ROAD COURSE SURFACING USING RECYCLED CONSTRUCTION AND DEMOLITION WASTE AGGREGATE

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ABSTRACT

In recent years, innovations for recycling, reuse, and other waste utilization have arisen from the management of construction and demolition waste (CDW). Environmentally friendly construction practices should be pushed to reduce landfill waste and the amount of borrowed materials required to complete a project. The environmental impact of building is considerably reduced by reusing CDW materials. This study attempts to determine whether using construction waste as a base pavement layer material is technically feasible. Different types of pavement were tested in the field, including concrete, asphalt, and ceramic waste aggregate. The recycled material's quality was tested on a real stretch of road with actual vehicle traffic. For recycled artificial CDW aggregate, an acceptable load-bearing capability was determined.

Keywords: CDW, environmental impact, construction waste, waste aggregate

1. INTRODUCTION

Demolition waste is the material left over when a building is demolished. Plasterboard, for example, is hazardous when disposed of in a landfill because it breaks down and releases hydrogen sulphide, a deadly gas. Construction and demolition debris from individual homes,

1. Emptying waste storage facilities in the nearby area and adding weight to the municipal garbage.
2. As the quality of municipal trash deteriorates, composting becomes more challenging.
3. An estimated 10% to 20% of garbage is channeled into storm drains, where it accumulates and causes blockages (Akhtar, A.; 2018).

Industry estimates forecast a shortage of aggregates of up to 55,000 million cubic metres for the housing industry (Arun Kumar. U, 2016). The road sector's objectives will necessitate an additional 750 million m3 of water. Construction and demolition trash can be recycled to produce aggregate material that can be used in the industry (Ahmed S.F.U. 2012).

In compliance with federal, state, and local government requirements, C&D material should be sorted before it is transferred to landfills and other waste treatment facilities. Authorities must first ensure that safety laws for managing and disposing of hazardous materials including lead, asbestos, and radioactive materials have been followed before demolition can commence. All waste products, including those from building and demolition, are subject to inspection as the focus on sustainable development rises. The only way to access these valuable minerals is by razing existing buildings (Arulrajah, A.; 2011). As natural aggregates become scarcer, recycling construction and demolition waste is becoming increasingly important. There are many ways to reuse and recycle them in the construction process (Bocci Edoardo, 2015).

1.1. Research objectives

1. CDWs can be enhanced by replacing natural aggregate with recycled aggregate, which will be the focus of this study.
2. To employ recycled aggregate as a whole or partial replacement for CDWs aggregates.
3. To come up with new ideas for recycling, reusing, or disposing of demolition waste.

2. RELATED WORK

Akhtar, A.; (2018). An ongoing study by the Federal Highway Administration's Technical Advisory Group on Pavements is looking into the possibility of incorporating recycled coarse particles into hot mix asphalt. As part of the NCHRP's 598th study, RCA was tested in the unbound pavement layer. This programme was established as a result of such investigation. There are a variety of natural and physical features that must be addressed if RCA is to be used in various transportation infrastructure projects. Arun Kumar. U, (2016). According to his studies, RCA-containing asphalt passed all technical requirements and had high long-term deformation resistance in low-class roadway pavements tests in Spain. On the other hand, due to its water sensitivity, the RCA had a short life. Hu Liqun constructed a variety of cement-stabilized base courses using leftover clay bricks in place of natural aggregates. For coarse and fine waste brick aggregate, a substitution ratio of no more than 70 percent and 90 percent, respectively, was recommended. Bocci Edoardo, (2015). Construction and demolition debris is not generated on a regular basis, unlike municipal solid garbage. In some way, the government should develop a system to charge building and demolition debris. Recycled items are still a new concept in India, therefore more work is needed to spread the word and build public trust. IS 456 and IRC112 banning the use of non-natural materials in the construction and demolition industry? Because natural aggregates are scarce in the country, concrete constructions must make use of recycled materials from construction and demolition. It is suggested that a comprehensive framework be used as a starting point for the development of applicable standards. Regulations and standards that encourage the recycling, repurposing, and reusing of waste-derived aggregates should be in place. Barbudo, A.; (2012). Over the last five years, RD aggregates have been used to build and maintain an increasing number of local government roads. RD aggregates have also been used in Australian road construction for the last 100 years, according to the study. Since the end of World War II, recycling has been widely practiced in Europe, according to the study's findings. Documents from the C and D recycling show that roads have been reconstructed using stones rescued from older ones since Roman times A lot of road construction is done with RD aggregate. Recycled aggregates have been the subject of a slew of research projects around the world.

