ABOUT THE ORGANISATION

NAME OF FIRM	:	TESTING AND CONSULTANCY CELL, GNDEC, LUDHIANA
ESTABLISHED	:	1979
ADDRESS	:	GURU NANAK DEV ENGINEERING COLLEGE, GILL PARK, GILL ROAD, LUDHIANA
TURN OVER	:	1.35 crore.

Testing & Consultancy Cell was established in the year 1979 with a basic aim to provide quality service for technical problems at reasonable and affordable rates as a service to society in general and Engineering fraternity in particular. It is a pioneer institute providing Consultancy Services in the states of Punjab, Haryana, Himachal, J&K and Rajasthan.

Consultancy Services are being rendered by various Departments of the College to the industry, Sate Government Departments and Entrepreneurs and are extended in the form of expert advice in design, testing of materials & equipment, technical surveys, technical audit, calibration of instruments, preparation of technical feasibility reports etc

This consultancy cell of the college has given a new dimension to the development programmes of the College. Consultancy projects of over Rs. 1.35 crore are completed by the Consultancy cell during financial year.

1.2 Various Major Clients of the Consultancy Cell are as under:-

1. Larson & Tubro
2. Multi National Companies like AFCON & PAULINGS
3. Power Grid Corporation of India
4. National Thermal Power Corporation
5. National Building Construction Co.
6. Northern Railway, Govt. of India
7. Municipal Corporation of Punjab & Chandigarh
8. Military Engineering Services
9. Punjab State Electricity Board
10. Punjab Mandi Board
11. Punjab Police Housing Corporation
12. Punjab Health System Corporation
13. Punjab State PWD (B & R, Public Health and Irrigation
14. Punjab Water Supply & Sewerage Board
15. Punjab State Education Board, Mohali
16. Hindustan Petroleum Corporation Limited
17. National Fertilizers Ltd.
18. PUNSUP
19. Postal & Telecom Department, Govt. of India
20. Sonalika Tractors & Cars Ltd. (Punjab & H.P.)
21. Big Industrial Houses like Hero Cycles, Oswal Woollen Mills, OCM Woollen Mills, Vardhman
knitting Yarn Mills etc.
22. BBMP, Charkhi Dadri (Haryana)

1.3 FACILITIES AVAILABLE

A. GEO-TECHNICAL ENGINEERING

• Bearing Capacity of Soil by

(a) Plate Load test

(b) Standard Penetration test

• Pile Test

• Chemical Analysis of Soil

• Consolidation Test

• Compaction Test

• Field Density Test

• Relative Density Test

• Computerized Triaxial Shear Testing Machine

• Rapid Moisture Meter

• Permeability Test

• Particle Size Analysis

• Consistency Limits

• Liquefaction analysis

• Swell Test

B. TRANSPORTATION ENGINEERING

• CBR Test- Digital Equipment

• Abrasion Value Test

• Crushing Value Test

• Impact Value Test

• Softening Point Test of Bitumen

• Shape Test

• Ductility Test of Bitumen

• Specific Gravity Test

• Penetration No. of Bitumen

• Rougho meter

• Benkleman Beam Apparatus

• Marshall Stability Test

C. MATERIAL TESTING

• Testing of Materials like Cement, Steel, Sand, Aggregates,
Concrete Cubes, Flooring Tiles, Pavers, Bricks, Tiles etc

• Checking Strength of Hardened Concrete by Non-Destructive Test like:

(a). Ultra Sonic Technique

(b). Rebound Hammer Technique

• Chemical Analysis of Cement & Concrete

• Flexural Strength of Concrete Beams

• Timber (Water Content & Flexural Strength)

D. SURVEYING

• Preparation of Contour Maps with the use of Total Station
• Marking of Alignment of Different Structures
• Survey Plan & Leveling
• Preparation of L Section & X-section
• Preparation of Digital Maps

E. ENVIRONMENTAL ENGINEERING

• Analysis of Water Samples for Drinking, Construction & Boiler
• Analysis of Waste Water
• Treatability Studies for Industrial Wastes
• Design & Commissioning of Effluent Treatment Plants
• Preparation of Project Feasibility Reports for ETPs
• Design of Air Pollution Control Devices
• Adequacy reports for Existing/Designed ETPs & APCDs
• Environmental Auditing
• Environmental Impact Assessment

F. ENGINEERING DESIGN

• Structural Design of Reinforced Concrete Structures like
• Industrial Structures, Institutional Building, Other Buildings,
• Residential Buildings, OHSR & Treatment Plants
• Structural Design of Steel Structures
• Structural Design of Masonry Structures
• Mix Design
• Pavement Design

G. OTHER SERVICES

• Estimation & Costing of Project
• Supervision & Quality Control
• Calibration of different Equipments

DETAILS OF TECHNICAL STAFF

GEOTECHNICAL	Dr. J.N. Jha, Ph.D
	Prof. Kulbir singh Gill, M.E.
	Dr. B.S. Walia, Ph.D
	Prof. Harjinder Singh, M.E.
	Prof. Gurdeepak Singh, M.Tech.
STRUCTURE	Dr. Harpal Singh, Ph.D
	Dr. Hardeep Singh Rai, Ph.D
	Dr. Harvinder Singh, Ph.D
	Dr. Jagbir Singh, Ph.D
	Prof. Kanwarjit Singh Bedi, M.Tech.
	Prof. Parshant Garg, M.Tech.
	Prof. Harpreet Kaur, M.Tech.
	Prof. Inderpreet kaur, M.Tech.
HIGHWAY	Prof. Kulbir Singh Gill, M.E.
MATERIAL TESTING	Dr. Jagbir Singh , Ph.D
	Prof. Kanwarjit Singh Bedi, M.Tech.
SURVEY	Dr. B.S. Walia, Ph.D.
CHEMICAL TESTING	Dr. R.P. Singh, Ph.D.
ENVIRONMENT ENGG.	Prof. Puneet Pal Singh Cheema, M.E.

2. PLANNING/METHODOLOGY FOR THE TRAINING

The whole of the work is divided into different categories namely:

1. Testing
2.Surveying
3.Estimation & Costing of a project
4.Structural Designing

The work of above mentioned categories is carried on the rotational basis.

1. TESTING :

It includes different tests such as SPT (Standard Penetration Test) to calculate the safe bearing capacity of the soil, MDD & OMC i.e. Maximum Dry Density & Optimum Moisture Content of a compacted soil sample, Triaxial shear test, C.B.R test , Tests on Highway materials, ultrasonic pulse velocity test, rebound hammer test.

2. SURVEYING:

Surveying includes the preparation of layout plan of Punjab Dyers Association near Central Jail , Ludhiana.

3.ESTIMATION & COSTING:

It includes the detailed estimate of a project i.e. total quantity of cement, sand, aggregates etc. And to prepare its abstract of cost.

4.STRUCTURAL DESIGNING:

It includes the designing of isolated column footings ,calculation of bearing capacity ,and design of OHSR and Septic tank.

3.1 STANDARD PENETRATION TEST

INTRODUCTION:

This test is the most common used in-situ test, especially for cohesion less soils which cannot be easily sampled. The test is extremely useful for determining the relative density and angle of shearing resistance of cohesion less soils. It can also be determine the unconfined compressive strength of cohesive soils.

Apparatus:

- Standard split-spoon sampler

  - It consists of three parts:-

  (a) Driving shoe, made of tool-steel, about 75 mm long

  (b) Steel tube about 450mm long, split longitudinally in two halves having inner dia as 38mm & outer dia as 50mm.

  (c) Coupling at the top of the tube about 150 mm long.

- Drop hammer weighing 63.5kg

Procedure of SPT:

- A bore hole is to be drilled to the desired depth, the drilling tools are removed.
- The split spoon sampler is lowered to the bottom of the hole.
- The sampler is driven in to the soil by a drop hammer of 63.5 kg mass falling through a height of 750 mm at the rate of 30 blows per minute.
- The number of hammer blows required to drive 150 mm of the sampler is counted. The sampler is further driven by 150 mm and the number of blows recorded. Likewise, the sampler is once again further driven by 150 mm and the number of blows recorded.
- The number of blows recorded for the first 150 is disregarded. The numbers of blows for the last two 150 mm interval are added to give the standard penetration number (N).

- Then the sampler is taken out from the hole and split sampler is opened the length of the soil sample is measured and the soil sample is packed in the air tight bag.

- Likewise, another sample of soil is collected at the interval of 1.67 m or where the soil profile or strata changes (IS 6403:1981).

  In other words, the penetration number (N) is equal to the number of blows required for 300 mm of penetration on beyond seating drive of 150mm.

CORRECTIONS:

The standard penetration number is corrected for dilatancy correction and overburden correction as explained below.

1) Dilatancy Correction:

Silt and fine sands below the water table develop pore pressure which is not dissipated. The pore pressure increases the resistance of the soil and hence penetration number (N).

The corrected penetration number, $N_C = 15+0.5(N_R - 15)$

Where N_R is the recorded value and N_C is the corrected value

If $N_R \leq 15$, $N_C = N_R$

2) Overburden Pressure Correction:

In granular soils, the overburden pressure affects the penetration resistance. If the two soils having same relative density but different confining pressure are tested, the one with a higher confining pressure gives a higher penetration number. As the confining pressure in cohesion less soils increases with the depth, the penetration number for soils at shallow depths is underestimated and that at greater depths is overestimated. For uniformity, the N-value obtained from field tests under different effective overburden pressure are corrected to a standard effective overburden pressure.

