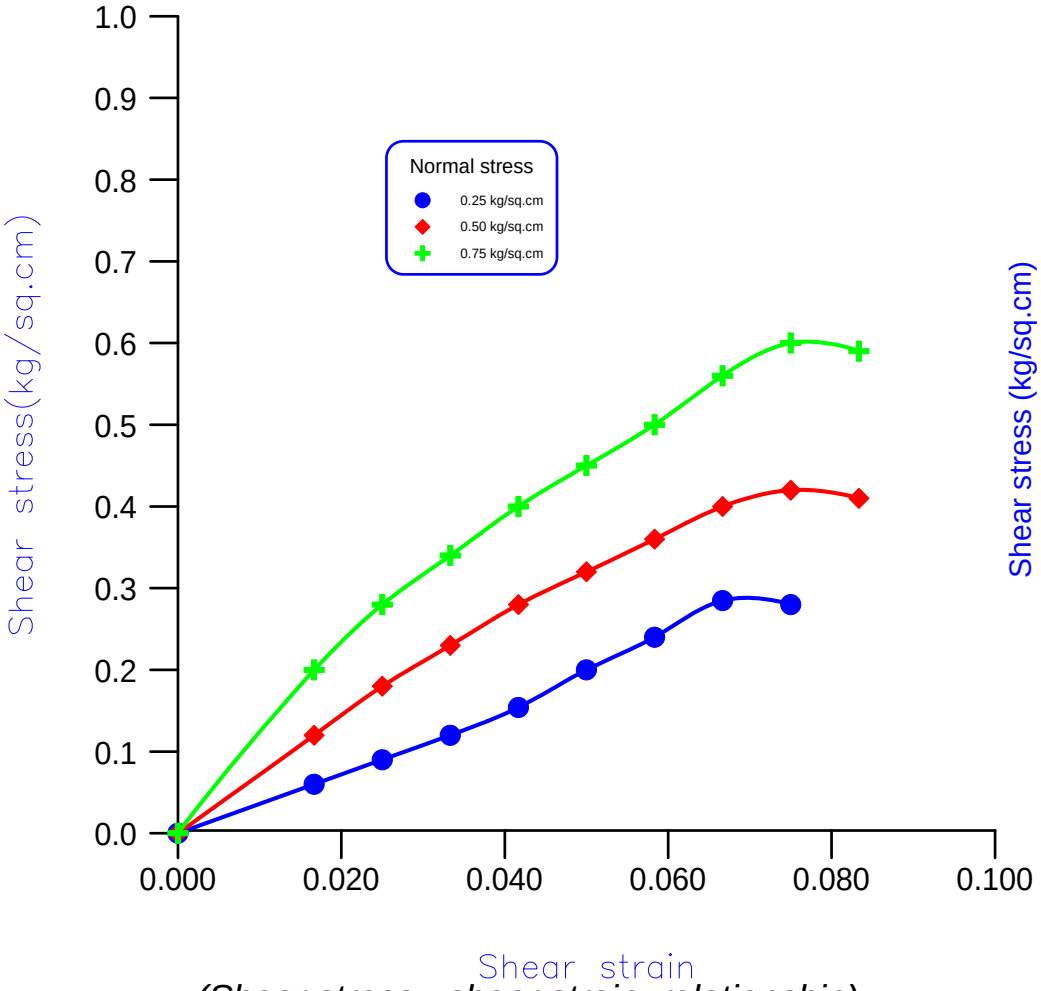
(Shear stress - Normal stress relationship)



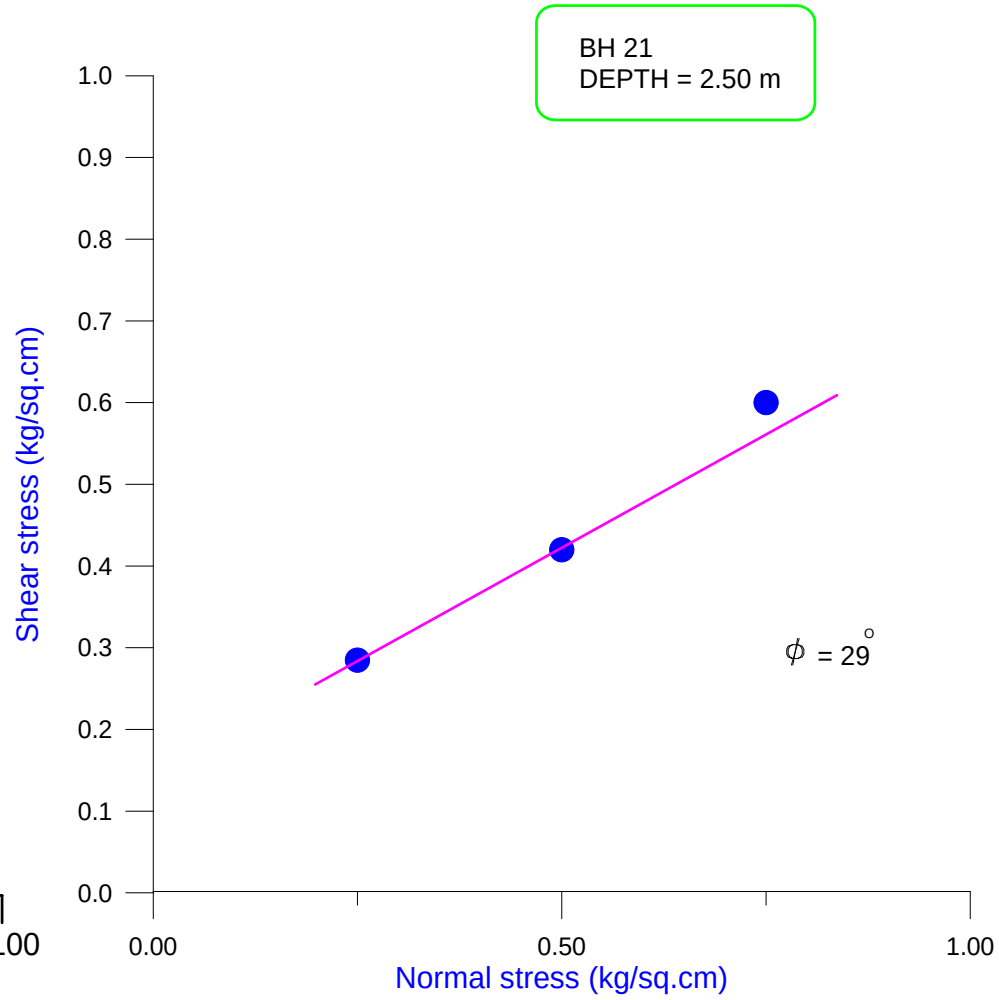
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



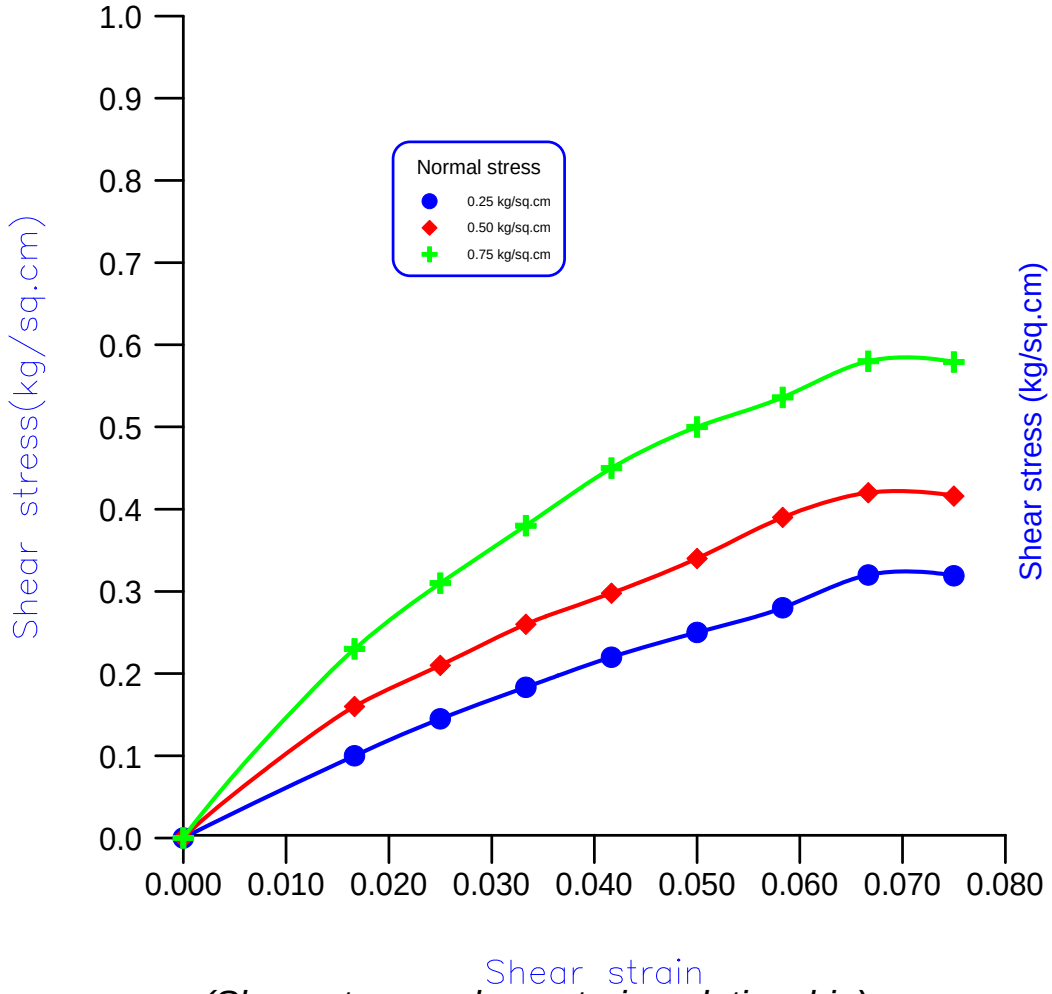
(Shear stress - shear strain relationship)



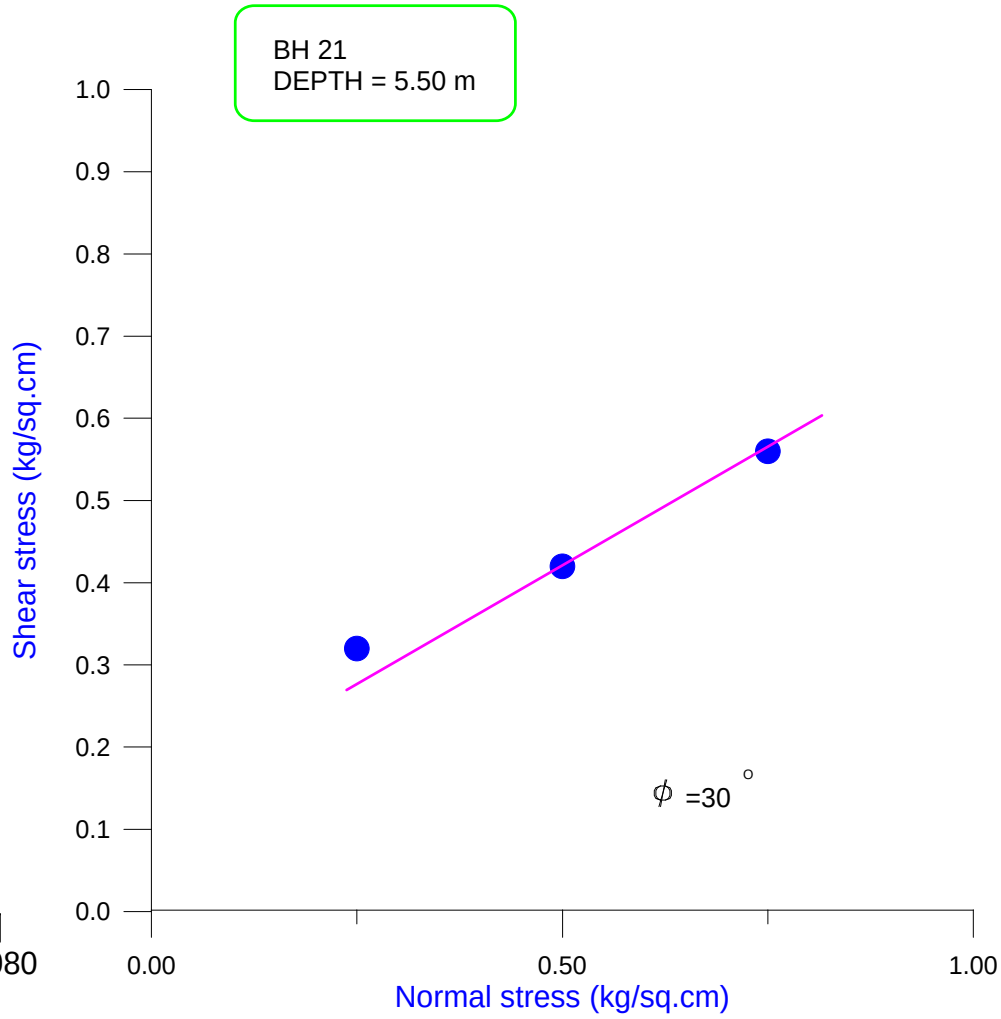
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 21-1



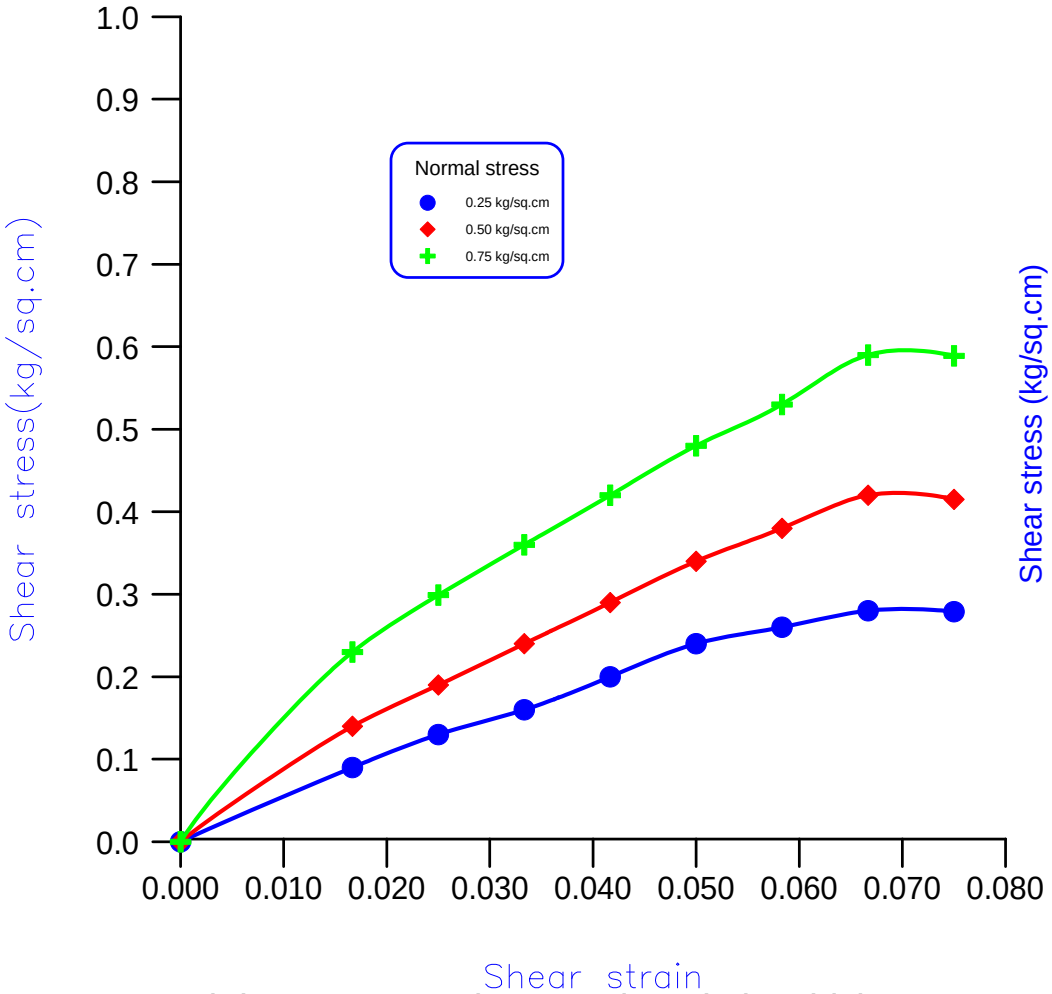
(Shear stress - shear strain relationship)



