Classification and Identification of Soil

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ABSTRACT

Before start any construction whether it is small or big it is very necessary to determine the classification and identification of the soil for safe structure construction. Poor judgment of soil selection provides bad results such as always problem of unsettlement of soil, cracks development, shear strength failure and problem of unstability of the structure so overcome of all these problems a geotechnical engineer needs to classified and identified the soil as their properties and uses. Experience in the geotechnical fields gives the best results in good selection of soil as well as project economically**.**

INTRODUCTION

Soil is heterogonous mixtures of many of the minerals particles having different properties, lies on the throughout the Earth, According the use selection criteria of soil may be different example Black Cotton Soil is the soil which is very beneficial for the growth of plants but it is very dangerous for construction due to its very low bearing capacity. Structural Design based on the type of the underground soil strata condition of that site. So it is very necessary to a geotechnical engineer to identify and classifies the soil. All the tests which are help to identify the soil classifications are conduct only in the lab. A general idea based on the visualization on the site gives not good result always.

Principal Types of Soil

The materials that constitute the earth crust are rather arbitrary divided by the civil engineer into two categories, soil and rock. Soil is the natural aggregate of mineral grains that can be separated by such gentle mechanical means as agitation in water. On the other hand Rock is a natural aggregate of minerals connected by strong and permanent cohesive forces. Since the term "Strong" and "permanent" are subject to different interpretations, the boundary between soil and rock is necessarily an arbitrary one. As a matter of fact, there are many natural aggregates of mineral particles that are difficult to classify either as a soil or rock. In the text, however the term soil will be applied only to materials that unquestionable satisfy the preceding definition. Although the terminology described in the preceding paragraph is generally understood by civil engineers, it is not in universe use. According to the geologist, for example the term rock implies all the materials that constitute the earth crust, Regardless of the degree to which the mineral particles are bound together, whereas the term soil is applied only to the portion of earth's crust that is capable of supporting vegetation. Therefore civil engineer to make use of information prepared by workers in other filed must understand the sense in which the terms soil and rock are used.

On the basis of origin of their constituents, soils can be divides into two large groups

1. **Residual Soils:** Residual soils are those that remain at the place of their formation as the result of weathering of parent rock. The depth of residual soils depends primarily on climatic conditions and the

time of exposure. Residual soils that have developed in semiarid or temperate climates are usually stiff and stable and do not extend to great depth. However, particularly in warm humid climates where the time of exposure has been long, residual soil may extend to hundred of meters. They may be strong and stable, but they may also consist of highly compressive materials surrounding blocks of less weathered rock.

2. **Transported Soils:** Transported soils are that are found at locations far remove from their place of formation. The transporting agencies of such soils are glaciers, wind and water.
   The soils are designated according to their mode of transportation such as alluvial soils, lacustrine soil, marine soil, colluvial soil, glaciels soil. Alluvial soils are those that have been transported by running water,.Lacustrine soil is the soils that have been deposited in quiet lakes are known as lacustrine soil. It is type of brown clay. The soil material consists of clay and silt mixture. It is also known as brown clay because clay is dominating as compare to slit. Marine soils: Marine soils are those deposited in the sea water, the soil transported and deposited by wind and Aeolian soils.

Organic soil:

Soils of organic origin are formed chiefly in situ either growth or subsequent decay of plants such as peat mosses or by the accumulation of fragments of the inorganic skeleton or shells of organisms. Hence a soil of organic origin can be either organic or in organic. The term organic soil ordinarily refers to a transported soils consisting of the products of rock weathering with a more or less conspicuous admixture of decayed vegetable materials.

TERMINOLOGY OF DIFFERENT TYPES OF SOIL

A geotechnical engineer should be well versed with the nomenclature and terminology of different type of soils. The following list gives the names and salient characteristics of different types of soils arranged in alphabetical order.