For $\sigma \geq 24$ KN/m^2

Correlation of N with Engineering Properties:

The value of standard penetration number N depends upon the relative density if the cohesion less soil and then unconfined compressive strength of cohesive soil.

If the soil is stiff or compact, the penetration number is high.

The angle of shearing resistance (Φ) of the cohesion less soil depends upon the number N. In general the greater the N-value, the greater is the angle of shearing resistance.

Projects:

1.1.1. Constuction of factory shed at Mehta Engineers Limited D-118-119,Phase-V,Focal Point , Ludhiana.

1.1.2. Constuction of Building at State Forest Research Institute, Ladowal, Ludhiana.

1.1.3. Construction of Building at Govt. Model Senior Secondry School, PAU, Ludhiana.

1.1.4. Construction of Fisheries at GADVASU, Ludhiana.

1.1.1Construction of Factory Sheds at Mehta Engineers Limited, D-118-119, Phase-V, Focal Point, Ludhiana

Introduction

The soil investigation for the proposed **Construction of Factory Sheds at Mehta Engineers Limited, D-118-119, Phase-V, Focal Point, Ludhiana** had been taken up on request of **M/s Mehta Engineers Limited, D-118-119, Phase-V, Focal Point, Ludhiana.** The field soil investigation as per requirements was carried out on **10.01.2014** by testing team of this institution in the presence of **S. Jaswant Singh** of the concerned department.

The purpose of this soil investigation was to determine the nature of the subsoil stratum and the safe net allowable bearing capacity of the soil.

Field Soil Investigation

Two bore holes were tested in the field Standard Penetration Test (S.P.T) was carried out at the proposed site as per I.S.Code 2131-1981 in the soil deposits at the foundation level and at an interval of 1.5 m or at the location where change of soil strata takes place during field testing. The samples of the soil both disturbed and tube samples were collected at different depths and were properly sealed in air-tight plastic bags after labelling them carefully to maintain the natural moisture content.

Laboratory Testing

The various samples (disturbed and tube) collected during field soil investigation were tested in the laboratory (as per Standard Methods) for finding.

(i) Grain size analysis and wet analysis

(ii) Atterberg's limits

(iii) Field moisture content

(iv) Bulk density

(v) Direct/ triaxial shear/Unconfined compression tests

Safe Bearing Capacity

As per I.S. Code 6403-1981, the least of the following shall be taken as safe net allowable bearing capacity of the soil.

(i) The safe net allowable bearing capacity from shear considerations is obtained dividing net ultimate bearing capacity by a suitable factor of safety.

(ii) The safe net allowable bearing pressure that can be imposed on the base of the foundation without the settlement exceeding a permissible value is calculated either from settlement analysis or from the Standard Penetration Test Values(N)whichever is applicable depending upon the nature of sub soil strata.

Water Table

The underground (i.e. sub-soil) water was not encountered at the time of field soil investigation.

Proposed Substructure

The substructures i.e. foundations of the proposed Factory Sheds may be taken as wall footing and isolated column foundation. The least soil properties have been taken for calculating the bearing capacity of soil for the following types of foundations.

(i) Wall Foundation

Depth of wall foundation, $D_f = 2.5$ m

Width of wall foundation, B = 1.0 m

(ii) Column Foundation

Depth of column foundation, D_f = 2.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The data obtained from the field soil investigation and the laboratory tests have been used in the preparation of this report.

Bearing Capacity Calculations

(A) Bearing Capacity Based on Shear Considerations

(As per I.S.Code - 6403:1981)

(i) Wall Foundation

Depth of wall foundation, D_f = 2.5 m

Width of wall foundation, B = 1.0 m

The least soil properties at the foundation level i.e. at 2.5 m depth are:

γ = 17.1 kN/m^3, c = 2.0 kN/m^2 $\phi = 28^0$, $\phi' = 19.50^0$

Bearing Capacity factors are:

Nc' = 14.40, Nq' = 6.15 and Nγ ' = 5.10

Shape factors are:

Sc = 1.0 Sq = 1.0 Sγ = 1.0

Depth factors are:

dc = 1.71 , dq = dγ = 1.35

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x2.0 x14.40 x1.0 x1.71 +17.1 x2.5 x5.1x1x1.35+0.5 x17.1 x1.0 x5.10 x1.0 x1.35 x1.0

= 32.47 +298.10 +59.04 = 389.61 kN/m^2

Safe net allowable bearing capacity = q_u'/2.5 = 389.61/2.5 = <u>155.84</u> kN/m^2 . ..... (a)

(ii) Column Foundation

Depth of column foundation, D_f = 2.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The least soil properties at the foundation level i.e. at 2.5 m depth are:

γ = 17.1 kN/m^3, c = 2.0 kN/m^2

ϕ = 28^0 , ϕ' = 19.50^0

Bearing Capacity factors are:

Nc' = 14.40, Nq' = 6.15 and Nγ ' = 5.10

Shape factors are:

Sc = 1.3 Sq = 1.2 Sγ = 0.8

Depth factors are:

dc = 1.35 , dq = dγ = 1.18

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x2.0 x14.40 x1.3 x1.35 +17.1 x2.5 x5.15 x1.2 x1.18

+0.5 x17.1 x2.0 x5.10 x0.8 x1.18 x1.0

= 33.46 +310.96 +82.12 = 426.54 kN/m^2

Safe net allowable bearing capacity = q_u'/2.5 = 426.54/2.5 = <u>170.61 kN/m^2</u> .....(b)

(B) Bearing Capacity Based on Standard Penetration Test Value

(As per I.S. Code -6403: 1981)

S.No.	Depth (m)	Overburden pressure (kN/m^2)	Correction factor	Observed value of N	Corrected value of N
1	2.5	42.75	1.27	06	07.62
2	3.0	51.30	1.21	06	07.25
3	4.5	76.95	1.07	10	10.73
4	6.0	102.60	0.98	12	11.72
5	7.5	128.25	0.90	14	12.63
6	9.0	153.90	0.84	16	13.46

i) Depth of wall foundation, D_f = 2.5 m

Width of wall foundation, B = 1.0 m

Safe net allowable bearing pressure for

B = 1.0 m, N = 8.53 , S = 0.04 m & w' = 1.0] = <u>129.53 kN/m^2</u> .....(a)

Taking least of A & B the safe net allowable bearing capacity = <u>129.53 kN/m^2</u>

The safe gross allowable bearing capacity = 172.28 kN/m^2

ii) Depth of column foundation, D_f = 2.5 m

Width of column foundation, B = 2.0 m

Safe net allowable bearing pressure for

B = 2.0 m, N = 9.33, S = 0.04 m & w' = 1.0] = 115.97 kN/m^2 .....(b)

Taking least of A and B the safe net allowable bearing capacity = 115.97 kN/m^2

The safe gross allowable bearing capacity = 158.72 kN/m^2

Remarks:

(i) The bore hole logs showing the nature of subsoil stratum alongwith standard penetration test values(N) at different depths and soil properties from laboratory test results are attached.

(ii) The safe **net** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 2.5 m from the existing surface is 129.53 kN/m^2

(iii) The safe **gross** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 2.5 m from the existing surface is 172.28 kN/m^2

(iv) The safe **net** allowable bearing capacity for column foundation of size 2.0 x2.0 m at a depth of 2.5 m from the existing surface is 115.97 kN/m^2

(v) The safe **gross** allowable bearing capacity for column foundation of size 2.0 m x2.0 m at a depth of 2.5 m from the existing surface is 158.72 kN/m^2(vi) The sub-soil water was not encountered at the time of field soil investigation.

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

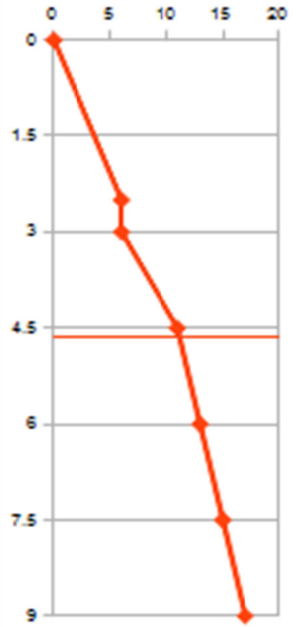
Testing & Consultancy Cell

Project - **Construction of Factory Sheds at Mehta Engineers Limited, D-118-119, Phase-V, Focal Point, Ldh.**
Bore Hole Log. II
Type of Boring:- **Manual**

Date of Commencement:- **10.01.2014**
Date of Completion:- **15.01.2014**
Ground Water:- **Not encountered**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution % Grav.	% Sand	% Silt	% Clay	C (kN/m²)	Ø	'N' Value
2.1	Filling												
2.5	Silty sand (SM) with Occasional kanker		-	-	17.2	6.2	09	55	36	-	2.1	28°	06
2.75													
3.0	Sandy silt (MS)		-	-	17.3	6.6	-	45	55	-	4.0	27°	06
3.3													
4.5	Sand (SP)		-	-	17.6	7.2	-	78	22	-	1.0	31°	11
6.0													13
7.5													15
9.0													17

Graphical Representation of 'N'



1.1.2Construction of Building at State Forest Research Institute, Ladowal, Ludhiana

Introduction

The soil investigation for the proposed Construction of Building at State Forest Research Institute, Ladowal, Ludhiana had been taken up on request of Sub Divisional Engineer, Constr. Sub Division No.3, PWD B & R Br., Ludhiana. The field soil investigation as per requirements was carried out on 11.02.2014 by testing team of this institution in the presence of S. Kamaljit Singh, SDO, S. Gurminder Singh, JE & S. Harinder Singh, JE of the concerned department.

