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STUDY OF STABILITY OF SOIL WITH USING STEEL FIBER

Dhyanendra Singh Rajput[1], Mukesh Pandey[2]

1. M.tech Student, ITM University, Gwalior, M.P., India
2. Professor & Head, Department of Civil Engineering, ITM University, Gwalior.

ABSTRACT - *Rapid improvements in the engineering world have influenced the lifestyle of human beings to a great extent. But the day to day activities of mankind are augmenting risks to the environment in the same proportion. Use of steel products in various industries is increasing day by day leading to various environmental concerns. Therefore, the disposal of the steel wastes without causing any ecological hazards has become a real challenge. Steel wastes have become one of the major problems for the world. In recent years, researchers from various fields have attempted to solve environmental problems and huge waste caused by the production of non-biodegradable wastes like steel. Using a geotechnical viewpoint, this study proposes a partial solution to a major item which piles up in the wastages i.e. Steel waste. But the primary objective of this study is to examine the potential capability of stabilizing soil using waste steel fiber. Various tests such as Standard Proctor, CBR were carried out with different samples to determine the effect of steel fibers in silty clay. The initial results obtained were promising and supporting the fact of achieving stability of the soil. The advantages of this study results in three folds- Utilization of natural resource (silty clay), Economy, and waste management. Mixing of steel waste fiber with expansive soil helps to mitigate the volume change behavior of soil.*

Keywords: *Soil, Plastic cover, Stabilization, Optimum moisture content (OMC)*

INTRODUCTION

Soil stabilization means the improvement of stability or bearing power of the soil by the use of controlled compaction, proportioning and/or the addition of suitable admixture or stabilizers. The basic principles of soil stabilization are:

a. Evaluating the properties of given soil.
b. Deciding the lacking property of soil and choose effective and economical method of soil stabilization.
c. Designing the stabilized soil mix for intended stability and durability values.

Stabilization can increase the shear strength of a soil and/or control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations. Stabilization can be used to treat a wide range of sub-grade materials from expansive clays to granular materials. The most common improvements achieved through stabilization include better soil gradation, reduction of plasticity index or swelling potential, and increases in durability and strength. In wet weather, stabilization may also be used to provide a working platform for construction operations. These types of soil quality improvement are referred to as soil modification. Benefits of soil stabilization are higher resistance values, reduction in plasticity, lower permeability, reduction of pavement thickness, elimination of excavation, material hauling and handling, and base importation, aids compaction, provides all-weather access onto and within projects sites. The determining factors associated with soil stabilization may be the existing moisture content, the end use of the soil structure and ultimately the cost benefit provided. As good soil becomes scarcer and their location becomes more difficult and costly, the need to improve quality of soil using soil stabilization is becoming more important. Soil stabilization using raw plastic bottles is an alternative method for the improvement of subgrade soil of pavement. It can significantly enhance the properties of the soil used in the construction of road infrastructure.

RESEARCH SIGNIFICANCE

For many years, road engineers have used additives such as lime, cement and cement kiln dust to improve the qualities of readily available local soils. Laboratory and field performance tests have confirmed that the addition of such additives can increase the strength and stability of such soils. However, the cost of introducing these additives has also increased in recent years. This has opened the door widely for the development and introduction of other kinds of soil additives such as plastics, bamboo, liquid enzyme soil stabilizers etc.

Soil stabilization using steel fibers is an alternative method for the improvement of soil. It can significantly enhance the properties of the soil used in the construction of road infrastructure and other structure. Results include a better and longer

lasting road with increased loading capacity and reduced soil permeability. This new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials that lead to the foundation of sustainable society. It can be effectively used in strengthening the soil for road embankments and in preparing a suitable base for the upper pavement structure. Since it increases the bearing capacity of soil considerably, the land use can be increased. It can lower the road construction and maintenance costs while increasing the overall quality of its structure and surface.

The promise that soil stabilization technology can actually improve the mechanical qualities of soil so that stronger, more durable structure can be built has prompted around the world to conduct extensive testing to verify that this new technology is truly cost-effective. The result is that this new advance in soil stabilization technology is increasingly being used in both constructing and improving/rehabilitating soil structure worldwide.

METHODOLOGY

Soil material: The soil types in the study were Silty-clay soil and sandy soil. Soil collected from the ITM University campus was used in this study for Laboratory testing. the maximum dry density and maximum water content of soil as determined from the relative tests.

Steel fiber material: The steel fiber material was sourced from a local market was used in this study for Laboratory testing of different percentage with different types of soil. The tests were conducted at various waste plastic contents of 0%, 5%, 10% and 15%.

IV. RESULTS

Soil Characteristics

Test was conducted to find various characteristics of the soil sample. The results obtained are tabulated.

Natural Moisture Content	***27%***
Liquid Limit	***26.7%***
Plastic Limit	***23%***
Plasticity Index	***4%***
Specific Gravity	***2.17***
Sieve Analysis	***GM-GW***
Optimum Moisture Content	***8%***
Maximum Dry Density	***18.24%***

Engineering Property Tests:

Tests were conducted on untreated sample and Samples 0%, 5%, 10% and 15%. replacement of soil with steel fibers. The tests were conducted as per the procedure specified in IS 2720 part VII- 1980.the standard proctor test and CBR tests were conducted. The results from the CBR test are given below.

1. Unsoaked Soil Sample

The CBR value is determined.

CBR Unsoaked Soil Sample

Penetration (mm)	Load (kg) – Pure Soil	Load (kg) – 0.05% Plastic Fiber Mix Soil	Load (kg) – 0.10% Plastic Fiber Mix Soil	Load (kg) – 0.15% Plastic Fiber Mix Soil
0.5	280	270	285	290
1	293	295	305	314
1.5	297	300	315	323
2	304	308	323	330
2.5	315	322	330	345
3	330	345	348	357
4	380	383	385	390
5	400	405	415	430

CBR Value: Unreinforced Soil at 2.5 mm penetration = 23.0%
0.05% Plastic reinforced at 2.5 mm penetration = 23.5%
0.10% Plastic reinforced at 2.5 mm penetration = 24.1%
0.15% Plastic reinforced at 2.5 mm penetration = 25.2%

2. Soaked Soil Sample

Penetration (mm)	Load (kg) – Pure Soil	Load (kg) – 0.05% Plastic Fiber Mix Soil	Load (kg) – 0.10% Plastic Fiber Mix Soil	Load (kg) – 0.15% Plastic Fiber Mix Soil
0.5	164	173	180	187
1.0	169	180	185	196
1.5	173	185	193	207
2.0	179	190	196	213
2.5	182	195	200	220
3.0	194	205	220	230
4.0	215	225	235	245
5.0	238	245	260	286

CBR Value: Unreinforced Soil at 2.5 mm penetration = 13.3%
0.05% Plastic reinforced at 2.5 mm penetration = 14.2%
0.10% Plastic reinforced at 2.5 mm penetration = 14.6%
0.15% Plastic reinforced at 2.5 mm penetration = 16.1%

CONCLUSIONS

tests were conducted and the observed results were:

- There is improvement in CBR value when waste steel fibers are mixed with the soil samples.
- The addition of reclaimed steel fiber waste material was to increase the CBR value of the soil. The increase in CBR value with addition of steel fibers would mean that the thickness of the subgrade flexible pavement road would also be reduced.
- This new technique of soil stabilisation can be effectively used to meet the challenges of society, producing useful material from non-useful waste materials.
- The use of steel wastes has significantly helped in ground improvement.
- It can significantly enhance the properties of the soil used in the construction of road infrastructure. Results include a better and longer lasting structure with increased loading capacity.

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