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Analysis of Stability of Road by Using Geotech Cell

Ganesh Nandkishor Mahore, Dr. B. S. Shete, Prof.Ashish Bijwe

Department of Civil Engineering, Dr. Rajendra Gode Institute of Technology and Research, Sant Gadge Baba Amravati University, Amravati, India

ABSTRACT:Steel slag is a by-product of steel industry. It has been declared as useful construction material, not an industrial waste by most of the developed countries. Successively, it is recycled as an aggregate for construction of road, base and for the surfacing of flexible pavement. In this project, construction of rural road with high density polyethylene geocell having honeycomb shape of compartment and utilizing the industrial steel slag as filling material in the form of aggregate, will be used. The main purpose of the project is to construct the better quality rural road. The project will evaluate the properties of natural aggregate with steel slag and will study the behavior of GEOCELL and STEEL SLAG under compressive load, settlement of subgrade and wearing of surface. The aim of this work is to construct road for the rural area having better serviceability, longer durability, less time of construction and at minimum cost.

KEYWORDS: Geocell; Steel Slag; RoadConstruction;

I. INTRODUCTION

India is home of large rural population. Most of the rural areas in India do not have asset to all weathers roads and hence have a through time during the monsoon. This problem is more significant in the northern and the northeast part of the country. The government is in its 11th five-year plan has allotted in Rs.100000 cores for construction and maintenance of the village road.

A large proportion of the population of India lives is villages. Rural connectivity has tremendous impact on agriculture, employment, socio – economic services and over and above leads to general area development. The rural roads are engineering structures and should be designed and constructed based on the requirement. The cost involved in the maintenance should compare with the likely benefits accrued to the road users. Certain new concepts which can be applied for the rural road development are use of geocell and the waste material steel slag in the construction of the road for the rural road.

Development of the infrastructure is the most important need in present time. To full fill the infrastructural need of population, small multi-story buildings, express highways, high speed rail tracks, new bridges, airports etc. are required to construct. Ultimately loads from such structure come on the ground. Due to space constrains many times construction takes place on poor soil. Construction over poor soil with high loads is a challenge for civil engineers. Replacement of weak soil by some strong soil or improvement of engineering properties of weak soil by different ground improvement techniques are used in such situation. If such soil cannot be removed or uneconomical to remove then we can use ground improvement techniques. Soil reinforcement is one of the most popular ground improvement techniques. Ease of construction, overall economy and less time consumption are major advantages of soil reinforcement. Use of metal bars, sheet, and strips were traditional form of reinforcement. Geosynthetics are human-made materials made from various types of polymers used to enhance, augment and make possible cost effective environmental, transportation and geotechnical engineering construction projects. They are used toprovide one or more of the following functions; separation, reinforcement, filtration,drainageor liquid barrier

II. RELATED WORK

Rural road are the tertiary road system in the total road network which provides accessibility for the rural habitations to market other facility center. In India, during the last five decades, rural roads are being planned and programmed in the context of overall rural development, and tried to provide all weather connectivity with some level of achievement. The long-term road development plans for the country provided policy guidelines and priorities for rural roads, while the found for rural roads were allocatedin five-year plans. Conventionally concrete is mixture of cement, sand and

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aggregate. Properties of aggregate affect the durability and performance of concrete, so aggregate is an essential component of concrete. Fine and coarse aggregate constitute about 75% of total volume.
It is therefore, important to use right type and good quality aggregate in concrete, because the aggregates the main matrix of concrete. Now a days aggregate is obtained from natural rocks which is decreases day to day.
Therefore, it becomes more necessary to find suitable sustainable alternative source to natural aggregates for preparing concrete. At present many steels plant are being set up across the globe causing a huge production of solid waste material like slag. Steel plants in India generate about 29 million tons of waste material annually, and 50 million tonnes worldwide. Now most of the industrial slag are being used without taking full advantage of their properties or thrown off rather than used. In accordance to chemical and mineral composition of the slag, these steel slags have cementations and/or pozzolonic property and can be potentially used as a main constituent of cement. Slag causes reduction in porosity of soil as well as permeability of soil thus causing water logging problem. The disposing of this material will have negative impact on environment. Steel slag is industrial waste resulting from steel refining plants in conversion process. Owing to the large production, the research work for the last 30 years has shown that 65% of steel slag used today is for qualified fields of application. But remaining 35% of slag is still dumped. As a more active approach, slag can be used in the production of composite material of strength value 42.5 to 32.5kN. The slag present in concrete satisfy physical properties which slows down the hydration of blended cement due to morphology and low calcium silicate content.

