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Experimental Study on Foam Concrete

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ABSTRACT

Foam Concrete is a type of concrete which contain an expanding agent which increases the volume of the mixture while giving additional qualities such as flow ability and reduce the dead weight. Foam concrete is a vast majority of concrete containing NO large aggregates, only fine sand and with extremely light weight material containing cement, water and foam. Foam concrete mainly challenges the strength parameter, as the density of concrete is very less; hence the strength is also less. This study focus to increase the strength parameter of Foam concrete by using GGBS mixes to achieve the strength with low densities. It is found that when GGBS is added along with CEMENT mixes the strength increases is more as compared with normal conventional concrete.

Keywords-Ground-Granulated Blast Furnace Slag(GGBS), FOAM.

I.INTRODUCTION

Foam Concrete is a type of versatile light weight concrete where the density varies from 400 kg/ m3 – 1900 kg/ m3, which is very less than when compared with normal concrete. The Foam concrete is used for various applications thermal insulation, formation of light weight concrete blocks, ground stabilization works, void filling in structures etc.Foamed concrete is formed by adding air-voids where the air is entrapped in mortar by using foaming agent. Production of stable foam is very important to maintain the density and this affected by various factors , type of foaming agent, method of foam preparation, pressure at which the foam is generated from the foam generation machine. In today's world of Sustainable concrete solution it becomes necessary for use of GGBS. This study focus to increase the strength parameter of Foam concrete by using GGBS mixes to achieve the strength with low densities. It is found that when GGBS is added along with cement mixes the strength increases is more as compared with normal concrete.

II.CHARACTERISTICS OF FOAMED CONCRETE

2.1Light weight:

The density of foamed concrete is low than ordinary concrete about 50%-80%, and its apparent density is usually maintained at 300-1200kg/m³. Because of its low density and small load, the weight of today's

construction can reduce weight about 25% whether its application on the inside(outside) wall or column structure, sometimes even reach 30%-40% of the overall quality of the structure.

2.2. Good heat-insulating property:

Foamed concrete is a kind of heat preservation and insulation material which is mainly used in building wall and roof, and has high efficiency of energy saving. Its interior has many uniform pores which control the air in a large part and prevent from the cold and the heat exchanging. The thermal conductivity of the commonly used foam concrete is about 0.1W (K /m), which is 7 times less than that of the clay brick and 14 times less than that of the ordinary cement concrete.

2.3 High fire resistance and sound insulation

Foamed concrete is mainly composed of cement paste, aggregate, other inorganic materials (which don't have the chemical characteristics of spontaneous combustion) and dispersed pores, so it has the good fire resistance. At the same time, because of the existence of many closed pores, the foam concrete has a good sound insulation performance.

2.4 Good seismic performance

The foamed concrete is of light weight, small density and small elastic modulus. It is a kind of porous structure with many closed bubbles. The foam concrete is a kind of building material with excellent seismic performance when it is subjected to the action of earthquake wave, which can diffuse and absorb the impact load.

2.5 Other performance

Because of the porous structure, foamed concrete has good frost-resisting property and corrosion resistance. The foam comes from foaming machine in the stirring process can play a role in reducing the water and lubricating. The foam concrete can use large quantities of industrial waste and other materials, which is not only conducive to the environmental protection, but also reduce the production cost.

III. CONSITUENTS OF FOAM CONCRETE

3.1 Cement -Cement is the main binder for foam concrete. Foam concrete can be produced with all types of cements and is less affected with changes in cement types. However, OPC 53 Grade cement is generally preferred in the production process.

3.2 GGBS–Ground-Granulated Blast Furnace Slag is obtain by quenching molten iron slag (a by-product of iron and steel making)from a blast furnace in water or steam , to produce a glassy, granular product that is then dried and ground in to fine powder.

3.3 Water -Water used in the manufacture of foam concrete is potable water free from suspended solids and other wastes.

3.4 Foaming Agent - The surfactant is a key factor in the types of bubbles generated. Surfactants are wetting agents that lower the interfacial tension between two liquids and also lower the surface tension of liquid, allowing easier spreading. There are extensive varieties of surfactants (foaming agent) available in the market. Surfactants are formulated to produce stable air bubbles whichcanresist the physical and chemical forces imposed during mixing, placing and hardening in the process of making foamed concrete. But it is very important to store all surfactants accordingly because they are inclined to deterioration at low temperatures. The surfactant solution consists of one part surfactant and between 5 to 20 parts water. But the optimum value is a function of the type of surfactant and the technique of production.

IV. METHODOLOGY

There is no proper or exact method found for proportioning foamed concrete (i.e. mix design), but it is a specified target plastic density that becomes a prime design criterion. On the basis of target plastic density a theoretical mix design is to be formulated and site trials are undertaken and the results from the site trials are used as mix design for the foamed concrete. Various Trials were done with GGBS addition with 60% replacement of cement in the mixes.Below is the mix design attached with GGBS mixes.As been discussed before, trial and error method was used in determining the most suitable mixture in preparing research samples.

