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RESEARCH ARTICLE

AREVIEW ON GGBS CONCRETE.

Ramesh kumar G. B[1], Jayashree. B[2] and Lawrence Adil[2].

1. Associate Professor, Department of Civil Engineering, Saveetha School of Engineering, Saveetha University, Chennai.
2. U G Student, Department of Civil Engineering, Saveetha School of Engineering, Saveetha University, Chennai.

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Abstract

The architecture industry is the bigger customer of natural assets which led to depletion of natural sand (Fine aggregate). Natural sand is the most commonly used building material in any part of the world and they sustain their status, because of demand, utilization and expansion of construction activity all over the world. Till now concrete is made up of cement, coarse aggregate, fine aggregate and water. Nowadays the major problem in the construction industry is the demand of fine aggregate and it has impelled the researchers to think about some alternate option. The Iron industries produce a large quantity of blast furnace slag as by–product, which is a non–biodegradable waste material from that only some amount of percentage is used by cement industries to manufacture cement. The generation of slag would be dual problem in disposal difficulty and environmental pollution. The advantage of using blast furnace slag is economically less comparative to other slag. This bearing leads us to analyse blast furnace slag and its cardboard highlights aloft the achievability abstraction for the appliance of blast furnace slag in architecture applications (Masonry & plastering). In this investigation the compressive strength & split tensile strengths, brick adhesive crushing, compaction component pulls strengths and their co-relations had been studied.

Introduction:-

Concrete is a composite material made out of granular materials like coarse totals implanted in a network and bound together with bond or cover which fills the space between the particles and pastes them together. Right around 75% of the volume of cement is made out of totals. To meet the worldwide request of cement later on, it is turning into an all the more difficult errand to discover reasonable other options to regular totals for get ready concrete. In this manner the utilization of option hotspots for regular aggregates is turning out to be progressively essential. Slag is a co-result of the iron making process. Press can't be set up in the impact heater without the generation of its co-item i.e. impact heater slag. The utilization of impact heater slag totals in cement by supplanting regular totals is a most encouraging idea since its effect quality is more than the regular total. Steel slag totals are as of now being utilized as totals in black-top clearing street blends because of their mechanical quality, firmness, porosity, wear resistance etc.

Corresponding Author:- Ramesh kumar G.B
Address:- Associate Professor, Department of Civil Engineering, Saveetha School of Engineering, Saveetha University, Chennai 602 105, TamilNadu.

Literature Review:-

Experimental Studies on Concrete Replacing Fine Aggregate with Blast Furnace Slags:-
J. Selwyn Babu, Dr. N. Mahendran

The aim of this research is to study the physical and mechanical properties of concrete, replacing fine aggregate with blast furnace slag and ground granulated blast furnace slag. The following conclusions were drawn based on the experimental results obtained. The results obtained encourage the use of blast furnace slag in concrete as a partial replacement to fine aggregate up to 25%. The maximum compressive strength of 40.69 N/mm2 was obtained by replacing 25% of fine aggregate with BFS. Workability was found to be a problem with the fresh concrete, and hence usage of superplasticiser was recommended. The usage of BFS will reduce the cost of concrete by 8 to 10%. [1]

Replacement of Natural Fine Aggregate with Air Cooled Blast Furnace Slag An Industrial By Product -
Dr. B. Krishna Rao, Dr.M.Swaroopa Rani, A.Siva Sai Teja

The aim of the investigation is to replace natural fine aggregate with Air Cooled Blast Furnace Slag in OPC concrete. The following conclusions are drawn from the present investigation: The Compressive strength of 7days, 28days, 56 days and 90 days has highest value for 25% replacement. The Split tensile strength of 7days, 56days and 90 days has highest value for 25% replacement. The Split tensile strength of 28 days has highest value for 12.5% replacement. The flexural strength of 7days, 28days, 56days and 90 days has highest value for 25% replacement. [2]

Use of Blast Furnace Slag Aggregate in Concrete:-
K.G. Hiraskar and Chetan Patil

Blast furnace slag is a by-product and using it as aggregates in concrete will might prove an economical and environmentally friendly solution in local region. The demand for aggregates is increasing rapidly and so as the demand of concrete. Thus, it is becoming more important to find suitable alternatives for aggregates in the future. The results showed that it has properties similar to natural aggregates and it would not cause any harm if incorporated into concrete. The research were encouraging, since they show that using blast furnace slag as coarse aggregates in concrete has no negative effects on the short term properties of hardened concrete.[3]

Properties Of Materials:-

Cement:-

Cement is a binding material for concrete. The Ordinary Portland cement (OPC) of 53 grade conforming to IS 269-1976 was used in the experiment. Different tests and results were given in Table 1 and to ensure the results as per the limits are given in Indian Standards.

