International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL INVESTIGATION OF THE FOAM CONCRETE USING STEEL DUST AS PARTIAL REPLACEMENT OF FINE AGGREGATE

J. Ajitha Lakshmi[1], V. Howsalya[2], V. Kavitha[3], M. Maheswari[4]

[1,2,3,4]UG Student, Department of Civil Engineering, Renganayagi Varatharaj College of Engineering, Sivakasi, Tamil Nadu, India

---

Abstract- *This is a type of aerated light weight concrete, also known as aircrete; light weight concrete or reduced density concrete is defined as cement based slurry .As mostly no coarse aggregates used for production of foam concrete. We are using this foaming agent at 0% without steel dust. Disposal of waste materials to the environment can cause various problems. Hence the special attention is on reuse of waste material. This steel waste can be used as an admixture for partial replacement of fine aggregate and the environment is protected from waste deposits. The waste product which we are using is also a solid waste product, namely Steel Dust. We are using this steel dust with foaming agent to prepare the block of concrete of proportion 1:2 with the replacement at 5%, 10%, 15% .The compression test and split tensile test is available to the specimen for 7 days and 28 days respectively. In our thesis for this proportion, the high compressive strength obtained for 28 days is 20N/mm² for conventional cube and for adding 15% of steel dust when compared to the 5% and 10% of steel dust for 28 days is 29.33 N/mm². The high split tensile strength obtained for conventional cylinder is 6.79 for 28 days and for adding 15% of steel dust gives high strength compared to 5 % and 10 % of steel dust.*

Key words: foam concrete, steel dust, light weight concrete, partial replacement, and High strength.

1. INTRODUCTION

In the past design of building, the choice was normally between a concrete structure and masonry structure. But one of the methods of reducing density of concrete relies on the introduction of stable voids within the hardened cement paste or otherwise called mortar. The voids can be formed by gas or by air. Because a foaming agent introduces the air, the concrete produced is called foam concrete. It was first introduced by the Romans in the second century where 'the pantheon' has been constructed using pumice. It is the most common type of aggregate used in second century. Use of foam concrete can provide extremely economical structural systems with high durability and superior seismic performance characteristics. Foam concrete is a vast majority of concrete which containing no coarse aggregate, only fine sand, cement, water, foaming agent. It is a very fluid fill material, produced by a cement paste, with pre-formed foam. The density of foam concrete is generally determined by the ratio of foam to slurry and density range varies between 300 to 600 kg/m^3.

2. REVIEW OF LITERATURE

2.1. *Mahesh Kumar h. Thakrele.**ET. Al., EXPERIMENTAL STUDY ON FOAM CONCRETE,** international journal of civil ,structural, environmental and infrastructure engineering research and development, vol.4,issuse 1, Feb. 2014,145-158.*

The density of foam concrete (300 to 1850 Kg/m^3) is very low when compared with conventional concrete (2200 to 2600 Kg/m^3), therefore , the self weight of a structural built with foamed concretes would undoubtedly be reduced significantly, leading to tremendous savings in this use of reinforcement steel in the foundations and structural members. **Use of light weight concrete as an alternative to nominal concrete in construction can decrease the buildings dead load as well as force exerted on the structure due to earthquake excitation**. The result are presented that the compressive strength for foamed concrete are low density mixture and increases with density increases. It is observed that the use of fly ash in foam concrete, either in fine aggregate or as cement replacement can be greatly improves its properties. Fine aggregate in foamed concrete increases its density but it have beneficially effect on significantly increases in compressive strength and can reduce the construction cost. **It is observed that the de-moulding of high density foamed concrete is possible after 24 hrs but for low density foamed concrete could require 3 days because their strength is very low.**

3. MATERIAL USED

3.1 Binder:

Cement was used as a binder in this thesis. It determines the strength and other properties of both fresh and hardened state of concrete. The role of cement is to bind the fine and coarse aggregate. OPC conforming to IS 12269-1987 is the most common type of cement in general use around the world. The OPC grade 53 is known for its rich durability and quality

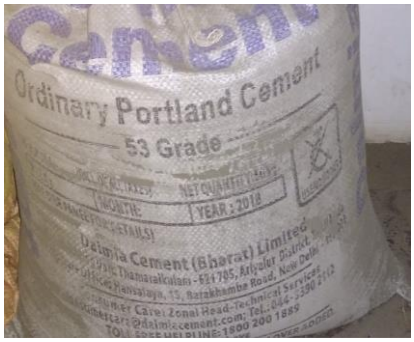


Fig 3.1- Ordinary Portland cement

3.2 FINE AGGREGATE:

In the present work, concrete mix were done by using the normal river sand free from silt, organic matter and passing through 4.75 mm sieve. The sand used was confining to zone 2 of IS: 383-1970. The composition of sand is highly variable depending on the local rock source and condition.