3. RESEARCH METHODOLOGY

A material's possible health and environmental hazards, cost effectiveness, and on-the-job performance must all be taken into account in order to make an informed decision. A chemical should be properly disposed of if the results of an EHS examination are unclear. Physical and chemical properties as well as technological design can then be thoroughly analyzed in order to determine environmental concerns. Testing methodologies can be used to evaluate the engineering properties of a material if its chemical and physical characteristics are similar to those of commonly used construction materials (M. M. Reddy, 2012).

It is necessary to create a test plan if one does not already exist. Standard materials must be tested and approved by a transportation agency or a local public works department. Determine whether or not candidate material can be used in place of typical paving materials through cost analysis (N. Tatlisoz, C. 2001). The whole cost of a road project can be estimated using life-cycle costs thanks to the development of new materials. Field testing of the new material is necessary to acquire information on the road's short- and long-term performance, respectively. New road materials can be selected based on criteria developed through the use of performance studies (Nwakaire, 2020).

4. RESULTS AND DISCUSSION

In this section, we will review the findings and observations made in the earlier trials. Materials such as Marshall Properties and a presentation of Marshall Properties are utilized throughout this chapter (N. Tatlisoz, C. 2001). Additionally, DGBM binder content calculation and binder content calculation for DGBM utilizing recycled and virgin coarse aggregates are presented.

4.1. Result of aggregates test

According to the statistics, one possibility worth considering for the construction of roads is the utilization of waste materials (Arun Kumar. U, 2016). Given the potential hazards to both the environment and human health posed by some of the waste products from the India-age, one ought to proceed with extreme caution (Barbudo, A.; 2012). This inquiry needs to be completed before a particular type of waste material can be used for the construction of roads (R. V. Silva, 2015). Waste materials have the potential to be utilized for future environmentally responsible road construction so long as the necessary technologies, policies, and stakeholder awareness are in place (Cameron, D.A.; 2012).

Table.4.8. List of the aggregates tests

S.No.	List of aggregate test	CWDs	Conventional aggregate	Range of test	Remark
1.	Aggregate impact test	12.07%	6.74%	<10.00 (exceptionally strong), 10.00 – 20.00 (strong)	Hence the tested values are in optimum range, so we can use it in all the layers except top wearing surface layer of road pavement.
2.	Aggregate crushing value test	13.06%	11.92%	<45 (wearing course), <30 (concrete pavement)	
3.	Specific gravity value test	3.01	3.10	2 - 3	
4.	Water absorption value test	1.50%	1.89%	1.00 – 2.00%	
5.	Loss Angeles absorption test	28.87%	11.08%	<40.00%	

1. The Impact Value of demolition aggregates is 12.07%, these shows the aggregates' resilience.
2. Two. The Crushing Value of demolition aggregates is 13.06%, which falls below the 30% threshold. In this way, the aggregates might be employed in the top layer.
3. Some deconstruction aggregates fall within a specified range of Specific Gravity.
4. The aggregates are therefore suitable for use in road construction.
5. Water Absorption is greater than 1.50% in demolition aggregates. The aggregates meet the study's requirements, hence they are suitable.
6. In terms of Los Angeles Abrasion Value, demolition aggregates get a 28.87 percent Therefore; the aggregate can be used in the construction of road pavement.

Consequently, every test involving demolition aggregates was a success, and these materials are ideal for use in the construction of roads.