Table .1:- Properties of Cement.

S.NO.	DISCRIPTION	RESULTS OBTAINED
1	Fineness	7%
2	Initial Setting Time Final Setting Time	74mm 270mm
3	Consistency	33%

Table.2:- Chemical properties of cement and GGBFS (%)

Oxide	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	LOI	Na_2O	K_2O
Cement	19.71	5.20	3.73	62.91	2.54	2.72	0.96	0.25	0.90
GGBS	36.70	14.21	0.98	32.61	10.12	0.99	–	0.42	0.76

Fig. 1:- Cement Mortar in Wet Condition

Aggregates:-

Dry and clean natural, river aggregate was used in concrete mixture. The gravel was 16 mm maximum nominal size. The aggregate grading is suitable for concrete production. The fine aggregate has been sieved in 2.36 mm sieve and coarse aggregate had been sieved 20mm sieve. Tests has been done for both fine aggregate and coarse aggregate and the results has been given in Table 3 and 4.

Fig. 2:- Fine Aggregate

Fig. 3:- Coarse Aggregate

Table. 3:-Properties of Fine Aggregates.

S.NO.	DESCRIPTION	RESULT OBTAINED
1	Specific Gravity	2.5
2	Bulk Density	4%

Table. 4:- Properties Of Coarse Aggregate.

S.NO.	DESCRIPTION	RESULT OBTAINED
1	Specific Gravity	2.8
2	Impact Value	12.10%
3	Bulk Density	1724.40Kg/m^3
4	Water Absorption	4.06%

Ground Granulated Blast Furnace Slag (GGBS):-

Its chemical oxide composition is given in Table 4. The specific gravity of GGBFS was 2.81 g/cm^3. The GGBFS was ground granulated in Iskenderun Cement Factory to have a Blaine specific surface area about 4250 cm^2/g. According to ASTM C 989 hydraulic activity index, the GGBFS used was classified as a category 80 slag.

Fig.4:- Ground Granulated Blast Furnace Slag.

Physical Properties Of Blast Furnace Slag:-

Table 5:- Physical Properties of GGBS.

S. NO.	DESCRIPTION	RESULTS OBTAINED
1	Specific Gravity	2.85
2	Loose Bulk Density	1.20
3	Silt(Wet Sieving)	<1.5%
4	Particle Shape	SUB ANGULAR TO SUB ROUND
5	Water Absorption	1%

Chemical Properties:-

It depicts the typical chemical composition of blast furnace slag. The chemical compositions shown are in general applicable to all types of slag. The data presented in Table 6 suggest that the chemical composition of blast furnace slags produced in North America has remained relatively consistent over the years. When ground to the proper fineness, the chemical composition and glassy (non crystalline) nature of vitrified slags are such that when combined with water, these vitrified slags react to form cementitious hydration products. The magnitude of these cementitious reactions depends on the chemical composition, glass content, and fineness of the slag. The chemical reaction between GGBFS and water is slow, but it is greatly enhanced by the presence of calcium hydroxide, alkalies and gypsum ($CaSO_4$).

Table 6:- Chemical properties of GGBS.

