

A BRIEF REVIEW ON VARIOUS METHODS AND MATERIALS USED FOR STABILIZATION OF SOIL

Ayushi Lakhanpal¹, Avani Chopra²

¹Research Scholar, Department of Civil Engineering, Chandigarh University, Punjab, India

²Assistant Professor, Department of Civil Engineering, Chandigarh University, Punjab, India

Abstract - Soil is an important part of the construction industry. Be it constructing any structure on it or using it as a building material, its significance cannot be neglected. Soil is found in abundance on the earth's surface, but all of it is not suitable for carrying out construction on it. The engineering properties of soil vary from place to place. Thus proper tests are required to be performed on the soil to check its suitability for construction. In earlier times when soil of a particular place was found to be unfit for construction then it was completely replaced by another soil having better properties. But gradually as time passed this technique proved to be very costly and difficult. Thus a new technique of stabilizing the soil was used in which the soil was stabilized by adding various materials in it, thus improving the soil properties. Materials like lime and cement were mostly used for soil stabilization. But now a day's alternative materials like waste from various industries such as marble dust, waste foundry sand, fly ash etc are used for stabilizing the soil due to scarcity of the conventional materials. Apart from the material used the method applied for stabilizing the soil is also important. Soil stabilization is done using various methods such as mechanical and chemical stabilization. This paper presents an appraisal on the various materials and methods used to stabilize the soil.

Keywords: soil stabilization, mechanical, chemical, lime, cement, fly ash

1. INTRODUCTION -

The word "soil" is derived from the latin word "solium", which basically means the upper layer of the earth's crust. To a geologist soil is that material on which plants can grow while for an engineer, soil is the material formed by the disintegration of rocks on which buildings and other structures can be built. It is also an important material used in construction. According to the Indian Council of Agricultural Research soils are classified into 8 main categories, they are, alluvial soil, red soil, laterite soil, black cotton soil, mountainous or forest soils, arid or desert soils, saline or alkaline soils, peaty or marshy soils. Each type of soil has different type of chemical composition as well as different properties. Based upon the geographical locations the soil availability varies from place to place. For example the arid soils are found mostly in the areas of Gujarat and Rajasthan while the

laterite soils are found in regions of Assam, Mysore etc. The engineering properties of these soils need to be checked properly before starting the construction work as all the soils are not suitable for construction always. In earlier times when soil of a particular place was found to be unfit for construction then it was completely replaced by another soil having better properties. But gradually as time passed this technique proved to be very costly and difficult. Thus a new technique of stabilizing the soil was used in which the soil was stabilized by adding various materials in it, thus improving the soil properties. Apart from the materials used the methods used for stabilizing the soil are also equally important. The right selection of material and method will stabilize the soil properly which will thus increase the bearing capacity thereby making it fit for construction. One of the recent examples of a building failure due to loose soil occurred in Bangalore city of India. A five-storey building under construction at Vinayaka Layout near Electronic City caved in dramatically, apparently due to a weak foundation and poor quality of materials used in the construction [1]. Below picture shows the tilted building.



2. METHODS USED FOR STABILIZATION OF SOIL

The main purpose of the soil stabilization process is to increase the bearing capacity of the soil, thus making it fit for construction. A lot of methods are employed for stabilizing the soil. The 3 main methods are mechanical

stabilization, chemical stabilization and stabilization with the help of geosynthetics.

2.1 Mechanical stabilization-

Mechanical solutions involve physically changing the property of the soil somehow, in order to affect its gradation, solidity, and other characteristics [2]. Dynamic compaction and Vibro compaction are the two techniques used for mechanical stabilization. In vibro compaction the soil is compacted with the help of vibrations while dynamic compaction uses a heavy weight for the same. This is one of the oldest methods of stabilizing the soil.

2.2 Chemical stabilization-

Chemical solutions are the techniques that rely on adding an additional material to the soil that will physically interact with it and change its properties [3]. Lime and cement are the most common and the oldest materials used for stabilizing the soil chemically. But with the advent of new materials and excess of industrial waste available, lime and cement are now used less. Some of the industrial wastes that are used are fly ash, kiln dust, marble dust, foundry sand etc.

