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Effective Utilisation of Construction and Demolition Waste (Cdw) As Recycled Aggregate in Concrete Construction – A Critical Review

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ABSTRACT

Solid wastes are the inevitable production of the operations of various industries like construction Industry, Machines Manufacturing Units, Textile industry etc. In India the construction industry generates large amounts of waste, which can be composed of different origin materials, most of them classified as non-hazardous. Construction and Demolition waste (CDW) constitutes a major portion of total solid waste production in the world and most of it is used in landfills. Dumping of these construction and demolition waste in landfill causes contamination of soil, water and air from toxic substances. Research by structural concrete engineers has clearly suggested the possibility of appropriately treating and reusing such waste as aggregates in new concrete. The aim of this paper is to explore the separation process of CDW and further use of recycled aggregates from construction and demolition waste (CDW) in concrete mixes. A review of most recent research and legislation applied in India is developed regarding the production of concrete by using these recycled aggregates.

Keywords: Waste management, Concrete, CDW Replacement, Recycled aggregate, Strength Properties.

1. INTRODUCTION

Rapid industrial development causes serious problems all over the world such as the depletion of natural aggregates and creates an enormous amount of waste material from construction and demolition activities. One way to reduce this problem is to utilize recycled concrete aggregates in the production of concrete. Recycled aggregates are the main component of old concrete and recycling operations have the added benefit of reducing landfill disposal.

Construction and Demolition (C&D) waste constitutes a major portion of total solid waste production in the world, and most of it is used in landfills. Research by concrete engineers has clearly suggested the possibility of appropriately treating and reusing such waste as aggregates in new concrete, especially for lower level applications. This study discusses recycled aggregates (RA) produced from C&D waste and their use in concrete construction. Along with a brief overview of the engineering properties of recycled aggregates, the study also gives a summary of the effect of recycled aggregate son the properties of fresh and hardened concrete. Recycled aggregates are treated with epoxy resin to reduce the water absorption. This research, however,

shows that the recycled aggregates that are obtained from site-tested concrete specimen make good quality concrete. The influence of aggregates of varying sizes on the compressive strength, split tensile and water absorption of concrete is presented in this paper.

OBJECTIVES

- The main objectives of this study are to reduce, reuse and recycle C & D wastes.
- C & D wastes can be used as an aggregate replacement in concrete.
- Recycled aggregates can also be used in structural concrete by applying special mixture, curing and casting methods.

LITERATURE REVIEW

1. B.Gonzalez-Fonteboa, F.Martinez-Abella had dealt with using of recycling aggregates from construction and demolition reducing amount waste per yr in spain 326kg, 5% was recycled .increased to 90%and 87%. First stage selection of natural and recycled aggregates and water reducing admixture and cement. Second stage adjustment were made CC, CCS, RC, RCS.
2. ChangjiangLiu, Xiaowei Deng, Jian Liu, David Hui conducted an experiment that Mechanical Properties and Micro Structures of Hypergolic and Calcined Coal Gangue Based Geopolymer Recycle Concrete. In this research, The geopolymer recycled concrete specimens were produced by hypergolic or calcined coal gangue, slag and RA. Two types are hypergolic coal and calcined coal gauge. Compressive and splitting tensile strength of specimen is studied. Mixing ratio about 30-50%. Mechanical properties of recycled concrete include internal porous, micro-cracks and recycled coarse aggregate.
3. Mostafa Kazemi et al., had studied that Compressive Strength Assessment Of Recycled Aggregate Concrete Using Schmidt Rebound Hammer And Core Testing. In his research work, the compressive strength of recycled aggregate concrete by Schmidt rebound hammer and core testing. Leads to decrease in construction cost. Non-destructive and semi destruction techniques such as core testing, are long-established methods for strength estimation. RAC, compare results 150mm cube specimens, 70% replacement of recycled coarse aggregate, 96 cube specimens and 8 concrete slabs. Efficiently predict the compressive strength of RAC and conventional concrete.
4. Juan A. Ferriz-Papihad dealt with recycled aggregates from construction and demolition waste in production of concrete blocks. The results are, Industry construction generates large amount of waste catalogued as non –hazardous. European targets waste for 2020 was been already achieved by UK by down cycling processes. Further uses of recycled aggregates in CDW.70% waste are soil waste from excavation and rest was mixed of waste. Two concrete mixes were made 80% replacement of recycled aggregate. Mixed CDW as recycled aggregates in concrete mixes.
5. Andreus Gonzalez – corminas, MirenExteberria experimented that effects of using recycled concrete aggregate on the shrinkage of high performance concrete. The results, Use of recycled concrete aggregate (RCA) mostly limited to normal –strength concrete. Compared to natural aggregate, Recycled concrete aggregates from C&D properties are lower density, crushing resistance, fragmentation resistance etc.. Use of RCA has successfully developed by following minimum qualities, maximum replacement ratios, and particular mixing methods. Mostly MPC is using in recycled aggregates; replacement ratio of RCA is 20,50and 100% depend on RCA amount in HPC. Tests of concrete like physical and mechanical properties, pore size distribution, plastic shrinkage, Autogenous shrinkage,

drying shrinkage test are tested. Higher compressive strength results of concretes containing RCA compared to obtain.