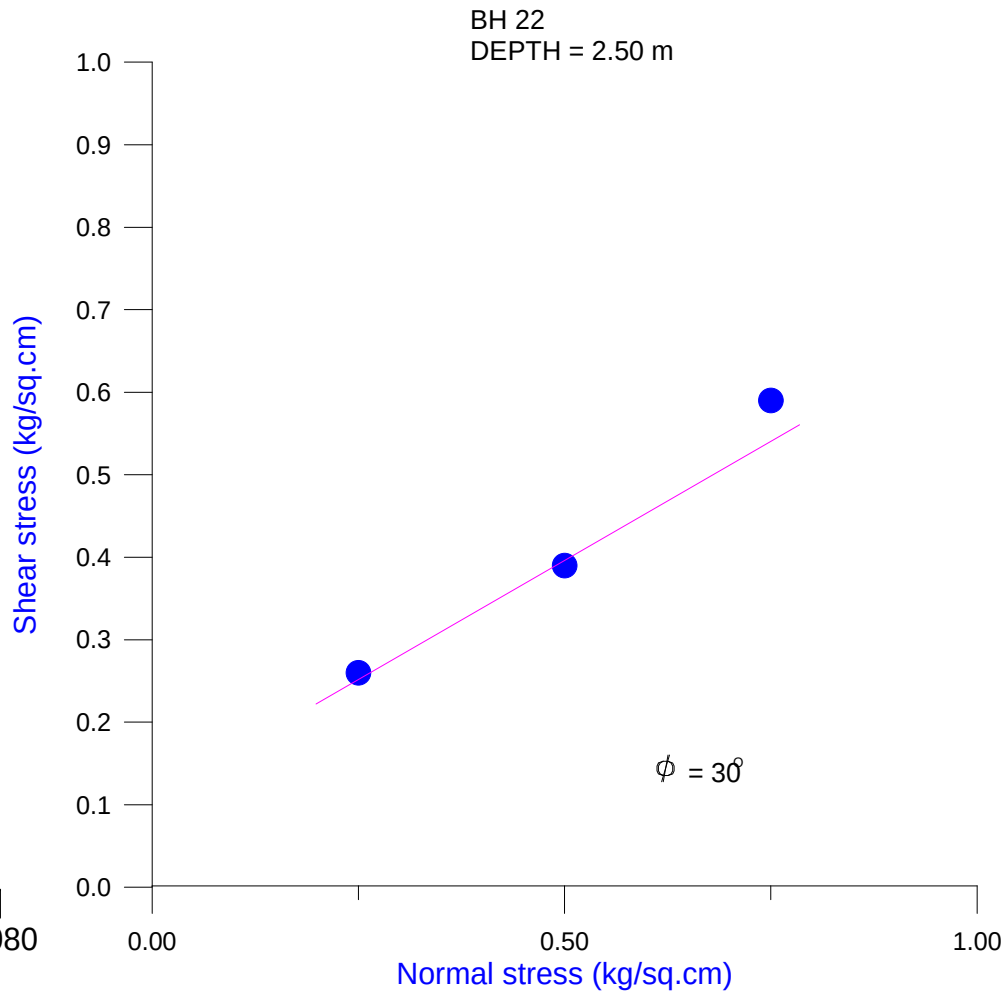
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

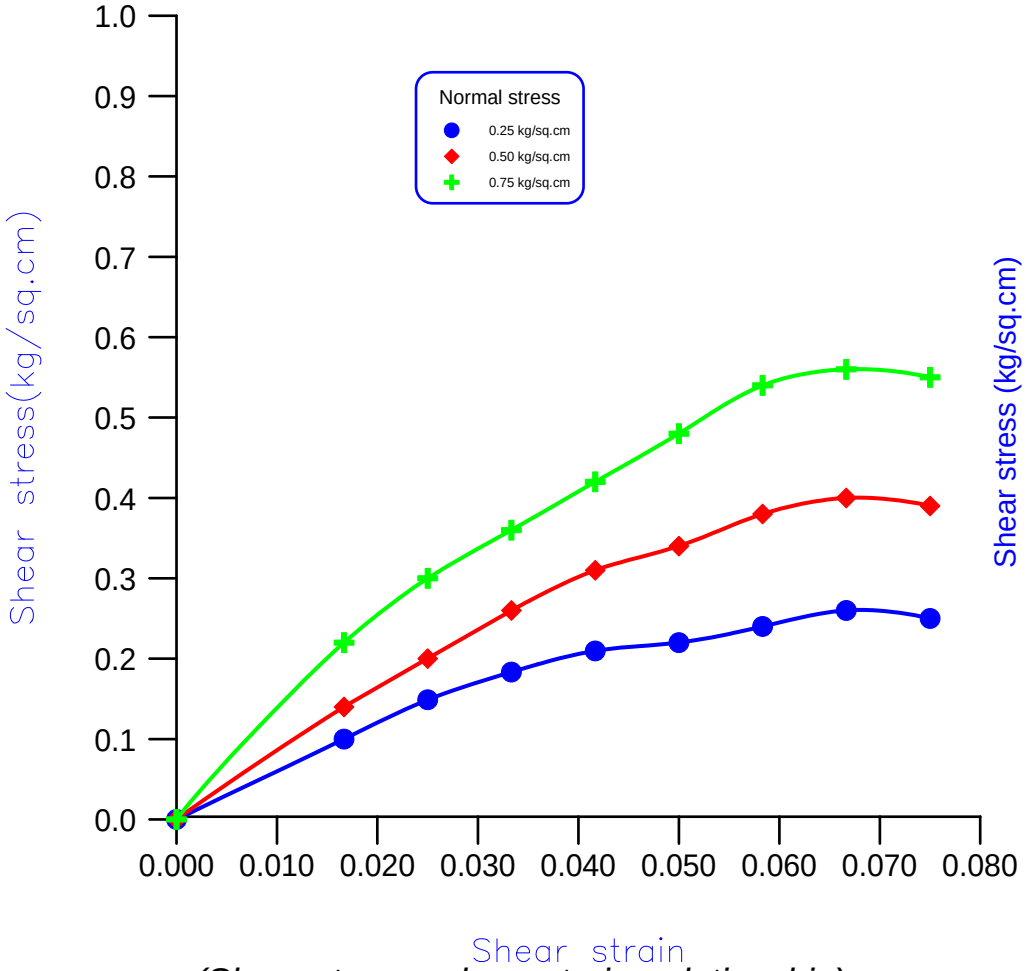
FIG- DS 21-2



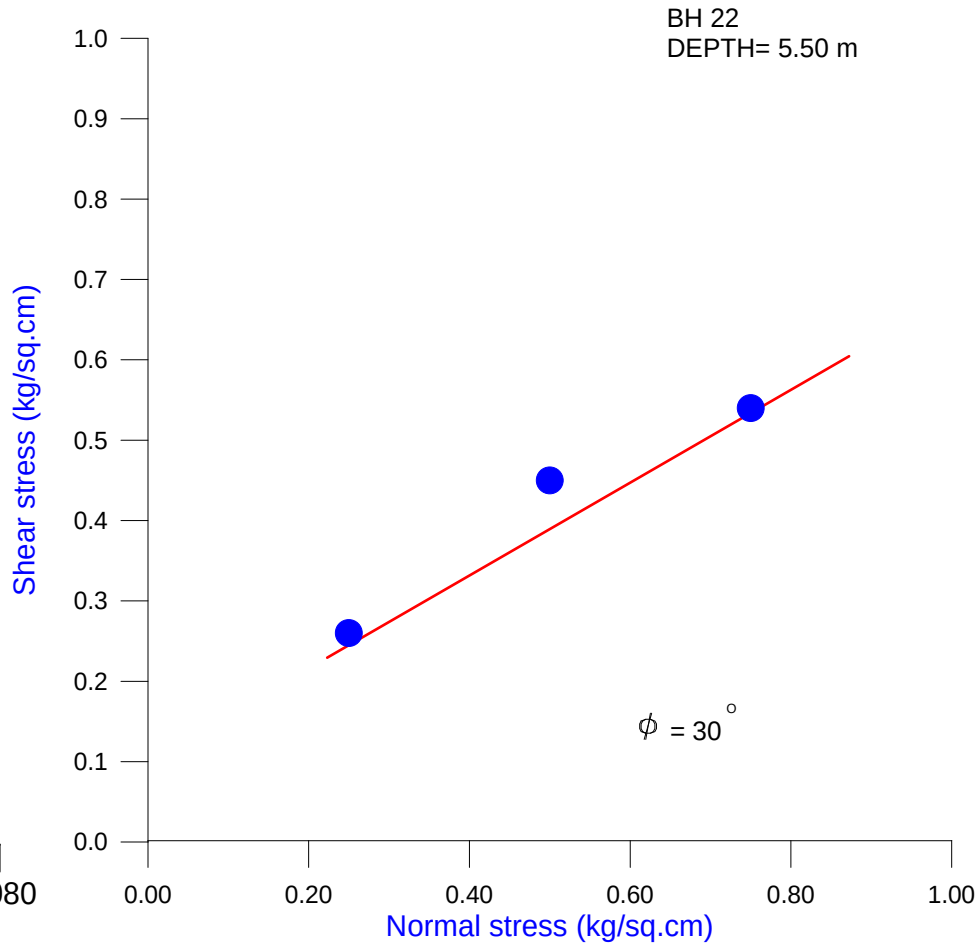
(Shear stress - shear strain relationship)



(Shear stress - Normal stress relationship)



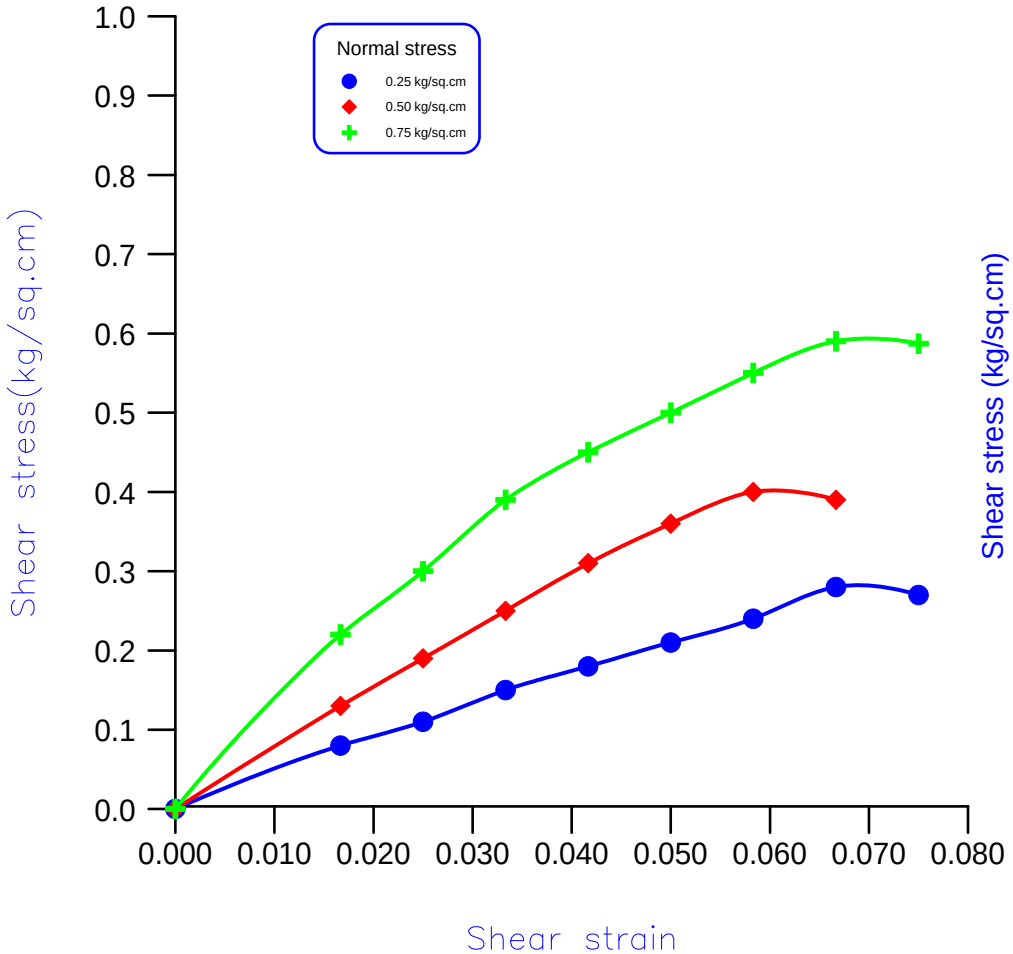
(Shear stress - shear strain relationship)



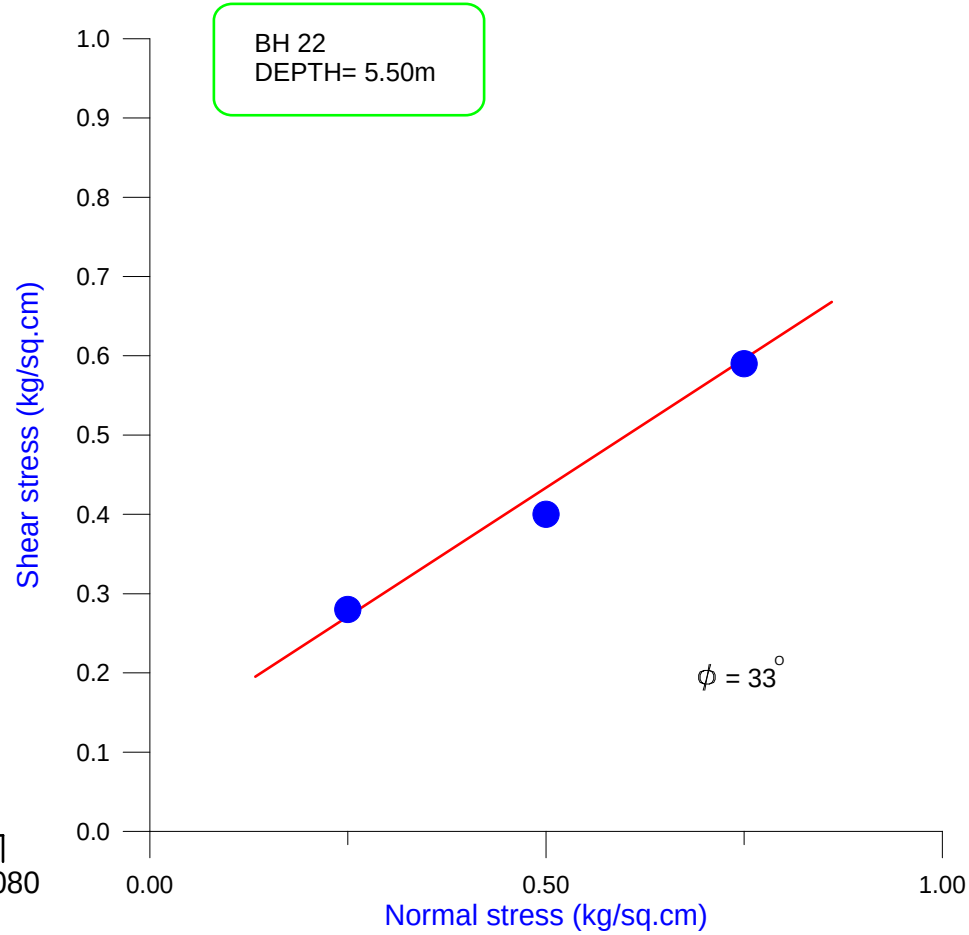
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 22-2



