AN EXPERIMENTAL STUDY ON STRENGTH PERAMETERS BY REPACEING CEMENT WITH FLY ASH AND FINE AGGREGATE WITH GROUND GRANULATED BLAST FURNECE SLAG

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Abstract
The growth in industrial progress leads to the increased production of industrial waste. Hence industrial waste materials management too is a challenging problem. There by handling and disposal of industrial waste is a big issue in this contemporary world. Keeping all the above problems in view, in this present experimentation, an attempt has been done to utilize the industrial waste products such as fly ash and granulated blast furnace slag in cement concrete by way of replacing them to cement and fine aggregate in the production of concrete.
The percentage of replacement of sand by granulated blast furnace slag are 0%, 20%, 40%, 60%, 80%, 100% and keeping fly ash as 25% constant for cement. This research is focused on the combined behaviors of granulated blast furnace slag and fly ash in study some of the strength properties. It can be seen that the effective utilization of both the materials will lead to the restriction of environmental hazards. This paper gives the test results of hardened properties of concrete i.e. Impact strength test, compressive strength test & Flexural test.

1 Introduction
The international use of concrete is next to water in this era. As the call for for concrete as construction material increases, the demand and scarcity has been raised to a top. There has been speedy increase within the waste materials and by merchandise manufacturing due to exponential growth fee of populace from last few many years the fundamental strategies to lower solid waste disposal problems were focused on the reduction of waste production and healing of usable substances from the waste as raw substances as well as utilization of waste as uncooked materials each time viable. The beneficial use of commercial waste or by means of-merchandise in concrete has been widely known for decades and huge studies has been published with regard to use of materials such as coal fly ash, pulverized gasoline ash, blast furnace slag and silica fume as partial replacement for Portland cement. Such substances i.E., commercial waste usage in concrete no longer only complements sturdiness however offers exact strength when in comparison to Portland cement. The different important benefit of the use of such materials is to reduce the cost of creation and environmental pollutants.

2. MATERIAL PROPERTIES

2.1 Cement

Ordinary Portland Cement (OPC) is the cement best suited to general concreting purposes. OPC 53 grade confirming with IS: 8112-2007 is used. The cement is kept in an airtight container and stored in the humidity controlled room to prevent cement from being exposed to moisture. The specific gravity of cement is 2.82

2.2 Aggregates:

2.2.1 Fine aggregate are basically sands gained from the land or the marine environment. Fine aggregates typically encompass herbal sand or overwhelmed stone with most particles passing via a nine.5mm sieve. As with coarse aggregates these may be from Primary, Secondary or Recycled assets.

2.2.2Construction aggregate, or truely "aggregate", is massive class of coarse to medium grained particulate fabric applied in construction, The coarse aggregate used in this research is 20 mm length is used for this take a look at. Specifications for coarse combination are as consistent with IS 383:1970. The physical Houses have been decided as consistent with IS 2386:1963.Fine Aggregates

(Sand)The size of the quality combination is underneath 4.75mm.Fine aggregates can be herbal or synthetic. The grade need to be at some stage in the paintings. The moisture content or absorption traits have to be intently monitored. The pleasant mixture used is natural sand obtained from the river Godavari conforming to grading zone-II of table3of IS:10262-2009.The experiment changed into conducted as consistent with IS:2386-1963and the cost is2.Sixty six

2.2.2 Coarse aggregate:

ThematerialwhoseparticlesareofsizeareretainedonISsieveofsize4.75mmis termed as coarse aggregate and containing only so much finer material as is permitted for the varioustypesdescribedinIS:383-1970isconsideredascoarse aggregate. Aggregates should be of uniform quality with respect to shape and grading. The size of coarse aggregated dependsuponthenatureofthework.Thecoarseaggregateusedinthisexperimental investigation is 20mm and 10mm size, crushed and angular in shape. The aggregate sare free from dust before used in the concrete. The specific gravity of the coarse aggregate is 2.8

2.2.3Water

According to IS: 456 - 2000, water is utilised for concrete's mixing and curing.

2.2.5 GGBS(Granulated Blast furnace slag)

GGBS become acquired from Simhadri iron industry at Guntur in Andhra Pradesh. The houses of GGBS are given underneath table, because of unavailability of XRF,we've got taken the values immediately from global journals . The specific gravity of
The GGBS is two.017

1. **EXPERIMENTAL PROGRAM**

3.1 Parameters for mix design

Table3.1 DesignedValuesofMaterialsM25

S.No	Item name	As per mixed design(kg/m3)
1	Cement	448.6
2	Fine aggregates	752.71
3	Coarse aggregates	1064.65

