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# EXPERIMENTAL INVESTIGATION ON HIGH STRENGTH CONCRETE BY USING PARTIAL REPLACEMENT OF RECYCLED COARSE AGGREGATE

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## ABSTRACT:

Concrete has unlimited opportunities and applications for innovative design and construction techniques. Its great versatility and ability to fill wide range of needs, has made it a very competitive building material. The use of concrete in recent years, have spread to highly harsh and hoist environment resulting in premature failure of number of structures. Coarse aggregate recycling is now a day's popular technique to utilize aggregate left behind when structures are demolished. Previously most of the concrete wastes were dumped in low lying lands to increase the level of ground. But when Environment is taken into consideration recycled coarse aggregate promotes their reuse and lowers the construction cost.

## 1.1 INTRODUCTION

Concrete has unlimited opportunities and applications for innovative design and construction techniques. Its great versatility and ability to fill wide range of needs, has made it a very competitive building material. The use of concrete in recent years, have spread to highly harsh and hoist environment resulting in premature failure of number of structures. Although compressive strength of concrete is a measure of durability to great extent it is

not entirely true that the strong concrete is always durable. In addition to strength of concrete another factors what we call as exposure conditions has become an important consideration for durability. Coarse aggregate recycling is now a day's popular technique to utilize aggregate left behind when structures are

demolished. Previously most of the concrete wastes were dumped in low lying lands to increase the level of ground. But when Environment is taken into consideration recycled coarse aggregate promotes their reuse and lowers the construction cost.

## 1.2. NEED FOR THE STUDY

The scarcity and availability at reasonable rates of sand and aggregate are now giving anxiety to the construction industry. Over years, deforestation and Extraction of natural aggregates from river beds, lakes and other water bodies have resulted in huge environmental problems. Erosion of the existing topography usually results in flooding and landslides. Moreover, the filtration of rain water achieved by deposits of natural sand is being lost, thereby causing contamination of water reserves used for human consumption. Hence, to prevent pollution authorities are imposing more and more stringent restrictions on the extraction of natural aggregates and its crushing. The best way to overcome this problem is to find alternate aggregates for construction in place of conventional natural aggregates.

## 1.3. OBJECTIVES AND RESEARCH SIGNIFICANCE

The main objective of this study were

- To reduce the consumption of natural sources by replacing recycled coarse aggregate.
- To study the characteristics of the recycled coarse aggregate concrete for structural applications.
- To find the compressive strength, tensile strength, flexural strength of concrete with replacing of coarse aggregate by recycled coarse aggregate.
- To prepare a low cost concrete with good environmental factors.

# MATERIAL AND ITS PROPERTIES

## 2.1. GENERAL

This chapter briefly describes the various materials used in this project work. The following are the materials used in this work.

## 2.2. MATERIALS USED

Materials that go for making concrete for this study were tested before casting the specimens.

- Cement
- Fine Aggregate
- Coarse aggregate
- Recycled coarse aggregate

## 2.3. CEMENT

Cement is well known building material and has occupied an indispensable place in construction works. Cement is an extremely ground material having adhesive and cohesive properties, which provide a binding medium for the discreet ingredients. It is obtained by burning together, in a definite proportion, a mixture of naturally occurring argillaceous and calcareous material to a partial fusion at high temperature. The product obtained by burning, cooled and ground to the required fineness is known as cement. We are using Ordinary Portland cement of 53 grade.

## 2.4. PROPERTIES

| | |
|---|---|
| Fineness | - 4.5% |
| Consistency | - 32% |
| Initial setting time | - 50 minutes |
| Final setting time | - 430 minutes |
| Specific gravity | - 3.15 |

## 2.5. FINE AGGREGATES

Aggregates are generally imparted greater volume stability and durability to concrete. The aggregate is used primarily for the purpose of providing bulk to the concrete. The most important function of the fine aggregate also assists the cement paste to hold the coarse aggregate in suspension.