CHEMICAL PROPERTIES	PERCENTAGE OF COMPOSITION, %							
	1949		1957		1968		1985	
	MEAN	RANGE	MEAN	RANGE	MEAN	RANGE	MEAN	RANGE
Calcium Oxide (CaO)	41	34-48	41	31-47	39	32-44	39	34-43
Silicon Dioxide (SiO_2)	36	31-45	36	31-44	36	32-40	36	27-38
Aluminum Oxide (Al_2O_3)	13	10-17	13	8-18	12	8-20	10	7-12
Magnesium Oxide (MgO)	7	1-15	7	2-16	11	2-19	12	7-15
Iron (FeO or Fe_2O_3)	0.5	0.1-1.0	0.5	0.2-0.9	0.4	0.2-0.9	0.5	0.2-1.6
Manganese Oxide (MnO)	0.8	0.1-1.4	0.8	0.2-2.3	0.5	0.2-2.0	0.44	0.2-0.76
Sulphur (S)	1.5	0.9-2.3	1.6	0.7-2.3	1.4	0.6-2.3	1.4	1.0-1.9

Tests Conducted For Finding Workability Of Blast Furnace Slag:-

The compressive strength of the concrete specimens at 7 days and 28 days were illustrated in Table7. It depicts that the early age compressive strength of concrete specimens can be improved marginally by incorporating 30% crusher dust in place of river sand and beyond which the decreasing trend is observed. On the other hand, the strengths of concrete mixes at the age of 28 days is same as controlled concrete with increasing percentage replacement of river sand with crusher dust and coarse aggregate with blast furnace slag up to 30% and thereafter shows again the decreasing.

Fig.6:- A Set-up of Universal Testing Machine.

Result and Discussion:-

Table 7: Compressive Strength Of Concrete Mixes:-

SNO	REPLACEMENT %	7 DAYS	28 DAYS	AUTHORS
1	0	19.61	28.92	J. Selwyn Babu (2014)
	5	20.06	29.36	
	10	21.36	31.25	
	15	22.22	34.59	
	20	23.54	36.47	
	25	28.92	40.69	
	30	22.82	32.99	
2	0	27.11	36.67	Dr.B.Krishna Rao (2015)
	12.5	28.44	39.11	
	25	29.33	39.56	
	37.5	27.56	38.22	
	50	26.22	37.78	
3	0	26.80	39.40	K.G.hiraskar (2013)
	50	25.20	38.70	
	75	22.90	33.40	
	100	24.90	38.70	
4	0	34.91	48.02	M.C.Nataraja (2013)
	25	35.60	49.07	
	50	33.11	48.41	
	75	31.87	04.11	
	100	25.61	44.81	
5	0	33.75	48.50	C.G.Konapure & (2016)
	20	33.20	48.01	
	40	31.68	48.20	
	60	30.55	46.29	
	80	29.69	45.80	
	100	29.00	43.61	

Conclusion:-

The present study shows that the use of blast furnace slag as aggregate not only an substitute of fine aggregate but also increases the strength of concrete. This study is important to develop eco-friendly construction materials based on recycling of waste resources on the basis of the concept of sustainable development for solving an environmental problem that is a major issue of the twenty-first century all over the orld, and help in preserving the environment and recycling resources for saving the natural resources.

References:-

1. J. Selwyn Babu, Dr. N. Mahendran,"Experimental Studies on Concrete Replacing Fine Aggregate with Blast Furnace Slags "International Journal of Engineering Trends and Technology (IJETT) – Volume 10 Number 8 - Apr 2014 .
2. Dr. B. Krishna Rao, Dr.M.Swaroopa Rani, A.Siva Sai Teja ," Replacement of Natural Fine Aggregate with Air Cooled Blast Furnace Slag An Industrial By Product" Dr. B. Krishna Rao et al. Int. Journal of Engineering Research and Applications ISSN : 2248-9622, Vol. 5, Issue 7, (Part - 1) July 2015, pp.36-40.
3. K.G. Hiraskar and Chetan Patil,'Use of Blast Furnace Slag Aggregate in Concrete' in 2013.
4. M C Nataraja, P G Dileep Kumar, A S Manu and M C Sanjay,' USE OF GRANULATED BLAST FURNACE SLAG AS FINE AGGREGATE IN CEMENT MORTAR'
5. C.G.Konapure1 and S.S.Patil2 of 'Effect of Granulated Blast Furnace Slag as Substitute for Fine Aggregate in Cement Mortar and Concrete 'IJRET: International Journal of Research in Engineering and eISSN: 2319-1163 | pISSN: 2321-7308, Volume: 05 Issue: 08 | Aug-2016.