Study of Soil Properties of Northern Hills (Kashmir) in comparison to the soil properties of Northern Plains (Punjab)

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ABSTRACT

Soil exhibits different properties in different regions. Construction of any structure completely depends upon the type of soil of a particular area. Soil properties indicate the stability of a construction structure because the load of a structure is finally transmitted to the soil. Northern Plains mostly have a soil with low moisture content while as the soil in northern hills has a soil with comparatively high moisture content because of the wet weather conditions in the hilly regions and the moderate temperature. This paper presents the results of a series of tests conducted on soil in Kashmir and Punjab region. Soil exhibited different properties and different loads were applied while determination of settlement.

Keywords:

Moisture content , Atterbergs Limits, Stress, Strain,Compaction,Consolidation

INTRODUCTION

Due to the climatic temperature differences in different regions especially when we compare hills with the plains it becomes mandatory to classify soils on basis of different properties. Suppose if we want to go for construction in Northern Plains like Punjab, the soil is less likely to get consolidated and compacted quickly because of less moisture content present whereas while construction of houses in areas like Kashmir where temperature is moderate mostly compaction and consolidation period is less due to high moisture content. The objective of conducting such tests majorly is to determine the soil strength of different soils and determining the moisture content, to find a pre-construction analysis plan for a particular structure depicting pros and cons of it at that particular site, to ensure the earthquake resistance of a structure which will be based on soil characteristics.

Materials

Soil

The samples for the present study were collected from 4 locations of Punjab and Kashmir which include Deep Nagar and Phagwara from Punjab region and Bandipora and Lal Bazar area of Kashmir. Two depths (0.5m and 1.5m) were taken into account from the locations in which both disturbed and undisturbed soils were collected.

Basic properties of Punjab soils are briefly summarized in TABLE 1

Results and Discussions

The tests which are very important as far as comparison point of view and geotechnical analysis is concerned are mentioned below:

Water Content Analysis

Water content is important aspect of soil for determination of bearing capacity and settlements of soils. Its determination indicates the suitability of soil for construction. If the moisture content is high the construction of any structure needs a halt because of the moisture content in soil and vice versa.

Sieve Analysis (Particle Size Distribution)

The particle size distribution curves for soil samples collected in Phagwara area is given in Table 1

Characteristics (%)	Readings
Water Content	11.70
Sand	7.6
Silt	8.2
Clay	84.2
Liquid Limit	39.45
Plastic Limit	21.40
Plasticity Index	18.05

Table 1: Soil Properties of samples in Phagwara Area

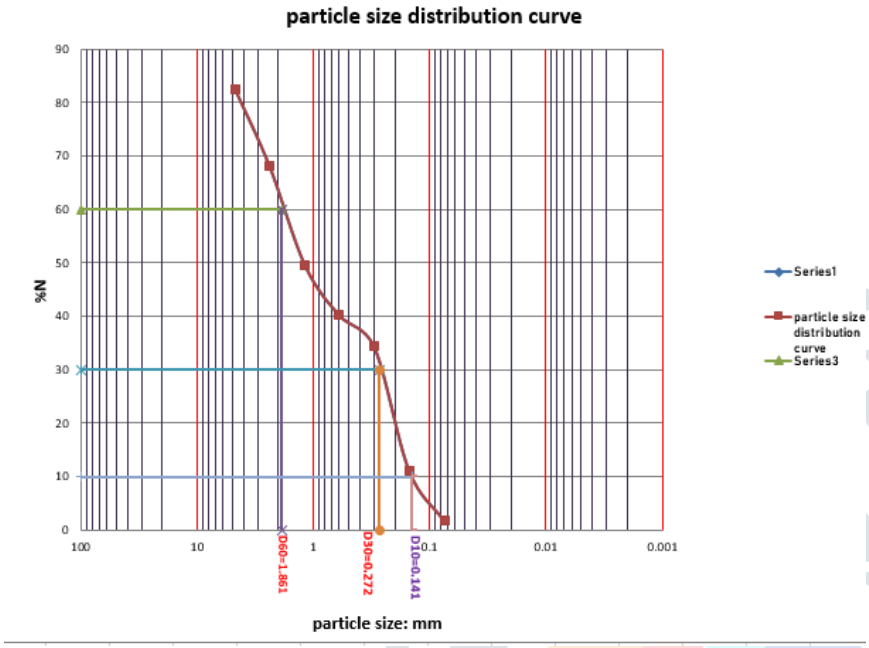

Figure 1: Particle Size Distribution Curve for soil sample collected at Phagwara

Optimum moisture content

During the building phase and during the operation span, the soil at the construction site must be durable enough to bear the loads from the structures across footings without experiencing undesirable settlements.

