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PARTIAL REPLACEMENT OF COARSE AGGREGATES WITH DEMOLISHED CONCRETE FOR RIGID PAVEMENTS- REVIEW

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Abstract - N*owadays road construction with rigid pavements constructed rapidly. Waste material management is very essential for better environment. The environmental condition improves by utilization of waste material it may be biodegradable or may be not biodegradable. This study is mainly focused on utilization of demolished concrete partially replaced with coarse aggregate in rigid pavements with an effective manner. Its use depends upon the outcomes which shall be obtain with addition in different percentages and performed different experiments.*

Key Words: Demolished concrete, rigid pavements, coarse aggregate, road construction.

1. INTRODUCTION

The construction activity requires several inputs like concrete, steel, brick, stone, clay, mud, wood, glass etc. However, the concrete remains the main construction material used in construction industries. The generation of aggregates in itself is a lengthy and tedious process as it involves the cutting of mountains or breaking river gravels or boulders, or breaking clay bricks. All these processes demand the huge inputs like labor, machinery and transportation etc. The working of machinery and transportation of the processed material (aggregates) also results in the environmental pollution and at the same time we are utilizing the natural resources. Hence it is very important to find new alternatives which helps us to save natural resources, reduce environmental pollution and at the same time is very economical. In the construction field of the world, use of construction & demolished waste as alternative of coarse aggregate plays a vital role to save natural resources, helps reducing environmental pollution and also provides an economic value for the waste material.

The amount of global demolished concrete is estimated at 2-3 billion tons. 20% of normal aggregates can be saved by recycling of demolished concrete. The recycling of demolished concrete will also result in the creation of additional business opportunities, saving money and saving the cost of disposal. In present days for human, environmental issue is very important thus it seeks to improve construction & demolished waste material for construction. The use of construction and demolition waste is giving a prospective application in construction and gave an alternative to natural coarse aggregate**.** In India, and other developing countries where low income communities are present there is use of recycled aggregate made from the waste recovered from the construction and demolition sites in new construction and other renovation projects has proved to be very economical after the global economic crises. In India due to industrial development a serious problem increases that is depletion of natural aggregates and creation of large amount of waste materials available from construction and demolition activities. One of the ways to reduce these problems is to utilize construction and demolition waste as a coarse aggregate in the new concrete construction.

LITERATURE REVIEW

Various researches for the partial replacement of coarse aggregate with demolished concrete, which are related to my work, are as under:

1. Ravindrarajah, et al., (1987) [1] reported the effects of using crushed concrete as coarse and fine aggregates upon strength and deformation of concrete. Various tests on hardened concrete were carried out. Compressive strength of 100mm cubes were determined at 3, 7, 28 and 90 days. The results showed that the effect of recycled aggregate on strength was greater than recycled fine aggregate. The strength and modulus of elasticity are reduced by about 10% and 35% respectively, whereas drying shrinkage is nearly doubled when recycled aggregates are used instead of natural aggregates in comparable mixes. The effect of recycled fine aggregate on the deformational properties is less than that of coarse aggregate. Fresh concrete properties are only marginally affected by the use of recycled aggregates.

2. Topcu, and Guncan (1995) [2] evaluated the properties of concrete made with waste aggregate. The

main objective of this research project was to determine the properties of concrete by replacing natural coarse aggregate with recycled aggregates. These concretes were obtained with the addition of C 16 (28-day compressive strength of 16 MPa) pieces as aggregate in weight percentages of (referred to total aggregate) 30%,50%,70% and 100 %.It was observed that the density, workability of concrete made with waste concrete is less than normal concrete. As the amount of waste concrete aggregate is increased, the compression strength and modulus of elasticity gets less than the normal ones at about 80%. With the increase in WCA, the value of toughness, plastic energy capacity, and elastic energy capacity decreases.

