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### Experimental study on high strength concrete by using recycled coarse aggregate

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#### ABSTRACT

Now days the critical shortage of natural aggregate, the availability of demolished concrete for use as recycled coarse aggregate is increasing. Using the waste concrete as RCA conserves natural aggregate, reduce the impact on landfills, decreases energy consumption and can provide cost savings. The main objective of this investigation is to find out the percentage of natural coarse aggregate can be replaced by the recycled coarse aggregate in the M30 concrete. Tests were carried out to determine the compressive strength, split tensile strength, flexural strength with and without recycled aggregates. Recycled coarse aggregates in concrete were replaced 15%, 25%, and 35% instead of conventional aggregate. For the strength characteristics, the result showed a gradual increase in mechanical properties by addition of RCA as the percentage of recycled aggregate is increased.

**Keywords:** RCA, Mechanical properties, M30 mix.

#### INTRODUCTION

Now days there are critical shortages of natural resources. A possible solution of these problems is to recycle demolished concrete and produce an alternative aggregate for structural concrete in this way. RCA reduces the impact on landfills decreases energy consumption and can provide cost savings. The use of recycled aggregates from construction and demolition wastes is showing prospective application in construction as alternative to natural aggregates. There are numerous skyscrapers, bridges, roads, underground tunnels, and deep water structures all over the world are constructed. To accommodate new structures many old buildings are demolished after their lie span and damaged condition caused by natural disaster. The demolition of structures is generating concrete rubbles and causing environmental problems due to unplanned disposal and scarcity of landfill sites. Nowadays this are used in construction industry.

#### ADVANTAGES OF RECYCLED COARSE

##### Aggregate

- Reduces the amount of natural aggregates to be created.
- Cost saving.
- Conserves landfill space, reduces the need for new landfills and hence saving more costs.
- Creates more employment opportunities in recycling industry.

##### Scope of this project

- To control the environmental pollution.
- To produce low cost concrete.
- Economical and profitable substitute to landfills, incinerator.
- Alternative material for coarse aggregate.

#### MATERIALS USED

The materials used are

- Cement ( 53 grade)

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- Fine aggregate
- Coarse aggregate
- Recycled coarse aggregate
- Water

## CEMENT

Cement is made by grinding claimed limestone and clay into a very fine, grey powder. Cement is

one of the binding agent in this project. The cement and water forms a paste and binds the other materials together. The Ordinary Portland Cement (53grade) conforming to IS: 8112-1989 is being used. Many tests were conducted on cement.

**Table No.1 Properties of Cement**

S. No	Property	Result Obtained
1	Specific Gravity	3.15
2	Consistency	33%
3	Initial setting time	30 min
4	Final setting time	600 min

## FINE AGGREGATE

Fine aggregate used throughout the work comprised of clean river sand with maximum size of 4.75mm conforming to Zone I as per IS 383-1970. Sand is naturally occurring granular material

composed of finely divided rock and mineral particles the physical properties of fine aggregate like specific gravity, fineness modulus and water absorption are tested in accordance with IS: 2386.

**Table No.2 Properties of FA**

S. No	Property	Result Obtained
1	Specific Gravity	2.60
2	Fineness modulus	4.67%
3	Water absorption	1.0%
4	Sieve zone	II

## COARSE AGGREGATE

Coarse aggregate consists of crushed granite or basalt rock, conforming to IS: 383. Coarse aggregate are used in the size of 20mm.The

physical properties of coarse aggregate like specific gravity, fineness modulus and water absorption are tested in accordance with IS:2386.

**Table No.3 Properties of CA**

S.No	Property	Result Obtained
1	Specific gravity	2.8
2	Water absorption	0.5%
3	Impact strength	8 %

## RECYCLED COARSE AGGREGATE

The waste concrete was brought from the demolished structure. The coarse aggregate (C.A) is separated from the concrete by hammering. Mortar adhered to the aggregate is also removed from the aggregate as much as possible. Obtained

CA is sieved under 20mm sieve and 4.75mm sieve (retained), later these aggregates can be used as RCA for future work. The replacement of coarse aggregate 15%, 25%and35%. The compressive strength and flexural strength was also determined in 7 days and 28 days.