1. Bentonite: - Bentonite is a type of clay is the product from the decomposition of volcanic ash. Bentonite is highly plastic soil due to dominating of high percentage clay mineral Montmorillonoite .It is highly water absorbent and has high shrinkage and swelling characteristics.
2. Black Cotton Soil:-Black cotton soil is a residual soil containing high percentage of clay mineral Montmorillonoite. It has very low bearing capacity and highly swelling and shrinkage properties. It is available in mostly part of India.
3. Boulders:-Boulders are rock fragments of large size more than 300 mm in the size.
4. Calcareous Soil: - Calcareous soil containing large quantity of calcium carbonate($CaCO_3$).
5. Caliche:- Caliche is a type of soil in which gravel, sand and silt. The particles are cemented by calcium carbonate.
6. Clay: - Clay consist of microscopic and submicroscopic particles derived from chemical decomposition of rocks. The Particle size is less than 0.002 mm. It contain large quantity of clay minerals such as Montmorillomnie, Kallite etc. Clay exhibits considerable strength when dry. It is a fine grained soil of cohesive nature.
7. Cobbles: - Cobbles are the large particles in the range of 80 mm to 300 mm.
8. Diatomaceous Earth:- Diatomaceous Earth are minute unicellular marine organisms . It is a fine, light grey, soft, sedimentary, deposit of siliceous remains of skeletons of diatoms.
9. Dispersive Clays:- Dispersive Clays are the special type of clays which defloculate in still water .Such soils erode if exposed to low –velocity water.
10. Dune Sand; - Dune Sands are wind transported soils. There are composed of relatively uniform particles of fine to medium sand.

11. Expansive Clays:- Expansive clays are prone to large volume changes as water content is changed. The soil contains the clay mineral montmorillonite.
12. Fills:-Fills are all man-made deposits of soil and waste-materials are called fills. These are the soil embankment raised above the ground surface Engineering properties of fills depend upon on the type of the soil, its water content and degree of compacion.
13. Gravel:- Gravel is a type of coarse- grained soil. The particle size ranges from 4.75 mm to80 mm. Gravel is a cohesionless materials.
14. Hardpans:- Hardpans are the type of the soils that offer great resistance to the penetration of drilling tools during soil exploration. These are generally dense, well grade ,cohesive aggregates of mineral particles .Hardpans do not disintegrate when submerged in water.
15. Humus:- Humus is a dark brown ,organic amorphous earth of the topsoil. It consists of partly decomposed vegetal matter. It is not suitable for engineering work.
16. Kankar:-It is a impure form of lime stone. It contains calcium carbonate mixed with some silicious material.
17. Laterites:-Laterites are the residual soils formed in tropical regions. Laterites are very soft when freshly cut but become hard after long exposure.
18. Loam:- Loam is the mixture of sand, silt and clay. The term generally used in agronomy. The soil is well suited for tilting operation.
19. Loess:-Loess are windblown deposit of silt. It is generally of the uniform graded with particle size between 0.01 to 0.05 mm.It consist of quartz and feldspar particles, cemented with calcium carbonate with iron oxide.
20. Marl:- A crumbly mixture of clays, calcium and magnesium carbonates, and remnants of shells that is sometimes found under desert sands and used as fertilizer for lime-deficient **soils** known as marl.
21. Moorum:- The word derived from Tamil state of India, It meaning powder rock. It consist of small pieces disintegrate rock or shells with or without boulders.
22. Peat:- Peat is a highly organic fibrous microscopic or submicroscopic material found in marshy or damp regions, composed of partially decayed vegetable matter.
23. Sand:-Sand is coarse grained soil having the particle size between 0.075 mm to 4.75mm.It cohisionless and previous.
24. Silt:- Silt is fine grained soil having the particle size between 0.002 mm and 0.075 mm. It has little or no plasticity. Silt not visible by naked eye.

CLASSIFICATION OF SOIL: As per Indian Standard 1498:1970, "Classification and Identification of soils for general engineering purpose". Soil broadly classified as coarse grained soil, fine grained soil and highly organic soil with other miscellaneous materials

COARSE GRAINED SOIL

In Coarse Grain Soils more than half of the total material by weight passing through 75 microns Indian Standard Sieve. Coarse grain soil further classified as: Gravel and Sand. Gravels is the soil in which more than half the coarse fraction (+75 Micron) is larger than 4.75 mm Indian Standard Sieve size. It is subdivided into Gravels and Gravelly Soils, Similarly Sand is the soil in which more than half the coarse fraction (+75 Micron) is smaller than 4.75 mm Indian Standard Sieve size .It classified as Sand and Sandy Soils ,Coarse grained soil further classified as table 1.

