

Experimental Study of Mechanical Behavior of Concrete by using Artificial Coarse Aggregate

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Abstract:- Concrete may be a combination of cement, water and aggregate. So that it will hold the natural resources, artificial coarse aggregate created thru the use of ash cement and sodium silicate. In this research the coarse aggregate is modified with fly ash artificial coarse aggregate. The mechanical strength of concrete have become tested thru performing compression take a look at on cube, split tensile take a look at on Cylinder sodium silicate is added to boom the Strength and houses of concrete. Adding sodium silicate to mixture brings down the lime with inside the mortar, at the same time as there can be a rise with inside the calcium silicate hydrate.

Keywords:- Concrete, fly ash artificial coarse aggregate, sodium silicate, calcium silicate hydrate.

I. INTRODUCTION

India produces 70% of its power requirement through thermal power plants. Fly ash is more overstated as "Pulverised gas ash" is that the derivative of coal combustion product this is composed of pleasant debris which are pushed out of coal-fired boilers. In order to conserve the natural resources, fly ash is used to create artificial coarse aggregate. Artificial coarse aggregate is created by Granulation technique where the pellets are created. Later these aggregate is subjected to a temperature of 1100°C to harden and achieve a better aggregate strength. The Fly ash aggregate specific gravity is 40% lesser than normal aggregate. Thus there is a reduction in the overall weight of the structure. This decreases the development price spent on foundation. During this study the ash coarse aggregate is replaced by normal coarse aggregate, and also the corresponding strength is checked and compared thereupon of the standard concrete. To extend the density and compactness of concrete, Addition of water glass decreases calcium hydrate content, while there is a growth in the steel detail silicate hydrate.

1. MATERIALS

- 1.1 Cement
- 1.2 Fine aggregate
- 1.3 Fly ash
- 1.4 Coarse aggregate
- 1.5 Sodium Silicate

1.1 Cement

Cement is employed of 43 grade regular cement (OPC) with decision ram-co is employed for all concrete mixes. The cement used is gift day and with none lumps and homes of cement conformist to IS 1489 (Part 1):1991.

1.2 Fine aggregate

M-sand is hired as first-class aggregate. The M-sand passing via 4.75 millimeter length sieve is used in the coaching of specimen. Sieve evaluation have region II.

1.3 Fly ash

In our project class F fly ash from RMC plant Harihara is used for manufacture of aggregate. It is important materials used in geopolymer concrete. In this class, F type is Low calcium and fly ash acquired from in extra thermal energy station and it become analyzed as consistent with IS:3812/1981 having a particular gravity of 2.7 is used ASTM fly ash got here from the coal-burning energy station.



Figure 1. Fly ash

1.4 Coarse aggregates

Coarse aggregates are a creation element made from rock quarried from floor deposits. Examples of those types of floor deposits consist of river gravel, beaten stone from rock quarries, and previously used concrete.

1.5 Sodium silicate

Sodium silicate is a glassy gel material that reduces the permeability in the concrete. This C-S-H gel blocks all micro pores and cracks in concrete to enhance its resistance to water permeability.

● OBJECTIVES:

- 1 Find the optimum percentage ratio(flyash:cement:sodium silicate)for artificial aggregate.
- 2 To carry out detailed characterization of fly ash aggregate.
- 3 To study the results on workability and strength because of the replacement of artificial aggregate.
- 4 To compare with natural aggregate.
- 5 To utilize the flyash coarse aggregate and also lower the usage of natural aggregate.
- 6 To determine properties of fly ash aggregate.

II.MATERIALSANDMETHODOLOGY

2.1 Materials

The residences of contemporary concrete and harder concrete of M25 grade mixed based upon on the houses of the components implemented in its manufacture. Hence, initial take a look at be come performed at the substances to training session their feature residences as in line with code of observe are in accordance below.

Materials decided on this Project are:

- 2.1.1 Cement
- 2.1.2 Fine aggregate
- 2.1.3 Coarse aggregate
- 2.1.4 Fly ash
- 2.1.5 Water

2.1.1 Cement

Test on Cement:

- (1) Grade of Cement: 43 grade (OPC)
- (2) Specific Gravity: 3.1
- (3) Normal Consistency: 30%
- (4) Initial Setting time : 35 minutes
- (5) Final Setting time: 600 minutes

2.1.2 Fine aggregates

Test on M-Sand:

- 1) Specific Gravity: 2.3
- 2) Bulkiness of sand: 6%
- 3) Grading of Sand: Zone-II

2.1.3 Natural coarse aggregates

The coarse combination used with inside the analysis is twenty millimetre down length regionally to be had destroyed stone non inheritable from out of the ground. It occupies nearly of extent in concrete and for this reason indicates have a control on varied residences which in corporates strength, workability, strength and economic system of concrete. The mixture having length bigger than 4.75 mm is called as coarse combination.