The purpose of this soil investigation was to determine the nature of the subsoil stratum and the safe net allowable bearing capacity of the soil.

Field Soil Investigation

Four bore holes were tested in the field Standard Penetration Test (S.P.T) was carried out at the proposed site as per I.S.Code 2131-1981 in the soil deposits at the foundation level and at an interval of 1.5 m or at the location where change of soil strata takes place during field testing. The samples of the soil both disturbed and tube samples were collected at different depths and were properly sealed in air-tight plastic bags after labelling them carefully to maintain the natural moisture content.

Laboratory Testing

The various samples (disturbed and tube) collected during field soil investigation were tested in the laboratory (as per Standard Methods) for finding.

(i) Grain size analysis and wet analysis

(ii) Atterberg's limits

(iii) Field moisture content

(iv) Bulk density

(v) Direct/ triaxial shear/Unconfined compression tests

Safe Bearing Capacity

As per I.S. Code 6403-1981, the least of the following shall be taken as safe net allowable bearing capacity of the soil.

(i) The safe net allowable bearing capacity from shear considerations is obtained by dividing net ultimate bearing capacity by a suitable factor of safety.

(ii) The safe net allowable bearing pressure that can be imposed on the base of the foundation without the settlement exceeding a permissible value is calculated either from settlement analysis or from the Standard Penetration Test Values(N)whichever is applicable depending upon the nature of sub soil strata.

Water Table

The underground (i.e. sub-soil) water was encountered at a depth 4.5 m at the time of field soil investigation.

Proposed Substructure

The substructures i.e. foundations of the proposed Building may be taken as wall footing and isolated column foundation. The least soil properties have been taken for calculating the bearing capacity of soil for the following types of foundations.

(i) Wall Foundation

Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

ii) Column Foundation

Depth of column foundation, D_f = 1.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The data obtained from the field soil investigation and the laboratory tests have been used in the preparation of this report.

Bearing Capacity Calculations

(A) Bearing Capacity Based on Shear Considerations

(As per I.S.Code - 6403:1981)

(i) Wall Foundation

Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

The least soil properties at the foundation level i.e. at 1.0 m depth are:

γ = 17.00 kN/m^3, c = 0.0 kN/m^2

$\phi = 30^0$, $\phi' = 21.10^0$

Bearing Capacity factors are:

Nc' = 16.10, Nq' = 7.34 and Nγ ' = 6.60

Shape factors are:

Sc = 1.0 Sq = 1.0 Sγ = 1.0

Depth factors are:

dc = 1.29 , dq = dγ = 1.15

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x0.0 x16.10 x1.0 x1.29 +17.00 x1.0 x6.34 x1.0 x1.15

+0.5 x17.00 x1.0 x6.60 x1.0 x1.15 x1.0

= 123.50 +64.28 = 187.79 kN/m^2

Safe net allowable bearing capacity = q_u'/2.5 = 187.79/2.5 = 75.12 kN/m^2

(ii) Column Foundation

Depth of column foundation, D_f = 1.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The least soil properties at the foundation level i.e. at 1.5 m depth are:

γ = 17.00 kN/m^3, c = 0.0 kN/m^2 ϕ = 30^0 , ϕ' = 21.10^0

Bearing Capacity factors are:

Nc' = 16.10, Nq' = 7.34 and Nγ ' = 6.60

Shape factors are:

Sc = 1.3 Sq = 1.2 Sγ = 0.8

Depth factors are:

dc = 1.22 , dq = dγ = 1.11

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x0.0 x16.10 x1.3 x1.22 +17.00 x1.5 x6.34

x1.2 x1.11

+0.5 x17.00 x2.0 x6.60 x0.8 x1.11 x1.0

= 215.23 +99.58 = 314.81 kN/m^2

Safe net allowable bearing capacity = q_u'/2.5 = 314.81/2.5 = <u>125.93 kN/m^2</u>

(B) Bearing Capacity Based on Standard Penetration Test Value

(As per I.S. Code -6403: 1981)

S.No.	Depth (m)	Overburden pressure (kN/m^2)	Correction factor	Observed value of N	Corrected value of N
1	1.0	17.0	1.58	03	04.73
2	1.5	25.5	1.44	03	04.33
3	3.0	51.0	1.21	03	03.63
4	4.5	76.5	1.08	06	06.45
5	6.0	102.0	0.98	07	06.85
6	7.5	127.5	0.90	06	05.43
7	9.0	153.0	0.84	07	05.90

i) Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

Safe net allowable bearing pressure for

B = 1.0 m, N = 4.79 , S = 0.04 m & w' = 1.0] = 41.81 kN/m^2 .....(a)

Taking least of A & B the safe net allowable bearing capacity = 41.81 kN/m^2

The safe gross allowable bearing capacity = 58.81 kN/m^2

ii) Depth of column foundation, D_f = 1.5 m

Width of column foundation, B = 2.0 m

Safe net allowable bearing pressure for

B = 2.0 m, N = 5.32, S = 0.05 m & w' = 1.0] = 53.01 kN/m^2

Taking least of A and B the safe net allowable bearing capacity = 53.01 kN/m^2

The safe gross allowable bearing capacity = 78.51 kN/m^2

Remarks:

(i) The bore hole logs showing the nature of subsoil stratum alongwith standard penetration test values(N) at different depths and soil properties from laboratory test results are attached.

(ii) The safe **net** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 1.0 m from the existing surface is 41.81 kN/m^2

(iii) The safe **gross** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 1.0 m from the existing surface is 58.81 kN/m^2

(iv) The safe **net** allowable bearing capacity for column foundation of size 2.0 x2.0 m at a depth of 1.5 m from the existing surface is 53.01 kN/m^2

(v) The safe **gross** allowable bearing capacity for column foundation of size 2.0 m x2.0 m at a depth of 1.5 m from the existing surface is 78.51 kN/m^2

(vi) The sub-soil water was encountered at a depth 4.5 m at the time of field soil investigation.

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

Testing & Consultancy Cell

Project- **Construction of Building at State Forset Research Institute, Ladowal, Ludhiana**

Bore Hole Log. I

Type of Boring:- **Manual**

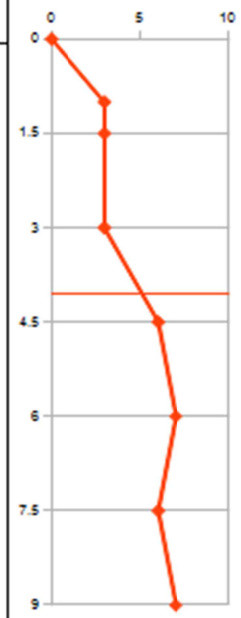
Date of Commencement:- **11.02.2014**

Date of Completion:- **18.02.2014**

Ground Water:- **4.5 m**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution				C (kN/m²)	Ø	'N' Value
							% Grav.	% Sand	% Silt	% Clay			
0.6	Silty sand (SM)		-	-	16.8	7.0	-	59	41	-	3.0	26°	
1.0	Sand (SP)		-	-	17.0	8.0	-	78	22	-	0.0	30°	03
1.5													03
3.0													03
4.5													06
6.0													07
7.5													06
9.0													07

Graphical Representation of 'N'



GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

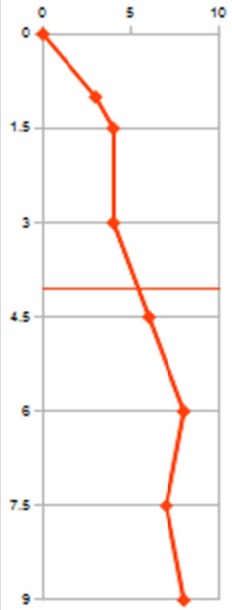
Testing & Consultancy Cell

Project- **Construction of Building at State Forset Research Institute, Ladowal, Ludhiana**
Bore Hole Log. II
Type of Boring- **Manual**

Date of Commencement:- **11.02.2014**
Date of Completion :- **18.02.2014**
Ground Water:- **4.5 m**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution % Grav.	% Sand	% Silt	% Clay	C (kN/m²)	Ø	'N' Value
0.6	Silty sand (SM)		-	-	17.0	7.3	-	61	29	-	3.0	27°	
1.0	Sand (SP)		-	-	17.3	8.2	-	79	21	-	0.0	30°	03
1.5													04
3.0													04
4.5													06
6.0													08
7.5													07
9.0													08

Graphical Representation of 'N'



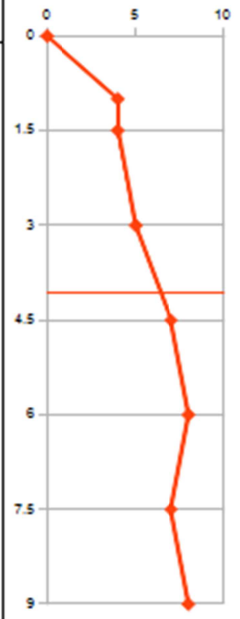
GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

