

**REPORT OF SOIL INVESTIGATION CONDUCTED AT THE
LOCATION OF GOVT. HIGH SCHOOL NO. 4, KAITHAL IN
CONNECTION WITH THE ADDITION OF FIRST FLOOR**

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Abstract:

Geotechnical investigation of soil formations at the location of Govt. High School No.4, Kaithal in connection with the addition of First Floor were conducted by Department of Civil Engineering, Haryana Engineering College, Kaithal. The field investigations consisted of making bore hole at the site, taking out soil samples and conducting standard penetration tests at various elevations inside the bore hole. The samples, so collected were subjected to laboratory testings. These investigations were carried out under the supervision of staff deputed by Headmaster, Govt. High School No.4, Kaithal in the month of March, 2011.

Sub area : Soil & Foundation Engineering

Broad Area : Civil engineering

Introduction: Initially bore hole were advanced for short depth by using post hole auger. A casing pipe was pushed in and driven by slow frequent rotations to avoid excessive disturbance. As the casing advanced, the soil material within the casing was removed.

The undisturbed soil samples were drawn by pushing thin walled steel tubes into the bore holes. The samples were taken below the bottom of casing after cleaning the bore holes of any loose material at all elevations. Immediately after collecting undistributed samples, these were marked and sealed using sealing wax.

Here a few words are defined for easily approach to the subject:

SITE : Addition of First Floor of Govt. High School No.4, Kaithal.

GROUND WATER TABLE : The position of GWT is as shown in the enclosed bore logs.

BORING OPERATIONS : One bore hole 15 feet deep were made in all at the location .

FIELD TESTS: STANDARD PENETRATION TESTS

The standard penetration tests were conducted by driving split spoon sampler at various elevations into the soil through bore hole made at site. A hammer of 63.5 Kg. weight with a free fall of 75 cm. was used to drive the sampler. The test was performed in three stages. The number of blows were counted for every 15 cm penetration of the sampler. The blows required for the first 15cm penetration were ignored as those required for seating drive. The number of blows required for next 30 cm penetration were recorded as SPT value (N-value). The test procedure adopted for conducting above test has been as per IS: 2131-1981-Standard Penetration Test.

LABORATORY TESTS:

The following lab tests have been conducted in the Soil Mechanics Laboratory of Haryana Engineering College, Kaithal to determine index and engineering properties of the soil samples collected from the bore hole made at the site.

- 1. Identification of soils:** The soils were identified by simple visual examination as per IS 1498:1970 - Classification and Identification of soils for General Engineering Purposes. Visual examination included the evaluation of colour, any fibrous matter, any vegetable content, shape and size of the particles. Shaking tests, strength tests and dispersion tests were also conducted.
- 2. Water Content:** The water content of soil samples has been determined by oven drying method as per recommendation of IS : 2720 (Part II) - 1973.
- 3. Consistency Limits:** The liquid limits and plastic limits of the soil samples collected at various elevations of the bore holes has been evaluated as per procedure laid down in IS : 2720 (Part V) – 1970.
- 4. Grain Size Distribution:** This classification test was conducted to determine the ranges of sizes of particles and percentage of particle in each of these size ranges of the soil met at various elevations of the bore holes. The test procedure standardized by Indian Standard IS: 2720 (Part IV)-1975 has been adopted to conduct the above test. The percentage of gravel, coarse sand, medium sand, fine sand, silt and clay evaluated from this test has been presented in the enclosed bore hole sheets.
- 5. Triaxial Compression Tests:** A series of triaxial compression tests were got conducted on undistributed samples collected from the bore holes to estimate shear strength parameters (c and ϕ). The height to diameter ratio of the samples was kept as 2. These samples were tested in triaxial cell under various confining pressures. The samples were tested under each cell pressure after consolidation. The cell pressure was applied by constant mercury pressure application unit and the samples were sheared under constant strain.

Mohr's failure envelopes were plotted from the results of a series of triaxial compression tests to determine shear strength parameters. These parameters have been presented in the enclosed bore hole sheets.

