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An Investigation Report on Failure of Building Foundations

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***Abstract*:** The construction site is located just ahead of Shri Shankaracharya Mahavidyalaya, Junwani, Bhilai. During the pre-construction of foundation, shear failure occurred in the soil which resulted in settlement of foundation, development of cracks and various other problems. Movement and distress in low rise building most commonly occur due to the interaction between the footing system and the ground. This summarizes the study that is carried out to assess the possible causes of risk in the G+1 residential building founded on pile foundation.

***Keywords*:** Foundations, Footings, Failure, Footings, Soil mechanics, Shear stress, Shear Strains.

I. INTRODUCTION

A **foundations** is the component of an Architectural structure which connects it to the ground, and transfers the load from structure to the ground. Foundations are generally considered, either **Shallow** or **Deep**. Foundation Engineering is the application of Soil mechanics and Rock mechanics (Geotechnical Engineering) in the design of foundation element of structures. Foundations are primarily required to support building construction. The foundation is that portion of a structure that transfers the loads from the building to the underlying foundation material.

There are two major requirements to be satisfied in the design of foundations:

1. Provision of an adequate factor of safety against failure of the foundation material. Failure of the foundation material may lead to failure of the foundation and may also lead to failure of the entire structure.
2. Adequate provision against damage to the structure which may be caused by total or differential settlements of the foundations.

II. FAILURE OF FOUNDATION

Failure of foundation can cause the building to collapse. Foundation is the first term element of a building where the construction starts, but when it falls it can cause many defects in the structure including failure or collapse of the structure. Repair of defects in foundation are most difficult and very costly, so it is most important to understand the types of foundation failure to avoid them by taking necessary steps before the construction starts.

The design of structures should satisfy three fundamental requirements:

1. Stability: The structure should be stable under the action of loads.
2. Strength: The structure should resist safely stresses induced by the loads.
3. Serviceability: The structure should perform satisfactorily under service loads.

The main causes of failure of foundations are as follows:

1. Unequal settlement of the sub-soil
2. Unequal settlement of the masonry
3. Withdrawal of moisture from the sub- soil
4. Lateral pressure on the superstructures
5. Lateral movement of the sub-soil
6. Weathering of sub-soil due to Transpiration of trees and shrubs
7. Atmospheric action.

III. EVALUATION OF SOIL STRENGTH

The soil mass can be evaluated by determining the following aspects of the soil component:-

1. Bearing strength of soil
2. Penetration Strength of soil

3. Shear strength of soil

A. Bearing strength of soil

Bearing capacity is the power of foundation soil to hold the forces from the superstructure without undergoing shear failure or excessive settlement. Foundation soil is that portion of ground which is subjected to additional stresses when foundation and superstructure are constructed on the ground.

B. Penetration strength test of soil

The main purpose of the test is to provide an indication of the relative density of granular deposits, such as sands and gravels from which it is virtually impossible to obtain undisturbed samples. The great merit of the test, and the main reason for its widespread use is that it is simple and inexpensive. The soil strength parameters which can be inferred are approximate, but may give a useful guide in ground conditions where it may not be possible to obtain borehole samples of adequate quality like gravels, sands, silts, clay containing sand or gravel and weak rock. In conditions where the quality of the undisturbed sample is suspect, e.g., very silty or very sandy clays, or hard clays, it is often advantageous to alternate the sampling with standard penetration tests to check the strength.

C. Shear strength of soil

Shear strength is a term used in soil mechanics to delineate the extent of the shear stress that a soil can sustain. The shear resistance of soil is a result of friction and interlocking of particles, and possibly adherence or bonding at particle contacts. Due to interlocking, particulate material may expand or contract in volume as it is subject to shear strains. If soil expands its volume, the density of particles will decrease and the strength will decrease; in this case, the peak strength would be followed by a reduction of shear stress. The stress-strain relationship levels off when the material stops expanding or contracting, and when interparticle bonds are ruptured. The theoretical state at which the shear stress and density remain constant while the shear strain increases may be called the critical state, steady state, or residual strength.

There are three modes of shear failure, i.e. General, Local and Punching shear failures depending upon the compressibility of soil and depth of footing with respect to its breadth (i.e D/B Ratio).

IV. TESTS FOR EVALUATION OF SOIL STRENGTH

There are various tests carried out for evaluation of soil strength. Generally it is done by -

a. Shear test

1. Direct shear test
2. Triaxial shear test
3. Vane shear test
4. Unconfined compression test.

b. Penetration test

1. California Bearing Ratio (CBR) Test

c. Bearing test

1. Plate Load test.

d. Group Index Test.

V. PREVENTIVE MEASURES AGAINST FOUNDATION FAILURE

- Lowering water table
- Pre-loading
- Drive pile to rock
- Compaction
- Use of deep foundations
- Treat or stabilize soil
- Maintain constant water table
- Maintain constant water table
- Include swell pressure in design

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CONCLUSION

After analyzing the various foundations and processing them into the decision matrix, Bored pile foundations appear to be the most suitable, however there is very little information known at this stage and it would be possible to use raft, driven piles or bored piles on such a project. Strip and pad foundation would not be suitable sue to land, size of building and loads the foundations would have to cope with. Raft foundation although used mainly for light weight structures could be designed to cope with greater loads.

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