Review on Improvement of Engineering Properties of Soil Using Structural Concrete Waste and Polypropylene

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Abstract: India has been coming into view as one of the world's fastest growing economies, which has brought it with a significant jump in construction activities. Hence, Structural Concrete Waste is increasing with the rapid growth in construction activities during construction process at construction sites and in plants, for the production of construction materials.

In addition to this, with the rapid increase in generation of waste from plastics industry all around the world due to Changing Consumption, Production Patterns and Economic Growth. The world's annual consumption of plastic materials has increased from around 5 million tonnes in the 1950s to nearly 100 million tonnes. Thus, presently 20 times more plastic is produced as compared to 50 years ago. After food waste and paper waste, plastic waste is the third major constitute at municipal and industrial waste in cities. This situation gets worsened due to the fact that they are not even aware of the ill-effects of plastic waste to environment.

Due to the large quantities of structural concrete waste and extremely long periods required for natural decomposition of waste plastic, they are often the most visible component in waste dumps and open landfills resulting in serious environmental problems. So depending on this, the object of this thesis was chosen as **"Improvement of Engineering Properties of Soil Using Structural Concrete Waste and Polypropylene"**.

KEYWORDS: Soil Stabilisation, Structural Concrete Waste (Fines), Fibres of Waste Plastics, Plain Soil, Mixed Soil, Reinforcement, Reinforced soil, Polypropylene, Maximum Dry Density, Optimum Moisture Content, Direct Shear Strength Parameters, Unconfined Compressive Strength.

I. INTRODUCTION

For any structure, the foundation is most crucial and has to be strong to prop the entire structure. Soil near by the foundation plays very crucial part in foundation's strength. We need to have proper view about their properties and factors act on their behavior. The process of soil stabilization or improvement of properties helps us to achieve the required properties in a soil needed for the construction work. In recent life span, with the increase in the need for infrastructure, ungraded materials and fuel, soil stabilization has started to take a new shape. With the availability of better research, materials and equipment, it is emerging as a popular and cost-effective method for soil improvement to improve soil other than replacing the poor soil at the building site.

Here, in this project, soil stabilization has been done with the help of using the fines obtained from demolished concrete structures and randomly distributed polypropylene fibers obtained from waste materials. To upgrade soil in the shear strength parameters has been lay emphasis on and number of comparative studies has been carried out by using different methods of shear resistance measurements.

In this research work, the laboratory work is to carried out for the utilization of fines obtained from structural concrete waste of structures demolished in NITTTR, Sector – 26, Chandigarh and waste fibres of polypropylene (randomly distributed) obtained from the Supreme Industries, Village – Serseni (Lalru), Ambala – Chandigarh Highway, Distt.-S.A.S.Nagar, Punjab; producing a number of plastic items which are globally used for the different works, in the improvement of the various properties of the Clayey (CI) type of soil obtained from Chandigarh College of Engineering and Technology (CCET), Sector – 26, Chandigarh.

II. PURPOSE OF REVIEW

The purpose of this review is to introduce and summaries literature pertaining to the application of structural concrete waste or polypropylene fibre as reinforcement for the improvement of soil, by examining the performance of experimental soil test samples. The review is limited to published research reports, journal articles, and conference proceedings.

This review is structured to illustrate the value added to foundations by the use of structural concrete waste and polypropylene as waste fibres for the improvement in soil engineering properties as reinforcement. In particular, the review is designed to illustrate the benefits derived from the structural concrete waste and waste polypropylene fibre reinforcement, the conditions under which the composition of these is beneficial. Conclusions from this section are used later to evaluate the existing design procedures, to comment on develop application specifications.

All work reviewed in this section is taken at face-value, meaning that the work has not been critiqued in the process of review. Every attempt has been made to report details and conclusions as contained in the original references.

