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Influence of Mineral Admixture on to the Workability of Recycled Coarse Aggregate Concrete

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Abstract

In countries like India and elsewhere, the natural aggregate resources had already reached at alarming rate due to day by day high demand of construction activities in recent years. On the other hand, million tons of Construction and demolition wastes are generated which can be utilized as a partial replacement of natural coarse aggregate and desired mechanical properties of recycled aggregate concrete can be achieved with the use of mineral admixtures. AS individual properties of recycled C&D waste aggregate is different than that of natural aggregate, the use of such recycled aggregate will differ the workability property of concrete mix. Present study investigated the effect of recycled C&D waste aggregate (RA) and mineral admixtures Metakaolin on to the fresh properties of concrete. Results reveal that workability of concrete mix decreases with percentage increase of recycled C&D waste aggregate and decrease with the percentage increase of Metakaolin.

***Keywords**: - Recycled aggregate, C&D waste, workability*

INTRODUCTION

In countries like India and elsewhere, the natural aggregate resources had already reached at alarming rate due to day by day high demand of construction activities in recent years. On the other hand, million tons of construction and demolition (C&D) residues are generated can be utilized as a Recycled Aggregate (RA) but the whole construction and demolition wastes can't be directly used as an aggregate. The unplaster waste in building may result into

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liberation of hydrogen sulphide. Hence government bodies and local authority suggest that some sorted wastes can be used as C&D wastes. Again, the aggregates used in concrete mixes, pavement or other drains can be recycled but this recyclable product is amalgamation of variety of mixture products

Although this is one of the advanced topics in Western countries, only a few researchers in India have begun to study this topic. This is a plan to start working in this direction. Due to the lack of available raw materials and current environmental and economic issues [56], the use of recycled materials in construction has become increasingly popular. With the release of slow-release and non-corrosive materials, waste disposal landfills are rapidly depleting. In addition, as the world's population grows, the amount of waste generated is also increasing [151]. As the world's population continues to increase, the demand for facilities continues to increase, which in turn requires limited natural resources. For this reason, many industries are now looking for ways to reuse materials when manufacturing new products and are supported by government support and regulations. This process has been running for many years, and the world-wide construction industry is no exception. In Europe and other developed countries, recycling of building materials began at the end of the Second World War, when bricks and other materials recovered from the ruins of the war were used to rebuild the facilities [122,19]. For various reasons, the reuse of construction and demolition (C&D) waste in the construction industry has become increasingly important. In addition to environmental protection, the preservation of natural aggregate resources, the shortage of land for waste disposal and the increase in waste disposal costs are the main factors that increase the interest in the recovery of construction and demolition wastes from inert construction and demolition wastes [110,21].

Experimental Programmes

The experimental programme consists of

- Preliminary investigations of C&D waste aggregate and its comparison with natural coarse aggregate.

- Study the conduct of fresh properties of recycled C&D waste aggregate concrete and contrast the particular properties with that of conventional concrete.

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MATERIALS

C&D waste aggregate

The C&D waste could not be acquainted in appropriate size as per necessity of crushing machine. First it broken into small pieces of up to 150 mm sizes using hammer and these small pieces are then fed into a jaw crusher to have the required nominal size (Max 20 mm).

Other ingredients (Cement, FA, NCA)

Ordinary Portland Cement 53 Grade conforming to IS 12269-1987 [5], locally available 'Bhogavo' river Fine aggregate (specific gravity 2.67 and fineness modulus 2.55) conforming to IS 383-1970 [8] and natural crushed stone aggregate of maximum size 20 mm (specific gravity 2.79 and fineness modulus 9.91) conforming to IS 383-1970 [6] were used in the conventional concrete. Particle size distributions of natural aggregate and ceramic waste aggregate are shown in Figure-1.