Testing & Consultancy Cell

Project- **Construction of Building at State Forset Research Institute, Ladoval, Ludhiana**
Bore Hole Log. **III**
Type of Boring - **Manual**

Date of Commencement:- **11.02.2014**
Date of Completion :- **18.02.2014**
Ground Water:- **4.5 m**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution				C (kN/m²)	Ø	'N' Value	Graphical Representation of 'N'
							% Grav.	% Sand	% Silt	% Clay				
0.6	Silty sand (SM)		-	-	16.9	7.1	-	62	28	-	3.0	27°		
1.0	Sand (SP)		-	-	17.4	8.3	-	80	20	-	0.0	31°	04	
1.5													04	
3.0													05	
4.5													07	
6.0													08	
7.5													07	
9.0													08	



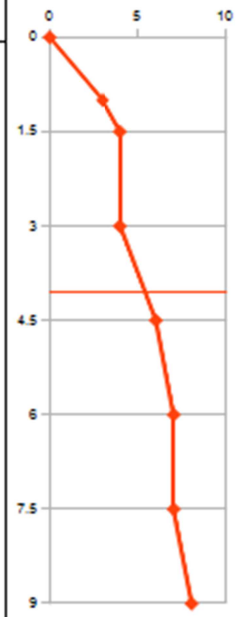
GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

Testing & Consultancy Cell

Project- **Construction of Building at State Forset Research Institute, Ladowal, Ludhiana**
Bore Hole Log. **IV**
Type of Boring.- **Manual**

Date of Commencement:- **11.02.2014**
Date of Completion:- **18.02.2014**
Ground Water:- **4.5 m**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution % Grav.	% Sand	% Silt	% Clay	C (kN/m²)	Ø	'N' Value	Graphical Representation of 'N'
0.6	Silty sand (SM)		-	-	16.9	7.2	-	63	27	-	3.2	26°		
1.0	Sand (SP)		-	-	17.3	8.3	-	81	19	-	0.0	31°	03	
1.5													04	
3.0													04	
4.5													06	
6.0													07	
7.5													07	
9.0													08	



1.1.3Construction of Building at Govt. Model Senior Secondary School, PAU, Ludhiana

Introduction

The soil investigation for the proposed **Construction of Building at Govt. Model Senior Secondary School, PAU, Ludhiana** had been taken up on request of **Executive Engineer, Provl. Division PWD B & R Br., Ludhiana.** The field soil investigation as per requirements was carried out on **04.03.2014** by testing team of this institution in the presence of **Sh. Naresh Lal, JE** of the concerned department.

The purpose of this soil investigation was to determine the nature of the subsoil stratum and the safe net allowable bearing capacity of the soil.

Field Soil Investigation

Three bore holes were tested in the field Standard Penetration Test (S.P.T) was carried out at the proposed site as per I.S.Code 2131-1981 in the soil deposits at the foundation level and at an interval of 1.5 m or at the location where change of soil strata takes place during field testing. The samples of the soil both disturbed and tube samples were collected at different depths and were properly sealed in air-tight plastic bags after labelling them carefully to maintain the natural moisture content.

Laboratory Testing

The various samples (disturbed and tube) collected during field soil investigation were tested in the laboratory (as per Standard Methods) for finding.

(i) Grain size analysis and wet analysis

(ii) Atterberg's limits

(iii) Field moisture content

(iv) Bulk density

(v) Direct/ triaxial shear/Unconfined compression tests

Safe Bearing Capacity

As per I.S. Code 6403-1981, the least of the following shall be taken as safe net allowable bearing capacity of the soil.

(i) The safe net allowable bearing capacity from shear considerations is obtained by dividing net ultimate bearing capacity by a suitable factor of safety.

(ii) The safe net allowable bearing pressure that can be imposed on the base of the foundation without the settlement exceeding a permissible value is calculated either from settlement analysis or from the Standard Penetration Test Values(N)whichever is applicable depending upon the nature of sub soil strata.

Water Table

The underground (i.e. sub-soil) water was not encountered at the time of field soil investigation.

Proposed Substructure

The substructures i.e. foundations of the proposed Building may be taken as wall footing and isolated column foundation. The least soil properties have been taken for calculating the bearing capacity of soil for the following types of foundations.

(i) Wall Foundation

Depth of wall foundation, $D_f = 1.0$ m

Width of wall foundation, B = 1.0 m

(ii) Column Foundation

Depth of column foundation, D_f = 1.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The data obtained from the field soil investigation and the laboratory tests have been used in the preparation of this report.

Bearing Capacity Calculations

(A) Bearing Capacity Based on Shear Considerations

(As per I.S.Code - 6403:1981)

(i) Wall Foundation

Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

The least soil properties at the foundation level i.e. at 1.0 m depth are:

γ = 16.8 kN/m^3, c = 6.0 kN/m^2

$\phi = 24^0$, $\phi' = 16.60^0$

Bearing Capacity factors are:

Nc' = 12.31, Nq' = 4.73 and Nγ ' = 3.53

Shape factors are:

Sc = 1.0 Sq = 1.0 Sγ = 1.0

Depth factors are:

dc = 1.27 , dq = dγ = 1.13

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x6.0 x12.31 x1.0 x1.27 +16.8 x1.0 x3.73 x1.0 x1.13

+0.5 x16.8 x1.0 x3.53 x1.0 x1.13 x1.0

= 61.84 +71.08 +33.63 = 166.55 kN/m^2

Safe net allowable bearing capacity = q_u'/2.5 = 166.55/2.5 = 66.62 kN/m^2 . ..... (a)

(ii) Column Foundation

Depth of column foundation, D_f = 1.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The least soil properties at the foundation level i.e. at 1.5 m depth are:

γ = 16.8 kN/m^3, c = 6.0 kN/m^2

ϕ = 24^0 , ϕ' = 16.60^0

Bearing Capacity factors are:

Nc' = 12.31, Nq' = 4.73 and Nγ ' = 3.53

Shape factors are:

Sc = 1.3 Sq = 1.2 Sγ = 0.8

Depth factors are:

dc = 1.20 , dq = dγ = 1.10

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x6.0 x12.31 x1.3 x1.20 +16.8 x1.5 x3.73 x1.2 x1.10

+0.5 x16.8 x2.0 x3.53 x0.8 x1.10 x1.0

= 76.13 +124.15 +52.22 = 252.51 kN/m^2

Safe net allowable bearing capacity = q_u'/2.5 = 252.51/2.5 = <u>101.0 kN/m^2</u> .....(b)

(B) Bearing Capacity Based on Standard Penetration Test Value

(As per I.S. Code -6403: 1981)

S.No.	Depth (m)	Overburden pressure (kN/m^2)	Correction factor	Observed value of N	Corrected value of N
1	1.0	16.8	1.58	04	06.33
2	1.5	25.2	1.45	09	13.02
3	3.0	50.4	1.21	12	14.58
4	4.5	75.6	1.08	14	15.11
5	6.0	100.8	0.98	16	15.73
6	7.5	126.0	0.91	20	18.16
7	9.0	151.2	0.85	20	16.95

i) Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

Safe net allowable bearing pressure for

B = 1.0 m, N = 12.26 , S = 0.04 m & w' = 1.0] = 216.68 kN/m^2 .....(a)

Taking least of A & B the safe net allowable bearing capacity = 66.62 kN/m^2

The safe gross allowable bearing capacity = 83.42 kN/m^2

ii) Depth of column foundation, D_f = 1.5 m

Width of column foundation, B = 2.0 m

Safe net allowable bearing pressure for

B = 2.0 m, N = 14.61, S = 0.04 m & w' = 1.0] = 212.59 kN/m^2 .....(b)

Taking least of A and B the safe net allowable bearing capacity = 101.00 kN/m^2

The safe gross allowable bearing capacity = 126.20 kN/m^2

Remarks:

(i) The bore hole logs showing the nature of subsoil stratum alongwith standard penetration test values(N) at different depths and soil properties from laboratory test results are attached.

(ii) The safe **net** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 1.0 m from the existing surface is 66.62 kN/m^2

(iii) The safe **gross** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 1.0 m from the existing surface is 83.42 kN/m^2

(iv) The safe **net** allowable bearing capacity for column foundation of size 2.0 x2.0 m at a depth of 1.5 m from the existing surface is 101.00 kN/m^2

(v) The safe **gross** allowable bearing capacity for column foundation of size 2.0 m x2.0 m at a depth of 1.5 m from the existing surface is 126.20 kN/m^2

(vi) The sub-soil water was not encountered at the time of field soil investigation.