**Fig.1 Recycled coarse aggregate**

**Table No.4 Physical Properties of RCA**

S.No	Property	Result Obtained
1	Specific Gravity	2.45
2	Water absorption	4.5 %
3	Fineness modulus	6.6
4	Impact strength	12.92 %

## **WATER**

Water cement ratio (w/c) of 0.45 was used in the preparing of concrete and for this purpose portable water used for mixing and curing purpose

## **DESIGN MIX**

The concrete mix design was proposed using IS10262:2009. The grade of concrete used was M30 with water to cement ratio 0.45. The mix design proportions for 1 m<sup>3</sup> of concrete

## **EXPERIMENTAL INVESTIGATION**

### **Test on Fresh Concrete**

Slump cone test determines the consistency and workability of all concrete mixtures. Slump cone test utilizing a metallic slump mould. The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.

**Table No.5 Slump Value**

% of Replacement	Slump cone value (mm)
15	180
25	195
35	180

## **Casting of Moulds**

Casting of conventional concrete of M30 mix ratio and also casting of 0%, 15%, 25% and 35%

replacement of natural coarse aggregate by recycled coarse aggregate.



**Fig.2 Casting of Moulds**

### **COMPRESSIVE STRENGTH TEST**

The concrete specimens were cured under normal conditions as per IS 516-1979 and were tested at 7 days and 28 days for determining compressive strength and split tensile strength. Compressive strength Test results for cube

specimens of size 150mm×150mm×150mm. In this test, the cubes are subjected to compressive force in a compression testing machine and the ultimate load at which the failure occurs is noted. Then the compressive stress is ultimate load by area exposed to load and stress value is obtained in  $N/mm^2$ .



**Fig.3 Compression strength test @ 28days**

### **SPLIT TENSILE STRENGTH**

This test is carried out in a cylindrical specimen of 150 mm diameter and 300 mm length. The cylindrical specimen is placed horizontally between the loading surface of a compression-

testing machine and the load is applied until failure of cylinder occurs along the vertical diameter. The split tensile strength is given by the formula  $2P/(\pi DL)$  and the stress value is obtained in  $N/mm^2$ .



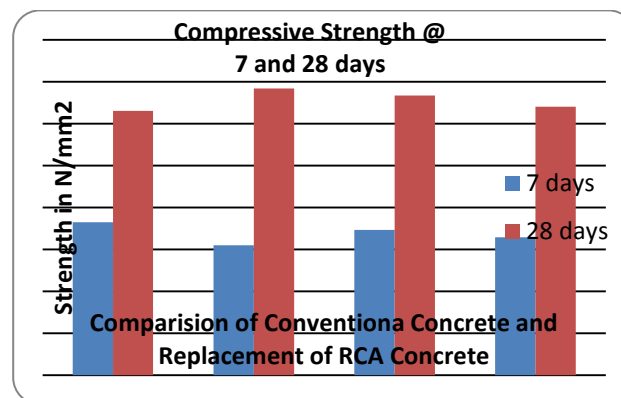
**Fig.4 Split tensile strength**

## CONCLUSION

- Finally we conclude our project by partial replacement of recycled coarse aggregate at 7 days and 28 days
- The compressive strength of concrete increases during 7 and 28 days for M30 grade concrete and the replacement of recycled coarse aggregate is done from 0%, 15%, 25% and 35%.
  - When replacing 25% of RCA the compressive strength at 28 days is slightly increase in the range 13.5 % when compared to conventional concrete.
  - When replacing 35% of RCA the compressive strength at 28 days is slightly decreased.
  - In future study when water cement ratio of mix was decreased, the compressive strength increases.

**Table No.6 Compressive Strength test result @ 7 and 28 days**

S.NO	RCA	Compressive test at 7 days N/mm <sup>2</sup>	Compressive test at 28 days in N/mm <sup>2</sup>
1	C	18.22	31.5
2	15%	15.5	34.2
3	25%	17.33	33.33
4	35%	16.44	32



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