PRODUCTION OF SUSTAINABLE BITUMINOUS CONCRETE MIX USING RECYCLED AGGREGATES

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Introduction:

Bituminous concrete mixture is a combination of aggregate and binder. The aggregate acts as the structural skeleton of the pavement and bitumen acts as the glue of the mixture. The properties of the aggregate have direct and significant effect on the performance of the pavement. The utilization of industrial by-products and recycled materials in road construction as secondary and alternative materials has gained widespread acceptance and is becoming more important. The demands for industrial by-products and recycled materials are increasing every year. Using industrial by-products in pavement engineering not only provides construction materials with possible savings over new materials, but it also reduces demands on natural construction materials. It also can protect the environment and save money through reducing the amount of waste materials requiring disposal. The use of secondary aggregates like Recycled aggregates is increasing. It is still very limited if comparison is made with use of primary crushed stone aggregate.

The resulting large quantities of slag produced and their potential impact on the environment have prompted materials scientists and civil engineers to explore the technically sound, cost effective and environmentally-acceptable use of a wide range of slag in civil and highway construction.

Objectives:

- To evaluate the behavior of bituminous concrete by incorporating recycled aggregates at different proportions for the binder course.
- To characterize the materials used, including both virgin and recycled aggregates.
- To develop a mix design for DBM Grade-II using a job mix formula.
- To create mix designs for DBM using recycled aggregates at different percentages
- To compare the Marshall properties of control DBM and recycled aggregate DBM

Methodology:

1) Analysing the physical and mechanical properties of recycled aggregates, such as particle size distribution, absorption, and abrasion values, ensures their suitability for use in bituminous concrete.

2) Conducting a parallel evaluation of recycled and natural aggregates provides a baseline for understanding performance difference sand optimizing mix designs.

3) Utilizing the Marshall method to determine optimum bitumen content and develop mix proportions ensures structural integrity and sustainability.

4) Conducting laboratory tests like Indirect Tensile Strength, Fatigue Resistance, and Moisture Sensitivity evaluates the durability and reliability of sustainable mixes.

5) Performing a cost-benefit analysis to weigh the financial feasibility of adopting recycled aggregates ensures practicality alongside sustainability.

6) Aligning the methodology with Indian and international standards ensures the developed mixes meet industry requirements and are widely applicable.

7) Summarizing findings and providing actionable recommendations supports knowledge dissemination and promotes future research in sustainable constructions.

8) Customizing the methodology to fit project scope, resources, and objectives ensures flexibility and enhances its practical application in varied scenarios.

Result and Conclusion:

1) The physical test results conducted on Recycled aggregates are found to be in compliance with MORT&H specifications which are same as for the natural aggregates.
2) The Marshall properties obtained by inducing the Recycled aggregates in place of crushed aggregates are found in compliance with specification as mentioned in the MORT&H.
3) The stability increases slightly high when compared with the stability obtained for the natural aggregates. This indicates high stiffness, resistance to permanent deformation.
4) The optimum bitumen content obtained at different proportions with different percentage of Recycled aggregates is slightly towards the right side of the VMA curve. But still the VMA values are found within the limits.
5) The values of VFB in all the proportions of Recycled aggregates are found within the limits so that it will not cause bleeding.
6) The OBC increases with increase in recycled aggregates percentage, by the experimental investigations the percentage of recycled aggregates can be replaced up to 50% for economy purpose.
7) Since the addition of recycled aggregates increased the stability value and flow value indicates the stiff mixture, up to 50% replacement of recycled aggregates can to allowed.

Future Scope:

1) Resource Conservation: Utilizing recycled construction and demolition waste (C&D waste) to produce sustainable road construction materials.

2) Environmental Protection: Reducing the environmental impact of construction and demolition activities by diverting waste from landfills.

3) Economic Benefits: Promoting cost-effective and resource-efficient construction practices.