

A Study on Recycle Concrete as a Substitute of Fresh Concrete to Reduce the Use of Natural Resources

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ABSTRACT

Concrete has been used by humans from very long to construct houses and different kind of structures to fulfil their different types of requirement that can be for living purpose or for transport or storage etc. But in our century, demand of concrete has been increased significantly as rate of construction of different structures are increased and now have come to situation that soon we are going to face a lot of troubles. At present it is estimated that about 20 billion ton of concrete is used in a year. One of the issue is Concrete is made up of cement, aggregates and water, we all know that because of significant use it is expected that soon we may have shortage of these things and hence it is very important that we start for searching alternatives so that in future our progress doesn't get stopped because of insufficient resource availability. That is why we are looking for alternatives like RECYCLED CONCRETE.

Key Words: Recycled Coarse Aggregates(RCAs), Natural Coarse Aggregates(NCAs), Concrete, Recycle, Reuse

INTRODUCTION

The recycling of Construction and Demolition Wastes has long been accepted to have the possible to conserve natural resources and to decrease energy used in its production. RCAs fit into present day motto of 'Reducing, Reusing, Recycling and Regenerating'. In some nations it is a standard substitute for both construction and maintenance, particularly where there is a scarcity of construction aggregate. The use of recycled aggregate weakens the quality of recycled aggregate concrete which limits its application. This project deals with the different tests we had performed for understanding thoroughly about RCAs and the use of recycled concrete as aggregates in concrete and proposes an approach for use of recycled concrete aggregate without compromising the strength in view for better economic growth to pave way for new construction as the old structures brought down.

TABLE 1
TYPES, SOURCES AND USES OF RCA

Type	Source	Use
RECYCLE CONCRETE AGGREGATE (RCA)	Crushed Stone & clean waste concrete of at least 95% by weight of concrete with typical total contamination lower than 1% of bulk mass.	Partial replacement (30%) of natural used in sidewalks, kerbs and gutters. Also for structural concrete with inferior permeability & shrinkage properties
RECYCLE CONCRETE AND MASONRY (RCM)	Graded aggregate produced from sorted and clean waste concrete and masonry	Road base course and sub base course
RECLAIMED AGGREGATE (RA)	Coarse aggregate reclaimed from returned concrete by separating the aggregate from water cement slurry	Upto 32 MPa concrete with 100% reclaimed aggregate and as partial replacement of natural aggregate in grades upto 80 MPa

RECLAIMED ASPHALT PAVEMENT (RAP)	Old asphalt concrete	New asphaltic concrete pavement
RECLAIMED ASPHALT AGGREGATE (RAA)	Reclaimed coarse aggregate and granules from waste asphalt concrete	Concrete with penalties in mix adjustment

SOURCE: Report by Patel Vivek on Techno Economical Study on Recycle Aggregate Concrete.

PROPERTIES**SPECIFIC GRAVITY**

Specific gravity of an aggregate is defined as the ratio of the mass of a solid to the mass of an equal volume of water at the same temperature.

SURFACE TEXTURE AND SHAPE

Recycled Concrete Aggregates have an irregular and granular structure, due to the adhered mortar which can be a point of concern as it is a factor which contributes toward higher water absorption, workability and ultimately the strength characteristics of the concrete made using RCAs. The structure of RCAs mainly depends upon the parent source of concrete rubble. RCAs from poorly compacted concrete are of irregular shape and the adhered mortar is not dense and thus exhibits weak bond between the mortar and the aggregate. While aggregates derived from concrete cubes yields aggregates with irregular shape and better bond between mortar and aggregate.

FLAKINESS AND ELONGATION INDEX

Flakiness index: It is defined as the percentage by weight of Particles in it whose least dimension is less than three fifths of their mean dimension.

Elongation Index: It is defined as the percentage by weight of particles whose greatest dimension is greater than 1.8 times their mean dimension.

BULK DENSITY, CRUSHING AND IMPACT VALUES

Bulk Density: Mass of aggregate per unit Volume.