Table 4.1 Shows the Trial mix Proportions

Materials	**Trial**	**Trial**	**Trial**	**Trial**	**Trial**	**Trial**
Kg/m^3	A	B	C	D	E	F
Cement	175	175	235	235	295	295
GGBS	105	105	141	141	177	177
Water	150	150	135	135	135	135
Foam	100	100	100	100	100	100
CRF	500	482	595	571	675	642
Target Density	1030	1012	1206	1182	1382	1349

4.1 Experimental procedure

Foam concrete with GGBS mix with and cement was prepared and was tested against the fresh and hardened properties wherein the method used to determine the physical (Density) as well as a specific structural property (compressive strength) of the foamed concrete mixtures..

4.2Composition of Foam Concrete Mixture

The foamed concrete used in this research is produced under controlled conditions from cement, sand, water pre-formed foam and GGBS.The cement used is 53 grade Ordinary Portland cement, locally available sand,GGBS JSW company.IS certified having density 860 kg/m3 , foaming agent (ACC CONCRETE Pvt Ltd)

forproduce the foam and water has been used for producing foam concrete. Foam was generated by using foam generator the out-put of generator is 30-32 lit/min. for producing the foam.Foaming agent is diluted with water in a ratio of 1:20.

4.3Mixing Procedure

Initially the materials were weighed and dry mixing was carried out for cement, GGBS and sand in the concrete mixer and then the water was added incrementally to obtain a reasonable workable mix. The mixing was carried out for one- two minute duration. The required quantity of foam was set in foam generator and then it was added to the wet mix and again the mixing was continued. Mixing for more duration after adding foam will disintegrate the foam. Then they were poured into the cube moulds of size 150x150x150 mm.

4.4 Curing

The 150 mm test cubes were cast in steel mould and de-moulded after ± 24 hours. As compared with the conventional concrete the curing was done for the cubes casted. Almost each trial -06 number of cubes where casted and where cured in the curing tank with a temperature of 27+_2 degree centigrade. Full time continuous curing has been done in the laboratory.

4.5 Compressive Strength

The cubes were crushed on on compression testing machine) which is usually used for normal concrete. Three cubes from the same mixture of foamedconcrete were crushed and the average of the three results is used to define the strength of the mixture.(According to IS: 516-1959) .Where in the compressive strength was recorded to the nearest 0.1 MPa. The Cubes were tested for Compressive strength which is recorded for 7 and 28 day

V. RESULTS

The Study shows the strength of Foam concrete with addition of GGBS. There is an increment in strength observed when the quantity of GGBS increases along with in the cementations content. The results are presented in Table 2 it can be seen that the compressive strength of foamed concrete is increases with Density.

Table 5.1 Shows the Trial mix Proportions with strength

Materials	**Trial**	**Trial**	**Trial**	**Trial**	**Trial**	**Trial**
Kg/m^3	A	B	C	D	E	F
Cement	175	175	235	235	295	295
GGBS	105	105	141	141	177	177
Water	150	150	135	135	135	135
Foam	100	100	100	100	100	100
CRF	500	482	595	571	675	642
Target	1030	1012	1206	1182	1382	1349

Density						
Achieved Density	1183	1210	1356	1398	1595	1603
Compressive Strength 7 Days N/mm^2	1.12	1.45	1.56	2.25	3.11	4.03
Compressive Strength 28 Days N/mm^2	2.93	3.45	3.78	4.52	6.89	9.75

VI.CONCLUSION

The density is directly related with compressive strength of foam concrete.The increment of voids throughout the sample which is achieved by the foam in the mixture will give lower the density. As a result, compressive strength will decrease as there increment in the voids. Usually the criteria for structural lightweight concrete are minimum 28-day compressive strength of 17 MPa and Dry density of 1850 kg/mother compressive strength of the trial results are less than 17 MPa, as reported in this investigation, hence it can be concluded that the prepared foam concrete mixtures cannot be used for structural purpose, but it can be used for making partition wall in buildings ,Sound insulation, ground works such as stabilization, tunnel repair works which will result in decrease in the self-weight of structure because the density is very low as compared to bricked masonry work.The density of foam concrete is very low when compared with conventional concrete; therefore, the self-weight of a structure built with foamed concrete would undoubtedly be reduced significantly, leading to tremendous savings in the use of reinforcement steel in the foundations and structural members. Use of foam concrete as an alternative to normal concrete in construction can decrease the building's dead load as well as the force exerted on the structure due to earthquake excitations and the resultant collapse weight of the building if it falls down.It is observed that the use of GGBSin Foam Concrete can be greatly improves its properties also same with case of Fine aggregate in Foamed Concrete increases its density as well as strength parameter. It is generally observed that the de-moulding of high density foamed concrete is possible after 24 hours but for low density foamed concrete could not be possible, it required minimum 3 days for de-moulding period because their strength is very low and the cube shape gets damaged.

VII.FUTURE SCOPE

The foam concrete has a desirable strength and can be used as an alternative construction material for the any building system.The strength of foam concrete is very low for lower density mixture hence for nonstructural areas of building this can be used successfully as this reduces the dead loads on the structures. So, significant reduction ofoverall weight results in ultimate saving in structural frames.The Foam concrete usually is flowablemix hence requires no vibration or compactionIt offers variety of advantages such as fast and

settlement free construction with good heatInsulation, good freeze/thawingproperties and has excellent fire resistance properties.

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