Table 1:- Classification of Coarse grained soil

Coarse Grained Soil		
Gravelly Soils		Sandy Soil
1.	Well Graded Gravel(GW)	Well Graded Sand(SW)
2.	Poorely Graded Gravel(GP)	Poorely Graded Sand(SP)
3.	Silty Gravel(GM)	Silty Sand(SM)
4.	Clayey Gravel(GC)	Clayey Sand(SC)

FINE GRAINED SOIL

In this system fine grained soil are not divided according to particle size but according to plasticity .Here compressibility mean volume changes shrinkage during dry periods and swilling during the wet periods as well as consolidation under load. The fine-grained soils shall be further divided into three subdivisions on the basis of the following arbitrarily selected values of liquid limit.

Table 2:- Classification of Fine Grained Soil

Classification of Fine Grain Soil based on the Liquid Limit and Compressibility	
Silts and Clays of Low Compressibility	Having a liquid limit less than 35 (represented by symbol L)
Silts and Clays of Medium Compressibility	Having a liquid limit greater than 35 and less than 50 (represented by symbol I)
Silts and Clays of High Compressibility.	Having a liquid limit greater than 50(represented by symbol H)

BOUNDRY CLASSIFICATION OF COARSE GRAINED SOIL

When a soil possesses characteristics of two groups, either in particle size distribution or in plasticity, it is designated by combinations of group symbols. For example a well-graded coarse grained soil with clay binder *is* designated by GWGC. Boundary classifications can occur within the coarse-grained soil division, between soils within the gravel or sand grouping, and between gravelly and sandy soils. The procedure is to assume the coarser soil, when there is a choice, and completes the classification and assigns the proper group symbol; then, beginning where the choice was made, assume a finer soil and complete the classification, assigning the second group symbol. Boundary classifications within gravel or sand groups can occur. Symbols such as GW-GP, GM-GC GW-GM, GW-GC, SW-SP SM-SC, SW-SM and SW-SC are common.

Boundary classifications can occur between the gravel and sand groups. Symbols such as GW-SW, GP-SP, GM-SM, and GC-SC are common. Boundary classifications can also occur between coarse and fine grained soils. Classifications such as SM-SL and SC-CL are common.

LABORATORY IDENTIFICATION AND CLASSIFICATION PROCEDURE

The laboratory method is intended for precise delineation of the soil groups by using results of laboratory tests, for gradation and moisture limits, rather than visual estimates. Classification by these tests alone does not fulfil the requirements for complete classification, as it does not provide an adequate description of the soil. Therefore, the descriptive information required for the field method should also be included in the laboratory classification.

CLASSIFICION CRITERIA FOR COARSE GRAINED SOIL

The coarse-grained soils containing between 5 and 12 percent of fines are classified as borderline cases between the clean and the dirty gravels or sands as for example, GW-GC, or SP-SM. Similarly border-line cases might occur in

dirty gravels and dirty sand where the *I.* is between 4 and 7 as, for example, GM-GC . It is possible, therefore, to have a border tine case of a border line case. The rule for correct classification in this case is tofavour the non-plastic classification. For example) a gravel with 10 percent fine, a Cu of 20, a Cc of 2·0 and *I.* of 6 would be classified GW.GM rather than GW-GC (*I.* is the plasticity index of the soil).