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

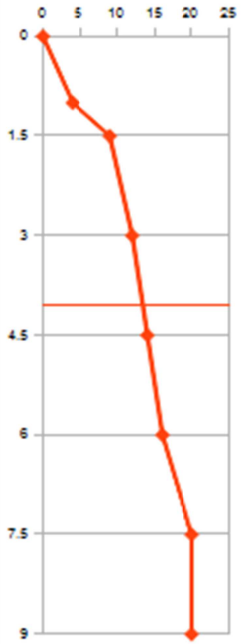
Testing & Consultancy Cell

Project- **Construction of Building at Govt. Model Senior Secondary School, PAU, Ludhiana**
Bore Hole Log. I
Type of Boring:- **Manual**

Date of Commencement:- **04.03.2014**
Date of Completion:- **07.03.2014**
Ground Water:- **Not encountered**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution % Grav.	% Sand	% Silt	% Clay	C (kN/m²)	Ø	'N' Value
0.9	Silt (ML)		20	02	16.7	6.0	-	16	81	03	7.0	24°	
1.0	Silt (ML) with Occasional Kanker		19	02	16.8	6.0	08	09	80	03	6.0	24°	04
1.5	Silty sand (SM)		-	-	17.1	6.5	-	55	45	-	2.0	28°	09
2.1	Sand (SP)		-	-	17.4	7.0	-	74	26	-	1.0	30°	
3.0													12
4.5													14
6.0													16
7.5													20
9.0													20

Graphical Representation of 'N'



GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

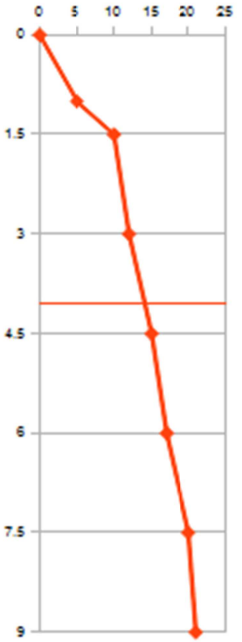
Testing & Consultancy Cell

Project- **Construction of Building at Govt. Model Senior Secondary School, PAU, Ludhiana**
Bore Hole Log. **II**
Type of Boring:- **Manual**

Date of Commencement:- **04.03.2014**
Date of Completion:- **07.03.2014**
Ground Water:- **Not encountered**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution % Grav.	% Sand	% Silt	% Clay	C (kN/m²)	Ø	'N' Value
0.9	Silt (ML)		21	02	16.7	6.0	-	18	79	03	7.0	24°	
1.0	Silt (ML) with Occasional Kanker		20	02	16.9	6.1	07	11	80	02	6.2	24°	05
1.5	Silty sand (SM)		-	-	17.3	6.7	-	58	42	-	2.3	29°	10
2.1	Sand (SP)		-	-	17.5	7.2	-	75	25	-	1.0	31°	
3.0													12
4.5													15
6.0													17
7.5													20
9.0													21

Graphical Representation of 'N'



GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

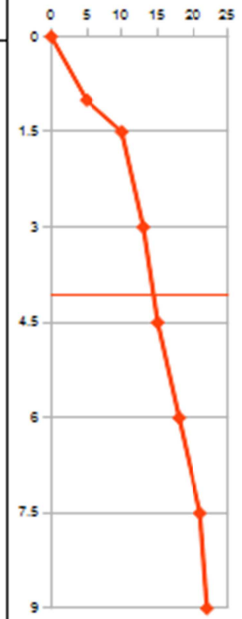
Testing & Consultancy Cell

Project- **Construction of Building at Govt. Model Senior Secondary School, PAU, Ludhiana**
Bore Hole Log. **III**
Type of Boring - **Manual**

Date of Commencement:- **04.03.2014**
Date of Completion:- **07.03.2014**
Ground Water:- **Not encountered**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution % Grav.	% Sand	% Silt	% Clay	C (kN/m²)	Ø	'N' Value
0.9	Silt (ML)		21	02	16.6	6.1	-	20	77	03	7.1	24°	
1.0	Silt (ML) with Occasional Kanker		20	03	17.0	6.2	06	13	79	02	6.1	25°	05
1.5	Silty sand (SM)		-	-	17.2	6.6	-	60	40	-	2.5	29°	10
2.1	Sand (SP)		-	-	17.6	7.3	-	76	24	-	1.0	31°	
3.0													13
4.5													15
6.0													18
7.5													21
9.0													22

Graphical Representation of 'N'



1.1.4Construction of Fisheries at GADVASU, Ludhiana

Introduction

The soil investigation for the proposed **Construction of Fisheries at GADVASU, Ludhiana** had been taken up on request of **Sub Divisional Engineer, Provincial Sub Division No.3, PWD B & R Br., Ludhiana.** The field soil investigation as per requirements was carried out on **12.05.2014** by testing team of this institution in the presence of **S. Daljit Singh, SDO** of the concerned department.

The purpose of this soil investigation was to determine the nature of the subsoil stratum and the safe net allowable bearing capacity of the soil.

Field Soil Investigation

One bore holes were tested in the field Standard Penetration Test (S.P.T) was carried out at the proposed site as per I.S.Code 2131-1981 in the soil deposits at the foundation level and at an interval of 1.5 m or at the location where change of soil strata takes place during field testing. The samples of the soil both disturbed and tube samples were collected at different depths and were properly sealed in air-tight plastic bags after labelling them carefully to maintain the natural moisture content.

Laboratory Testing

The various samples (disturbed and tube) collected during field soil investigation were tested in the laboratory (as per Standard Methods) for finding.

(i) Grain size analysis and wet analysis

(ii) Atterberg's limits

(iii) Field moisture content

(iv) Bulk density

(v) Direct/ triaxial shear/Unconfined compression tests

Safe Bearing Capacity

As per I.S. Code 6403-1981, the least of the following shall be taken as safe net allowable bearing capacity of the soil.

(i) The safe net allowable bearing capacity from shear considerations is obtained by dividing net ultimate bearing capacity by a suitable factor of safety.

(ii) The safe net allowable bearing pressure that can be imposed on the base of the foundation without the settlement exceeding a permissible value is calculated either from settlement analysis or from the Standard Penetration Test Values(N)whichever is applicable depending upon the nature of sub soil strata.

Water Table

The underground (i.e. sub-soil) water was not encountered at the time of field soil investigation.

Proposed Substructure

The substructures i.e. foundations of the proposed Building may be taken as wall footing and isolated column foundation. The least soil properties have been taken for calculating the bearing capacity of soil for the following types of foundations.

(i) Wall Foundation

Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

(ii) Column Foundation

Depth of column foundation, D_f = 1.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The data obtained from the field soil investigation and the laboratory tests have been used in the preparation of this report.

Bearing Capacity Calculations

(A) Bearing Capacity Based on Shear Considerations

(As per I.S.Code - 6403:1981)

(i) Wall Foundation

Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

The least soil properties at the foundation level i.e. at 1.0 m depth are:

γ = 15.98 kN/m^3, c = 0.0 kN/m^2

$\phi = 30^0$, $\phi' = 21.10^0$

Bearing Capacity factors are:

Nc' = 16.10, Nq' = 7.34 and Nγ ' = 6.60

Shape factors are:

Sc = 1.0 Sq = 1.0 Sγ = 1.0

Depth factors are:

dc = 1.34 , dq = dγ = 1.17

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x0.0 x16.10 x1.0 x1.34 +15.98 x1.0 x6.34 x1.0 x1.17

+0.5 x15.98 x1.0 x6.60 x1.0 x1.17 x1.0

= 118.53 +61.69 = 180.22 kN/m^2

Safe net allowable bearing capacity = $q_u'/2.5$ = 180.22/2.5 = <u>72.09</u> kN/m^2 . ..... (a)

(ii) Column Foundation

Depth of column foundation, D_f = 1.5 m

Size of column foundation = 2.0 m x2.0 m

Length of column foundation , L = 2.0 m

Width of column foundation, B = 2.0 m

The least soil properties at the foundation level i.e. at 1.5 m depth are:

γ = 15.98 kN/m^3, c = 0.0 kN/m^2

$\phi = 30^0$, $\phi' = 21.10^0$

Bearing Capacity factors are:

Nc' = 16.10, Nq' = 7.34 and Nγ ' = 6.60

Shape factors are:

Sc = 1.3 Sq = 1.2 Sγ = 0.8

Depth factors are:

dc = 1.25 , dq = dγ = 1.12

Water table correction factor, w' = 1.0

Ultimate net bearing capacity, q_u' = 0.67 x0.0 x16.10 x1.3 x1.25 +15.98 x1.5 x6.34 x1.2 x1.12

+0.5 x15.98 x2.0 x6.60 x0.8 x1.12 x1.0

= 204.24 +94.49 = 298.73 kN/m^2

Safe net allowable bearing capacity = q_u'/2.5 = 298.73/2.5 = <u>119.49 kN/m^2</u> .....(b)

(B) Bearing Capacity Based on Standard Penetration Test Value

(As per I.S. Code -6403: 1981)

S.No.	Depth (m)	Overburden pressure (kN/m^2)	Correction factor	Observed value of N	Corrected value of N
1	1.0	15	1.60	03	04.80
2	1.5	23	1.45	04	05.80
3	3.0	47	1.21	06	07.26
4	4.5	71	1.10	08	08.80
5	6.0	96	1.01	10	10.10
6	7.5	121	0.95	12	11.40
7	9.0	146	0.88	14	12.32

i) Depth of wall foundation, D_f = 1.0 m

Width of wall foundation, B = 1.0 m

Safe net allowable bearing pressure for

B = 1.0 m, N = 5.95 , S = 0.04 m & w' = 1.0] = 69.03 kN/m^2 .....(a)

Taking least of A & B the safe net allowable bearing capacity = 69.03 kN/m^2

The safe gross allowable bearing capacity = 84.03 kN/m^2

ii) Depth of column foundation, D_f = 1.5 m

Width of column foundation, B = 2.0 m

Safe net allowable bearing pressure for

B = 2.0 m, N = 7.99, S = 0.04 m & w' = 1.0] = 91.31 kN/m^2 .....(b)

Taking least of A and B the safe net allowable bearing capacity = 91.31 kN/m^2

The safe gross allowable bearing capacity = 114.31 kN/m^2

Remarks:

(i) The bore hole logs showing the nature of subsoil stratum alongwith standard penetration test values(N) at different depths and soil properties from laboratory test results are attached.