The moisture content at which the soil achieves optimum dry density is known as the optimal moisture content (OMC) or optimal water content (OWC). This OMC value refers to the amount of compaction energy that has been added to the soil.

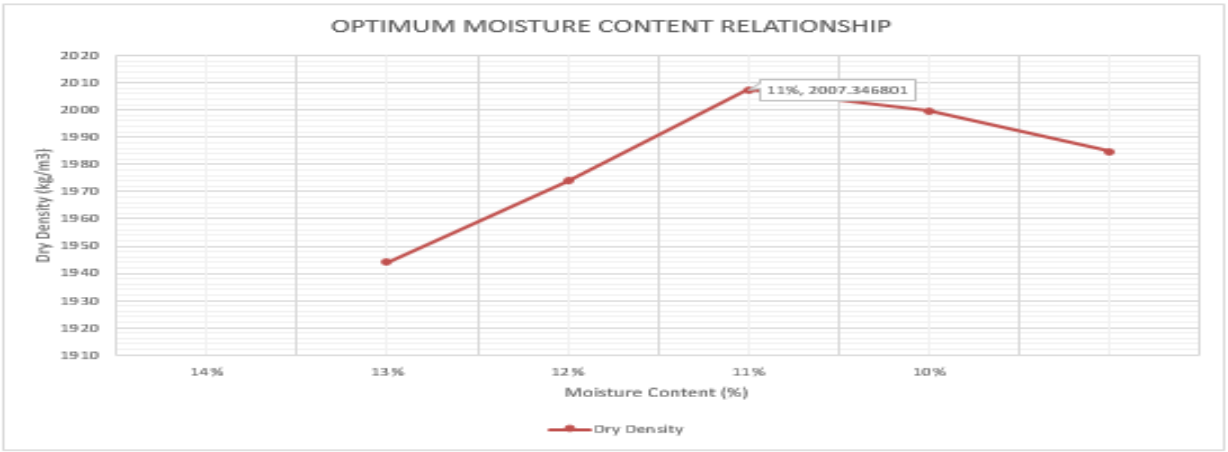

Figure 2

The liquid limit and plastic limits of the soil samples present in Phagwara area were comparatively less as compared to that of Kashmir. The values of the same are mentioned below

The average liquid limit came out as 39.45%

Plastic limit of the soil = 21.40%

Plasticity Index(Ip) = (LL - PL)= 18.05%

From the dry density and moisture content relationship, optimum moisture content and maximum unit weight were determined