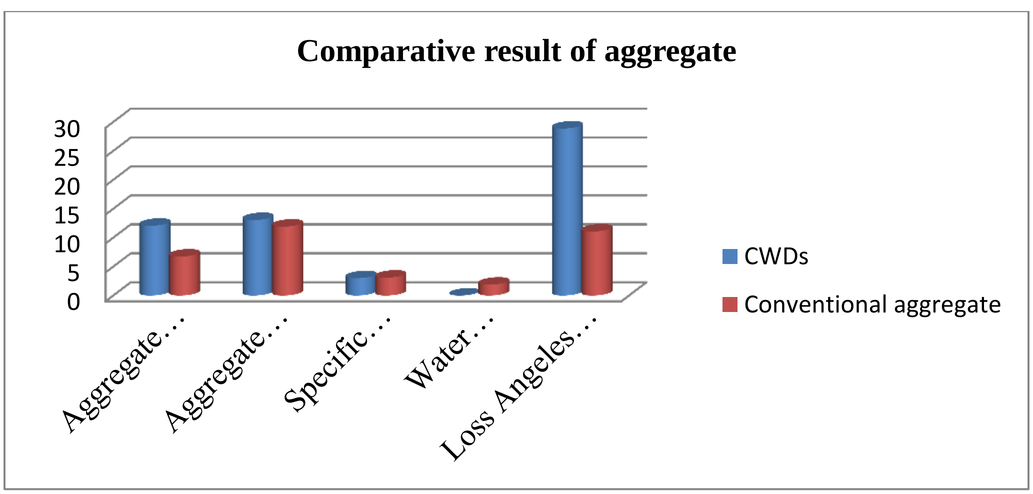

Figure.4.1. Comparative Test Results of Aggregate

4.2. Result of marshal stability test

Table.4.9. List of the marshal stability test

S.No.	List of aggregate test	CWDs	Conventional aggregate	Range of test	Remark
1.	Flow value (in mm)	3.00	4.05	3 – 5	Hence the value is in optimum range, so we can use in DBM course.
2.	corrected marshal stability value (in KN)	9.25	10.73	8.2 (minimum)	

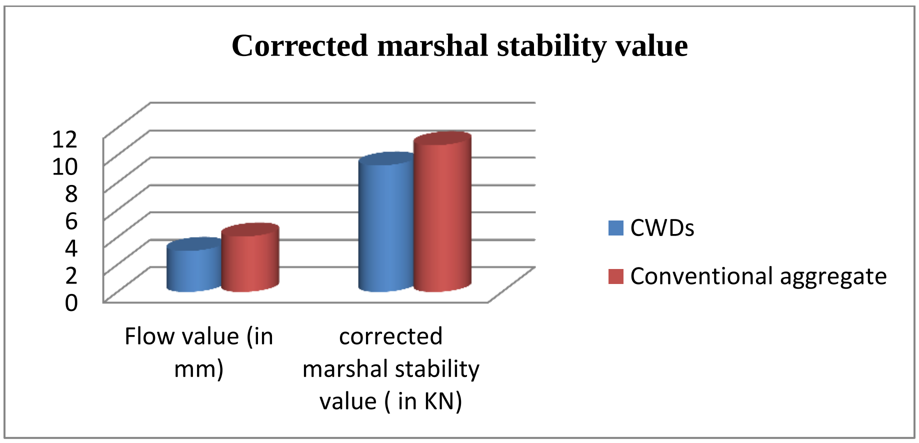

Figure.4.2. Comparative corrected marshal stability value

1. The Flow Value of a demolition aggregate is 3.00 mm. So, because they are suitable, the aggregates can be used in the DBM course of pavements.
2. The Corrected Marshal Stability Value for demolition aggregate is 9.25 KN. Thus, it can be used to make a DBM course for a road surface.

5. CONCLUSION

Construction and demolition waste properties were tested as part of a DBM course. A comparison of the impact of conventional aggregate versus construction demolition aggregate on the quality of road pavement.

1. It was determined that conventional aggregate had a Marshall Stability of 10.73 kN.
2. The typical aggregate had an average flow of 4.05 mm.
3. The CDW aggregate's Marshall Stability was found to be 9.25 KN.
4. CDW aggregate had an average flow of 3.00 mm.

Found in construction debris, the Marshall Stability of 10.15 KN meets the MORTH specification parameters for the DBM course. As a DBM course in pavement design, CDW aggregate can be utilized to reduce the requirement for conventional aggregate and to reduce pollution, according to the findings of this study. CDW aggregate can only be used in pavement design if a new crusher and segregation plant are built to handle the growing construction sector. Tossing CDW rubbish into a river or landfill is hazardous to the environment because of fast industrialization and infrastructural construction. CDW waste can be used in road pavement design to reduce pollution on the ground. Disposable digital waste from CDW. Crushing and sorting facilities for traditional aggregate are analogous to the need for a CDW waste recycling facility. No significant cost difference appears to exist, and the road construction process is identical for both aggregates.

5.1. Future recommendation

1. To be employed in transportation infrastructures, an evaluation of the long-term performance of RAC (even if RCDWA can be used in concrete) is required.

2. The amount of water absorbed by a given material varies depending on the source. The water absorption rate of waste materials generated from porous roof tiles, ceramic tiles, and bricks were significantly higher than that of concrete debris.

3. Similar to aggregates, a particle size distribution curve can be used to evaluate the grading of individual particles. The RCDW particle size distribution follows a particular pattern. Particle grading could be harmed if compaction leaves certain particles partially crushed and fractured.

4. Crushed fines from weakly adhering mortar or concrete in C&D waste may act as a bridging agent between coarse particles in RCA, according to this theory.

5. Increasing the thickness of the base reduces the compressive stress on the C&D waste material at the base's lower levels. A 20-mm-thick foundation layer has been shown to be the most effective after numerous trials.

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