2.3 Geosynthetic stabilization-

Geogrids are used in geosynthetic stabilization, to reinforce the road sections. Geogrid with reduced aggregate thickness option is designed for urban area and this provides a stable working platform corresponding to 97 percent of CBR [4].

3. MATERIALS USED FOR STABILIZATION OF SOIL

Apart from the methods employed the materials used for stabilization also play an important in strengthening the soil. Some of the conventional materials used are lime and cement. But now days a lot of waste from the industries is also used as stabilizing agents. Some of the examples of the waste materials used are fly ash, foundry sand, marble dust etc. By adding the appropriate proportions of these materials in the soil, its index properties can be significantly improved thereby making it suitable for construction.

3.1 Stabilization using lime-

Jawad and Taha studied literature of the lime stabilised soil extensively. They concluded that soil-lime mixtures have advantages and disadvantages. Its advantages consist of significant increase in the soil strength as well as reduce plasticity while a considerable reduction in consolidation settlement and improve compressibility characteristics were observed [5]. P Bhengu and D Allopi

also carried out review on using lime as a soil stabilizing agent. They stated that lime is an affordable chemical as it is less expensive than potential substitutes used in road soils stabilisation [6]. Thus although lime being an old material is still very much feasible for use. The suggested ratio for using lime in stabilizing the soil is around 4% to 7% by the dry weight of the natural soil [7]. Some of the main advantages by adding lime to soil are, a considerable reduction in the moisture content, increasing long term strength and a reduction in the swelling potential.

3.2 Stabilization using cement-

Cement is one of those materials that is widely used in the production of concrete. But apart from being an important component of concrete, cement is used extensively in the stabilization of soil also. Anil Pandey and Ahsan Rabbani carried out an experimental study on soil stabilization using cement, they added cement from 0% to 6% into the soil [8]. They observed that 5% addition of cement to the soil gives outstanding results with values like the optimum moisture content and maximum dry density increasing considerably with the addition of cement. The suggested ratio for using cement in soil stabilization is around 4% to 6% by the dry weight of soil [9]. Adding cement to the soil increases its tensile and ductile strength thereby allowing the soil to absorb more vibrations from the traffic of heavy vehicles too. Also since cement has a water resistant property, adding it to the soil makes it a leak proof surface.

3.3 Stabilization using fly ash-

Fly ash is a waste material that is obtained from the burning of coal in electric power generating plants. If not treated properly this fly ash causes a lot of harm to the environment. A lot of fly ash is used in concrete as a pozzolanic material which helps in increasing its strength. Similarly it can be used in soil also for stabilization. Phanikumar and Sharma carried out an experimental investigation to study the effect of fly ash on expansive soils [10]. They added fly ash in the ratio of 0% to 20% on dry weight basis and observed that increase in fly ash content reduces plasticity and there was a reduction in the free swell index by upto 50% on addition of 20% of flyash. The suggested ratio of fly ash usage in soil is around 10% to 16% by the dry weight of the natural soil [11]. Flyash is typically used in subgrade or subbase and not as a surfacing material in the soil. Addition of flyash in soil increases the workability as well as reduces the shrink swell potential. Unlike the lime and cement, utilizing flyash for stabilization is a more environment friendly as well as a sustainable option.

4 CONCLUSION-

The safety of the building not only depends upon the type and quality of the materials used but also depends a lot on the engineering properties of the soil. If the bearing capacity of the soil or the shear strength is not enough to withstand the building load then the structure might tilt or at times even fall. Thus it is very important to carry out soil tests in the laboratory before starting the construction process. The soil tests help to determine the properties based upon which the necessary stabilizing steps can be taken for its improvement if required. A lot of research is continuously going on to develop more and more standards that can help us in making soil more safe and stable for construction. Apart from the conventional materials like the lime and cement, waste materials like fly ash, kiln dust etc are also being used to stabilise the soil. By using these materials in an effective way we are able to stop the harm caused by them to the environment. Thus by taking proper precautions prior to the construction process, a lot of accidents can be prevented.

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