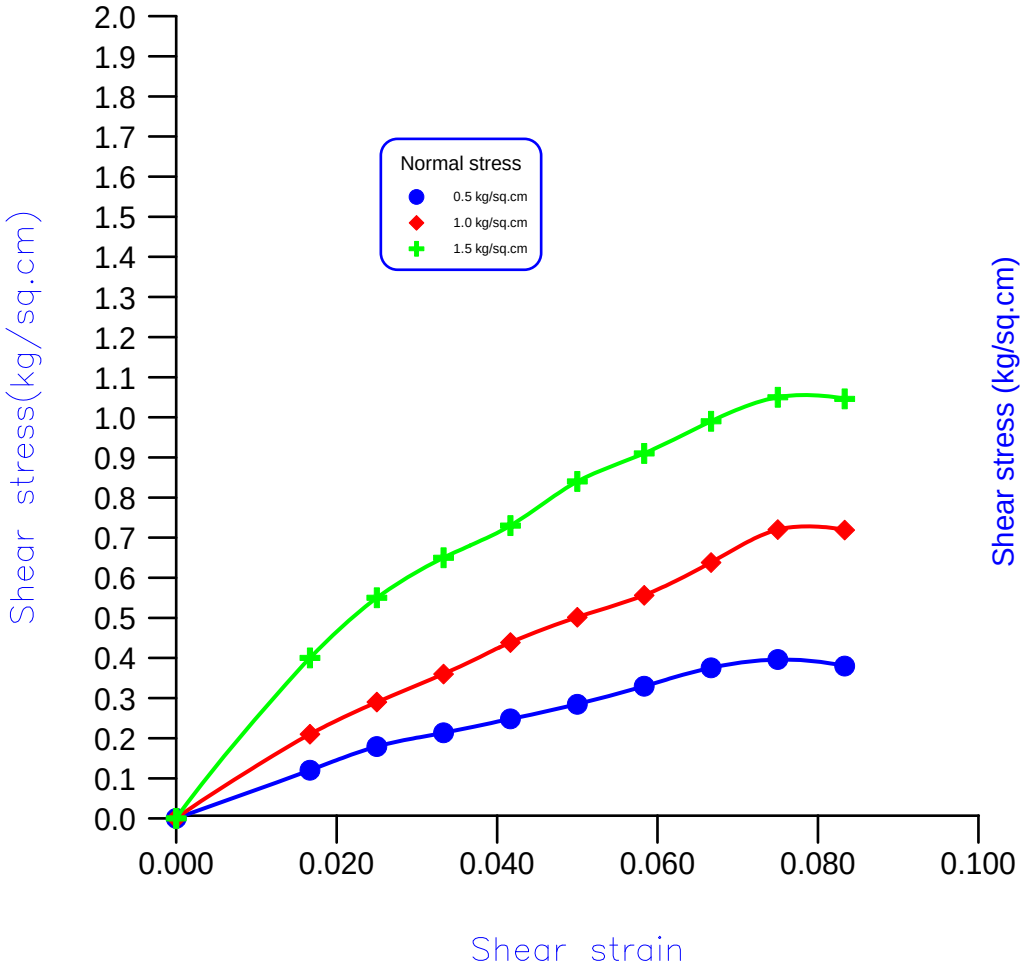
(Shear stress - shear strain relationship)



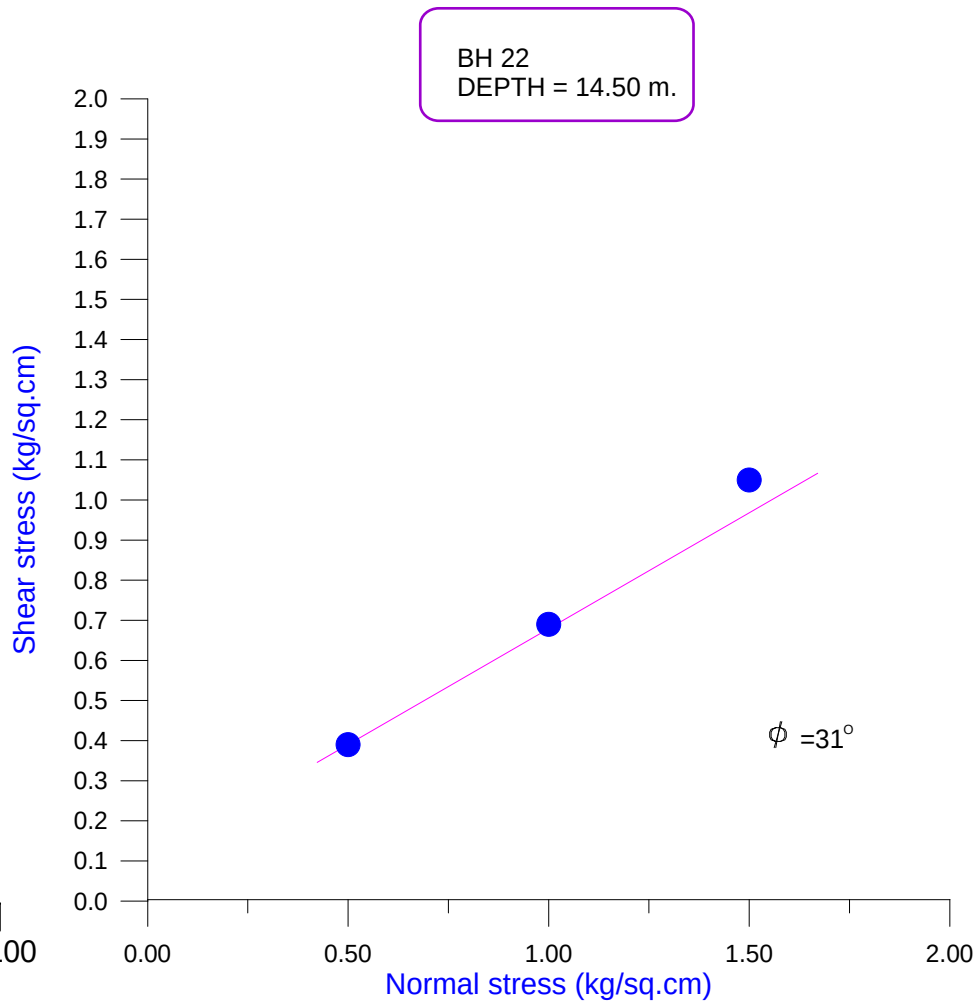
(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 22-3



(Shear stress - shear strain relationship)

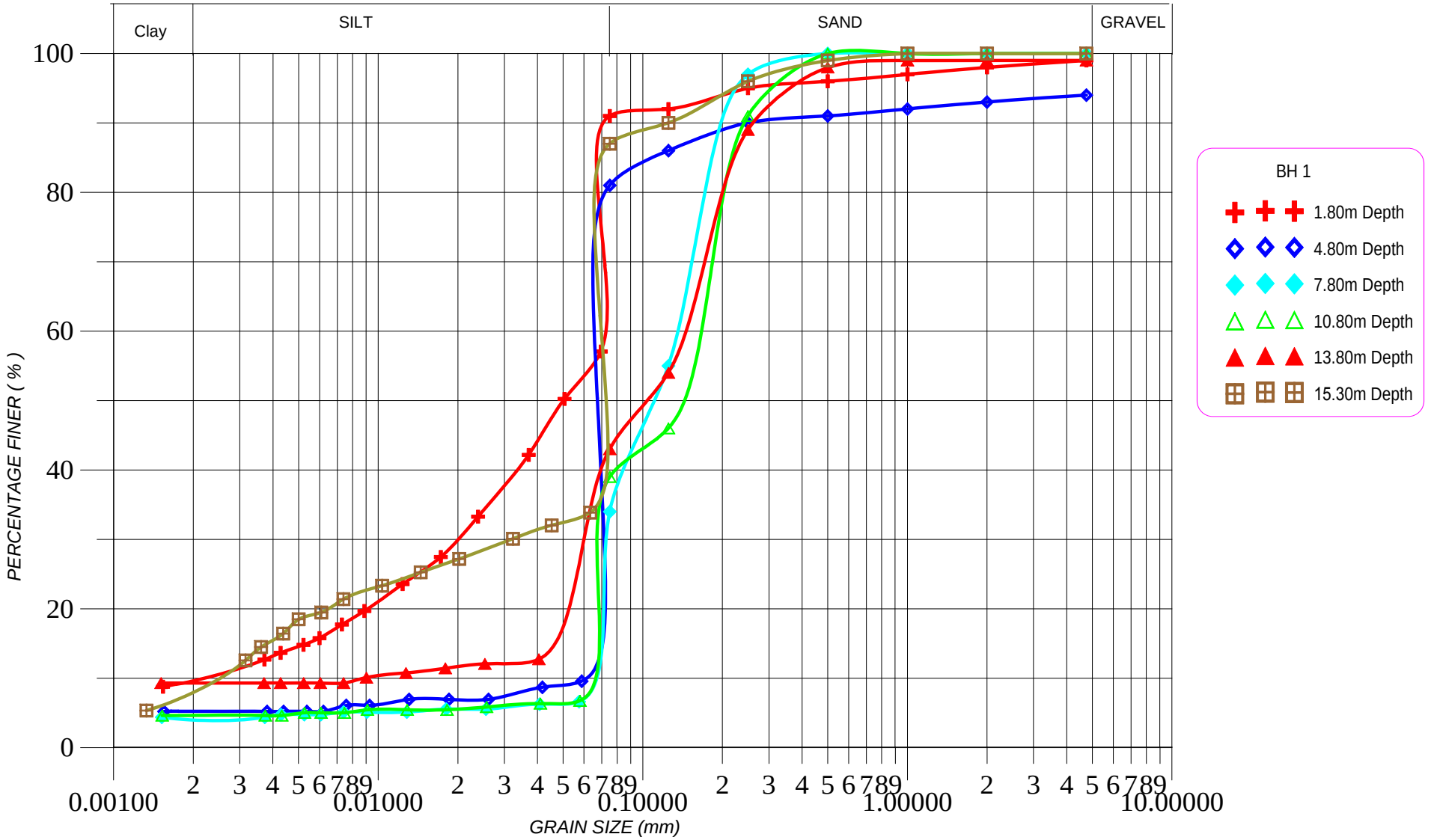


(Shear stress - Normal stress relationship)

PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

FIG- DS 22-4

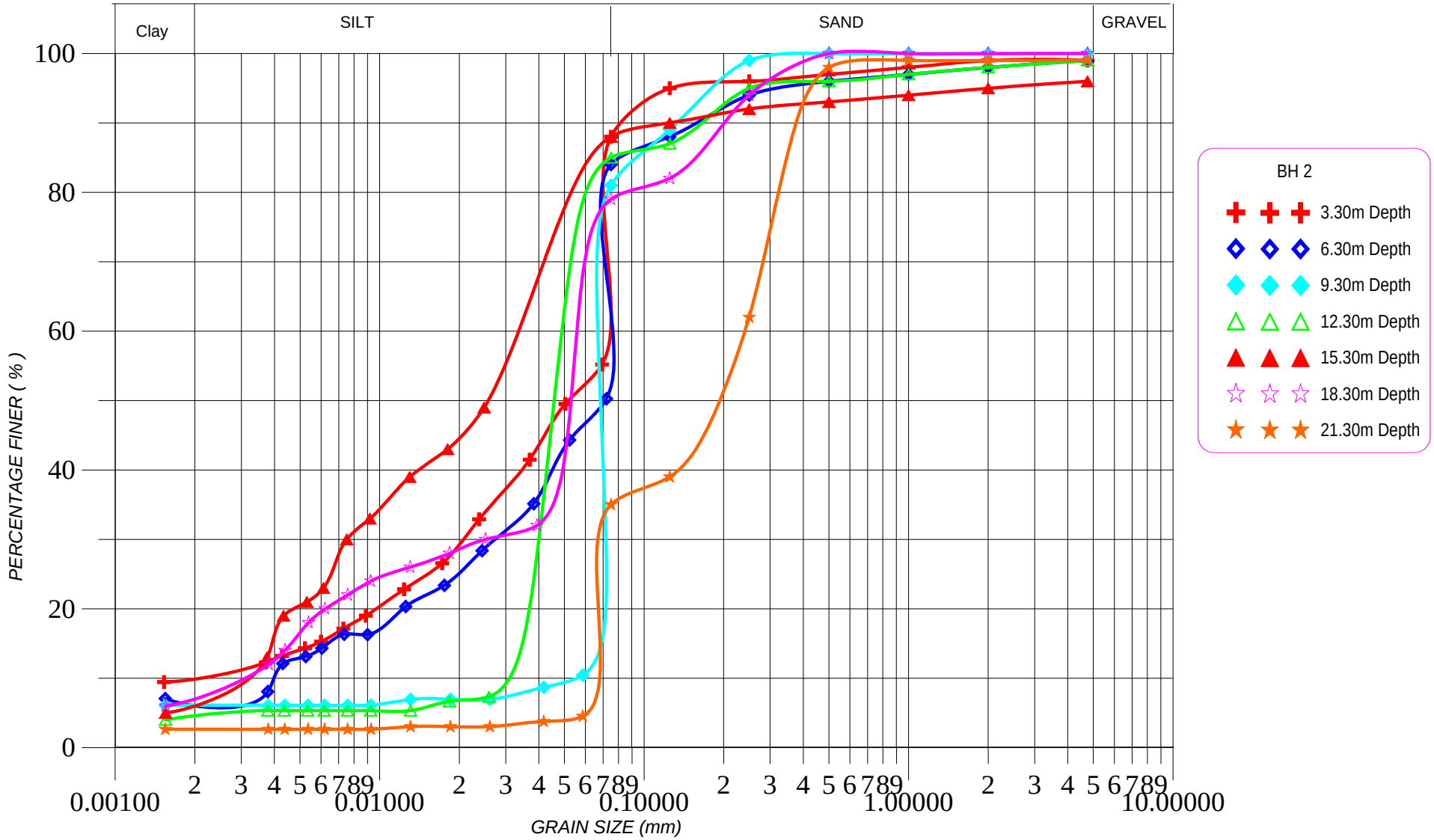
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD 1