Crushing Value: The Value which gives a relative Measure of Resistance of an aggregate under a gradually applied compressive load is called Crushing Value of an Aggregate.

Impact Value: The value which gives a Relative Measure of the resistance of an Aggregate to sudden shock or Impact is Called Impact Value of an Aggregate.

TABLE 2**PROPERTIES OF NCA AND RCAs**

Properties of aggregate	NCA-20mm	RCA-20mm
Sp. Gravity	2.80	2.54
Elongation index	34.9%	26.85%
Flakiness Index	14.75%	6.26%
Loose Bulk Density	1.45kg/lit	1.18kg/lit
Water Absorption	2%	5.65%
Impact Value	16.48%	32.23%
Crushing Value	22%	29.1%

SOURCE: Test results

PROBLEMS WITH RCAs

Following are the problems related with Recycle Aggregate (RCAs):

- Poor properties than that of natural aggregate
- Higher water absorption (3 – 9%)
- Lower density (2000 – 2500 kg/m³)
- Lower resistance to abrasion
- Higher content of impurities
- Lower specific gravity
- Lack of strong bond between cement paste and RCAs in concrete matrix.

APPLICATION OF RECYCLE AGGREGATE

In general applications of recycle aggregate are as follows:

- Many types of general bulk fills
- Bank protection
- Base or fill for drainage structures
- Road construction
- Noise barriers and embankments
- Construction of low rise buildings
- Manufacture of paving blocks & tiles
- Laying of flooring and approach lanes
- In sewerage structures and sub-base course of pavement
- Besides drainage layer in highways and retaining walls.

EFFECTS OF RCAs

Following are the effects of using Recycle Aggregate in hardened concrete:

- Lower compressive strength (upto 40%)
- Lower modulus of elasticity (upto 50%)
- Increased shrinkage (upto 50% if only bigger recycled fractions are used, upto 70% in case of all recycled fractions including recycled sand)
- Reduced durability
- Higher water absorption, water permeability and gas permeability
- Lower freeze-thawing resistance
- Increased resistance to abrasion: For a 100% amount of the recycled fraction was determined 30% lower LA abrasion los than in the case of the original concrete.

CASE STUDY

The use of high percentages of recycled aggregates in concrete would usually worsen the concrete properties. In this study, M25 concrete mixtures was prepared with water-to-binder W/B ratios of 0.45 and the recycled aggregate was used as 0% and 100% by weight replacements of natural aggregate.

A concrete mixture was prepared in the laboratory with a water-to-binder W/B ratio and a cement content of 0.45 and 400 kg/m³, respectively. The absolute volume method was adopted to design the mix proportions of the concrete mixtures as shown in Table 3. For M25 it is 1:1:2.

TABLE 3
PROPORTIONING OF THE CONCRETE MIXTURES

Notatio n	RCA %	Constituents (kg)				
		Water	Cemen t	Sand	Granit e	RCA s
R0	0	7.2	16	8	8	0
R100	100	7.2	16	8	0	8

For each concrete mixture, 150 mm cubes were casted to determine the compressive strength of concrete. All the specimens were cast in steel molds and compacted using a vibrating table. Three cubes were immediately used after de-moulding to measure the 1 day compressive strengths. The rest of the specimens were cured in a water-curing tank at 27 ±1°C until the age of testing.

The compressive strength of concrete was determined using a Denison compression machine with a loading capacity of 3,000 KN. The loading rate applied in the compressive test was 200 KN/min. Hence the compressive strength obtained was 15.9KN/mm² for RCAs.

CONCLUSION

Hence a **Recycled Concrete** can be defined as a concrete in which the waste concrete/older concrete has been used in its making. It is used in form of aggregates/ as replacement, mixed up of with cement and water in definite proportion as per our requirement. So we conclude that the recycled concrete that was prepared by us was about 23-25% less in strength than the fresh aggregate concrete which means that this concrete cannot be used in high rise buildings or buildings that are made to bear heavy loads. Thus our recycled concrete is safe for being used as riprap revetments, or pipeline beddings,

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