Maximum dry density = 1.80 Optimum water content = 8.7%

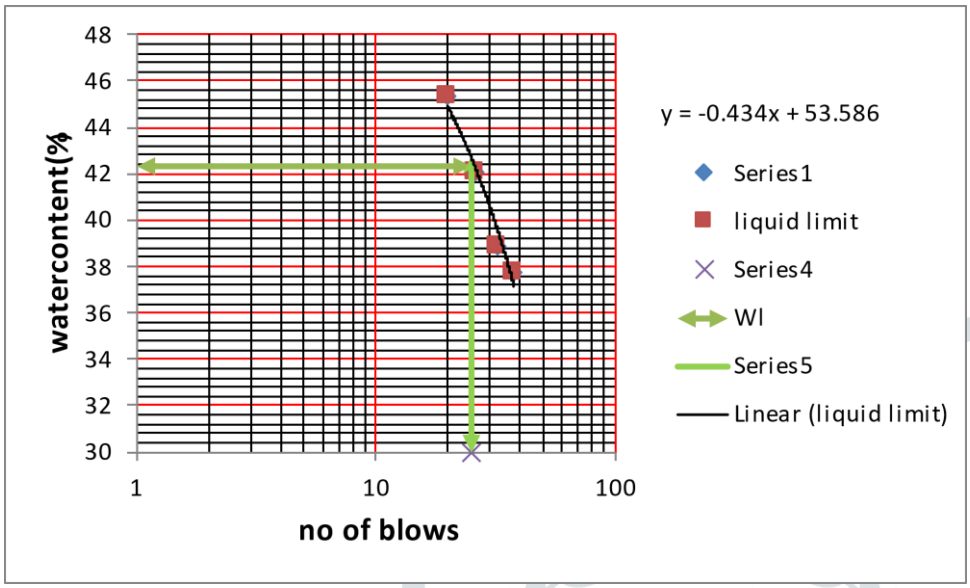

Figure 3

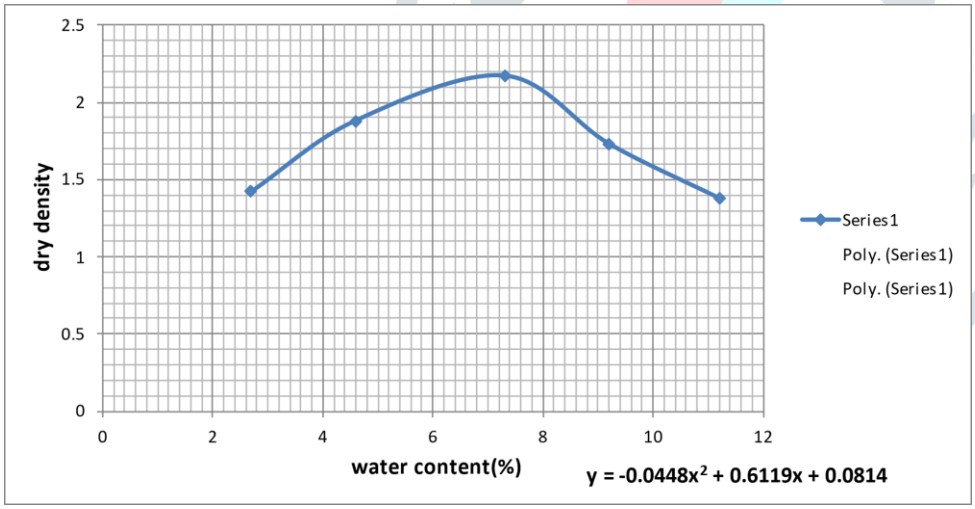

Figure 4

Testing In Kashmir (Results and Discussions)

Sieve Analysis (Particle Size Distribution)

The particle size distribution curves of the sample of soils collected are shown as in figure 2.

Analysis of particle size distribution for soil sample collected at the depth of 0.5m was found to have 87% of the silt content with some substantial amount of sand content and the silt content for the soil sample collected at the depth of 1.5m was found to be 76% with considerable amount of clay particles. Results of the tests have been encapsulated in Table 2. [1]

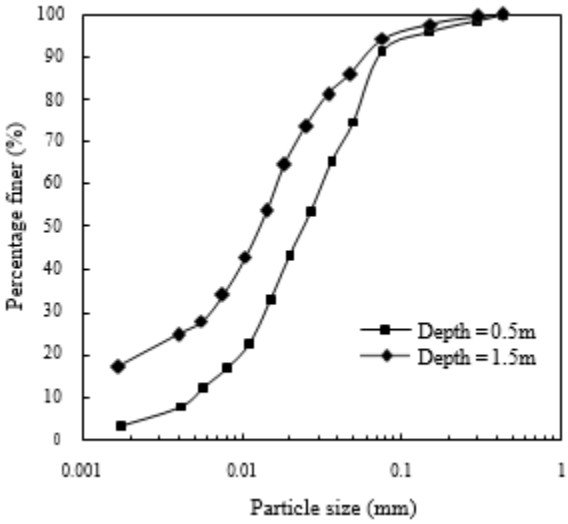

Figure 3. Particle size distribution curve for Bemina soil.

Index Properties

Atterberg limits such as liquid limit, plastic limit and shrinkage limit are extensively used in geotechnical engineering. The values of liquid limit and plastic limit are useful in the classification of fine grained soils. Since, the soil obtained at 0.5m is silty in nature, therefore, liquid limit tests were also conducted using cone penetration method for cross-check. However, there was negligible variation between test values. The liquid limit (air dried) and plastic limit of the soil at 0.5m varies in the range of 31- 34 % and 22-26 respectively. Whereas, liquid limit and plastic limit of soil at 1.5m depth varies in the range of 50 - 53 % and 35 - 37 % respectively. However, the atterberg limit tests on oven dried sample of 1.5m depth shows significant difference when compared to air-dried sample at same depth. This may be due to the presence of organic matter which is also evident from specific gravity values. [1]

Compaction Characteristics

From the dry density and moisture content relationship, optimum moisture content and maximum unit weight were determined. The compaction curve is as shown in figure 4.[1]

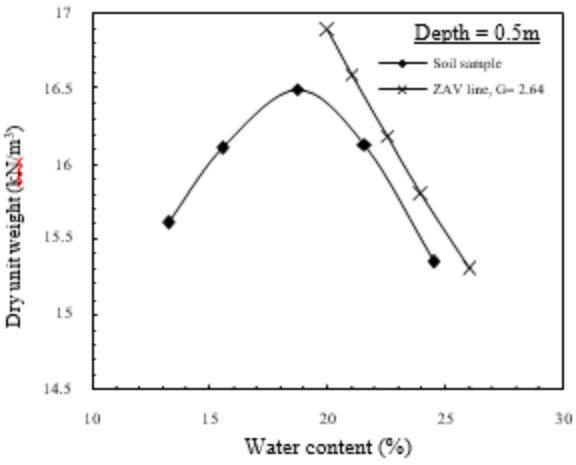

Figure 4. Compaction curve of Bemina soil.