3. Topcu, and Sengel (2004) [3] had studied the effect of waste aggregate on properties of concrete. Experimental investigations have been carried out to assess the effect of partial replacement of coarse aggregate by waste aggregate. Recycled aggregates were used in concrete in replacement of nominal concrete aggregates in varying percentages of 30%, 50%, 70% and 100%. Afterward, these mixtures underwent freeze –thaw cycles. As a result, it was found that C16-quality concrete could be produced using less then 30% C14-quality waste concrete aggregate. Moreover, it was observed that the unit weight, workability, and durability of the concrete produced through WCA decreased in inverse proportion to their endurance for freeze –thaw cycles.

4. Gandhi, et al., (2011) [4] evaluated the use of recycled aggregate in concrete. In this study recycled coarse aggregate have been used to replace virgin coarse aggregate. Natural aggregate had been replaced with demolished waste in varying percentages of 20%, 40%, and 60% 80% and 100%. Then the tests were carried out which include compression strength test to evaluate the strength of concrete. On comparing it was observed that the compressive strength first increased with the increase in percentage of recycled aggregate up to 60%. With further increase in recycled aggregate, the compressive strength decreased. Maximum compressive strength of 28.96 Mpa after 3 days of curing was achieved at 60% of recycled aggregate and maximum compressive strength of 33.92 Mpa after 7 days of curing was achieved at 60% of recycled aggregate.

5. Murali, et al., (2012) [5] had studied the effect of partial replacement of coarse aggregate with demolished concrete. The study on effects of shahbad (a variety of cudappah) stone and the chemical admixture (supaflo) on concrete were investigated. Natural aggregate had been replaced with the waste shahabad stone in four different percentages namely 10%, 20%, 30% and 40%. A comparison was made between the specimens of partially replaced coarse aggregate and the same set of specimens admixed with supaflo. The effects on compressive strength, split tensile strength and modulus of rupture were reported. Test results indicated that the replacement of coarse aggregate by 30% had attained a good strength.

6. Monish, et al., (2013) [6] evaluated the study as a part of comprehensive program wherein experimental investigations have been carried out to assess the effect of partial replacement of coarse aggregate by demolished waste on workability and compressive strength of recycled concrete for the study at 7 and 28 d. Demolished waste was collected from IIT building near Jhalwa, Allahabad. For this study, cubes of 100mm size were cast replacing coarse aggregate by 10%, 20%, and 30% with demolished concrete. Compressive strength of this recycled concrete was observed with respect to conventional concrete. Results showed that up to 30% of coarse aggregate replaced by demolished waste gave strength closer to the strength of plain concrete cubes and strength retention is in the range of 86.84-94.74% as compared to conventional concrete.

7. Subramani, and Kumaran, (2015) [7] assessed a study on concrete which incorporate over burnt brick ballast and concrete waste partially due to their abundance. The main objective of this research project was to determine the properties of concrete by replacing natural coarse aggregate with over burnt brick ballast aggregate and concrete waste. 25% , 50%(M15, M25) incorporation was used as a partial replacement of natural coarse aggregate. The compressive strength was observed to be optimum when containing 50% of concrete waste. Also it was found that as the percentage of concrete waste and crushed brick fine aggregate was increased it influences more hardened properties of concrete.

8. Patel, and Patel, (2016) [8] investigated effect of demolished waste and carried out comparative study of its mechanical properties. Recycled concrete aggregates were used in concrete in replacement of nominal concrete aggregates in different percentages 25%, 50%, 75%, and 100%. It was observed that the compressive strength was optimum with 50% replacement of recycled coarse aggregate.

9. Veeraselvam, and Dhanalakshmi, (2017) [9] focused on utilizing the demolished concrete waste and reduces the

generation of waste. Based on the experimental investigations carried out, the following conclusions were drawn, on Comparing Compressive strength of Nominal Concrete and Demolished Concrete Aggregate, the percentage of DCA replacement up to 20%, the strength increased as 2.5%. Concrete Aggregate, the percentage of DCA replacement up to 20%, the strength increased as 7.07%. On Comparing Flexural strength of nominal Concrete and Demolished Concrete Aggregate, the percentage of DCA replacement showed reduction in the strength. From the study the Replacement of DCA Concrete allowed to use up to 20 % with adding fiber. For more replacement of DCA Concrete had shown a decline in strength.