III. STUDIES ON STABILISATION OF SOIL USING WASTE MATERIALS

Vipul Kerni et al. (2015), "Subgrade Soil Stabilization Using Fines Obtained from Demolished Concrete Structures" Soil stabilization may be defined as the process of changing soil engineering properties to improve the bearing capacity and durability property of weak soil. The aim of the study was to review on stabilization of clayey soil using demolished waste material. Various methods are available for stabilizing clayey soil. These methods include stabilization with chemical additives, soil replacement, compaction control, moisture control and thermal methods. All these methods may have the disadvantages of being ineffective and expensive. Based on literature fines obtained from demolished waste is a low cost and effective soil stabilization method.

Shish Pal et al. (2015), "Soil Stabilisation Using Polypropylene as Waste Fibre Material" There is a rapid increase in generation of waste plastics all around the world due to Economic Growth, Changing Consumption and Production Patterns. The world's annual consumption of plastic materials has increased from around 5 million tonnes in the 1950s to nearly 100 million tonnes. Thus, presently 20 times more plastic is produced as compared to 50 years ago. So, with this, more and more resources are being used to meet the increased demand of plastics, which results in higher generation of plastic waste. Due to extremely long periods required for natural decomposition, waste plastic is often the most visible component in waste dumps and open landfills. Plastic waste recycling can provide an opportunity to collect and dispose off, plastic waste in the most environmental friendly way and conversely, it can be converted into a resource.

Due to growing concern about the disposal off plastic waste, and the panic in the current environmentalist, the object of this thesis was chosen as "Soil Stabilisation Using Polypropylene as Waste Fibre Material" which is one of the type of the plastic waste.

Pramod S. Patil (Jun-2014), "Innovative techniques of waste plastic used in concrete mixture." Disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. In recent time use of such, Industrial wastes from polypropylene (PP) and polyethylene terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Plastic recycling was taking place on a significant scale in an India. As much as 60 % of both industrial and urban plastic waste is recycled which obtained from various sources. People in India have released plastic wastes on large scale have huge economic value, as a result of this, recycling of waste plastics plays a major role in providing employment.

Ghatge Sandeep Hambirao et al.; (Feb-2014), "Soil stabilisation using waste shredded rubber tyre chips." Construction of engineering structures on weak or soft soil is considered as unsafe. Improvement of load bearing capacity of the soil may be undertaken by a variety of ground improvement techniques. In the present investigation, shredded rubber from waste has been chosen as the reinforcement material and cement as binding agent which was randomly included into the soil at three different percentages of fibre content, i.e. 5% 10% and 15% by weight of soil. The investigation has been focused on the strength behaviour of soil reinforced with randomly included shredded rubber fibre. The samples were subjected to California bearing ratio and unconfined compression tests. The tests have clearly shown a significant improvement in the shear strength and bearing capacity parameters of the studied soil.

N.Vijaya Kumar et al.; (Jan-2014), "Evaluation of wear properties of industrial waste (Slag) reinforced polypropylene composites." A lot of waste is produced by industries and they are piled up on land which creates land and environmental problem. Government policies and regulations force us to look for alternatives. Therefore researchers are trying to utilize these wastes as reinforcement in composites. Slag is an industrial waste reinforced in polypropylene composites. The pin-on disc wear testing machine has been used to study the friction and wear behaviour of the polymer composites. The wear loss and coefficient of friction are plotted against the normal loads and sliding velocities. It is observed from the graphical representation of the result that with the increase in load weight loss decreases and increase in sliding velocity weight loss also increases.

Rifai et al. (2014), "Effect of Volcanic Ash Utilization as Substitution Material for Soil Stabilization in View Point of Geo-Environmental." Studied the effect of volcanic ash utilization as substitution material for soil stabilization in the view

point of Geo-environment. They studied the engineering properties of soil mixture, the effect of volcanic ash content and its finest level. The fineness of volcanic ash is a prime factor in the stabilization. Utilization of volcanic ash with grain size passing sieve no 270 is more effective. The study revealed that the volcanic ash content can improve the engineering properties of soft soil, change the grain size distribution curve by decreasing the fine fraction, decreases the consistency limits and become non plastic soil, increases the bearing capacity and decreases swelling potential.