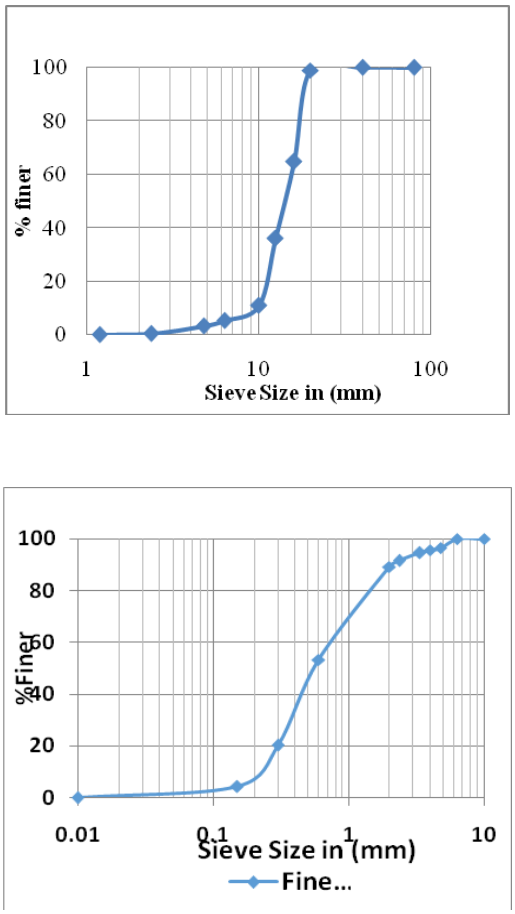


Figure: 1 Particle size distribution of Natural course aggregate and recycled C&D waste aggregate

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Mix proportions

After evaluating the properties of varies ingredients, the concrete with mixes M20 and M30 adopted as per IS Code method. The mix proportions of mix M20 and M30 are presented in Table 1 and Table 2 respectively.

Table: 1 Mix Proportion of M-20

Cement(kg/m3)		350
Coarse Aggregate (kg/m3)	20 mm	779.18
	10 mm	419.56
Fine Aggregate(kg/m3)		684.68
Water(kg/m3)		197
W/C		0.56

Table: 2 Mix Proportion of M-30

Cement(kg/m3)		438
Coarse Aggregate (kg/m3)	20 mm	757
	10 mm	407
Fine Aggregate(kg/m3)		665
Water(kg/m3)		197
W/C		0.45

Concrete in conjunction with C&D waste aggregate used as a partial replacement of natural coarse aggregate was evaluated. The C&D waste was used as partial replacement of natural coarse aggregate ranging from 20% to 100% for two different grades of mix M20 and M30. The mixes were designed by weigh batching. C&D waste coarse aggregate and natural coarse aggregate were in a saturated and surface dry condition prior to the mix.



Figure 2 Recycled Sanitary Ceramic Waste and Aggregate (CWA)

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Test details

Physical and mechanical properties of recycled C&D waste aggregate were determined conforming to IS: 2386 (Part I-VIII)-1963 [7].

To understand the workability of all the recycled aggregate concrete mixes and conventional concrete, slump test was conducted as per IS 7320-1974 [8].

DISCUSSION

Characteristics of Recycled Ceramic waste Coarse Aggregate

The physical appearances of C&D waste coarse aggregate are presented in Table 3. The surface texture of the C&D waste aggregate was found rougher than that of crushed stone aggregate***. (See Table: 3)***

Fresh properties of Recycled C&D Waste Aggregate Concrete (RAC)

The vigorous traits of C&D waste as a coarse aggregate have been demonstrated in figure 3 for both grade M20 and M30 mix. Fresh C&D waste coarse aggregate concrete found less cohesive and workable than conventional concrete. This is due to the higher water absorption and rough surface texture of the C&D waste aggregate because of adherent mortar that is attached with parent material. ***(Figure: 3)***

Table: 3 Properties of Aggregate

Properties	Natural Aggregate (NA)	Recycled C&D Waste aggregate(RA)
Specific Gravity	2.79	2.37
Water Absorption (%)	0.95	2.47
Crushing Value (%)	17.15	20.58
Impact Value (%)	14.46	17.10
Abrasion Value (%)	8.4	13.56