10. Hedge, et al., (2018) [10] aims at reuse of demolished concrete. The demolished waste had been collected from some college work site. Coarse aggregates were replaced by demolished waste in various proportions of 10, 20, 30 40, 50 and 100. Cubes, cylinder, beams were casted for different mix proportions and were kept under curing for 7, 14 and 28 days. Up to 30% replacement of fresh coarse aggregate, the compressive strength was found above 30 N/mm^2. When replaced by 50%, the compressive strength was observed 27.11 N/mm^2 which is higher than target strength of 26.6 N/mm^2. Hence, the concrete up to 50% replacement is more suitable for the regular construction works.

11. Reema, et al., (2020) [11] assessed the use of demolished waste for partial replacement of coarse aggregates in varying percentages. The specimens were casted with 10%, 15% and 20% replacement of recycled coarse aggregate and tested after 7 & 28 days in Laboratory. Demolished concrete found to have lower bulk density, higher workability, crushing strength, impact value and water absorption value as compared to normal concrete. Use of recycled coarse aggregate up to 20% did not affect the functional requirement of demolished concrete decreased with increasing the percentage of RCA (recycled coarse structure as per calculated test result. The results indicated that the compressive strength and split tensile strength aggregate) in concrete as compared to conventional concrete.

These conclusions indicated that partial replacement of coarse aggregate with demolished concrete can be a good alternative, to be used as a new aggregate in concrete construction. Though a number of researches have been conducted for the partial replacement of coarse aggregates with demolished concrete, my research work will prove to be an additional benefit to the already existing researches.

MATERIALS TO BE USED

Various materials to be used in this research include Cement, Coarse aggregate, Fine aggregate,

Demolished concrete and water:

a) CEMENT: cement can be defined as a binding agent which is used for construction purpose that helps in binding the other materials together. The basic ingredients of cement are calcareous which means calcium carbonate and argillaceous which means clay.

Fig. 1.1 – Cement

b) AGGREGATES: There are mainly two types of aggregates:

1) Fine Aggregate

2) Coarse Aggregate

1) FINE AGGREGATE: Fine aggregates are essentially any natural sand particles obtained from land through the mining process. The grain size of fine aggregates lies between 4.75mm and 0.15mm. Filling up the voids and acting as a workability agent is the main function of fine aggregate.

Fig. 1.2 – Fine Aggregate

2) COARSE AGGREGATE: Coarse aggregates can be defined as irregular broken stone or naturally-occurring rounded gravel used for making concrete. Coarse aggregates are retained on the sieve of mesh size 4.75mm. It acts as a

volume increasing component and is responsible for strength, hardness and durability of concrete.

Fig. 1.3 -Coarse aggregate

c) DEMOLISHED CONCRETE: Waste material to be used is demolished concrete. It involves crushing, breaking, and removing irrelevant and contaminated materials from existing concrete.

Fig. 1.4 – Demolished concrete.

d) WATER: For concrete construction, potable clean water is essentially to be used and curing is to be done with reference to IS: 10262.

Fig 1.5 - Water

OBJECTIVES OF THE STUDY

The objectives of this research are as following:

- To find out the effect of demolished waste on strength of concrete.
- To find out the optimum replaced percentage of use of waste material i.e. demolished concrete instead of natural aggregate by conducting various tests as per Indian Standards.
- To safely utilize the waste material i.e. demolished concrete.

REFRENCES

1. R. Sri Ravindrarajah, and Y. H. Loo Beng, "Recycled concrete as fine and coarse aggregate in concrete", *Magzine of Concrete Research,* Volume No. 39, Issue No. 141, Page No. 241- 220, 1987.