4	water	197.4

3.2 Mixed design proportions

- In this experimental paintings, concrete specimens have been casted with 25% steady fly ash by using the load of cement and replacement of GBF slag within the area of high-quality aggregate numerous via 0%, 20%, 40%, 60%, 80% and 100% respectively taken into consideration on this research. The nominal concrete does not include fly ash and GBF SLAG.
- In this studies paintings 15 Standard cubic specimens of size 150mm (nine pattern for every percent partial substitute of cement with flyash and first-rate aggregates with GBF) have been casted for the compressive electricity of concrete and it was saved underneath curing for 7, 14 days & 28 days of age. Total cubes for compressive power trying out changed into 36 (9 cubes * four proportions).
- In this research work 10 standard beams of size (three sample for each percentage partial replacement of cement with flyash and fine aggregates with GBF) were casted for flexural strength of concrete and it was kept under curing for 28 days of age. Total cubes for flexural strength testing was 12 (3 beams * 4 proportions).
- In this research paintings 150 mm diameter and seventy five mm (three pattern for every percent partial replacement of cement with flyash and high-quality aggregates with GBF) had been casted for effect test of concrete and it changed into kept below curing for 7 and 28 days of age.
- Mass of ingredients required will be calculated for 9 no's cubes assuming 25% wastage
- Volume of the Cube = $9*1.25*(0.15)^3 = 0.037969\ m^3$
- Mass of ingredients required will be calculated for 3 no's beams assuming 20%wastage
- Volume of the Beam = $3*1.20*((0.10)^2*(0.50)) = 0.018\ m^3$

Table 3.2: Material Proportions for M25 (Cubes)

replacement % age of flyash and GBF Slag	0% - 0%	25% - 20%	25% - 40%	25% - 60%	25% - 80%	25% - 100%
Cement (Kgs)	17.0328	12.7746	12.7746	12.7746	12.7746	12.7746
Flyash (kgs)	0	4.2582	4.2582	4.2582	4.2582	4.2582
coarse aggregate (Kgs)	40.4236	40.4236	40.4236	40.4236	40.4236	40.4236
water (lit)	7.495	7.495	7.495	7.495	7.495	7.495
fine aggregate (Kgs)	28.579	22.8632	17.1474	11.4316	5.7158	0

GBF slag(kgs)	0	5.7158	11.4316	17.1474	22.8632	28.579

Table 3.3: Material Proportions for M25 (beams)

replacement % age of coal dust & iron slag	0% - 0%	25% - 20%	25% - 40%	25% - 60%	25% - 80%	25% - 100%
Cement (Kgs)	8.0748	6.0561	6.0561	6.0561	6.0561	6.0561
Flyash (kgs)	0	2.0187	2.0187	2.0187	2.0187	2.0187
coarse aggregate (Kgs)	19.1637	19.1637	19.1637	19.1637	19.1637	19.1637
water (lit)	3.5532	3.5532	3.5532	3.5532	3.5532	3.5532
fine aggregate (Kgs)	13.548	10.8384	8.1288	5.4192	2.7096	0
GBF slag(kgs)	0	2.7096	5.4192	8.1288	10.8384	13.548

3.3 Compressive Strength

Compressive energy or crushing strength is the primary assets found in testing the cubes. The cubes of length 150 x a hundred and fifty x 150mm had been casted. After 24 hours, the specimens are eliminated from the moulds and subjected to curing for 28 days in transportable water. After curing, the specimens are tested for compressive electricity the use of compression testing device of 2000 KN capacity (IS: 516 – 1959). Cubes are tested to calculate Compressive electricity by means of applying gradual loading in Compression Testing Machine. The most load at failure happens on the top of the system. For M30 grade concrete, Atotalof54cubeswerecastforthefivemixes.I.E.,for each mix nine cubes have been prepared.Testing of the specimens turned into finished at 7 days, 28 days and 90 days, on the charge of three cubes for each mix on that specific day. The average price of the three specimens is reported because the power at that unique age

Compressive strength = ultimate compressive load/cross sectional area

= P/A

= load/area N/mm2

3.4 Flexural strength test:

In the flexural power check theoretical maximum tensile pressure reached at the bottom fibres of the check beam is called them odulu so frupture. When concrete is subjected to bending stress, compressive as well as tensile stresses are advanced at pinnacle and backside fibres respectively. The electricity shown with the aid of the concrete towards bending is referred to as flexural strength. The trendy length of specimen is 100mm×100mm×500m with as pan of 600mm. The flexural electricity of the specimen is expressed because the modulus of rupture 'fb' which, if 'a 'equals the distance between the line of fracture and then earnest support measure don the centre line of the tensile side of the specimen, in cm,is calculated to the nearest 0.05M paas follows

$fb=PL \quad bd^2$

3.5 Impact Test :

The effect resistance of the specimen was determined by using the usage of drop weight technique of Impact check recommended via ACI committee tactics. The size of the specimen advocated with the aid of ACI-544 committee is one hundred fifty mm diameter and 75 mm thickness and the weight of hammer is 4.50 Kg with a drop of 457mm. The specimens positioned on the bottom plate with the completed face up and positioned inside four lugs of the impact testing equipment. The bracket with the cylindrical sleeve is constant in location and the hardened metal ball is positioned on the top of the specimen within the bracket. The drop hammer is then positioned with its base upon the metal ball and held vertically. The hammer is dropped time and again. The range of blows required for remaining failure to be recorded. The effect electricity introduced to the specimen are calculated by using every impact is calculated as follows:

EI = Nmgh
Where EI is impact energy (N m), N is the number of blows,
m is mass of the drop hammer (kg), g is gravity acceleration (N/kg),
and h is height of drop hammer (m).