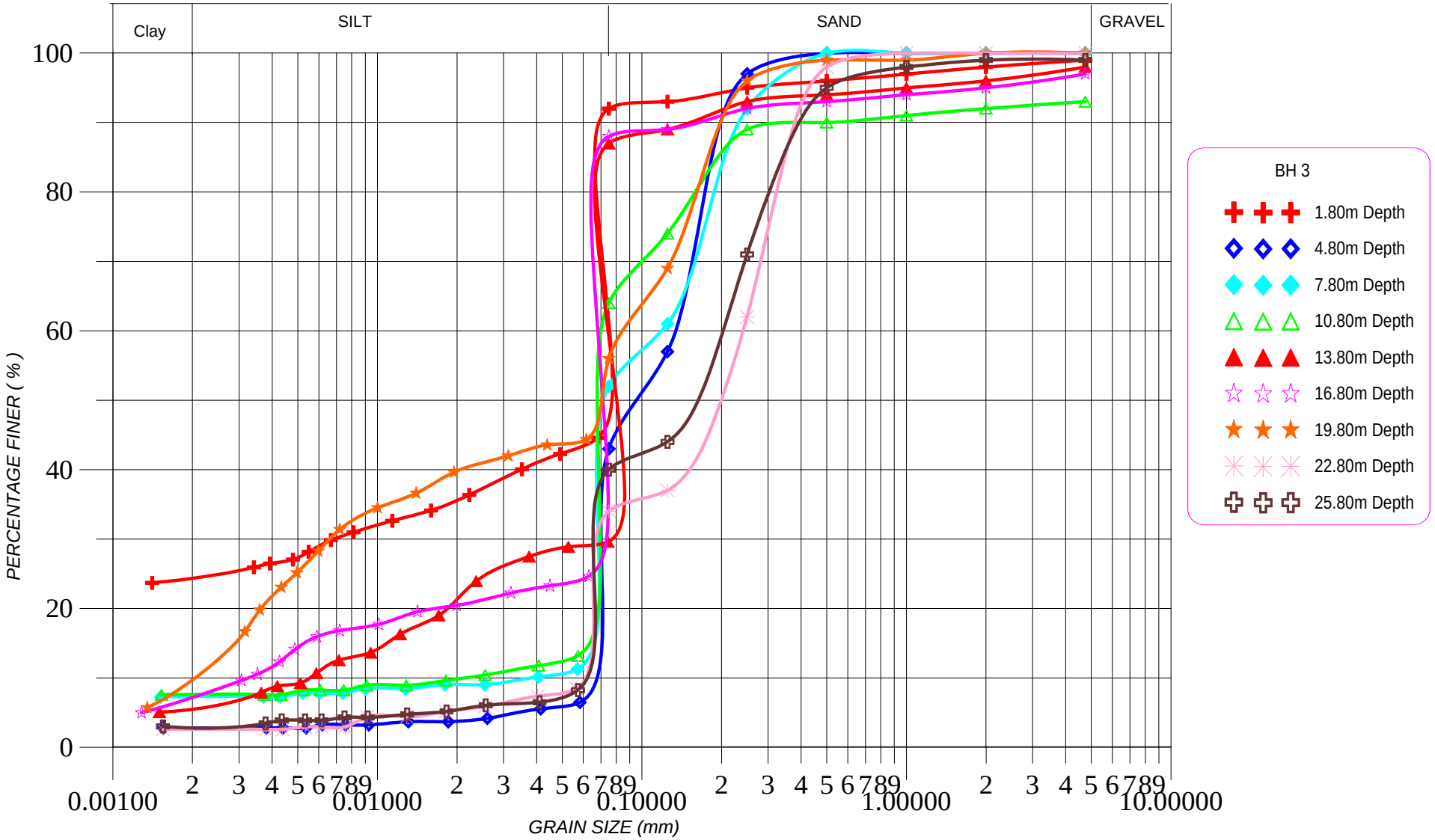
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD 2

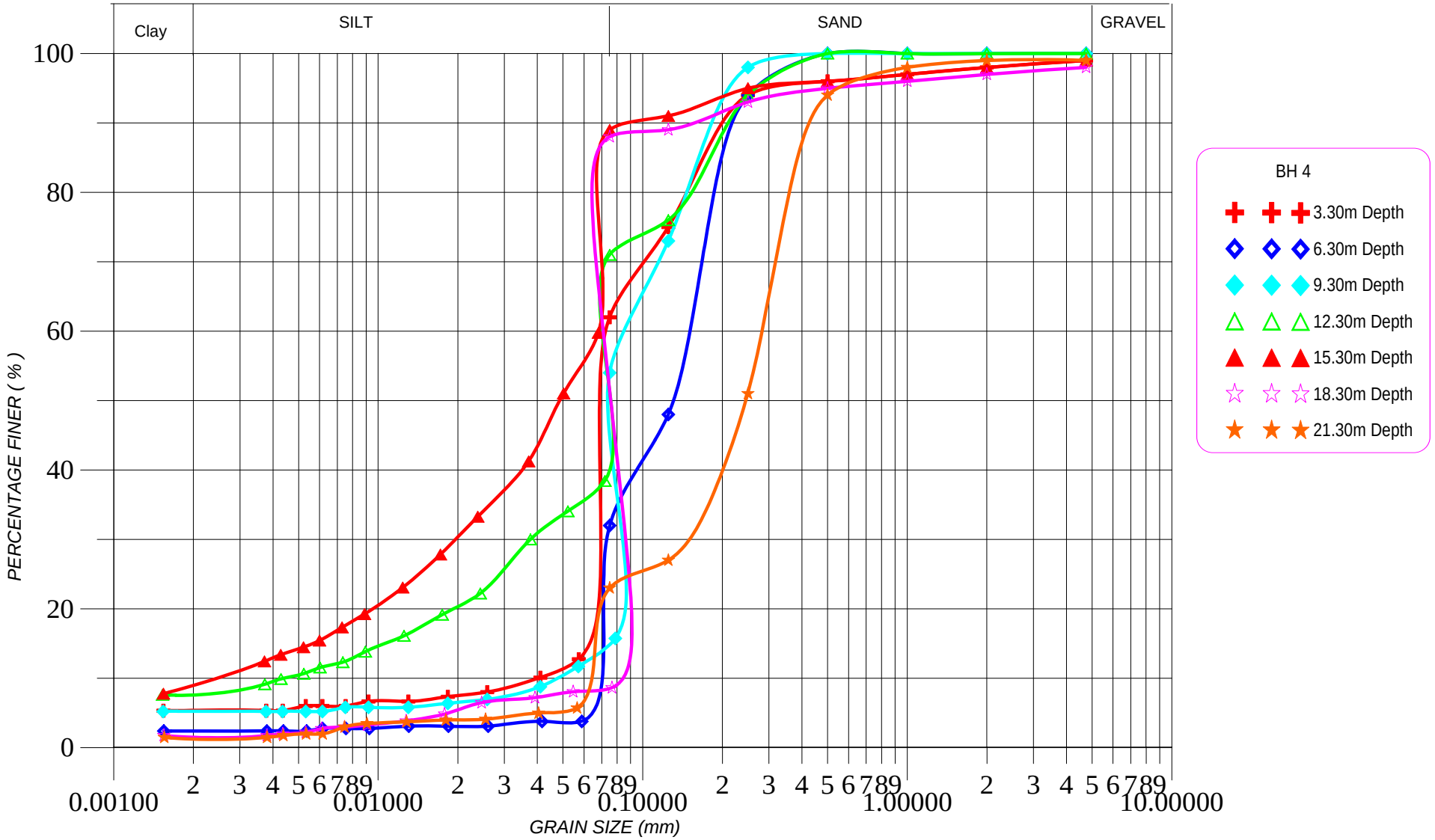
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD 3

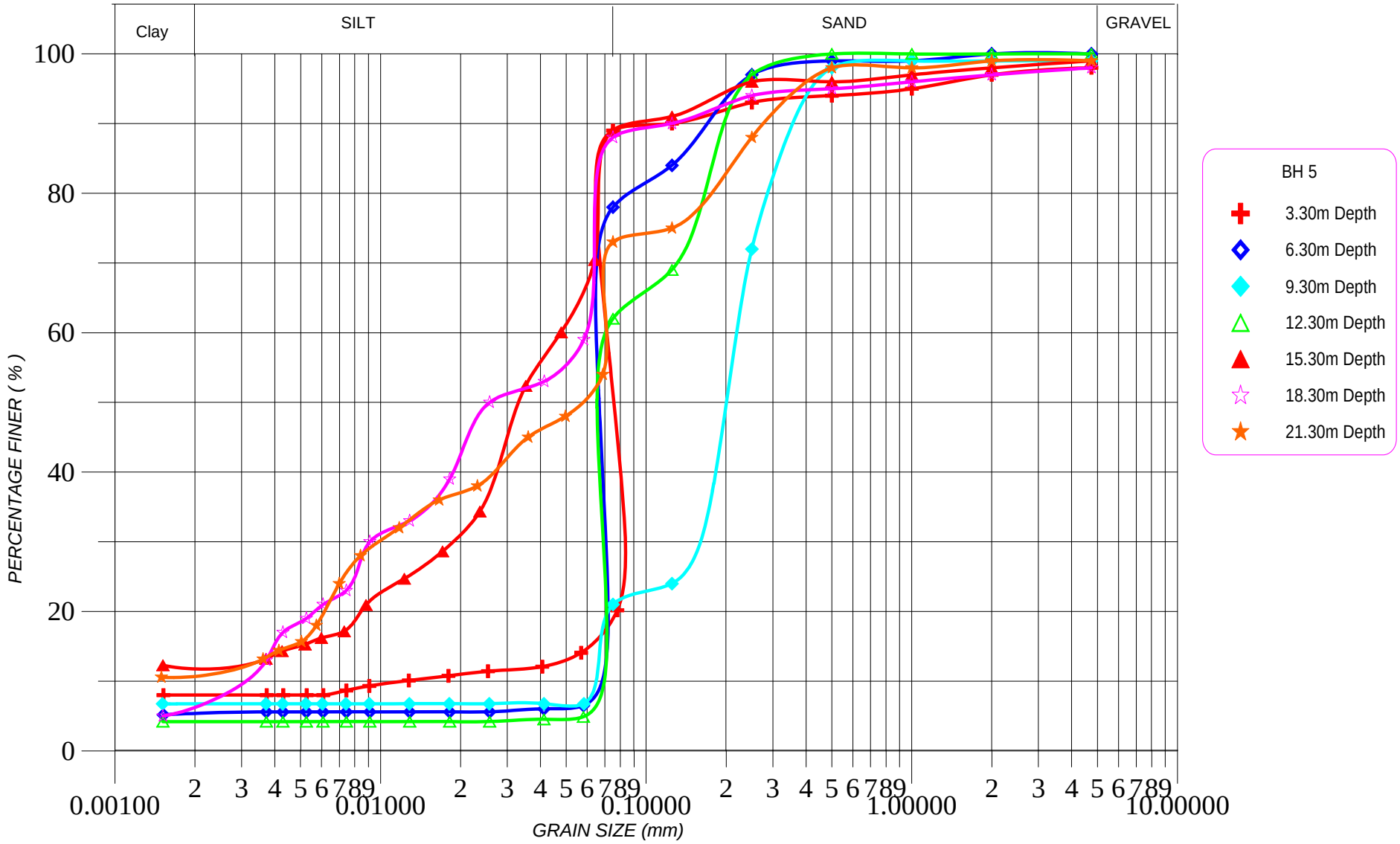
GRAIN SIZE DRISTRIBUTION CURVE



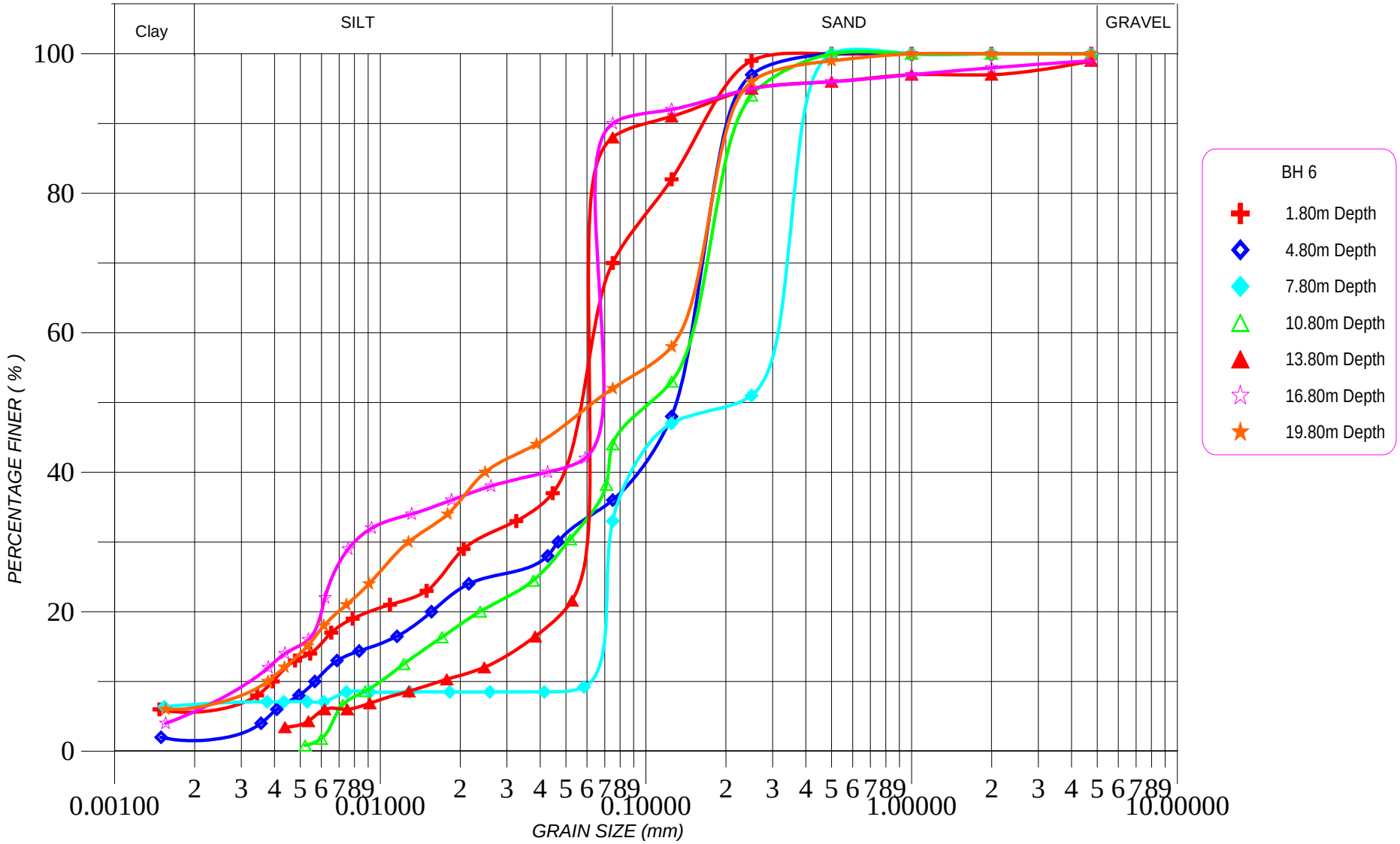
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD -4