Test on Normal coarse aggregate:

1. Specific Gravity: 2.7
2. Flakiness: 11.4%
3. Water Absorption: 1%
4. Impact value : 20.23%
5. Shape: Angular

2.1.4 Fly ash

In this class, F kind is Low calcium and ash obtained from in additional thermal station and it absolutely was analyzed as per IS:38121981 having a selected gravity of 2.7.

Test on fly ash:

- (1) Specific Gravity: 2.57

2.1.5 Water:

Palatable (portable) water has been used thru out this studies work.

2.2 Methodology

2.2.1 The Following methodology is adopted for the present work

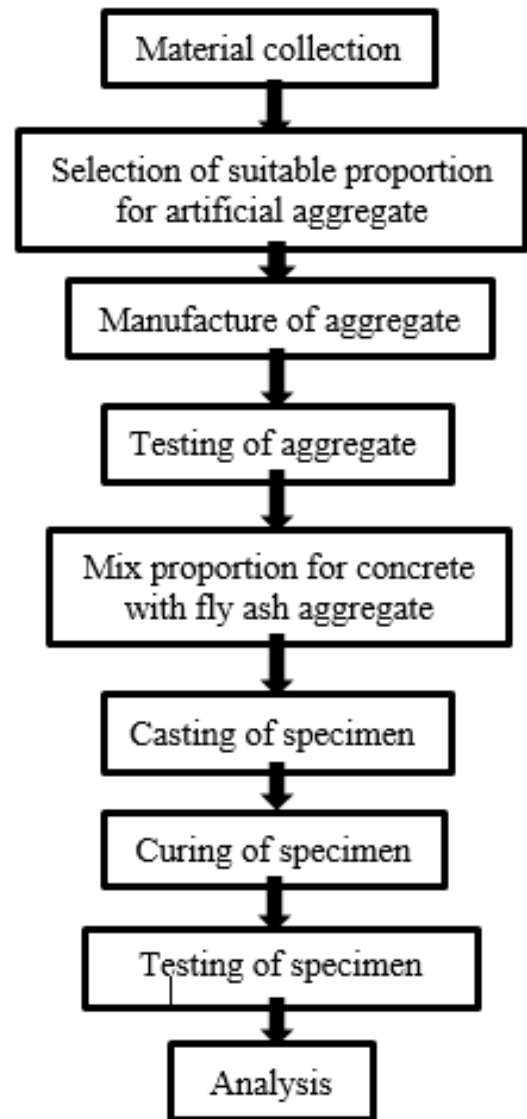


Figure 2. Flowchart

2.3 Preparation of pellets

2.3.1 Method of formation of fly ash pellets (coarse aggregate)

- The parts like cement fly ash, sodium silicate and water are used to provide the fly ash aggregates.
- The fly ash coarse combination is ready via way of means of blending the cement and fly ash in 70:25:5ratio.

2.3.2 The manufacturing process goes as follows

- The required quantity of fly ash and cement is fascinated about in the true ratio of 70:25:5.
- Formation of pellets is primarily based totally absolutely absolutely at the mechanism involved in balling phenomenon of powdery materials.
- When a satisfactory grade cloth is moisturized particals touch every other. The partly circled in to balls bonding forces broaden gradually.
- Initially a few percent of water is introduced with inside the bender after which poured in a mixer closing water is sprayed at some stage in the rotating length due to the fact even as rotating without water with inside the combination the fly ash powder has a tendency to shape lumps and dose now no longer growth the distribution of particle size.



Figure 5. Drying of fly ash aggregate



Figure 6. Curing of fly ash aggregate



Figure3. Dry mixture



Figure4. Preparation of pellets

2.3.3 Curing and Drying of fly ash aggregates

- After the aggregate is formed they are taken in a separate container allowed to dry in an open place. The dry curing is just drying the aggregate in open are exposed to light and air.
- The dry curing of aggregate is done for about one day. If the aggregate remains wet even after one day of dry curing the period of dry curing can be extended. But normally a 14 days wet curing can be adopted.