Fine aggregate most of which passejs through a 4.75 mm IS sieve and contains only so much fine material as its permitted by the specification. Sand is generally considered to have a lower size limit of about 0.07mm. Material between 0.06mm to0.002mm classified as silt, and still smaller particles are called clay.

Fine aggregate is added to concrete to assist workability and to prevent segregation of the cement paste and coarse aggregate during its transportation. It fills the voids in coarse aggregate. Usually, the natural river sand is used as fine aggregate. Ordinary river

sand conforming IS 383-1970 is used in this project.

## 2.6. PROPERTIES

Fineness modulus - 3.415 (Zone II)

Specific gravity - 2.65

Moisture Content - 1%

## 2.7. COARSE AGGREGATES

In coarse aggregate most of which are retained on the 4.75mm IS sieve and contain only so much of coarse material as is permitted by the specification are termed coarse aggregate. Crushed gravel or stone obtained by the crushing of gravel or gravel or hard stone. Uncrushed gravel or stone resulting from the natural disintegration of rock. Partially crushed gravel or stone obtained as product of the building of the two types. The graded coarse aggregate is described by its nominal size i.e. 40mm, 20mm, 16mm and12.5mm.The grading of coarse aggregates should be as per specifications of IS 383-1970.

## 2.8. PROPERTIES

Finenessmodulus- 7.1

Specific gravity- 2.78

Water absorption- 1.5%

## 2.9. RECYCLED COARSE AGGREGATE

Recycled coarse aggregates are the materials which obtained while demolish the concrete buildings. From the demolished material the coarse aggregate is separately taken for the project and that coarse aggregate has some bonding agent on it. We can't use that coarse aggregate with bonding agent because it has more water absorption property. So, the recycled coarse aggregate is treated with NAOH at 2N for 24hrs.

**Fig: 2.1 Recycled Coarse Aggregate**

## 2.10. Sieve analysis

The sample is brought to an air-dry condition before weighing and sieving. This

may be achieved either by drying at room temperature or heating at a temperature of $1000^0$C to $1100^0$C.. Table 4.3 shows the sieve analysis of recycled coarse aggregate.

| Materials | Fineness modulus |
|---|---|
| Natural coarse aggregate | 7.14 |
| Recycled coarse aggregate | 7.92 |

**Table 2.1 Sieve Analysis of recycled coarse aggregate**

## 2.11. Specific gravity

The pycnometer is dried thoroughly and its weight is taken as $W_1$. Fill two third part of no pycnometer with RCA and is weighed as $W_2$. The pycnometer is filled with water up to the top without removing the copper RCA. Then it is shaken well and stirred thoroughly with the glass rod to remove the entrapped air. After the air has been removed, the pycnometer is completely filled with water up to the mark.

Then outside of the pycnometer is dried with a clean cloth and is weighed as $W_3$. The pycnometer is cleaned thoroughly. The pycnometer is completely filled with water up to top. Then outside of the pycnometer is dried with a clean cloth and is weighed as $W_4$.Table 4.4 shows the specific gravity for RCA.

| Sl. No. | Observations | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| 1. | Weight of empty pycnometer | 0.690 | 0.690 | 0.690 |
| 2. | Weight of pycnometer + | 1.035 | 1.030 | 1.040 |
| 3. | Weight of pycnometer + | 1.765 | 1.760 | 1.770 |
| 4. | Wt of pycnometer + water$W_4$ (kg) | 1.510 | 1.510 | 1.510 |
| 5. | Specific Gravity | 2.58 | 2.49 | 2.62 |

**Table 2.2 Specific Gravity for RCA**

Specific Gravity of RCA

$$= (W_2-W_1) / [(W_2-W_1)-(W_3-W_4)]$$

Specific Some quantity of RCA was taken in bucket and was taken as $W_1$. Place it in oven for 24 hours and the dried sample was weighed as $W_2$.