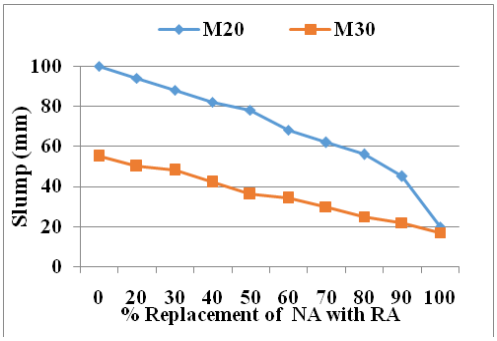


Figure: 3 Slump values of various Recycled C&D waste Aggregate Concrete mixes.

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Effect of Metakaolin on workability of RAC mix

To overcome the deficiency of hardened properties of recycled C&D waste aggregate concrete, Metakaolin can be utilized as a partial replacement of cement at different percentage level.

In present study, cement is replaced with MK with 5%, 7.5% and 10% in order to check the best replacement level as far as its fresh properties of recycled C&D waste aggregate concrete mix.is concerned.

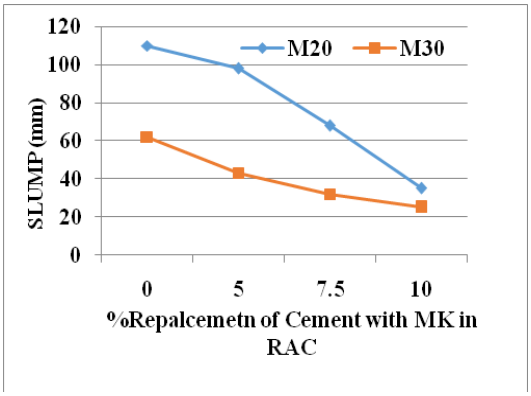


Figure 4Slump test result with different percentage of Metakaolin in RA2C

CONCLUSIONS

The following conclusions are drawn from the experimental studies on sanitary ceramic waste aggregate concrete.

- Compare to the Natural aggregate C&D aggregate observed little poor in the Properties like specific gravity, crushing value, Impact value, and Abrasion value and also it is having higher water absorption.

- C&D waste can be transformed into useful coarse aggregate. The properties of C&D waste aggregate are well within the range of the values of concrete making aggregates.

- Water absorption of recycled ceramic waste aggregate observed higher than that of natural aggregate.

- Slump value is decreased with the replacement level of recycled C&D waste aggregate in different concrete mixes because of because of the higher water absorption of adherent mortar.

- Slump value of different concrete mixes observed lower with Metakaolin addition in concrete.

- Use of plasticizer can be the solution to improve workability of concrete.

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REFERENCES

I. C. Medina, Sánchez de Rojas, M. I., and M. Frías, Properties of recycled ceramic aggregate concretes: Water resistance, Cement and Concrete Composites, 40, 21-29 (2013).

II. A. Halicka, P.Ogrodnik, and B.Zegardlo, Using ceramic sanitary ware waste as concrete aggregate, Construction and Building Materials, 48, 295-305 (2013).

III. A.V. Alves, T.F. Vieira, J.de Brito, and J.R. Correia, Mechanical properties of structural concrete with fine recycled ceramic aggregates, Construction and Building Materials, 64, 103-113 (2014).

IV. K.Rashid, A.Razzaq, M. Ahmad, T. Rashid and S.Tariq,Experimental and analytical selection of sustainable recycled concrete with ceramic waste aggregate, Construction and Building Materials, 154(Supplement C), 829-840 (2017).

V. IS 12269:1987 Specification for 53grade ordinary Portland cement, Bureau of Indian Standards, New Delhi.

VI. IS 383:1970 Specification for coarse and fine aggregates from natural sources for Concrete, Bureau of Indian Standards, New Delhi.

VII. IS 2386:1963 (PART I-VIII), Method of test for aggregate for concrete, Bureau of Indian Standards, New Delhi.

VIII. IS 7320:1974 Specification for concrete slump test apparatus, Bureau of Indian Standards, New Delhi.

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