GRAIN SIZE DRISTRIBUTION CURVE



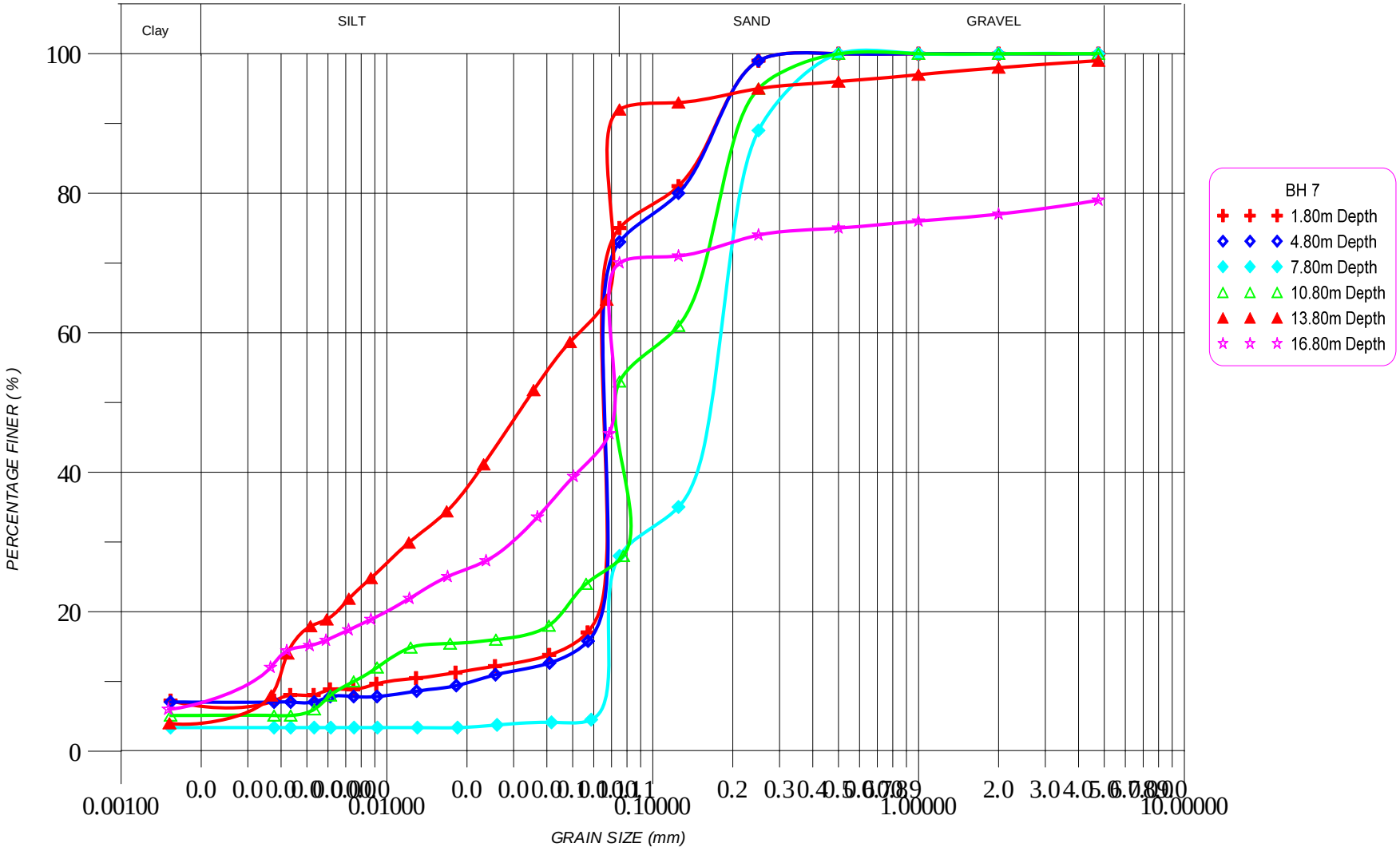
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD 6

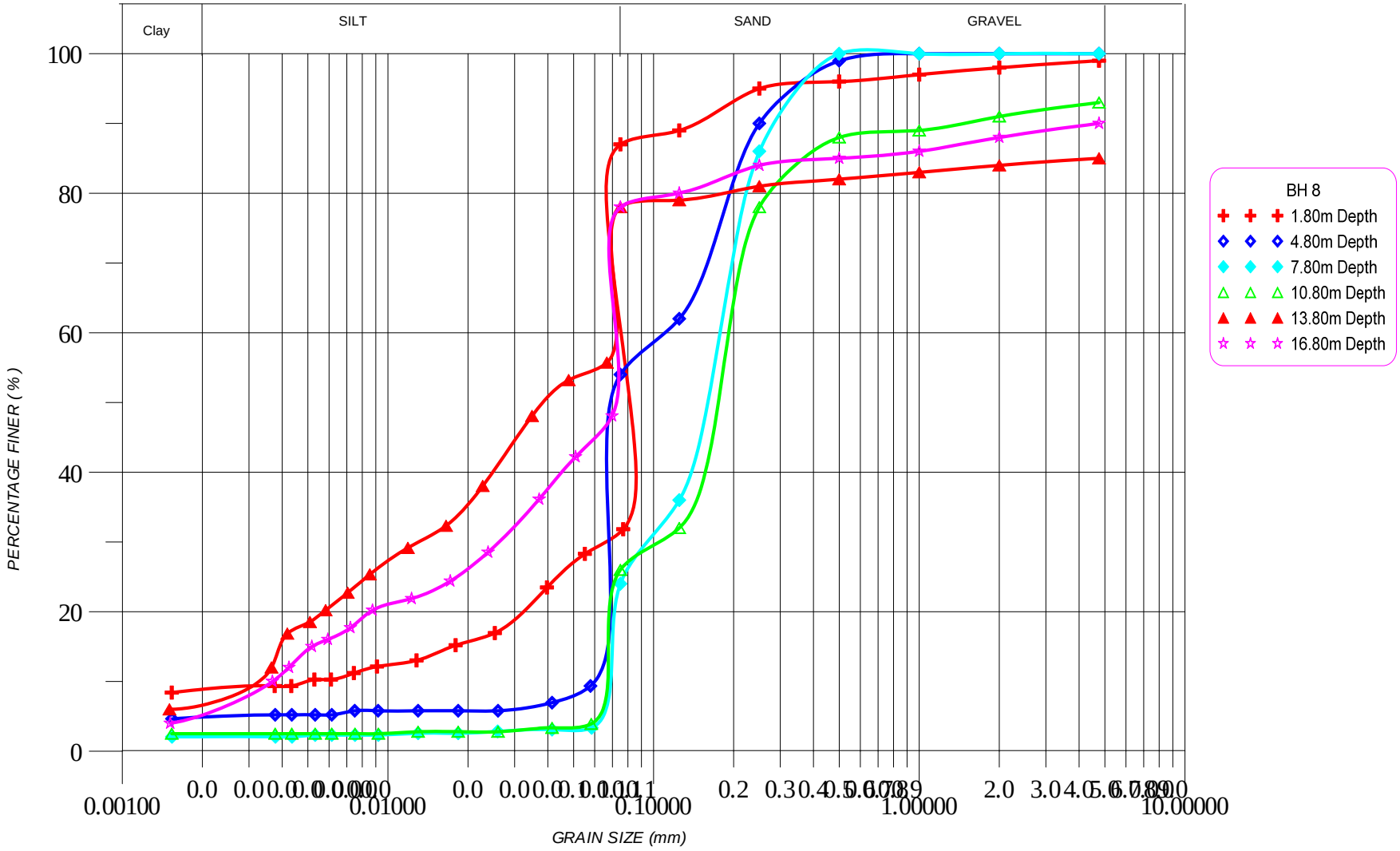
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD 7

GRAIN SIZE DRISTRIBUTION CURVE



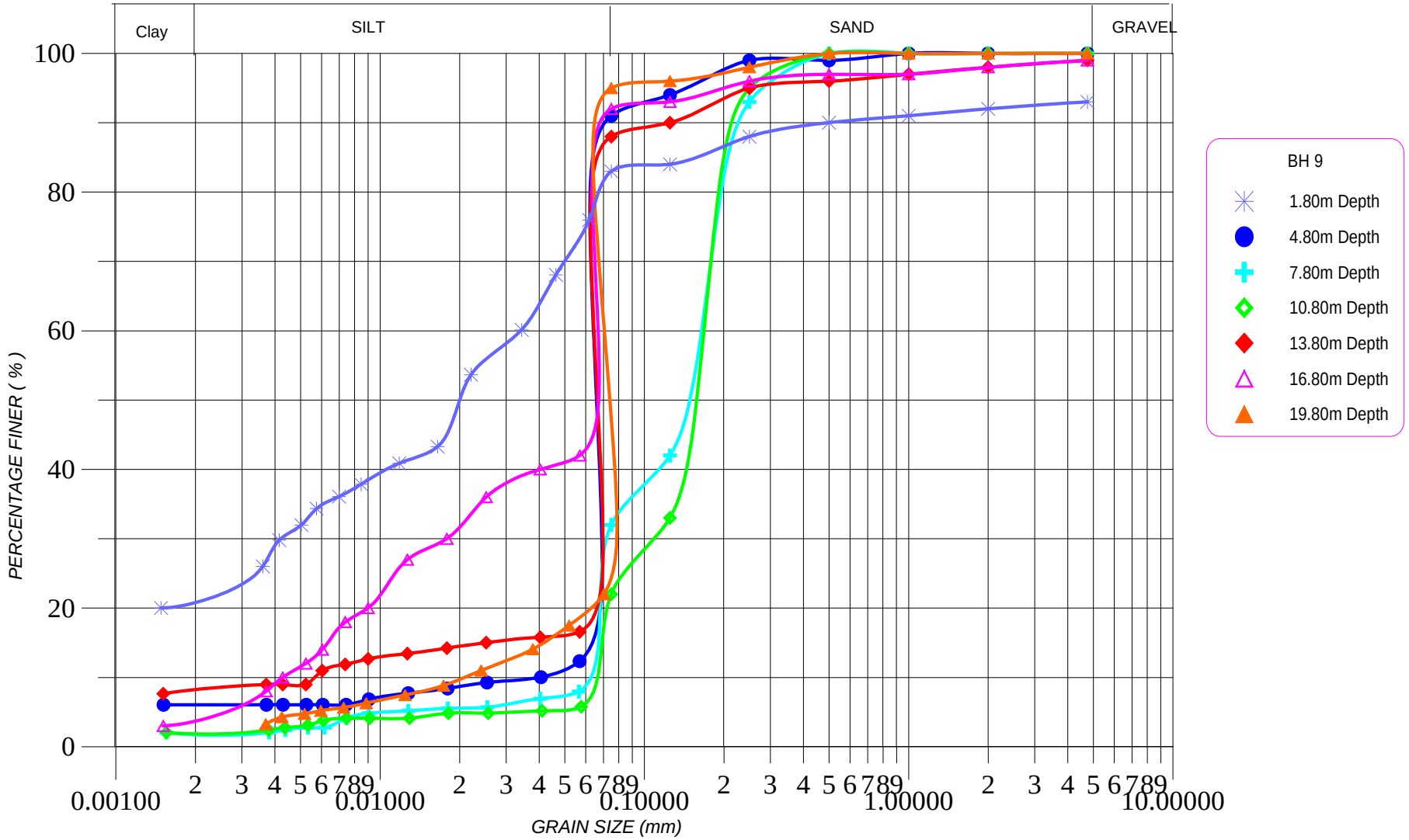
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD 8

SUVIDHI Testing Engineers

Job No 2137

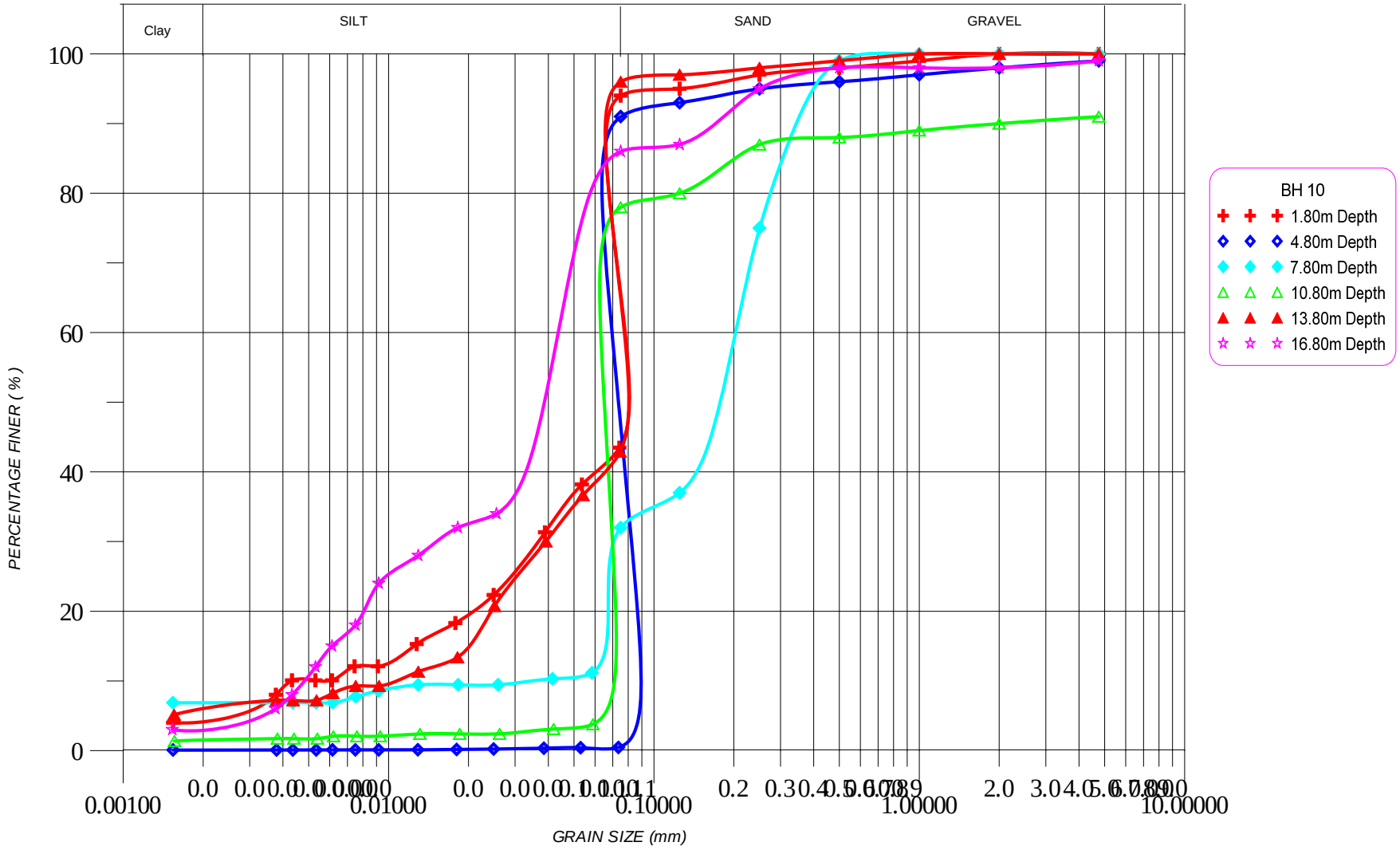
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD-9