(ii) The safe **net** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 1.0 m from the existing surface is 69.03 kN/m^2

(iii) The safe **gross** allowable bearing capacity for wall foundation 1.0 m wide at a depth of 1.0 m from the existing surface is 84.03 kN/m^2

(iv) The safe **net** allowable bearing capacity for column foundation of size 2.0 x2.0 m at a depth of 1.5 m from the existing surface is 91.31 kN/m^2

(v) The safe **gross** allowable bearing capacity for column foundation of size 2.0 m x2.0 m at a depth of 1.5 m from the existing surface is 114.31 kN/m^2

(vi) The sub-soil water was not encountered at the time of field soil investigation.

GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

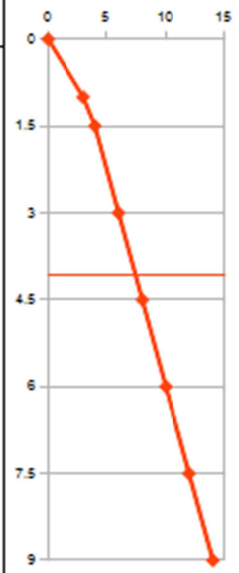
Testing & Consultancy Cell

Project- **Construction of Fisheries at GADVASU, Ludhiana.**
Bore Hole Log. I
Type of Boring- **Manual**

Date of Commencement:- **12.05.2014**
Date of Completion :- **19.05.2014**
Ground Water:- **Not encountered**

Depth (m) B.L.	Type of Soil	Bore Hole Log	L.L. %	P.I. %	Bulk Density (kN/m³)	W %	Grain Size Distribution % Grav.	% Sand	% Silt	% Clay	C (kN/m²)	Ø	'N' Value
1.0	Sand (SP)		-	-	15.64	2.39	-	73	27	-	2.0	26°	03
1.5	Sand (SP)		-	-	15.98	3.92	-	88	12	-	-	30°	04
3.0													06
4.5	Sand (SP)		-	-	16.49	6.19	-	90	10	-	-	31°	08
6.0													10
7.5													12
9.0													14

Graphical Representation of 'N'



Material Testing

The testing of material of hostel construction was performed. It includes:

1) Tensile testing of steel.
2) Compressive strength of concrete.

Tensile Test report of steel

The pieces of steel bars are taken and the marking is done on them on the spacing of five times the diameter of the bar. They are then tested for the tensile strength in Universal testing machine. The ultimate load and the value of elongation are noted down.

Sr. No.	Φ(mm)	%elongation	Load(ton)	Ultimate Stress(N/mm²)	Proof Stress(N/mm²)
1	8	0.25	3.8	757.5	756
2	10	0.24	5.3	676.3	675
3	12	0.233	8	708.5	707
4	16	0.225	15	747.5	746
5	20	0.24	19.5	622.2	621
6	20	0.21	19	606.2	605
7	25	0.208	34	694.4	693

Compressive Strength test of concrete cubes

The blocks are filled with concrete and they are left undisturbed for 24 hours and after that time they are opened and are placed in water for curing. The tests are generally performed after 3, 7&28 days from the day of casting.

Sr. No.	Date of testing	Load (KN)	Strength(N/mm²)	Remarks
1	25-01-2014	221	9.82	3 Days
2	03-02-2014	273	12.13	7 Days
3	13-02-2014	192.8	8.57	3 Days
4	05-03-2014	257	11.42	7 Days
5	06-05-2014	227	10.08	3 Days

4.SURVEYING

Introduction

Surveying is the art of determining the relative position of points on, above or beneath the surface
of the earth by means of direct or indirect measurements of distance, direction and elevation.

Instrument Used-TOTAL STATION

The survey of the field is very easy job as the manual calculations are almost negligible. The accuracy of the work is better with the total station as compared to the ordinary thedolite. To make
the layout plan and the contour map of the field is very simple and fast job with total station. The
survey of any place is done with Total Station.

The basic principles of surveying

• Location of a point by measurement from two points of reference.
• Working from whole to part.

Temporary Adjustments of Total Station

• Setting up the instrument.
• Levelling up.
• Elimination of the parallax.

Permanent Adjustments of Total Station

• The axis of the plate level must lie in a plane perpendicular to the vertical axis.
• The line of collimation must be perpendicular to the horizontal axis at its intersection with the
vertical axis.
• The horizontal axis must be perpendicular to the vertical axis.
• The axis of altitude level must be parallel to the line of collimation.

working Steps for Total Station

• First of all the instrument is set on the tripod and all the initial adjustments are performed like

centering, leveling, focusing as performed on the ordinary thedolite.

• After these adjustments, the initial coordinates are filled in the instruments like East (X), North

(Y), Z, height of target, height of instrument.

• The instrument is oriented along north direction and the horizontal angle is set as zero so to have

the horizontal angle w.r.t North.

• Then the target is set at the desired position and the instrument is transit towards the target and

the target is bisected.

• Then the button OBS (observation) is pressed and then the E, N, Z, Horizontal angle, vertical

angle are displayed on the screen of the instrument which can be recorded in the memory of the

instrument and the stored data can be extracted by connecting it to the computer through the

software of the instrument.

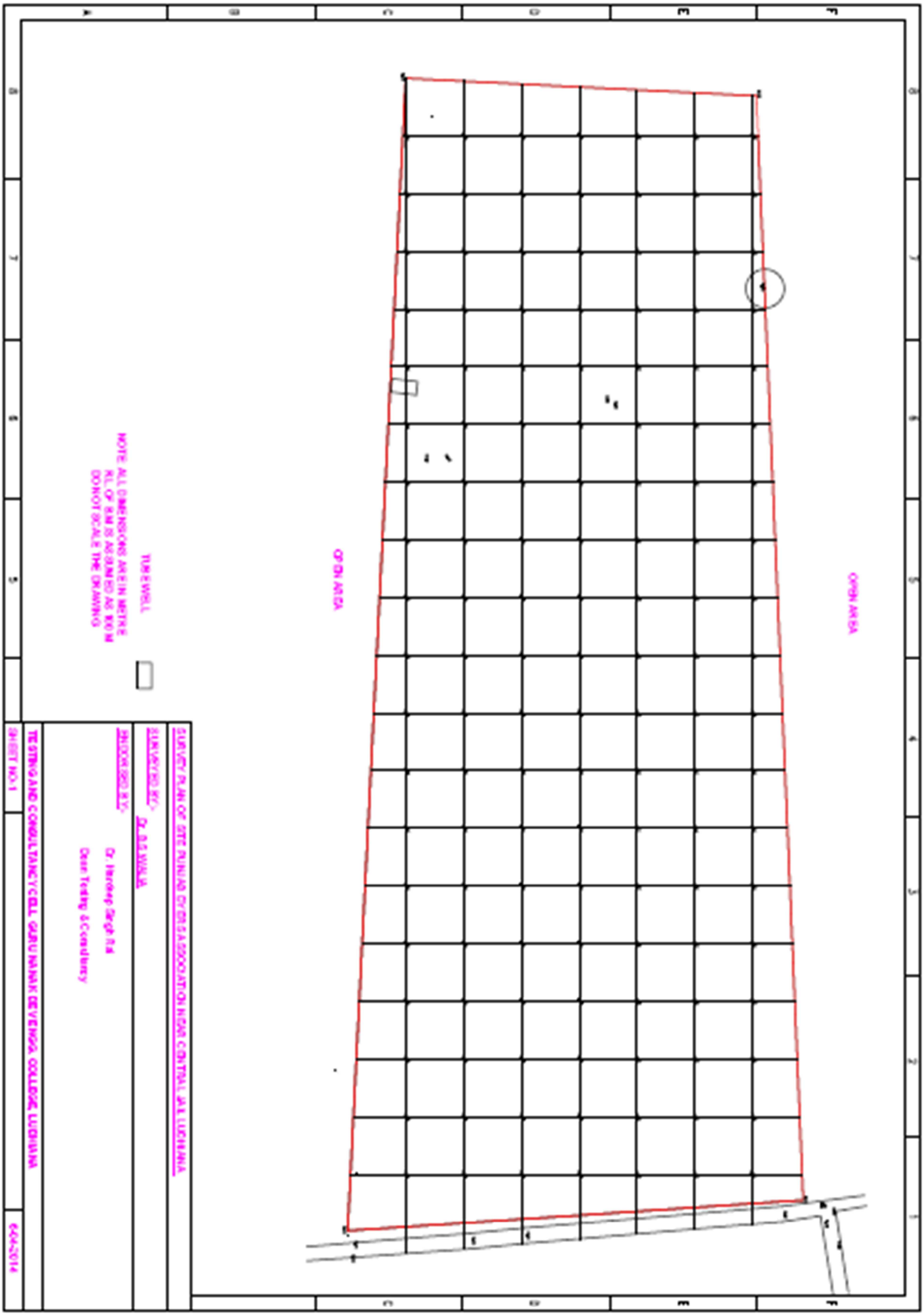
• Then with the data the plotting of the layout plan can be done with the any CAD software and the

contour map can be plotted with Grass/GIS.