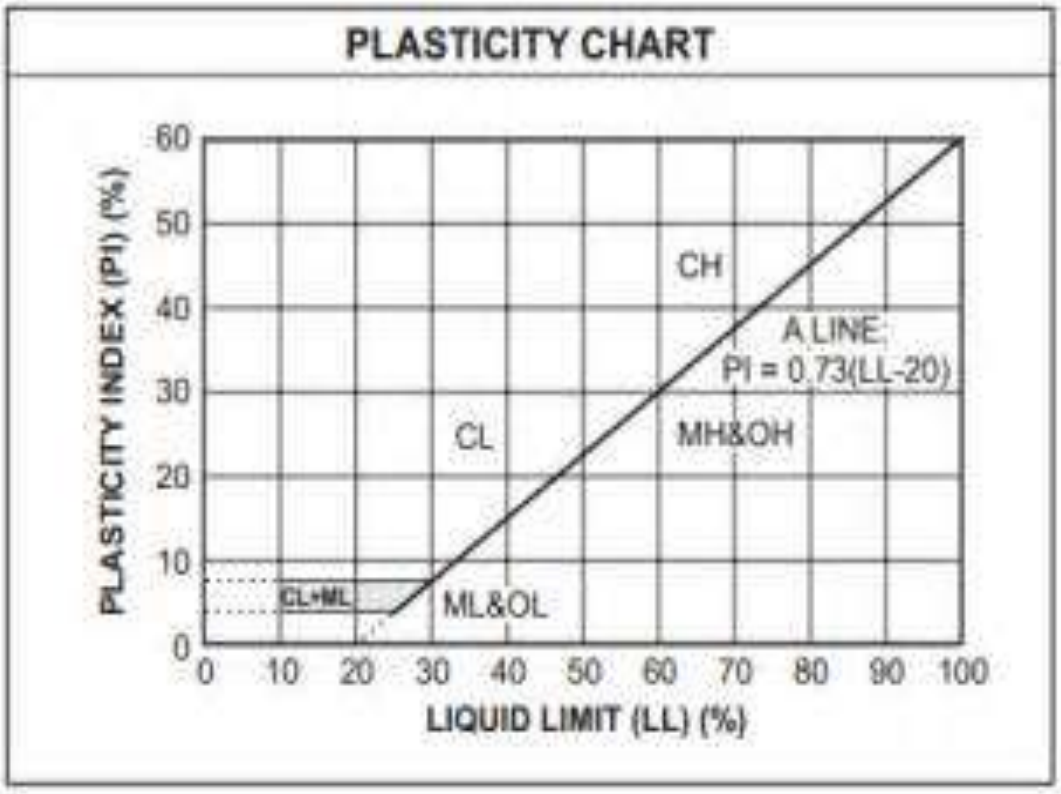
CLASSIFICATION CRITERIA FOR FINE–GRAINED SOILS

The laboratory classification criteria for classifying the fine-grained soils are given in the plasticity chart shown in Fig. 1 and Table 4. The' *A* ' line has the following linear equation between the liquid limit and the plasticity index:

$I_p = 0{\cdot}73\ (\ W_L - 20\ )$ where I_p.- plasticity index, and W_L- liquid limit.

Organic silts and clays are usually distinguished from inorganic silts which have the same position on the plasticity chart, by odour and colour. However, when the organic content *is* doubtful, the material can be oven dried, remixed with water, and retested for liquid limit. The plasticity of fine-grained organic soils is greatly reduced on oven drying) owing to irreversible changes in the properties of the organic material. Oven drying also affects the liquid limit of inorganic soils, but only to small degree. A reduction in liquid limit after oven drying to a value less than three-fourth of the liquid limit before oven drying is positive identification of organic soils

Figure 1 Plasticity Chart to classifies Fine Grained Soil



Boundary Classification of fine grained soils-

The fine-grained soils whose plot on the plasticity chart falls on, or practically on) *'A'* line · b) 'w*L*= 35 ' line

c) *'wL*= 50 ' line shall be assigned the proper boundary classification. Soils which plot above the ' *A* ' line, or practically on it, and which have plasticity index between4 and 7 are classified ML-C**L.**

CONCLUSION

Classification and Identification of the soil is the ease of good selection of the soil, it gives the information about the soil and difference between the different types of the soil and usefully make boundary line between fine and coarse grains soils. Before start any project the classification is necessary to make project economical and safe

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