Edeh et al. (2014), "Evaluation of Sawdust Ash-Stabilized Lateritic Soil as Highway Pavement Material." Conducted laboratory evaluation of the characteristics of lateritic soil stabilized with sawdust ash. The tests performed were unconfined compressive strength and California bearing ratio (CBR). The results of laboratory tests shows that the properties of lateritic soil improved when stabilized with sawdust ash (SDA).

Miss Apurva J Chavan (Apr-2013), "Use of plastic waste in flexible pavements." Disposal of waste materials including waste plastic bags has become a serious problem and waste plastics are burnt for apparent disposal which cause environmental pollution. Utilization of waste plastic bags in bituminous mixes has proved that these enhance the properties of mix in addition to solving disposal problems. Plastic waste which is cleaned is cut into a size such that it passes through 2-3mm sieve using shredding machine. The aggregate mix is heated and the plastic is effectively coated over the aggregate. This plastic waste coated aggregate is mixed with hot bitumen and the resulted mix is used for road construction. The use of the innovative technology will not only strengthen the road construction but also increase the road life as well as will help to improve the environment. Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes.

IV. FINDINGS FROM LITERATURE REVIEW (GAPS IDENTIFIED)

After critically studying the literature review followings gaps are drawn:

a) A number of research work have been reported for the use of waste demolished fines and the waste fibre materials separately but they can be used as a composite material to enhance the properties of the soil such as soil bearing capacity, shear strength of the soil and or unconfined compressive strength of the soil, which is identified as a major gap from the various papers as listed above.

b) As the current annual rate of generation of construction and demolition waste in India is estimated to 11.4 to 14.69 tonnes. These statics shows that there is a need to reuse these construction and demolition wastes.

c) Coarser fraction obtained from construction and demolition waste finds their application in improvement of soil bearing capacity and or pavement construction, but the finer material is being left out still as waste material.

d) Extensive research work is reported on use of oriented and randomly oriented fibre reinforcements using laboratory testing, while this brought out the positive improvement of geotechnical behavior of soils. However, little work reports on the use of waste fiber polypropylene materials.

e) The overview has brought out the need for systematic investigations into the various aspects of reinforcement in particular considering the influence of types of waste fibre inclusions.

f) The majority of works carried out in the field of sub-base or base improvements of the various types of pavements using coir geotextiles to control erosion and watershed management. Only a few works have been reported regarding the utilisation of polypropylene for the improvement of engineering properties of soil. Therefore, a scope of systematic research work in this area is lacking.

V. NEED FOR PRESENT STUDY

The review of literature shows that the structural concrete waste material obtained from the construction and demolition of structures and polypropylene (waste fibre material form plastics) can be used in the soil stabilization.

Using C&D waste in soil stabilization helps to reduce the hazardous environmental impacts of the waste and improves the geotechnical properties of soil which ultimately reduces the cost of construction and increases the life of the structure built on stabilized soil. Also, polypropylene is a versatile material with attractive characteristics and advantages, as a result of this polypropylene is now being used abundantly all over the world. Waste fibres or plastics have high strength, less cost, long life and also they are non-biodegradable, therefore, may be used for the enhancement of engineering properties

of soil (stabilisation of soil) and may also be used for control of seepage. The use of waste fibres or plastics will results in decreasing the requirement of valuable land for the disposal of wastes and it will also reduce the environmental impacts. Therefore, in this work an attempt had been made for utilisation of structural concrete waste and waste fibre material produced from polypropylene for the enhancement of engineering properties of soil.

VI. CONCLUSION

From the above discussion it can be concluded that there is a need to utilize the structural concrete waste obtained from construction and waste fibres of polypropylene obtained from the various industries across the country for the stabilisation of the soil, which will directly help in decreasing the requirement of the valuable land for their disposal and also decline the hazardous environmental impacts.

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