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Experimental Study on use of Construction and Demolition Waste in Bituminous Concrete

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Abstract - The increase in the population, industrialization and the implementation of new infrastructure projects, the construction industry has expanded very rapidly in recent decade. Because of this, the demand for building materials for construction activities is immense, also resulting in the production of enormous amounts of construction waste. About 90 percent of demolition waste may be used as soil fillings and it damage the soil making it worthless nature. The enormous financial setbacks, contractors, regional authorities and the nation on account of waste of building material. The goal of the paper is to research the feasibility of applying construction and demolition waste (CDW) to mitigate the disposal problems.

Key Words: C&D Waste, Demolition waste, Marshal stability, density, Optimum Binder Content

INTRODUCTION

India's road network has gradually expanded over the years, and it is now second only to the United States of America in terms of total road length. In anticipation of future road developments in the area, the special IRC publication 'Road Development Plan VISION 2021' specifies a requirement of 3500 million cubic metres of aggregates and 11.25 tonnes of bitumen for road construction. These investments will continue to increase as road network modernization continues and travel demand continues to grow in India. In India, therefore, it is important today to introduce a proven methodology for road construction and maintenance to minimise investment and reduce the requirement for raw materials. The demolition of building waste is a process in which demolished building waste is used in the construction of highways. In India, the use of demolition waste is not common. Owing to rapid growth in the field of infrastructure, there is a huge demand for aggregates. Construction and demolition waste may be used as a replacement of fresh aggregates to decrease the use of fresh aggregates.

Bituminous Concrete

Bituminous concrete is a combination of coarse aggregates, fine aggregate, stone dust, filler with bitumen as the binding material. It is a dense graded bituminous mix used as wearing course used for heavy traffic. A single layer of 30mm to 50mm is provided. This material is somewhat different from regular concrete, despite its name, and contains cement or lime as a filler to the extent of 2 to 3%. While most cement-based surfaces are white or grey, the distinctive black appearance of bituminous concrete is renowned. In order to build new roads and parking lots, it is mostly laid straight over a bituminious layer, but can also be poured over existing concrete to patch or smooth out bumps and voids. The installers use massive paving machines to smooth and compact the surface until the bituminous concrete has been poured onto the roadway. Bituminous concrete, which is relatively easy to lay and compact, is sturdy enough to withstand years of automobile traffic. It also offers a smoother and quieter ride than concrete surfaces, reducing noise emissions on highways and other congested roads. Asphalt paving is entirely recyclable, despite the fact that recycled products are not as solid as raw materials.

Need and Scope of the study

The research will primarily focus on the re-use of construction and demolition waste created from new construction, demolition, and renovation in building practices in India. To support the subject, current practices of construction and demolition waste management, as well as the benefits of reusing this waste, will be discussed. Through reusing and recycling building and demolition waste, we are able to meet the growing demand for energy by supplying recycled materials while also reducing emissions on the planet.

Proposed Objectives

The aim of this study is to study the properties of demolition waste, its effects and to suggest safe reuse especially in the highway pavement.

The following are the objectives of the study:

1. To study various ways in which C&D waste can utilized in road construction.
2. To determine Optimum Binder Content for the Control Mix for Bituminous Concrete using virgin materials.
3. To determine Stability, Flow and other parameters of Bituminous Concrete by addition of Construction and Demolition waste in different percentages.

4. To determine optimal percentage of C& D waste of various types as replacement of aggregate in Bituminous Concrete.
5. To make comparison of cost between the two sets of materials.

Research Methodology

This section lays out the step-by-step process for carrying out the proposed work in order to meet the study's objectives. It contains information about the materials and methodology that will be used in the proposed project. The following are the steps that will be taken to complete the work:

- Analysis of data and information through past studies for the design and preparation of bituminous mix using recycled aggregates.
- Collection of demolition waste from C&D plant located in Industrial Area Chandigarh.
- Demolition waste collected of different sizes (grading) and types.
- Determination of properties of demolition waste for example crushing value, Impact Value etc.
- Preparation of bituminous concrete mix by using virgin aggregates by Marshall Method.
- Preparation of bituminous concrete mix by using virgin aggregates and demolished waste by Marshall Method.
- Testing of samples to determine Marshall Stability, Flow value.
- Determine the parameters air voids V_a, V_b, VFB, VMA etc in samples with and without C&D waste.
- Compare between the results obtained for bituminous mix made with virgin aggregates and also addition of aggregates obtained from demolished waste.

