A Literature Review on Influence of Subgrade Soil Stabilization Using Demolished Waste Concrete on Pavement Surface

Priyank Soni[1] Dr. P.K. Roy[2]
[1]Research Scholar [2]Assistant Professor
[1,2]Department of Civil Engineering
[1,2]NRI Institute of Research & Technology, Bhopal, India

Abstract — The demand for new infrastructure and rapid urbanization has led to an escalation in pavement construction, concomitantly resulting in a notable quantity of construction and demolition waste, predominantly waste concrete. This research investigates the feasibility of employing Demolished Waste Concrete (DWC) as a stabilizing agent for subgrade soils in pavement structures. Laboratory tests were systematically conducted to assess the mechanical and geotechnical attributes of subgrade soil amalgamated with different proportions of crushed DWC. Preliminary findings unveiled that the DWC integration substantially augmented the bearing capacity, attenuated the soil's plasticity, and bolstered its overall resilience, an enhancement attributed to the pozzolanic reactions and particle interlocking provided by the waste concrete. A secondary focus of the study scrutinized the long-term performance of pavement surfaces laid atop the stabilized subgrade, evidencing diminished rutting, reduced surface irregularities, and an optimized load distribution capability.

Keywords: Subgrade Soil, Stabilization, Demolished Waste Concrete (DWC), Pavement Surface, CBR Test, Compaction Test

I. INTRODUCTION

Subgrade soil stabilization stands out as an essential process in road construction, setting the foundation for the road structure. It involves enhancing the physical properties of the soils used in the foundation layer of roads, thereby ensuring the overall stability and longevity of the road. Traditionally, materials like lime, cement, and fly ash have been employed for this purpose. However, the search for more sustainable and economical alternatives is now more relevant than ever, given the increased rate of infrastructure development and the associated environmental concerns.

A. Demolished Waste Concrete:

Every year, vast amounts of concrete structures are demolished, resulting in enormous quantities of waste concrete. While some of this is recycled into aggregate for new concrete or used as fill materials, a significant portion ends up in landfills, contributing to land degradation and other environmental issues. The untapped potential of this waste material as a component in soil stabilization is worth exploring, especially considering its inherent strength and durability characteristics.

B. Traditional Methods:

- Lime Stabilization: Lime, either in the form of quicklime or hydrated lime, has been a go-to material for soil stabilization. It is especially effective for clayey soils, reacting chemically with the soil to reduce its plasticity and improve compactness.
- Cement Stabilization: Adding cement to soils, especially those with low clay content, helps in binding the particles together, resulting in a semi-rigid to rigid subgrade layer. The process is beneficial for improving the soil's compressive strength.
- Fly Ash Stabilization: Fly ash, a by-product from coal combustion, has found its place in soil stabilization due to its pozzolanic properties. It's primarily effective in enhancing the properties of expansive soils.

II. LITERATURE REVIEW

- S. P. Arredondo-Rea et. al., (2023) concluded that the corrosion rate of steel and the electrical resistivity of concrete were determined on reinforced concrete specimens subjected to wetting-drying cycles (3.5% solution of NaCl). After 30% of RCA in the mixture, the total porosity increases, and compressive strength decreases significantly. Steel corrosion and the electrical resistivity in concrete are not significantly influenced by replacing a maximum of 20% of fine aggregate with RFA.
- A.Naveen Arasu et. al., (2022) concluded that the demolition waste is generated from construction, renovation, repair, and demolition of houses, large building structures, roads, bridges, dams, etc., and only 5% of C & D waste has been recycled & reused. Various percentages of replacement of crushed C & D waste fine aggregate such as 10%, 20%, 30%, 40%, and 50% for natural fine aggregates, and the test is carried out. The results obtained from the compressive strength test, split tensile test, and flexural test of recycled fine aggregate in concrete were compared with the conventional concrete. Various experimental studies, it was observed the compressive strength & tensile strength of concrete with recycling natural fine aggregates with 20% replacement of crushed C & D waste fine aggregates. The strength has been increased to about 5% in compressive strength, 6% in flexural strength, and 8% in tensile strength by different test. The strength has been increased to about 5.5% in compressive strength, 6.25% in flexural strength and 9% in tensile strength by different test. From the results obtained it is suggested that C&D waste with a replacement rate up to 30% can be used effectively as a fine aggregate in good concrete production without affecting the concrete standards.
- Ali Raza Khoso et. al., (2020) concluded that the high demand of tensile strength in concrete is always a critical issue for engineers, as 10% of the compressive strength is not sufficient the University of Michigan. ECC is an ultra-ductile cementitious composite that is highly crack resistant, with a high tensile strain capacity over that of normal concrete. The composite replaces coarse

aggregates and fine aggregates by sand and fly ash respectively. The tensile strength of ECC was measured by casting & testing cylinders of 4"x 8" in Universal Testing Machine (UTM). Tensile strength in ECC 1:0.8:1.2 is increasing from (0% - 1%) of fibers by weight of cement and it has not shown any decrement up to 1% PP fiber which indicates that the indirect tensile strength would increase further at upper trials than 1%. The workability of fiber-reinforced concrete is also an appreciable issue as satisfactory workability was observed.