2. Ilker Bekir Topcu, and Nedim Fuat Guncan, "Using waste concrete as aggregate", *Cement and Concrete Research,* Volume No. 25, Issue no. 7, Page no. 1385-1390, 1995.

3. Ilker Bekir Topcu, and Selim Sengel, "Properties of concretes produced with waste concrete aggregate", *Cement and Concrete Research,* Volume No. 34, Page No. 1307-1312, 2004.

4. Hardik Gandhi, Dr. Dharshana Bhatt, and Chetnaben Vyas, "Study on use of recycled coarse aggregate in concrete", *National Conference On Recent Trends in Engineering and Technology,* Page No. 13-14, 2011.

5. G. Murali, R. Saravanakumar, C. Balaji, R. Muthuraman, V. Sreekavitha, and S. Archana, "Experimental investigation on concrete with different waste stone as a aggregate", *International Journal Of Engineering Research and Application(IJERA),* Volume No. 2, Issue No. 3, Page No. 253-256, 2012.

6. Mohd Monish, Vikas Srivastava, V. C. Agarwal, P. K. Mehta, and Rakesh Kumar, "Demolished waste as coarse aggregate in concrete", *Journal Of Academia and Industrial Research (JAIR),* Volume No. 1, Issue no. 9, Page No. 540-542, 2013.

7. T. Subaramani, and S. Kumaran, "Experimental Investigation of using concrete waste and brick waste as a coarse aggregate", *International Journal of Application or Innovation in Engineering And Management (IJAIEM),* Volume No. 4, Issue No. 5, 2015.

8. Nikita Patel, and Dr. Piyush Patel, "Use of demolished concrete materials in concrete and comparative study of its mechanical properties", *International Journal of Innovative Research In Science, Engineering and Technology (IJIRSET),* Volume No. 5, Issue No. 4, 2016.

9. Veeraselvam K, and Dr. Dhanalakshmi G, "Utilization of demolished concrete waste for new construction and evaluation of its strength", *International Journal of Engineering and technology (IRJET), Volume no. 4, Issue no. 6, 2017.*

10. Dr. Ramakrishna Hedge, Prof. Shrinath Rao K, Shashank H, Shivaraja Hanumantha Madar, Askarali Hajaresab Jakathi, and Pujari Varunkumar Vijay Kumar, "A Study on Strength Characteristics of Concrete by Replacing Coarse Aggregate by Demolished Column Waste", *International Journal of Engineering Research and Technology(IJERT),* Volume No. 7, Issue No. 6, 2018.

11. Reema, Ram Kishore Singh, Dr. Md. Daniyal, and Sitesh Kumar Singh, "Partial replacement of coarse aggregates with demolition waste in construction", *Mukt Shab,.* Volume No. 9, Issue No. 6, 2020.

12. Dr. T. Sekar, N. Ganesan and Dr. NYN. Nampoothiri, "Studies on strength characteristics on utilization of waste materials as coarse aggregate in concrete", *International Journal of Engineering Science and Technology,* Volume No. 3, Issue No. 7, 2011.

13. Tu T, Chen Y, Hwang C, "Properties of HPC with recycled aggregates", *Cement Concrete Research,* 36(5): 943-950.

14. IS: 383- 1970, Specification for Coarse and Fine Aggregates from Natural sources for concrete (second Revision).

15. IS 10262:2009, Recommended Guidelines For Concrete Mix Design, *BIS.* New Delhi, India 2009.

16. IS 456-2000, Plain and reinforced Concrete- Code of Practice, Fourth Revision, BIS. New Delhi.

17. M. S Shetty - Concrete Technology, *S. Chand and company ltd. Reprint 2008.*

18. Gambhir, M. L. (1986), Concrete Technology, *Tata McGraw-Hill Publishing Company Limited, New Delhi.*