4.1 Detail of Project*:*

4.1.1 Construction of building near central jail, Ludhiana.

Layout of building near central jail, Ludhiana is attached here:


TUBEWELL
NOTE: ALL DIMENSIONS ARE IN METRE
R.L. OF B.M IS ASSUMED AS 100 M
DO NOT SCALE THE DRAWING
OPEN AREA
OPEN AREA
SURVEY PLAN OF SITE PUNJAB CYCLISTS ASSOCIATION NEAR CENTRAL JAIL LUDHIANA
SURVEYED BY:- Dr. B.S. WALIA
ENDORSED BY:- Dr. Hardeep Singh Rai
Dean Testing & Consultancy
TESTING AND CONSULTANCY CELL, GURU NANAK DEV ENGG. COLLEGE, LUDHIANA
SHEET NO.1
6-04-2014

5. ESTIMATION & COSTING

5.1 Introduction

• For all engineering works it is required to know beforehand the cost of construction known as the
estimated cost.

• In preparing an estimate, the quantities of different items of work are calculated by simple mensuration method and from these quantities the cost is calculated.

• The rates in estimate should consist of the cost of materials, cost of transport, labour cost, cost of
scaffolding, taxes, supervision charges, etc.

5.2 ESTIMATION & COSTING PROJECTS:-

GNPS School, Birmi for tender evaluate:

	A	B	C	D	E	F	G	H	I	J	K
1	**ESTIMATION OF CONCRETE AND STEEL AT GNPS-BIRMI**										
2			***Column***								
3	Description	Area(ft^2)	No. of colum	Length(ft)	Volume of concre	Dia. 1(mm)	No.	L11 (ft)	L1(ft)	Dia. 2(mm)	no.
4	C-12	4	2	12	96	16	4	12	96	20	8
5	C-13	4	2	12	96	16	4	12	96	20	8
6	C-9	1.5	2	12	36	16	8	12	192		
7	C-8	1.5	1	12	18	16	8	12	96		
8	C-41	1.31	4	12	63	16	8	12	384		
9	C-23	3	10	12	360	16	12	12	1440		
10	C-28	1.5	11	12	198	16	6	12	792	20	4
11	C-33	1.5	11	12	198	16	8	12	1056		
12	C-40	1.5	16	12	288	16	8	12	1536		
13	C-30	1.5	2	12	36	16	10	12	240		
14	C-31	1.13	2	12	27	16	8	12	192		
15	C-26	1.13	4	12	54	16	8	12	384		
16	C-23(a)	3	2	12	72	16	12	12	288		
17	C-30(a)	3	1	12	36	16	20	12	240		
18	C-27	2	1	12	24	16	10	12	120		
19				Total volume	1602	Ft^3	Total length of	16 dia bars	7152	Ft	Total length of
20					45.37	m^3			2180.49	m	

TOTAL QUANTITY OF CONCRETE AND STEEL REQUIRED FOR COLUMN

Including overlap

Description	Length (ft)	Length (m)	Weight(Kg/m	Total Weight(kg)
20 Dia bars	1003.2	305.85	2.47	755.46
16 Dia bars	8224.8	2507.56	1.58	3961.95
8 Dia bars	12293	3747.87	0.42	1574.10

Description	Volume of Concrete	
Column	45.37	m^3

	A	B	C	D	E	F	G
1			**SLAB**				
2					Steel		
3				Main Steel		Distribution Steel	
4				Dia (12 mm)	Dia (10 mm)	Dia (10 mm)	Dia (8 mm)
5	Type of Slab	Volume(L x W x H)					
6	S_1	2087.32		14096			10552.5
7	S_1	714.65			3731		2172
8	S_1	321.98		1990.8			1240
9	S_1	219.35		857.85			792
10	S_1	222.49		857.85			792
11	S_2	308.71		2748.35		1138.5	
12	S_1	154.44		819			500
13	S_1	252.89		1352.4			1474
14	S_1	60.16		409.5			250
15	Total Volume (ft^3)	4342.00	Total length (ft) =	23131.75	3731	1138.5	17772.5
16	Total Volume (m^3)	122.97	Total length (in m)	7052.36	1137.5	347.10	5418.45

TOTAL QUANTITY OF CONCRETE AND STEEL REQUIRED FOR SLAB

Including lap

Description	Length (ft)	Length (m)	Weight(Kg/m	Total Weight	Total Weight(t)
12 Dia bars	23131.75	7052.36	0.888	6262.50	6.262
10 Dia bars	5599.93	1707.29	0.617	1053.40	1.053
8 Dia bars	20438.375	6231.21	0.42	2617.11	2.617

Description	Volume of Concrete	
Column	122.97	m^3

	A	B	C	D	E	F	G	H	I	J	K
1	**Beams**										
2											
3	Description	size	Length	Volume of concrete(ft^3)		Dia. 20 mm	No.	L11 (ft)	L1(ft)	Dia. 16 mm	no.
4	B1	1	12	12		20	3	12	36	16	2
5	B2	1	13.75	13.75		20	3	13.75	41.25	16	5
6	B3		8.6								
7	B5	1	12.5	12.5		20	5	12.5	62.5	16	3
8	B6	1.18725	39.86	47.323785		20	8	39.86	318.88		
9	B7	1	10.5	10.5		20	3	10.5	31.5	16	2
10	B9	1.5	153.51	230.265		20		12.5	12.5	16	2
11	B10	1.5	29.5	44.25		20	3	36	108	16	2
12	B11	1.5	17.25	25.875		20	3	23.75	71.25	16	2
13	B12	1.5	19.35	29.025		20	6	49.35	296.1		
14	B13	0.20825	126.85	26.4							
15	B14	1.5	18	27		20	8	18	144		
16	B15	2.25	256.5	577.1		20	2	261.25	522.5	16	2
17	B16	0.28125	15.5	4.36							
18	B19	0.20825	16.55	3.4465							
19	B20	0.20825	16.55	3.44654							
20	B21	1.125	3.5	3.9375		20	3	3.5	10.5	16	2
21	B22	1.125	28.4	31.95		20	3	28.4	85.2	16	2
22	B23	0.20825	270.5	56.331625							
23	B25	1.16375	28.5	33.166875						16	3
24	B26	1.16375	28.5	33.166875						16	3
25	B27	1.125	15.5	17.4375		20	3	22	66	16	2
26	B28	1.16375	39	45.38625						16	3
27	B29	1.125	15.5	17.4375		20	3	22	66	16	2
28	B30	1.125	19.5	21.9375						16	3
29	B34	1.5	28.4	42.6		20	3	28.4	85.2	16	2
30	B52	1.125	212	238.5						16	5

TOTAL QUANTITY OF CONCRETE AND
STEEL REQUIRED FOR BEAM

Including extra and lap

Description	Length (ft)	Length (m)	Weight(Kg/m	Total Weight	Total Weight(t)
25 Dia bars	1444.5	440.41	3.86	1700.0	1.700
20 Dia bars	3667.91	1118.27	2.47	2762.1	2.762
16 Dia bars	4086.0	1245.73	1.58	1968.2	1.968
12 Dia bars	3343	1019.12	0.888	905.0	0.905
10 Dia bars		0	0.617		
8 Dia bars	4166.7	1270.3	0.42	533.5	0.534

Description	Volume of Co	ncrete
Total volume	74.3	m^3

Structural designing:

Projects:

6.1 Design of Intz tank having capacity of 9lac litres.

6.2 Design of Rectangular OHSR having capacity of 35000 litres for fish farm, Hoshiarpur.

sDESIGN OF OHSR 35000 LITRES CAPACITY F.S.L(22M) ,HOSHIARPUR

GIVEN DATA

fck=25 N/mm^2,fy=415 N/mm^2,бcbc=fck/3=8.5N/mm^2

m=280/(3* бcbc)=280/(3*8.5)=10.9

k=m* бcbc/(m* бcbc+бst)=10.9*8.5/(10.9*8.5+150)=0.383

j=1-k/3=1-0.383/3=0.872

Q=0.5* бcbc*j*k=0.5*10*0.872*0.383=1.623 N/mm^2

бcc=8 N/mm^2,бct=1.5 N/mm2,бcbc=10 N/mm^2,бcbt=2 N/m

Height of tank wall in vertical(H)=1.97m

Freeboard(f)=0.6m

DESIGN OF VERTICAL WALL(M25, 120MM THICK AT TOP)

Height of water level in vertical wall=1.97-0.6=1.37m

Height under cantilever action=1m

Height under hoop tension =1.37-1=0.37m

Hoop pressure acting on walls(p)=10*(1.37-1)=3.7 KN/m^2

Cantilever moment in long wall=4.28 KNm

Fixed end moments in short wall=9.7*(3.048)^2/12=7.50KNm

Eff. Depth reqd for balanced section=(M/Q/b)^0.5=160mm

(d)p=160mm

Overall thickness of wall (D)p=200mm

Eff clear cover=200-160=40mm

T_L=10*(1.97-1)*3.048/2=14.63 KN

T_s=10(1.917-1)=9.7 KN

IN LONG WALL(M25, 120MM THICK AT TOP)