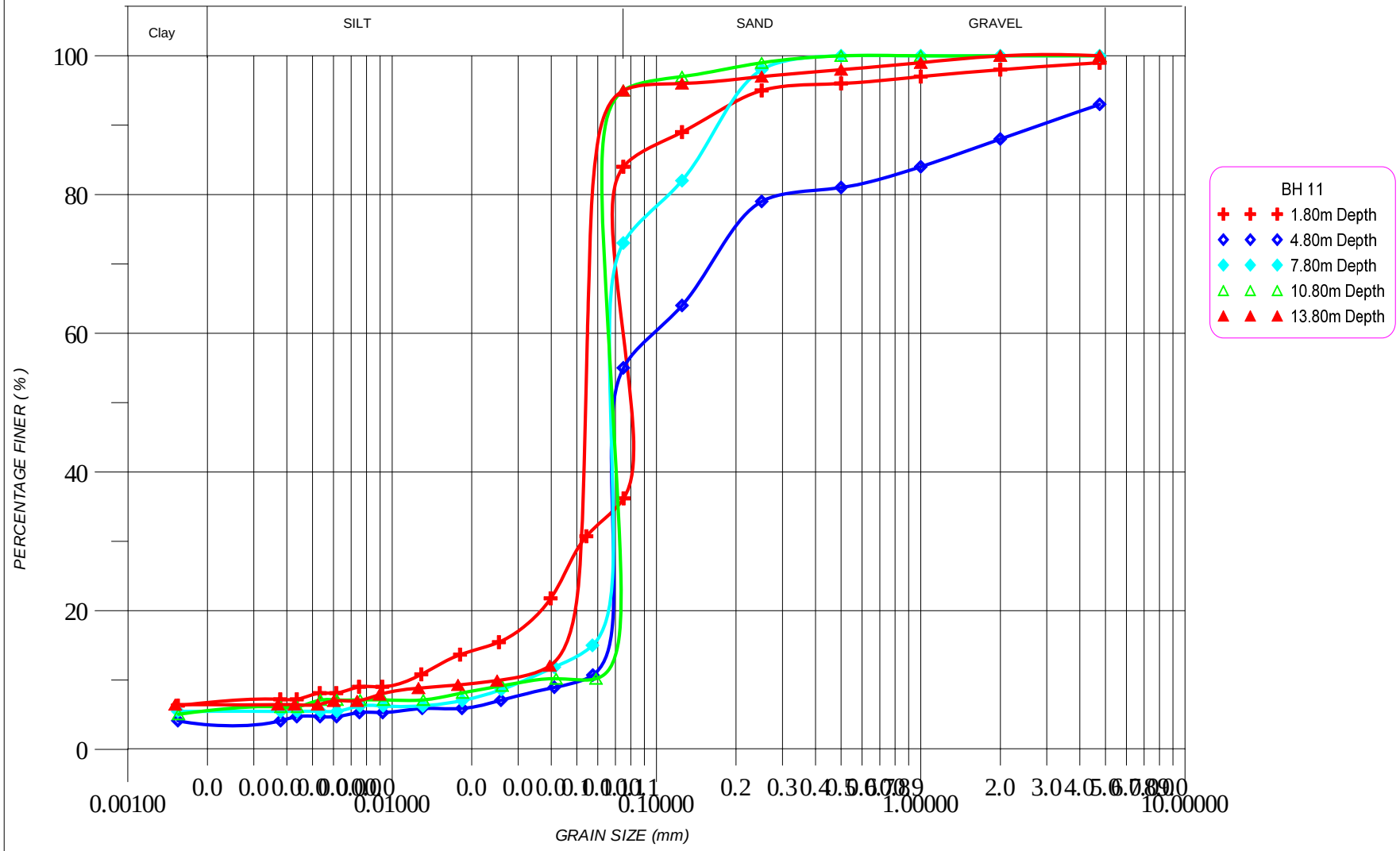
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD 10

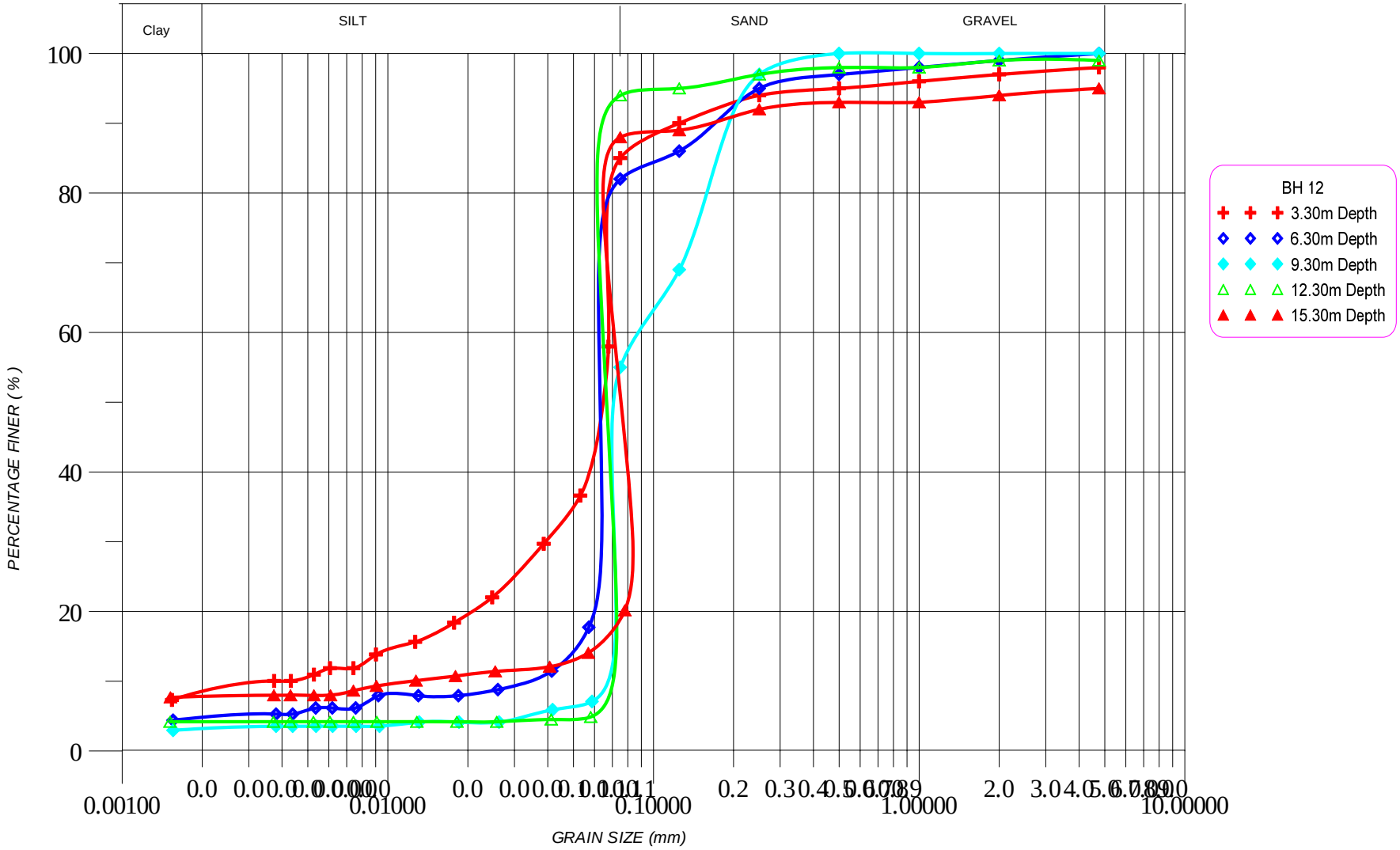
GRAIN SIZE DRISTRIBUTION CURVE



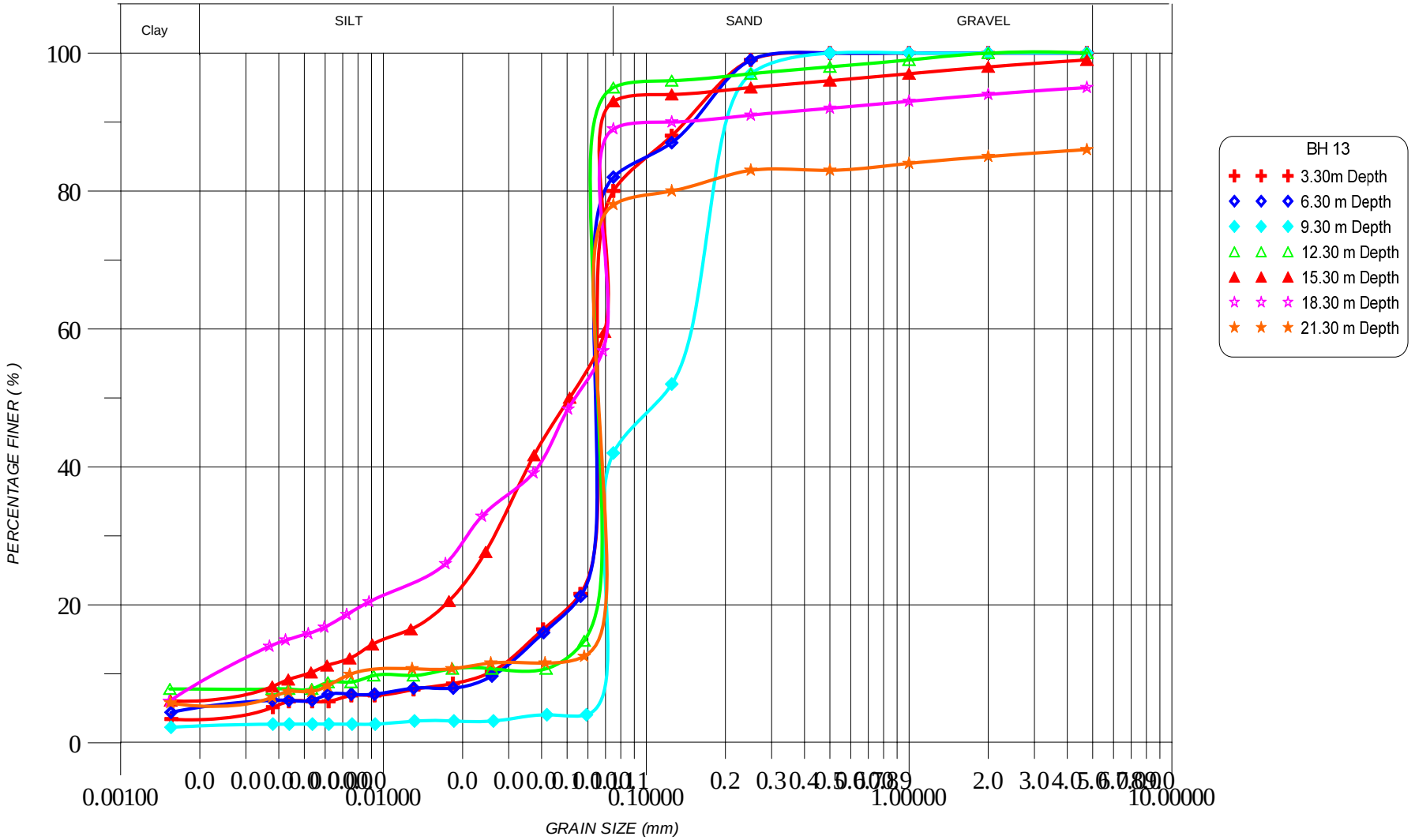
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD 11

GRAIN SIZE DRISTRIBUTION CURVE



GRAIN SIZE DRISTRIBUTION CURVE



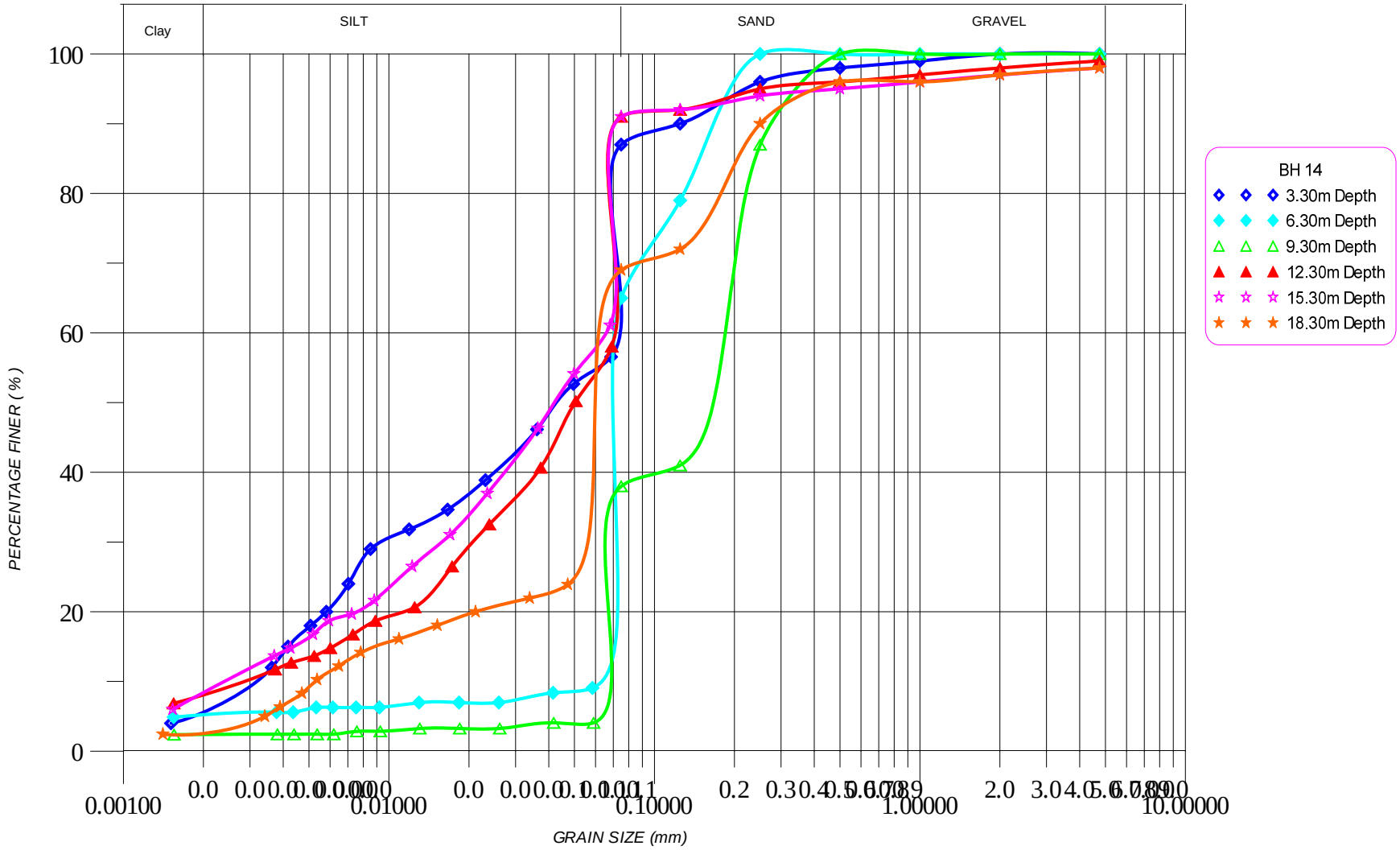
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD-13