ESTIMATION OF ALLOWABLE BEARING PRESSURE :

The stability of a foundation depends upon the safety of a soil against

- (1) its failure in shear (associated with plastic flow of soil material underneath the foundation and lateral expulsion of soil underneath the foundation) and
- (2) excessive vertical displacement, or settlement caused by process of consolidation of the soil under the foundation (elastic and plastic deformation).

Therefore, in order not to endanger the structure, these are two independent foundation stability criterion, which must be met simultaneously. These criterion being

- (i) there should be adequate safety against a shear failure within the soil mass, and
- (ii) the probable differential and maximum settlement of the soil , viz : foundation must be limited to safe, tolerable and acceptable magnitudes.

In the present report, the estimation of allowable bearing pressure has been made on the basis of above two criterion with following assumptions:

FOR THE ADDITION OF FIRST FLOOR IN GOVT. HIGH SCHOOL NO. 4, KAITHAL

Type of foundation	:	Open foundation
Depth of foundation	:	200 cm
Width of foundation	:	135 cm

SETTLEMENT CRITERION :

$$\begin{aligned} \text{Corrected "N"} &= 11.6, & W' &= 1.0 \text{ (actual at site)} \\ q_{na} &= 0.6925(N-3) (B + 30 / 2B)^2 \times W' \\ &= 0.6925 (11.6-3) (135 + 30 / 2 \times 135)^2 \times 1.0 \\ &= 0.6925 \times 8.6 \times 0.3734 \times 1.0 \\ &= 2.22 \text{ kg / cm}^2 \\ \text{Surcharge} &= (1.80 / 1000) \times 200 = 0.36 \text{ kg / cm}^2 \\ \text{Therefore } q_{ga} &= 2.22 + 0.36 = 2.58 \text{ kg / cm}^2 \end{aligned}$$

SHEAR CRITERION :

$$\begin{aligned} \text{Soil properties : } \phi &= 28^\circ ; c = 0.00 \text{ kg / cm}^2 \\ \text{For } \phi = 28^\circ : N_c' &= 14.83, N_q' = 6.40, N_\gamma' = 5.39, \\ q_{nu} &= (2 / 3) c N_c' + q(N_q' - 1) + 0.5\gamma B N_\gamma' W' \\ &= (1.80 / 1000) \times 200 \times (6.40 - 1) + 0.5 \times (1.80 / 1000) \times 135 \times 5.39 \times 1.0 \\ &= 1.944 + 0.654 = 2.598 \text{ kg / cm}^2 \\ q_{ns} &= 2.598 / 2.5 = 1.04 \text{ kg / cm}^2 \\ q_{gs} &= 1.04 + 0.36 = 1.40 \text{ kg / cm}^2 \end{aligned}$$

RECOMMENDATIONS:

The recommended values of allowable bearing pressures in connection with the addition of First Floor of Govt. High School No.4, Kaithal are:

Location	Allowable Bearing Pressure, Kg/cm ²	
	Net	Gross
For Addition of First Floor of Govt. High School No.4, Kaithal	1.04	1.40

The above values would need modifications if depth and width as assumed in the report are different than the adopted values.

Bore Hole No. 1													
Depth below Ground level in feet	Soil type	Description	SPT 'N' Value	Triaxial Results ϕ Deg. Kg/cm ²	Test c	GWT	LL & PL %	BD & DBD g/cc	Sieve Analysis percent				
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
5.0	ML	SANDY SILT	09						-	04	04	30	62
			28				NP	1.80	05	08	01	20	66
12			0.00					1.75	-	02	01	09	88
10.0							NP		-	-	-	49	51
15.0			11	28	0.00				-	-	02	16	82
				28	0.00			NP	-	-	-	08	92

**BORE HOLE DATA AND SOIL PROPERTIES
 AT THE SITE FOR THE ADDITION OF FIRST FLOOR IN GOVT. HIGH SCHOOL NO. 4, KAITHAL**

REFERENCES:

1. IS 1498-1970 For Classification and Identification of Soils
2. IS 6403-1981 For Determination of Breaking Capacity of Shallow Foundation
3. IS 2131-1981 For Standard Penetration Test Methods.