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Use of Recycled Concrete Aggregate in Construction

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Abstract

Today Worldwide, sustainability is need of the hour in the construction industry and towards this end, use of waste material in construction is being increasingly encouraged so as to reduce environmental impact. In the highway infrastructure, a large number of originate materials and technologies have been invented to determine their suitability for the design, construction and maintenance of these pavements. waste concretes are one of them.

The main aim of this study is to focus on using the available waste/recycled concrete present in abundant which can be used economically and conveniently. The use of these materials in construction proves eco-friendly and economical with appropriate proportion.

Waste concrete can be used as aggregate in Buildings and Pavement construction which can replace content of natural aggregate.

Keywords: Recycled Concrete Aggregate, Sustainability, Waste Concrete, Natural Aggregate.

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1. INTRODUCTION

The greatest potential for reusing old concrete at a high value is to use it as aggregate in new concrete. Many times, this old concrete sits in unsightly piles, is land filled or is used as random fill or sub-base material. On the other hand, natural aggregates, which consist of crushed stone or gravel and sand, constitute the major component of pavement concrete, occupying from 70% to 80% of the volume of concrete mixtures. Natural aggregate resources are vast but finite, and aggregate resources are being depleted, especially near urban areas. Environmental regulations and land use policies further limit the opening of new quarries or the expansion of existing aggregate quarries.

Natural aggregate costs are expected to rise with scarcity of sources and increasing haul distances. Using recycled concrete aggregate (RCA) as a substitute for natural aggregates is a way to potentially address these economic and environmental concerns.

2. MATERIAL PROPERTIES

Recycled Concrete Aggregate:

The aggregates we used as raw material were extracted from demolished building in Baramati. The demolished building was a Bus Station owned by MSRTC.

Cement:

The most commonly used is Ordinary Portland Cement. The OPC 53 grade compatible to IS 8112 – 1989 was the standard followed in the mix.

Coarse Aggregate:

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates was made from locally available resources.

Fine Aggregate:

Water is an important ingredient of concrete as it actively participated in chemical reaction with cement. Here Water-Cement ratio is maintained at 0.42

3. EXPERIMENTAL METHODOLOGY

1. To extract aggregates from demolished concrete.

2. Tests on aggregates:
   i. Impact value of aggregate
   ii. Crushing value of aggregate
   iii. Abrasion value of aggregate
   iv. Specific gravity of fine and coarse aggregate
   v. Water absorpbtion of aggregates

3. To find the optimum % of RCA that can be used as replacement for normal aggregates
   i. 50 % replacement
   ii. 100 % replacement

4. To find the optimum % of RCA that can be used as replacement for normal aggregates

5. To cast 150x150x150 mm cubes (12 specimen)

6. To test cubes for compressive strength using CTM.

7. To compare the results with standard value and conclusion.

8. Concrete Mix Design

1) Grade designation: M40
2) Type of cement: OPC (53 Grade)
3) Maximum nominal size of aggregate: 20mm
4) Minimum cement content: 320 kg/m3
5) Maximum water-cement ratio: 0.45
6) Workability: 100mm(slump)
7) Exposure condition: Severe
8) Method of concrete placing: Manual
9) Degree of supervision: Good
10) Type of aggregate: Recycled concrete aggregate/natural aggregate
11) Maximum cement content: 450 kg/m3
12) Chemical admixture type: Super-plasticizer

9. Test Data for Material

1) Specific gravity of cement: 3.15

2) Specific gravity of fine and coarse aggregate:
i) For 100% replacement- 2.78
ii) For 50% replacement- 2.64

3) Specific gravity of superplatisizer:1.08

4) Water absorption of fine aggregate:
i) For 100%replacement: 1.2%
ii) For 50%replacement: 1.0%

5) Water absorption of coarse aggregate:
i) For 100% replacement: 0.8%
ii) For 50%replacement: 0.6%

Concrete Mix Design Proportions for 100% Replacement with RCA:

Sr.No.	Water M3	Cement (Kg/m3)	Fine Aggregate (Kg/m3)	Coarse Aggregate (Kg/m3)
Content	157	392	753	1228
Proportion	0.4	1	1.92	3.13

Concrete Mix Design Proportions for 50% Replacement with RCA

Sr.No.	Water M3	Cement (Kg/m3)	Fine Aggregate (Kg/m3)	Coarse Aggregate (Kg/m3)
Content	157	392	715	1186
Proportion	0.4	1	1.824	2.97

4. RESULT

Compression Test on Concrete

Standard metallic cube moulds (150*150*150 mm) were casted for compressive strength. Compaction of the hand filled concrete cubes was done. The specimens were demoulded after 24 hours and subsequently immersed in water. We have casted total nine cubes (three cubes for each type of RCA proportion) and tested them periodically after 7 days, 14 days and 28 days. The test was performed on Compressive Testing Machine (CTM).

Following are the results of the tests.

100% Replacement with RCA

Days	Load (Ton)	Crushing Strength (Mpa)
7	78	34
14	94	40.95
28	107	46.65

50% Replacement with RCA

Days	Load (Ton)	Crushing Strength (Mpa)
7	90	39.24
14	96	42.25
28	112	48.83

Using Natural Aggregates

Days	Load (Ton)	Crushing Strength (Mpa)
7	93	40.55
14	102	44.47
28	113	49.27

5. CONCLUSION

- For grade of concrete M40, hybrid mix (natural aggregate and recycled aggregate) replacement with natural aggregate gives the design strength at 28 days.
- Hybrid mix (natural aggregate and recycled aggregate) samples up to 50% replacement gains required compressive strength at 28 days and beyond 50%, there is reduction in strength.
- The most suitable mix proportion is 50 % replacement of recycled aggregate and 50% natural aggregate resulting in increasing the compressive strength.
- The compressive strength obtained for M40 grade of concrete for 50% and 100% replacement with RCA does satisfy the requirement led down by IS code.
- Extraction of earthen materials for the production of natural aggregate is reduced resulting in prevention of harm to environment to some extent.
- This research concludes that using natural aggregate and recycled aggregate can be innovative supplementary Construction Material but judicious decisions are to be taken by engineers.

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