2. RESULTS

4.1 Compressive strength

The compressive strength test was performed on the cubes of size 15 cm x 15 cm x 15 cm tocheck the compressive strength of concrete and the results obtained are given in Table 4.1 .

Table 4.1: Compressive strength

Flyash	GBF Slag	Avg. Strength (N/mm²) 7days	Avg. Strength (N/mm²) 14days	Avg. Strength (N/mm²) 28days
0%	0%	20.78	27.11	31.56
25%	20%	20.47	26.89	30.79
25%	40%	23.69	33.72	34.75
25%	60%	21.32	31.54	32.04
25%	80%	19.67	25.77	30.55

25%	100%	18.94	23.83	28.71

For the 25% of flyash changed with cement and forty% GBF Slag changing with satisfactory aggregates gives more compressive power evaluate to govern blend and remaining percentages. The most advantageous percentage of including GBF Slag is 40%.

4.2 Flexural Strength Test

The Flexural test was performed on the beams of size 50 x 10 x 10 cm to check the flexural strengthoftherubberizedconcreteandtheresultsobtainedwhileperforming the flexural test on UTM aregiveninTable4.3&4.4.

Table 4.2: Flexural strength

Flyash	GBF Slag	Flexural strength (N.mm2)	% of increase / decrease
0%	0%	6.44	-
25%	20%	7.20	+11.80
25%	40%	7.66	+18.94
25%	60%	7.30	-13.35
25%	80%	6.90	-7.70
25%	100%	6.36	-1.242

4.3 Impact test

The Impact test was performed on the beams of size 150 mm diameter and 75 mm thicknessto check the Impact test of the concrete.

Table:4.3 Test results of impact test for specimens at 7 days

Flyash	GBF Slag	Impact Energy (N.m)	% of increase / decrease
0%	0%	1240	-
25%	20%	1140	-8.0696
25%	40%	2972.40	+22
25%	60%	1574.50	-26.93
25%	80%	882.85	-28.809
25%	100%	640	-48.38

Table:4.4 Test results of impact test for specimens at 28 days

Flyash	GBF Slag	Impact Energy (N.m)	% of increase / decrease
0%	0%	4830	-
25%	20%	5064	+4.41
25%	40%	6033	+24.39
25%	60%	4295	-11.44
25%	80%	3290	-32.16
25%	100%	2920	-39.79

5. Conclusions

- The electricity and sturdiness characteristics of concrete combinations have been computed in the gift paintings by means of replacing 25% flyash with the cement and GBF slag with sand. On the idea of present look at, following conclusions are drawn.
- There is a super ability for utilization of the abundantly to be had environmental pollution like GBF Slag fly ash in the structural Engineering.
- It is found that the impact resistance accelerated as much as forty % with substitute of best aggregate with GBF Slag and additionally retaining 25% substitute of cement by way of fly ash as steady. After that a lower is found on the substitute degree of 60 % to one hundred % with regard to conventional concrete. The maximum effect power attains at 40 % replacement of nice aggregate with GBF Slag.
- It is located that the flexural strength improved with alternative of nice aggregate with GBF Slag as much as eighty % and additionally maintaining 25 % replacement of cement through fly ash as regular. After that for one hundred % alternative of satisfactory mixture with GBF Slag a mild lower of 1.24 % determined. The maximum flexural power attains at 40 % substitute of first-class combination with GBF Slag is observed to be 18.Ninety four %. When as compared to the conventional concrete mix.
- The compressive energy of cubes were improved with addition of flyash and GBF Slag up to 25% & forty % respectively by using weight in vicinity of cement and sand, similarly any addition of flyash and GBF slag the compressive power decreases.
- The use of Flyash and GBF slag in concrete might be cost effective because this material is available at half the rate of sand and cement respectively.
- In M25 grade of concrete, the maximum compressive strength is obtained at 28 days for the mix proportion of 25% Flyash & 40% GBF Slag.

Finally it is able to be finish that the partial replacement of satisfactory aggregate with GBF Slag and with 25 % fly ash replacement for cement , there may be a benefit in dice compressive energy, impact resistance & flexural power of concrete. The use of GBF Slag and fly ash in conventional concrete has proved to be nice due to social benefits, fee reduction and utilization of waste fabric in to usable product.

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