2.4 Experimental Details

2.4.1. In this check finished the grades of concrete M-25. The mixture layout have grow to be achieved as ordinary with IS 10262- 2009. The trials had been organized and M-25 grade have grow to be layout for this check having the combination percentage 1:1:3 and the water cement ratio are 0.5. All domestically to be had substances are used in the course of the guidance of the combination percentage

Table.1.Mix Proportion as per IS 10262-2009 for 3 cube

Substance	Amount of item	Ratio
Cement	6.75kg	1
Fine aggregate	6.75kg	1
Coarse aggregate	13.50kg	2
Water	3.375lit	0.5

Table.2. Mix proportion as per IS 10262-2009 for 3 cylinder

Substance	Amount of items	Ratio
Cement	10.494kg	1
Fine aggregate	10.494kg	1
Coarse aggregate	20.988g	2
Water	5.247lit	0.5



Figure 7. Casting of specimens

After weigh in accurately cement, sand, fly ash aggregate, they are mixed dry until uniform colour is obtained. Proper mixing of cement, fine aggregate and fly ash aggregate has been ensured before adding to the mix. Have been spread evenly in mix fly ash aggregate can distributed uniformly throughout the mix. Water cement ratio is taken as 0.5. Similarly, concrete aggregate has been manufactured. Cubes and cylinders with a length of (0.15*0.15*0.15) m and (0.15×0.3) m were prepared. The specimens were full of concrete in 3 layers, and every layer of the concrete grow to be efficaciously compacted via way of method of desk vibrator.



Figure 8.sample of cube Casting

2.4.2 Curing of Specimens

After casting, all the take a glance at specimens are keep at temperature for 24hrs and thenceforth have been DE wrought and moved to the action tank till their take a look at in dates. Specimen grow to be tested for 7, fourteen and twenty eight days.



Figure 9. Curing of specimens

2.4.3 Testing of Specimens

After of completeness of the activity the associate degree attempt (attempting) out samples are dry around half an hour. Then Specimens are tested for its dates together with 7, 14 and 28 days for compressive strength, and spilt tensile test, thru technique of approach of massive attempting out machine (UTM).



Figure 10. Testing of cube



Figure 11. Testing of cylinder

III.RESULTS AND DISCUSSION

3.1 Compression test

The cube (150*150*150mm) specimen emerge as positioned in compression attempting out system and therefore the load is to be carried out at the same time as now not marvel and boom with out stop at a rate of about 140kg/cm2 min till the resistance of the specimen to developing load breaks down and no massive load are often restrained. The most load carried out to the specimens is to be recorded and the arrival of the concrete and any uncommon options within the style of failure is noted.

$$\text{Compressive strength (Mpl)} = P/A \quad (1)$$

3.1.1 Replacement of flyash pellets to natural aggregate.

Table 3.Compressive test.

SLNO.	Number of days (curing)	Compressive strength
1	7 days	15.77N/mm ²
2	14 days	22.66N/mm ²
3	28 days	27.5N/mm ²

3.2 Split tensile test

The cylinder specimen is found parallel among the loading floor of the compression checking out device and additionally the burden is applied until the failure of the cylinder, at the vertical diameter. slender packing strips of acceptable substances like laminate are set among the specimens and loading platens of the checking out device the packing strip is delicate decent to allow distribution the burden over an lower priced area to prevent large bit area. Then the weight is applied till the failure of the cylinder, aboard the vertical diameter. The

failure load of power of cylinder is calculated with the assistance of pattern using the formula

$$\text{Tensile strength} = 2P/\pi DL \quad (2)$$

Table 4. Split tensile test

SLNO.	Number of day (curing)	Split tensile test
1	7 days	1.49N/mm ²
2	14 days	1.96N/mm ²
3	28 days	2.2N/mm ²

IV.CONCLUSION

1. While comparing with natural aggregate, the specific gravity of fly ash aggregate is less than normal aggregate hence the light weight aggregates will reduce the dead load of the structure.
2. Fly ash aggregate has been consumed in large worth once it's used as a coarse aggregate replacement because of its occupation of huge volume in concrete reduces the matter of selling as landfills to larger extent.
3. Sodium silicate in pellets improves the water proofing performance of the structures by enhancing compactness which reduces small-pores, holes and fracture in the structure.
4. And the proportion 70:25:5 shows considerable strength than the other proportion. So the proportion suitable for the proportion of fly ash aggregate is 70:25:5 and above with considerable increase in cement content and reduction in the content of the fly ash.
5. We have a tendency to get 27.5N/mm² compressive strength for twenty eight days and equally 2.2N/mm² for split tensile strength.

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