Thus, steel slag can be used in conventional concrete to improve its mechanical, chemical and physical properties. Large quantities of natural materials are traditionally used in road construction. Uncontrolled depletion of natural, non-renewable resources leads to environmental destruction and distortion of natural balance. Concurrently the world faces the problem of management of an increasing quantity of waste, so that linking the two problems leads to a simple solution: a growing and more diverse application of waste materials in road building and other areas of civil engineering alike. Waste materials whose application is possible in road construction are divided into three basic groups: re-usable construction materials, industry by-products and natural construction materials of a lower usability value.
The first group includes the materials that were used one or more times, such as materials from unbound base courses (gravel, sand, and rock) and materials from bitumen and hydraulically bound layers. Slag and fly ash belong to the group of industry by-products, whereas the group of natural construction materials with lower usability value is primarily represented by excavation materials and quarry waste.

Mechanism of Reinforcement

If we compare Geocell reinforced base with unreinforced base then it is experimentally proved that geocell reinforced bases provide more lateral and vertical confinement, Tensioned membrane effect and wider stress distribution. According to Rajagopal geocell reinforcement imparts apparent cohesive strength even to cohesion less soils and the induced apparent cohesive strength depends on the tensile modulus of the geosynthetic used to form the geocell. Dash et al., concluded that very good improvement in the footing performance can be obtained even with geocell mattress of width equal to the width of the footing, because of the transfer of footing loads to deeper depths through the geocell layer. The surface footing in this case behaves like a deeply embedded footing thus improving the overall performance also Chevron pattern for the formation of geocells is more beneficial than the geocells in diamond pattern. Boushehrian et al., studied experimentally and numerically the effect of the depth of the first reinforcement layer (u), spacing between reinforcements (h), and reinforcement stiffness on the bearing capacity of circular and ring foundations of sand. Sitharaminvestigated the settlement response of geocell reinforced soil underlying soft clays. They reported a substantial reduction in footing settlement by providing geocell reinforcement in the soft clay bed. Vinod et al. has reported the results of model tests on the settlement behavior of strip footing resting on geocell reinforced sand during cyclic loading and concluded that Geocell reinforced foundation exhibit a four-fold increase in ultimate bearing capacity of the footing compared to unreinforced counterparts. Moreover, the laboratory results highlight that cyclic stress ratio and frequency has a significant influence on the settlement behavior of geocell reinforced foundation.

III. METHODOLOGY

India is the 3rd largest steel producer in the world with total steel production of 95.6 Million Ton per year and in an integrated steel plant, 2-4 tonnes of wastes (including solid, liquid and gas) are generated for every tonne of steel produced. Among all the solid/liquid wastes, the largest part are slags and the current utilization of steel slag is less than 30%, far behind the developed countries. The sustainable development concept requires a more efficient

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management of waste materials and preservation of environment and thus the emphasis on its recycling remains one of the most serious concerns that needs redressal.
Steel slag can be used potentially as a sustainable material in construction of pavements in India as our country has world's second largest road network in terms oflength with a total road length of 4.24 Million Km. Large scale highway constructionin India, emanating from rapid development has caused massive depletion of scarcenaturalaggregate.Theuseofsteelslagaggregateinrigidaswellasflexiblepavementsbyreplacingnaturalaggregateisamostpromisingconcept

This work presents a detailed study towards understanding the behaviour of geocell.HOWEVER, the performance of reinforced geocell is influenced by numerous factors dueto the limited time and resources, this study cannot address all this factor

IV. EXPERIMENTAL RESULTS

Figures shows the results of text detection from an image and inpainting by using exemplar based Inpainting algorithm. Figs. 2, 3, 4 (a) shows the original image. (b) is the image obtained by applying first set of criteria. All objects whose area greater than 10000 and filled area greater than 8000 are eliminated and major axis lengths are in between 20 to 3000 are considered to be text. Still, some small non-text objects are detected.