LITERATURE REVIEW

Conceiç Leiteda Fabiana, Santos Mottados Rosângela, Vasconcelos L Kamill and Liedi Bernucci, [2011] Pavement testing in the lab for recycled building and demolition waste. The aim of this study is to see whether aggregate from recycled building and demolition waste (RCDW) can be used in pavement applications. Geotechnical characterization, bearing power, and repeated load tri-axial tests were all part of the laboratory curriculum. The results show that the physical characteristics of the RCDW aggregate are influenced by the composition and compactive effort. Partially crushing and breaking RCDW particles during the compaction process changed the grain size distribution and increased the percentage of cubic grains. This physical change leads to the RCDW aggregate's densification, which results in increased bearing power, resilient modulus, and resistance to permanent deformation. According to the findings, RCDW aggregate can be used as a coarse base and sub-base layer for low-volume roads.

Sharma Jitender and Singla Sandeep [2014] ''Recycled Concrete Aggregates" was the subject of research. Tensile strength and modulus of elasticity increase as the water cement ratio in recycled aggregate mix is decreased. The RCA-replaced mixes have higher water absorption and porosity than standard mixes, but they are still within acceptable limits. The w/c ratio can be reduced to change these properties. Since RCAs contain mortar, their specific gravity, water absorption, and Los Angeles abrasion all mean that they are of lower quality than NCAs. Natural aggregates create harsher mixes with less workability than recycled aggregates.

Chouhan Rajesh and Yaseralwai, [2016] did experimental study of construction and demolition waste in flexible pavement. The demolition waste from building were used in proportion of 25%, 30%, 35% by the weight of aggregate the aggregate tests with demolition waste were in limits. Marshal Stability of C&D modified mix is more than the conational mix. Marshal stability of Maximum 12.22 KN was achieved at 35% replacement of aggregate by C&D waste. Bulk specific gravity also decreased as the brick and tile used have less density than normal aggregate. Indirect tensile strength test results also showed improvement. Indirect tensile strength at 0% C&D waste is found to be 0.571 N/mm^2& for 35% replacement at is equal to 0.711N/mm^2. However, there is decrease in its ratio which means susceptible to moisture. With the use of C&D waste the overall waste disposal problems can be reduced and the natural aggregate for the future generation can be saved hence will had to sustainable development.

Qasrawi Hisham and Asi Ibrahim [2016] The effect of bitumen grade on the properties of hot asphalt mixes made with recycled coarse concrete aggregate was investigated. The aim of this study is to see how recycled coarse concrete aggregates (RCA) affect the basic properties of hot mix asphalt made with various bitumen grades (60/70 and 80/100). First, the properties of recycled aggregates were calculated and compared to those of standard aggregates. There were no major variations between standard aggregates and RCA except for absorption. Later, recycled aggregates were added to asphalt mixes made with either 60/70 or 80/100 bitumen. Natural coarse aggregate was partially (0 percent, 25%, 50 percent, and 75 percent) or fully (100 percent) substituted by recycled aggregates in these mixes. The use of recycled aggregates improved the optimum bitumen content of the asphalt mixes, according to replacement data. Mixtures made from both grades of bitumen were

compared in terms of their properties and efficiency. Although increasing the RCA percentage decreased the asphalt mixes' robust modulus, it increased their skid resistance. In comparison to 80/100 bitumen, 60/70 bitumen improved the resilient modulus and skid resistance of the asphalt mixes. Water sensitivity (stripping resistance) is lower in RCA-containing mixes than in RCA-free mixes. Replacements of up to 50% do not, however, exceed the tensile strength ratio limit of 80%. The volumetric properties were violated at this replacement ratio, despite the 50 percent replacement limit being sufficient. As a result, replacements of more than 25% in hot mix asphalt for heavy traffic pavements should be avoided for all grades of bitumen.

CONCLUSION

The present study shall enable to not only predict the present but also future performance of demolition waste in terms of pavement life. It shall also help in determining the difference between mechanical properties of fresh aggregates and Construction demolition waste. It will help in reducing the cost and time required for effective pavement work.

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