SUVIDHI Testing Engineers

Job: 2137

GRAIN SIZE DRISTRIBUTION CURVE



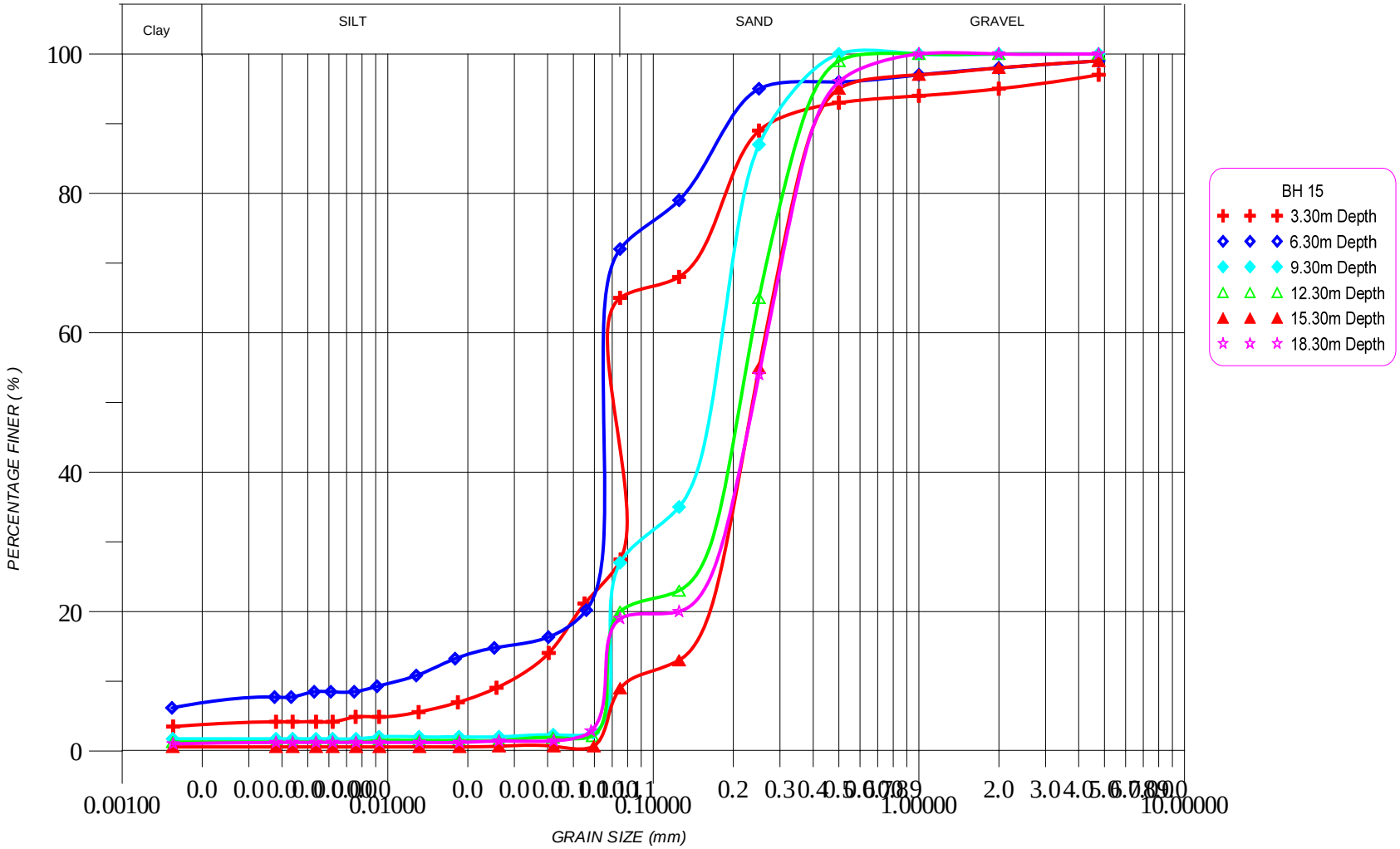
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD-14

SUVIDHI Testing Engineers

Job No 2137

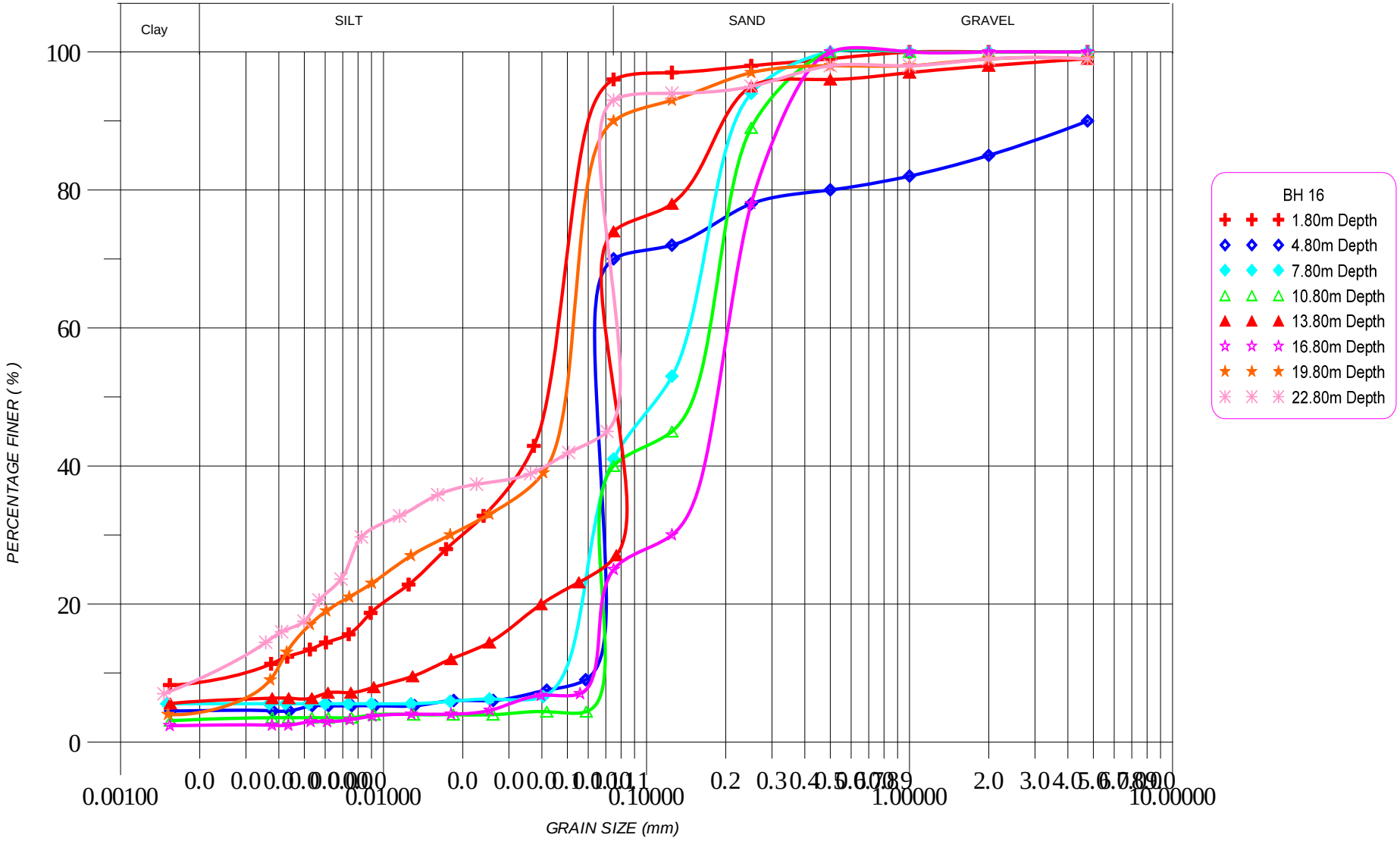
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD 15

GRAIN SIZE DRISTRIBUTION CURVE



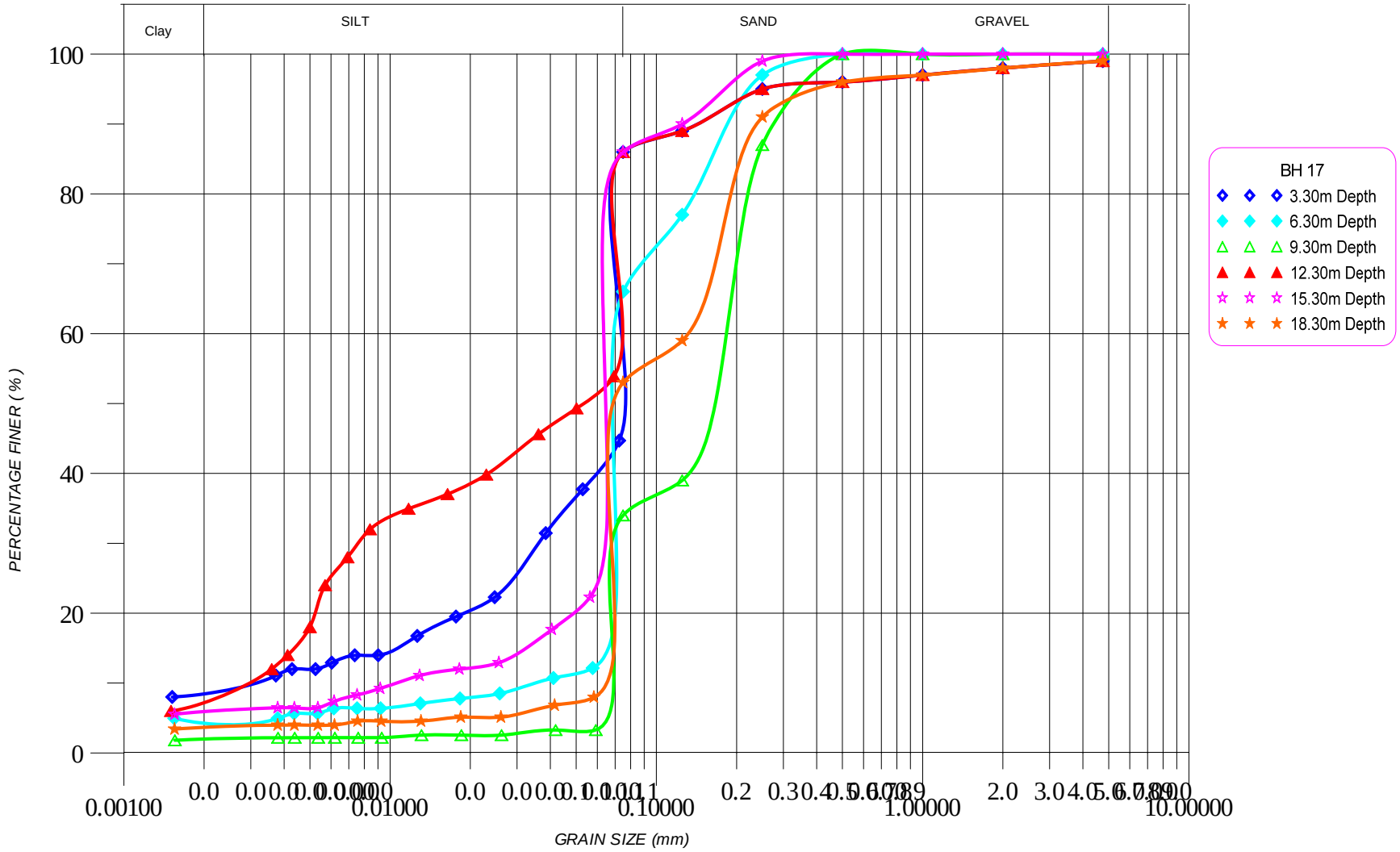
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD 16

SUVIDHI Testing Engineers

Job: 2137

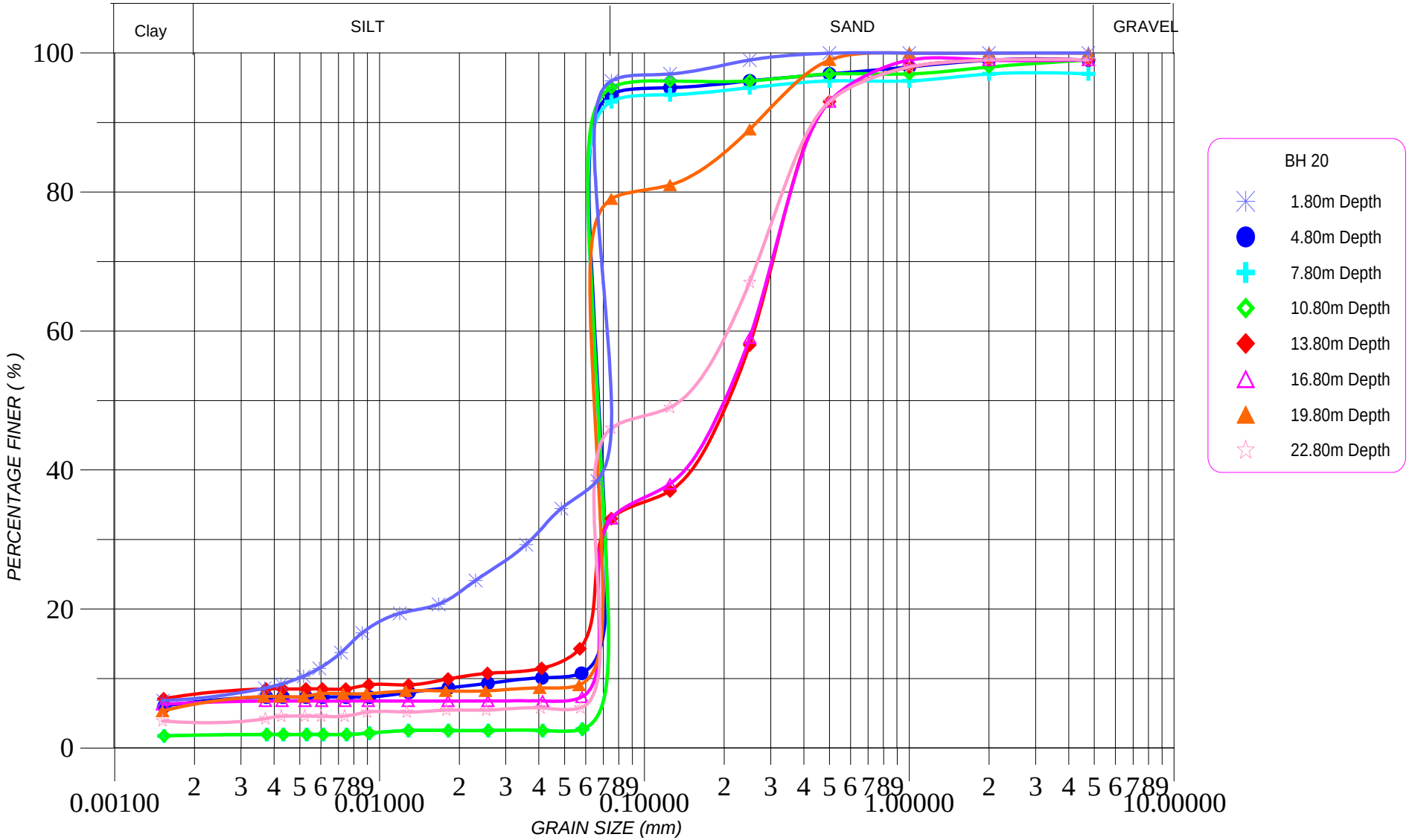
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra.