- Amruta Kulkarni et. al., (2020) This report shows the strength and durability properties of recycled coarse aggregate & also compares these properties with natural aggregates. As water is becoming a scarce material day by day, there is an urgent need to do research work pertaining to saving of water in making concrete and in construction
- Deepak R and Dr Vandhana Devi V, (2020) were concluded that the present study aims at making the sintered Construction demolition waste (CDW) fly ash aggregates and testing their behavior in concrete when it is partially replaced. The aggregates so prepared were fly ash-based light weight aggregates. The sintered CDW fly ash aggregates are light in weight, fire-resistant, sulphate resistant, etc. Tests have been conducted for the prepared lightweight aggregates and their results have been verified with the specifications given by Central Building Research Institute (CBRI), Roorkee. The mix design of concrete has been done according to Indian Standard guidelines for M 30 grade for the granite stone aggregates. The use of sintered CDW fly ash aggregates (SCDWFA) is not only used for concrete. It can be used for pavement works, backfilling of undercuts, etc. Thus, sintered CDW fly ash aggregates appear to have very broad applicability as an economical mode of construction especially in rural areas. It is not adequate to have awareness about the SCDWFA, all the people should adopt this new method to have sustainable development as well as to protect the environment from various industrial hazards.

A. Outcome of literature review:

- From the literature survey it is observed that research works have been carried out on using demolished concrete aggregate materials.
- However, it is seen that very little work has been reported on use of demolished concrete aggregate of concrete.
- This study is related to the reinforcement of concrete by using demolished concrete aggregate.
- In the present search, the effect of properties of demolished concrete aggregate is studied.

B. Problem Identification

- The strength of overall infrastructure will be measured experimentally with overall material cost is not done any researcher.
- Different properties of aggregate not completely compare fresh aggregate and concrete aggregate.
- In the past, various materials have been used as addendum to the mortar mixture and their effects have been studied

REFERENCES

[1] Chandler, R. J. (1984). The in-situ measurement of the degradation of soils and weak rocks. Géotechnique, 34(2), 159-172.
[2] Das, B. M. (2010). Principles of geotechnical engineering. Cengage Learning.
[3] Draper, N. R., & Smith, H. (1998). Applied regression analysis. John Wiley & Sons.
[4] Etxeberria, M., Vázquez, E., Marí, A., & Barra, M. (2007). Influence of amount of recycled coarse aggregates and production process on properties of recycled aggregate concrete. Cement and Concrete Research, 37(5), 735-742.
[5] Field, A. (2013). Discovering statistics using IBM SPSS statistics. Sage.
[6] Holtz, R. D., Kovacs, W. D., & Sheahan, T. C. (2011). An introduction to geotechnical engineering. Prentice Hall.
[7] Hopewell, J., Dvorak, R., & Kosior, E. (2009). Plastics recycling: challenges and opportunities. Philosophical Transactions of the Royal Society B: Biological Sciences, 364(1526), 2115-2126.
[8] Kabir, M. M., Wang, H., Lau, K. T., & Cardona, F. (2013). Chemical treatments on plant-based natural fibre reinforced polymer composites: An overview. Composites Part B: Engineering, 43(7), 2883-2892.
[9] La Mantia, F. P., & Morreale, M. (2008). Green composites: A brief review. Composites Part A: Applied Science and Manufacturing, 39(6), 954-961.
[10] Lee, S. H., Cho, J. Y., Park, Y. C., Rhee, K. Y., Park, S. J., & Nah, C. (2006). Mechanical properties of high-density polyethylene/particulate composites: the effects of micron size and distribution. Composites Science and Technology, 66(3-4), 581-589.
[11] Mitchell, J. K., & Soga, K. (2005). Fundamentals of soil behavior. John Wiley & Sons.
[12] Oikonomou, N. D. (2005). Recycled concrete aggregates. Cement & Concrete Composites, 27(2), 315-318.
[13] Rao, A., Jha, K. N., & Misra, S. (2007). Use of aggregates from recycled construction and demolition waste in concrete. Resources, Conservation and Recycling, 50(1), 71-81.