Basic properties of Kashmir soils are briefly summarized in Table 2.

Characteristics (%)	Depth = 0.5m	Depth = 1.5m
Water Content	28.56	85
Sand	8.6	5.8
Silt	87.1	76.2
Clay	4.3	18
Liquid Limit	33.2	53.4
Plastic Limit	26.3	37.8
Plasticity Index	6.9	15.6

TABLE 2

CONCLUSION:

The soil present in Northern Plains had less moisture content around 13.79% while as the soil samples collected from Northern Hills had a moisture content ranging between 35-77% (when takes from depths of 0.5m and 1.5m respectively), this clearly indicates that the soil bearing capacity holds good in Northern Plains. Less Reinforcement and stability materials can be used in basements and plinths at the time of construction because of low moisture content present in soil. Whereas deep foundations need with ample reinforcement need to be provided in Northern Hills because of high level of moisture content in soil. We can conclude that compaction is less likely useful in Northern Plains because of low moisture content whereas compaction would be good for soils in Northern Hills to achieve the density.

Similarly the dry density of the soil samples in Punjab (Phagwara area) came out to be around 1.69 whereas that of Kashmir (Bemina Area) was around 16.59. So dry density of the soil samples from Kashmir is more. It means increase in the dry density would result in increase in strength, lower permeability and better volume stability.

The Earthquake resistance depends upon the softness of soil as well. So if the moisture content of soil is more it is likely to be more soft. Test results clearly indicate that the soil of Northern Hills had more moisture content and thus structures are more prone to be impacted due to earthquakes.

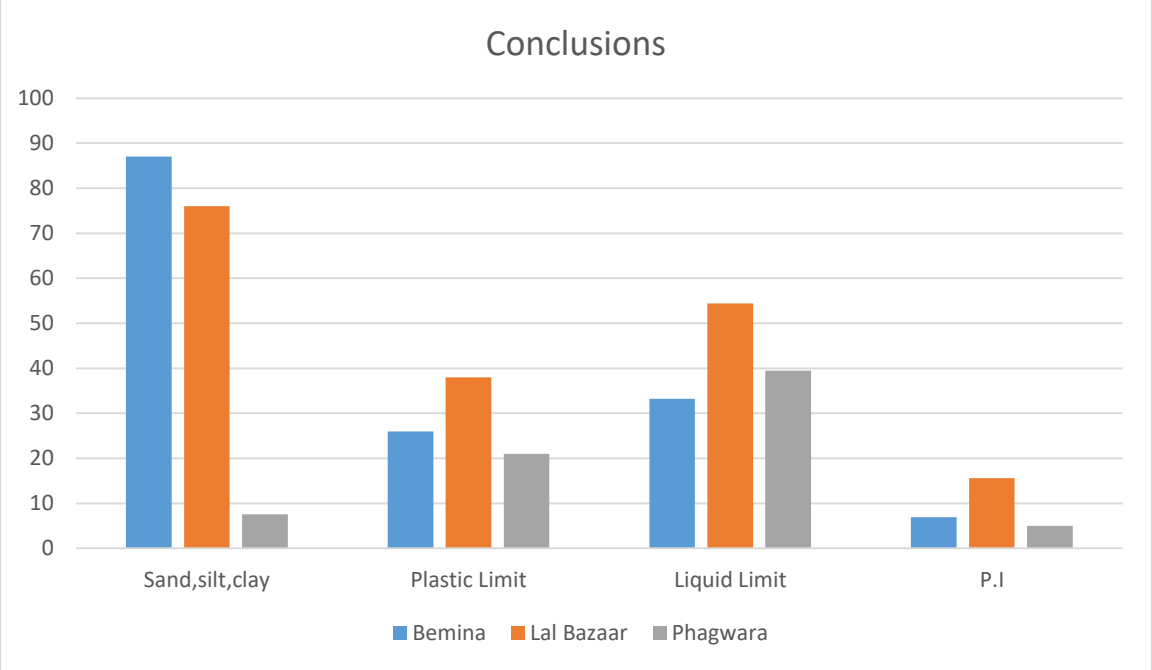

Figure 7

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