Fig : GSD-17

GRAIN SIZE DRISTRIBUTION CURVE



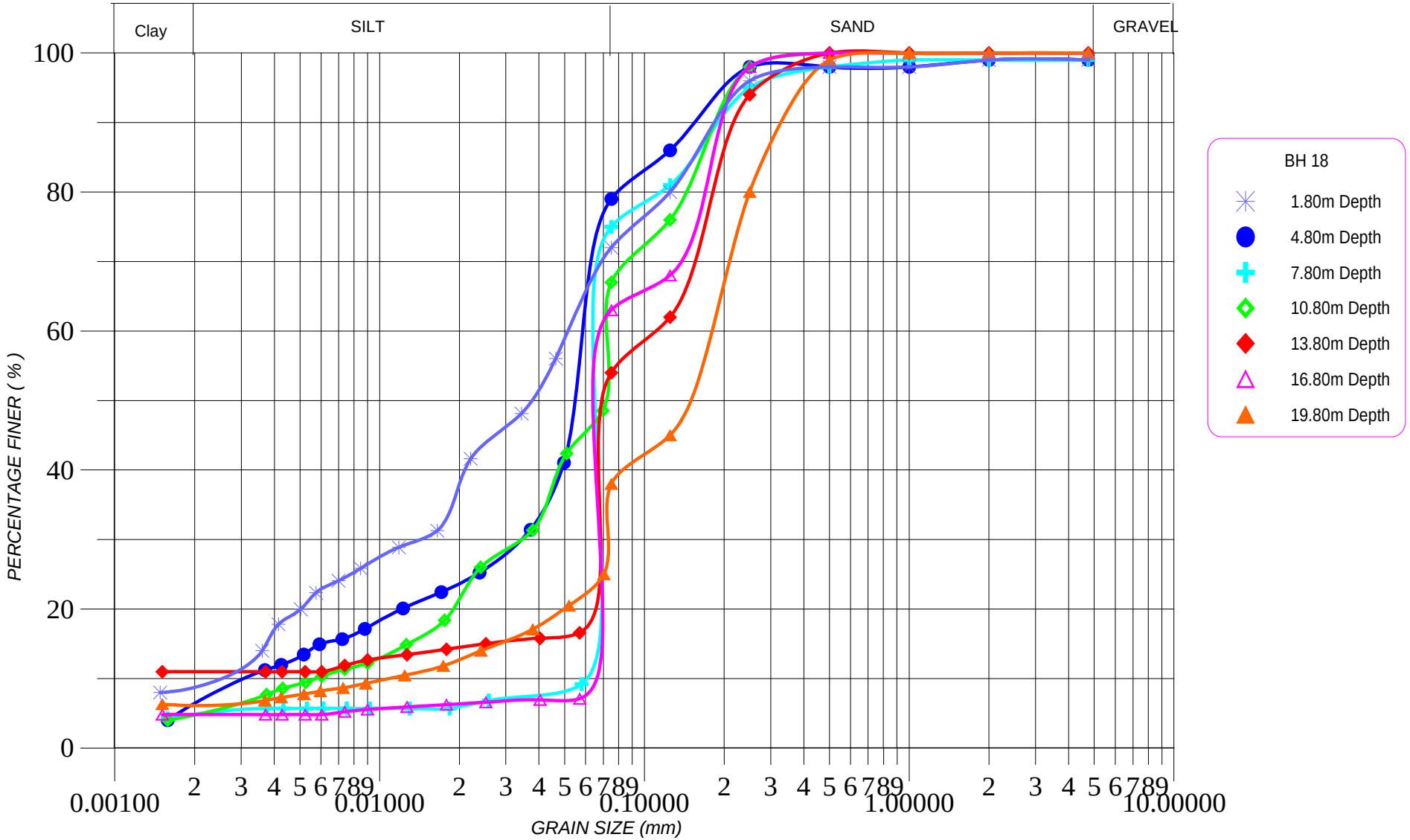
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD-20

SUVIDHI Testing Engineers

Job No 2137

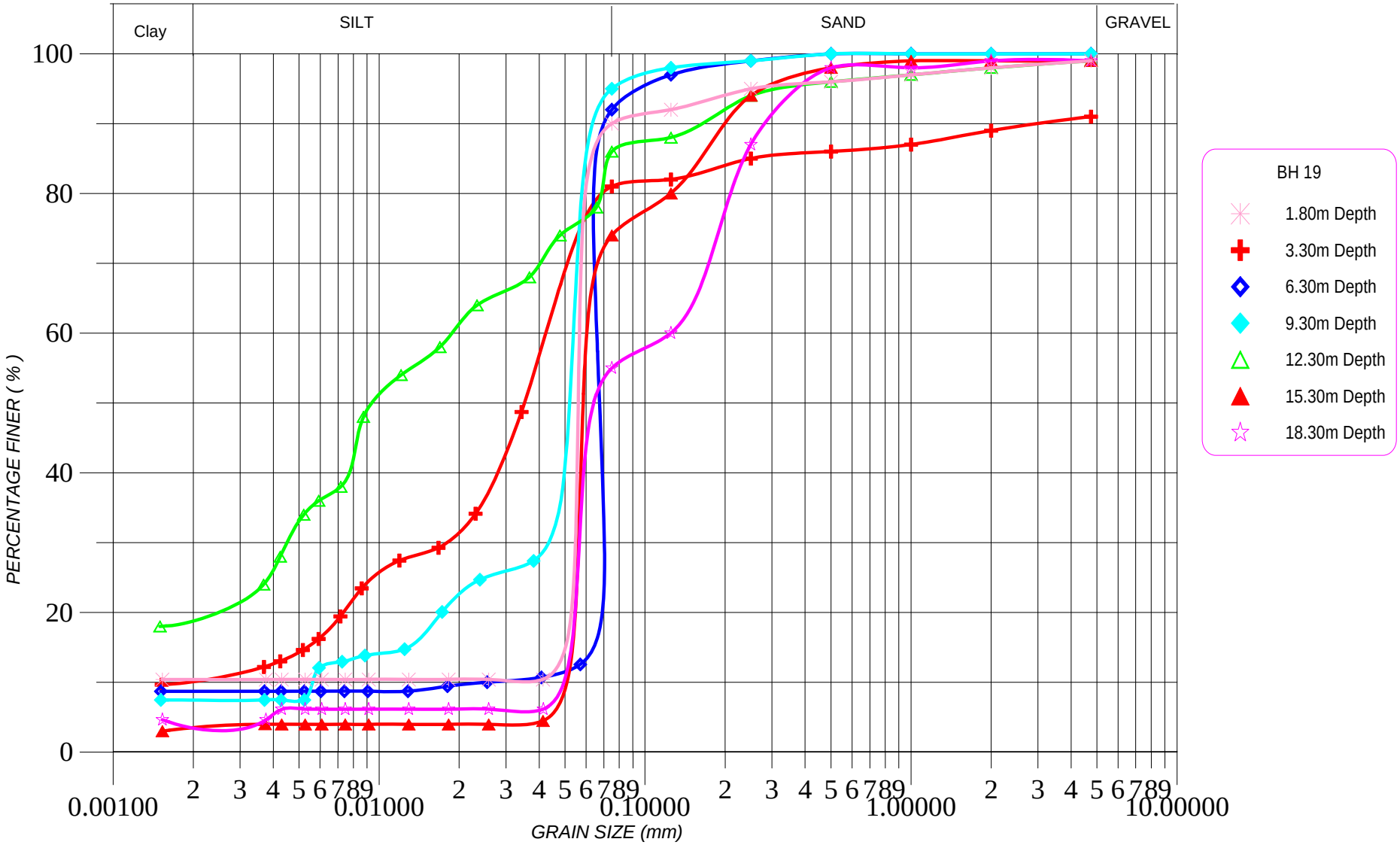
GRAIN SIZE DRISTRIBUTION CURVE



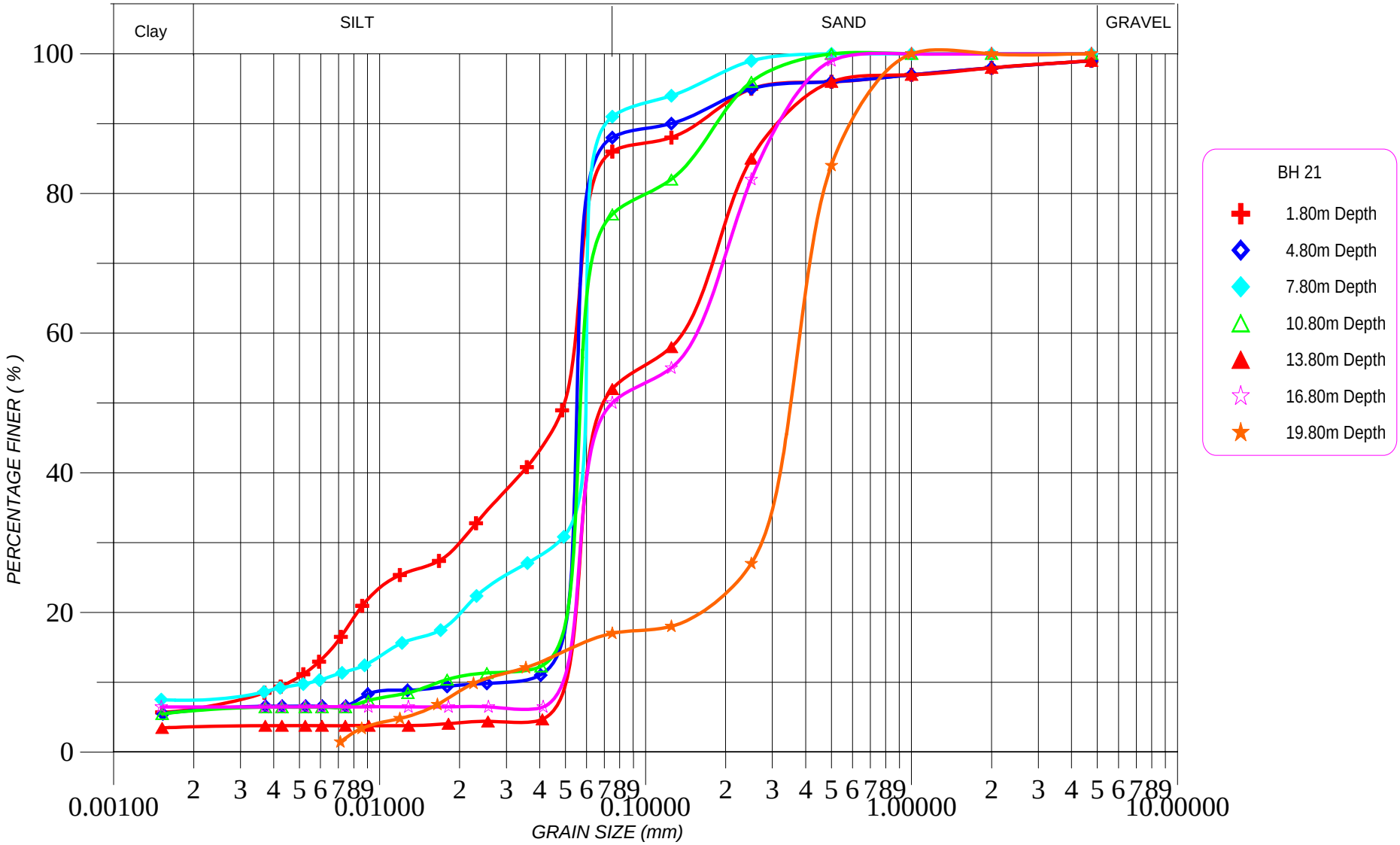
PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD-18

GRAIN SIZE DRISTRIBUTION CURVE



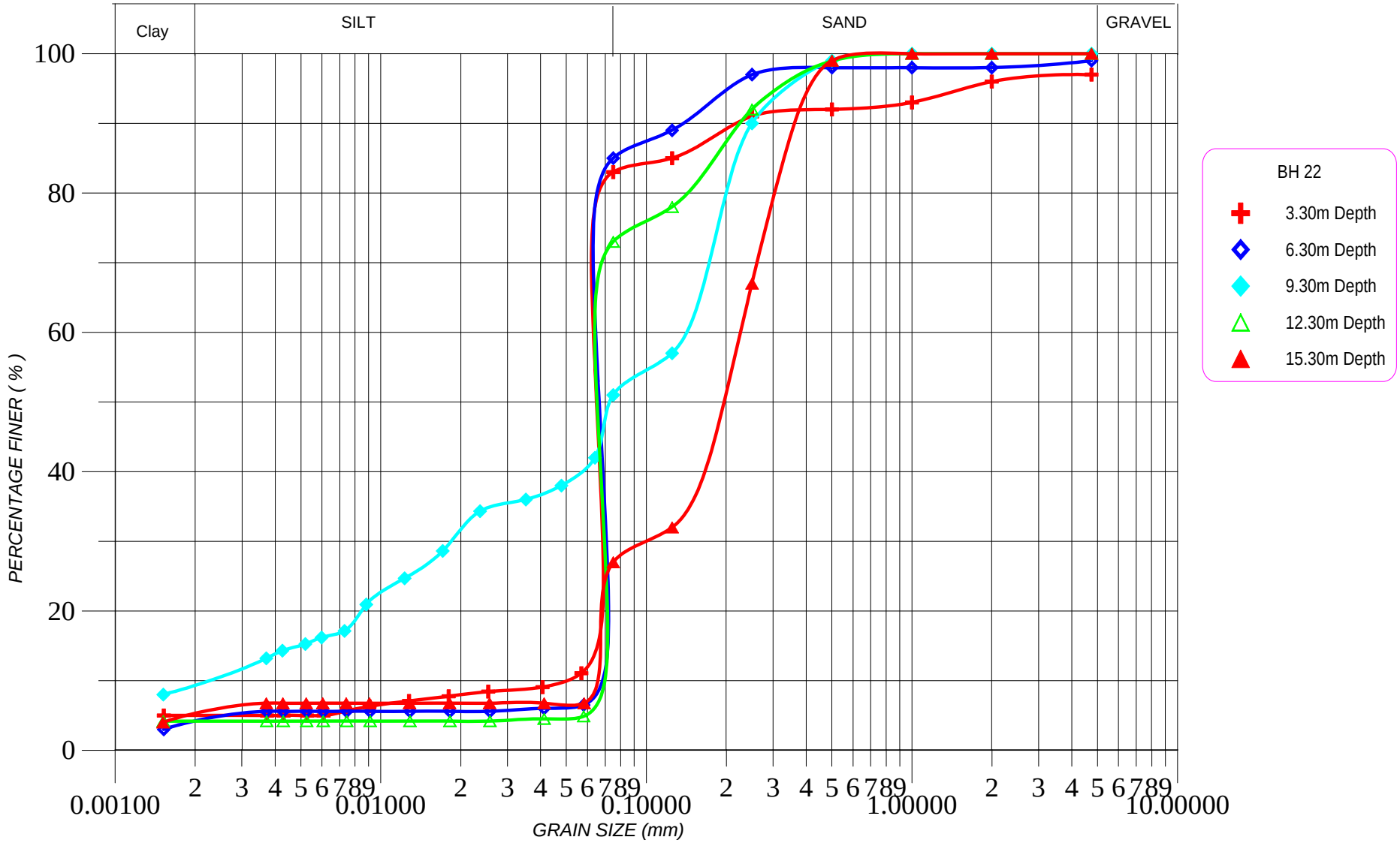
GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed Elevated Railway Track at Kurukshetra

Fig : GSD 21

GRAIN SIZE DRISTRIBUTION CURVE



PROJECT: Geotechnical Investigation work for proposed GPRA Colony at Nauroji Nagar, New Delhi.

Fig : GSD 22