Cantilever moment=4.29KNm

Ast required=4.28*10^6/150/0.85/140=239 mm^2

Ast for direct tension=14.63*1000/150=97.4 mm^2

Ast min.=0.3% of 1000*200=600mm^2

Provide 10φ@100mm c/c

IN SHORT WALL(M25, 120MM THICK AT TOP)

At corner

Design moment at corner of short wall=M-T_Bx

=7.63-9.7*7.5/1000=7.96 KNm

Ast at corner=7.96*10^6/150/0.85/140=445.8.7 mm^2

Ast for direct tension=9.7*1000/150=64.66mm^2

Total Ast=445.7+64.66=509.7 mm^2

Ast min.=0.3% of 1000*200=600mm^2

Provide 10φ@100mm c/c

At middle

B.M=10*(3.048)^2/16=5.66 KNm

Design Moment=5.66-9.7*7.5/1000=5.54 KNm

Since B.M is very small, therefore provide minimum steel

Ast =0.3 % of bD=0.3/100*1000*200=600mm^2

Provide 10φ@100mm c/c at outer face of short wall

REINFORCEMENT IN VERTICAL DIRECTION

For cantilever action, cantilever moment=(10*1^3)/6=1.66 KNm

Ast =1.66*10^6/150/0.85/140=92.6 mm^2

Provide minimum reinforcement

Provide 10φ@125 mm c/c @ both the faces as vertical steel

DESIGN OF BOTTOM SLAB(M25, 170MM THICK)

Ly/Lx=3.048/(6.096/2)=1.0

Let the thickness of slab be 170 mm

Wt of vertical wall =101.43

Wt of water in vertical wall=10*6.096*3.048*1.37=254.55 KN

Self wt of bottom slab=25*.160*6.31*3.048=77.5 KN

Total w= 432.89KN

Wt / m^2(wu)=816.75/6.096/3.048=23.3KN/m^2

-ɑx=0.058

+ɑx=0.045

+ɑy=0.043

-Mx=23.3*2.91^2*0.058=11.44 KNm

+Mx=23.3*2.91^2*0.045=8.878 KNm

+My=23.3*2.91^2*0.043=8.48 KNm

d=(11.48*10^6/1.623/1000)^0.5=84mm

(d)p=160 mm

(D)p=200 mm

Reinforcement along short span at edge strip

Ast=11.44*10^6/150/0.85/160=560 mm^2

Provide 12φ@170mm c/c upto 0.3m at edge strip of short wall on upper face

sReinforcement along short span in middle

Ast=8.482*10^6/150/0.85/160=443 mm^2

Provide 12φ@200mm c/c from each 0.3m at middle of short wall on lower face

Reinforcement along long span in middle

Ast=16.64*10^6/150/0.9/120=1027.3 mm^2

Provide 12φ@100mm c/c from each 0.3m at middle of long wall on lower face

Reinforcement along long span at edge strip

Ast=0.24% of bD=0.24/100*210*1000=384 mm^2

Provide 10φ@150mm c/c upto 0.3m at edge strip of long wall on upper face

Torsion reinforcement at discontinuous edges

M=11.45*3/4=8.84KNm

Ast=3/4*560.3=420mm^2

Provide 12φ@125mm c/c as top and bottom reinforcement upto 0.5m x 0.5m area of slab at discontinuous edges and 12φ@250mm c/c as top and bottom reinforcement upto 0.5m x 0.5m area of the slab.

DESIGN OF BEAM BELOW BOTTOM SLAB(B2)(M25,300X450)

Load including self weight of beam=33.94KN/m

Bending moment=39.51

Ast=417.89mm^2

Provide 4-12φ & 2-12 φbars with the nominal shear reinforcement of 2-legged 8φ@125 mm c/c in the beam

Provide 300 mm x 450 mm section of the beam

DESIGN OF BEAM BELOW THE INTERFACE OF BOTTOM SLABS (B1) (M25,300X450)

From above,total

Load=50.71KN/m

Bending moment=58.8KNm

Ast=635 mm^2

Provide 4-16φ & 2-12 φbars with the nominal shear reinforcement of 2-legged 8φ@125 mm c/c in the beam.

Provide 300 mm x 450 mm section of the beam

DESIGN OF STAGING

Wt of cylindrical wall =101.43 KNM

Load due to water retained in tank=10*6.096*3.048*1.37=254.55 KN

Load due to bottom slab=25*6.31*3.048*0.160=77.0KN

Load due to bottom beam=25*0.3*0.45*9.144=31.86 KN

Total load=101.43+254.55+77.0+31.86=464.84 KN

Load carried by each column=464.84/6=77.43 KN

Self wt of each column=25*0.3*0.3*6.3=14.18 KN

Self wt of each brace=25*0.2*0.45*2.91=6.5 KN/col

Total load on each column=98.15KN

SEISMIC DESIGN

Wt of tank when full=464.84KN

Wt of staging=125.41 KN

Eff. Wt of tank when full=464.84+41.80=506.64 KN

Eff. Wt of tank when empty=506.64-254.4=252.24 KN

MOI of one column=300*300^3/12=675893025 mm^4

When tank is full

Natural time period=2*pi()*(464.84/9.81/6339)^0.5=0.68

Structural response factor=1.69/0.64=2.48

Zone factor=0.24

Importance factor=1.5

Response reduction factor=5

Horizontal seismic coeff=2.48*0.24*1.5/5/2=0.08

Horizontal seismic force=464.84*0.08=41.5 KN

Acting at 8.2 m from the foundation top.

Overturning moment in Ist bay=41.5(8.2)=341.5 KNm

Seismic shear per column=41.5/6=6.9 KN

B.M.in col of Ist bay= 7.1*1.05=7.45 KNm

When tank is empty

Natural time period=2*pi()*(252.4/9.81/6339)^0.5=0.7

Structural response factor=1.67/0.685=2.44

Zone factor=0.24

Importance factor=1.5

Response reduction factor=5

Horizontal seismic coeff=2.44*0.24*1.5/5/2=0.088

Horizontal seismic force=252.4*0.088=20.6 KN

Acting at 6.3+1.5=8.2m from the foundation top.

Overturning moment in Ist bay=20.6*(8.2)=168 KNm

Seismic shear per column=20/6=3.5 KN

B.M.in col of Ist bay= 5*1.05=5.25 KN

DESIGN OF COLUMN(M25,300X300)

Col size=300 mm x 300 mm

eccentricity=(2.7-0.6) x 1000/500+ 300/30=14.2 mm

Ag=300 x300=90000 mm^2

Ast required=450mm^2

Therefore, provide 6-12φ in each column with 10φ@ 200mm c/c as the stirrups for lateral binding.

Ast provided=6x 113=678 mm^2

Area of concrete=90000-678=89322 mm^2

Area of stirrup bar=pi()*10^2/4=78.5 mm^2

Diameter of core Dc=(300-30*2-10)=230 mm

Pitch(p)=200 mm

Provide 300mm x 300mm col size with 6-bars of 12-φ tied together with 10φ@200mm c/c

Check

Vol of helical reinforcement =pi()*Dc*Asp*4/pi()/(Dc)^2/p > (Ag/Ac-1)*0.36*30*415

226885.8/33238050 >(90000/89322-1)*0.36*30/415

0.006>0.0001

Hence safe in reinforcement

DESIGN OF BRACE(M25, 200X450)

Provided section of the brace=200mm x450 mm

Bending moment=20.11KNm

Shear in the brace=42.69/6=15.11KN

M_u=20*1.5=30 KNm

Ast=0.5*25/415*200*400*(1-(1-4.6*30*10^6/25/200/400^2)^0.5)

=335 mm^2

Provide 4-12φ bar

Ast provided=113.1*4=454.4 mm^2

Shear reinforcement

V_u=1.5*15.11=22.67 KN

Tv=22.67*1000/200/400=0.28 N/mm^2

%age reinforcement=452.4*100/200/400=0.5

In M25 concrete,τc=0.49N/mm^2 $>\tau v$

Hence safe in shear.

Provide nominal shear reinforcement of 2-legged-10φ@250 mm c/c throughout.

DESIGN OF ISOLATED FOOTING SUPPORTING COLUMNS(M25,10MM THICK)

Load acting on each col=226.46 KN

Add 10% wt of footing=22.6 KN

Total wt(P)=248.6

Area of footing=248.6/87.5=2.85 m^2

Provided area of footing(A)=2*2=4

Pressure intensity at base=226.4/4=56.6<87.5 ,Hence safe

B.M at the face of the column=56.6*0.75^2/2=15.63 KNm

Using M25 concrete ,

Depth of footing required from bending criteria=104mm

Depth of footing required from 1-way shear=170mm

Provided eff depth of footing=170 mm

Provided overall depth of footing=170+80=250mm

Ast =0.25% of 1000*170=425mm^2

Provide 12φ@ 200mm c/c in bothways.

Distribution steel=0.12% of 1000*250=300mm^2

Provide 12 φ @200mm c/c

7. CONCLUSION:

The six month industrial training gave me good practical experience into the various aspect of designing and testing and I got the chance to know about the various other activities involved in construction.

I learnt a great deal about the surveying work involved in the field and lab testing of concrete and steel.

This training gave me very good exposure and I am hopeful that this experience helps me a lot in my carrier.

I once again thank each and every one who helped me in training.