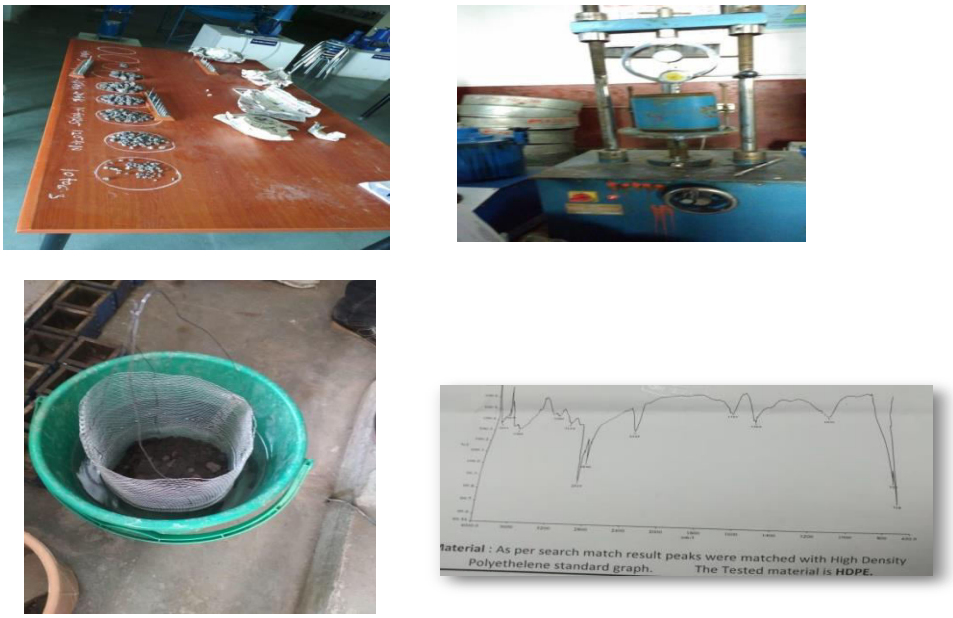

Fig. 2.Text Detection and Inpainting (a) Original image (b) Image after applying first set of criteria (c) Image after applying second set of criteria (d) Image mask (e) Inpainted image using patch size 4 x 4 and search window size 81 x 81

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Fig. 3 Text Detection and Inpainting (a) Original image (b) Image after applying first set of criteria (c) Image after applying second set of criteria (d) Image mask (e) Inpainted image using patch size 5 x 5 and search window size 81 x 81

Passingfrom	Retainedon	Wt. ofpassing	Wt.onretained
50	40	-	-
40	31.4	-	-
25	20	-	-
20	16	0.885	0.073
16	12.5	-	-
12.5	10	0.865	0.307
10	6.3	0.614	0.006
total	-	= 2.364	=0.386

Fig. 4 Text Detection and Inpainting (a) Original image (b) Image after applying first set of criteria (c) Image after applying second set of criteria (d) Image mask (e) Inpainted image using patch size 5 x 5 and search window size 81 x 81

To eliminate small objects, connected component labelling is applied to the resultant image.(c) represents text detection by applying second set of criteria which eliminates all the objects whose area is less than 300 and filled area is less than 500.

V. CONCLUSION AND FUTURESCOPE

Although all the properties of steel slag gives satisfactory results as compare to the natural aggregates but it was found that the geocells were not properly bonded with the steel slag. It might have happened due to improper grading of steel slag, the filler material. Thus we conclude that the work should be repeated again with due attention on the grading of filler material received from the source.

Following conclusions can also be drawn from part of study

The time required for total construction can be greatly reduced with the Application of geocell.

The waste so obtained from the steel industries can be reused to a productive form rather than disposing it into dump-yard.

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It prevent lateral spreading of steel slag on application of load. We can use geocell to increase the strength and stiffness of steel slag.

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