6. Jodilson Amorim Carneiro, Paulo Roberto Lopes Lima, Mônica Batista Leite, Romildo Dias Toledo Filho experimented that compressive stress- strain behaviour of steel fiber reinforced – recycled aggregate concrete. The results findings are, C&D was mostly used to replace the fine and coarse aggregate in recent days. Stress-strain behavior of concrete made with CDW aggregates. Flexural strength and splitting tensile strength of the mixtures were also determined. Coarse and fine aggregate was replaced by recycled coarse aggregate (RCA) and recycled fine aggregate (RFA). Two levels 0% and 25% by volume. Stress-strain behavior of recycled aggregate concrete was affected by recycled aggregate and presented behavior then previous one. Recycled concretes were increased and their behavior under compression becomes similar to fiber-reinforced natural aggregate concrete.

7. Claudio Javier Zega, Ángel Antonio Di Maio tested that use of recycled fine aggregate in concretes with durable requirements. In his work, the following results were obtained.

    - Construction waste is highly attractive compared to non –renewable natural resource.
    - Khatib (2005) concretes made with 25% and 100 % of RFA present reduction of 15% and 30% in the compression strength.
    - 2007 conclude use of 30% of RFA will not affect the compression strength.

8. Silva R.V et.al., experimented that, carbonation behaviour of recycled aggregate concrete. The results are, Recycled aggregate from C &D on the carbonation behavior of concrete. It includes level, size and origin, curing condition. Minimum of 90% by mass, Portland cement –based fragments and NA. RA sourced from crushed masonry, or recycled masonry aggregates (RMA). 95% Probability of exhibiting carbonation depths upto almost 2.5 times than NAC. 100% coarse or fine RCA are added with 95% confidence interval suggest that RAC mixes shows carbonation depth to 2.15 and 6.03 times of the NAC. Relationship between the compressive strength and coefficients of accelerated.

9. Mirjana Malešev et.al., experimented that, recycled concrete as aggregate for structural concrete production. In his research, Properties of fresh and hardened concrete with different replacement ratio of natural with recycled coarse aggregate. Three type of concrete mixture *are concrete* made *with natural* aggregate and recycled coarse aggregate (50% and 100%). RCA compared to NA, Decrease bulk density (3,10), Decrease specific gravity (3), Increase abrasion loss (3,11,12) , In which first concrete has 100% of river sand , second concrete has 50% of river coarse aggregate., Third concrete has 100% of recycled aggregate. Water absorption of concrete R0, *R50, and R100* was tested on 15 cm cube in hardened concrete testing. Necessary to use quality recycled concrete coarse aggregate and to follow the *specific rules* for design and production of this new concrete type.

10. Liam Butler, Jeffrey S. West, Susan L. Tighe c, worked that,effect of recycled concrete coarse aggregate from multiple source on the hardened properties of concrete with equivalent compressive strength. The results are,

    - The effect of fully replacing natural aggregate with several sources of recycled concrete aggregates.
    - Compressive strength and slump are 40 and 60MPa and slump between 75 and 125mm.

- The RCA concrete had modulus of elasticity values up to 19% lower than NA concrete.
- As evaluated and was proportional to the modulus of elasticity of concrete incorporating the RCA as coarse aggregate.
- Fracture energy of RCA concrete was measured using single edge notched double-cantilevered beam specimen.
- Fracture energy of RCA concrete was found to increase with an increase in aggregate strength.

CONCLUSIONS

According to these test results, the performance of recycled aggregate concrete, even with the total replacement of coarse natural with coarse recycled aggregate, is mainly satisfactory, not only in terms of the mechanical properties, but also the other requirements related to mixture proportion design and production of this concrete type. The only two properties those are lower than for the natural aggregate concrete properties are the modulus of elasticity and shrinkage deformation. Because of that, it is not recommended to apply this type of concrete for structural elements for which large deformations can be expected. Also, this type of concrete shouldn't be used for structures exposed to aggressive environment conditions without appropriate previous testing, as there are opposing conclusions about durability-related properties of RAC in existing literature

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Conflict of Interest

None of the authors have any conflicts of interest to declare.