Gravity of RCA = 2.58

## 2.12.Moisture content

Weight of sample taken =1000gm

Weight of sample after dried process =1038gm

Percentage of free moisture content
= $[(W_1-W_2)/W_1]$ x 100

Moisture content of RCA
= 0.038%

## TEST ON CONCRETE

## 3.1. Tests on fresh concrete

In order to determine the workability of fresh concrete, the slump test and compaction factor test were conducted as per IS 1199 : 1959.

## 3.2. Slump test

Slump test is used to determine the workability of fresh concrete. The apparatus used for doing slump test are Slump cone and tamping rod. The slump test is the most widely, primarily because of the simplicity of the apparatus required and the test procedure. The slump test indicates the behaviour of a compacted concrete cone under the action of gravitational forces. The test is carried out with a mouldcalled the slump cone, and filled in three equal layers of fresh concrete, each layer being tamped 25 times with a standard tamping rod. The top layer is struck off level and the mould lifted vertically without disturbing the concrete cone. The slump measured should be recorded in mm of subsidence of the specimen during the test. Any slump specimen, whom collapses or shears off laterally, gives incorrect result and if this occurs, the test should be repeated with another.

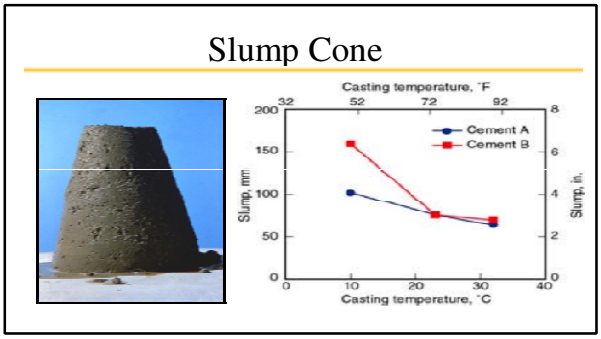


**Figure 3.1: Slump Cone Test**

## 3.3. Compacting factor

The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. It is more

precise and sensitive than the slump test and is particularly useful for concrete mixes of low workability as are normally used when concrete is to be compacted by vibration. Such dry concrete are in sensitive to slump test. The apparatus used is Compacting factor apparatus.

The compacting factor of the fresh concrete was found to be 0.825

## 4.1 Admixtures used

- Calcium carbide (CAC2)
- calcium carbonate (CACO3)

### Calcium Carbide (CAC2)

It is chemical compound with the formula CaC2. It is main use industrially is in the production of acetylene and calcium cyanamide

Chemival formula = CAC2

Molar mass = 64.099g/mol

Density = 2.22g/cm3


**Fig: 4.1 Calcium Carbide**

### Calcium Carbonate (CACO3)

It is chemical compound with the formula CaCo3. It is common substance found in rocks as the mineral calcite and aragonite and is the main component of pearls and the shells of marine organisms, snails, rocks and eggs

Chemical formula = $CACO_3$

Molar mass = 100.0869g/mol

Autoginition temperature: $305^0$ C

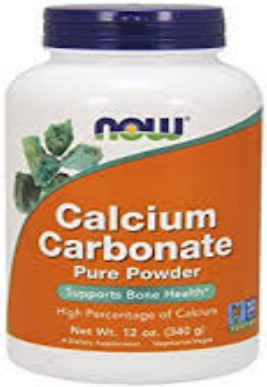


**Fig: 4.2 Calcium Carbonate**

## CONCLUSION

### 5.1 SUMMARY

Use of Recycled Coarse Aggregate is environmentally helpful to reduce the effects of waste material which produced from buildings. Replacing the building materials are more helpful to reduce lack of space in construction site.

- The compression and Tensile strength is evaluated by replacing RCA for coarse aggregate is compared with the conventional concrete as per IS codes.
- Admixtures like calcium carbide and calcium carbonate is used to achieve the high strength of concrete. Both admixtures are used at 2% to the weight of cement.
- Casting and curing the specimen after check the result of fresh and hardened concrete.
- By replacing RCA with the addition of CAC2 and CACO3 is replacement of RCA. The strength obtained at by different percentages, then comparing the result

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