Fig 3.2 -fine aggregate

3.3 WATER:

Potable water was used for mixing and curing of concrete specimens. The concrete solidifiers and hardens through a chemical process called hydration. The water reacts with the cement, which bonds the other components together, creating a robust stone like material.

Fig 3.3- water

3.4 SUPER PLASTICIZER:

CONPLAST SP430 is a high grade super plasticizer, highly recommended for increasing workability and high ultimate strength of the concrete. This makes the concrete highly workable and flow able even in low water cement ratio.

Reduce the water cement ratio permeability and improves durability and improved workability facilities easy placing of concrete and mortar.

Fig 3.4- super plasticizer

3.5 FLY ASH:

Fly ash is one of the naturally occurring products from coal combustion process. As per ASTM C618, fly ash is classified into 2categories, namely, Class F fly ash. The utilization and disposal of such large quantity of fly ash. The effective utilization of this resources material would not only minimize the disposal problem but help in conservation of scarce materials, reduce emission of green house gases and enhance performance and durability of structure.

Scope of utilization of fly ash in cement in future is limited only to the extent of rate of increase in cement consumption.

Fig 3.5- fly ash

3.6 FOAM AGENT:

Foam concrete is not a particularly new material, its first patent and recorded use dates back to the early 1920s. Protein based standard foaming agent or hydrolysed protein agent are made by protein hydrolysis from animal proteins such as keratin ,cattle hooves and fish scales, casein of cows, pigs and other remainders of animal carcasses. Their self life is about 1 year under sealed conditions.

Fig 3.6- foaming agent

3.7 STEEL DUST:

Steel dust is one of the waste produces in steel shop or lathe factory. It is collected near the dumpsite of the shop.. Waste steel can be used as an admixture in foam concrete, so that it varies the strength from normal concrete.

Fig 3.7 -steel dusts

4. MIX DESIGN

Specimen	Cement (g/m^3)	Fly Ash (g/m^3)	Sand (Kg/m^3)	Steel Dust (kg/m^3)	Foam (ml)	Super Plasticizer (ml)	Water Cement Ratio(l)
Conventional cube	466.67	200	1.3	-	7.65	17.6	0.9
Mix 1	466.67	200	1.235	0.065	7.65	17.6	0.9
Mix 2	466.67	200	1.17	0.13	17.6	17.6	0.9
Mix 3	466.67	200	1.105	0.195	7.65		0.9
Conventional cylinder	366.33	157	1.046	-	11.9	35	1.4
Mix 1	366.33	157	0.993	0.052	11.9	35	1.4
Mix 2	366.33	157	0.94	0.1046	11.9	35	1.4
Mix 3	366.33	157	0.889	0.156	11.9	35	1.4

5. TESTING OF SPECIMEN

The compressive testing machine of capacity 2000kN in such a way that the load was applied on the specimen. The maximum load applied to the specimen until the initial crack or failure produce in the specimen. Therefore, in this foam concrete, the strength was given to the specimen without any shock.

The cylinder was placed on the strip horizontally with its axis perpendicular to the loading direction. The second step is to find out by providing the steel rod on behalf of its length wise on the cylindrical centrally. The load is applied without shock and continuously increased at a rate of approximately a splitting tensile strength until failure occurs.

- Compressive strength test
- Split tensile strength test

6. RESULT ANALYSIS

The standard size of the specimen is 150mm diameter and 300mm height of the cylinder. Cubical specimen, which has a standard size of 150×150×150mm.

7. COMPRESSIVE STRENGTH FOR 7 AND 28 DAYS

Table1. Compressive strength for 7&28 days

Mix	7days (N/mm²)	28 days (N/mm²)
Conventional cube	9.78	20
Mix 1	21.78	26.67
Mix 2	19.56	22.67
Mix 3	24.44	29.78

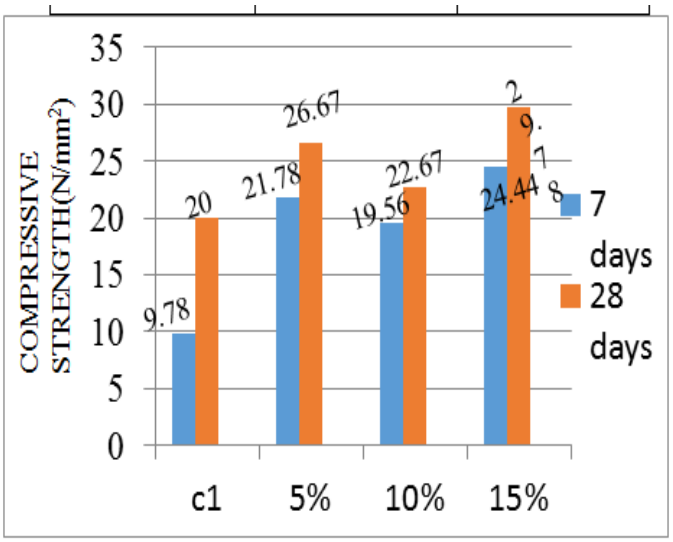
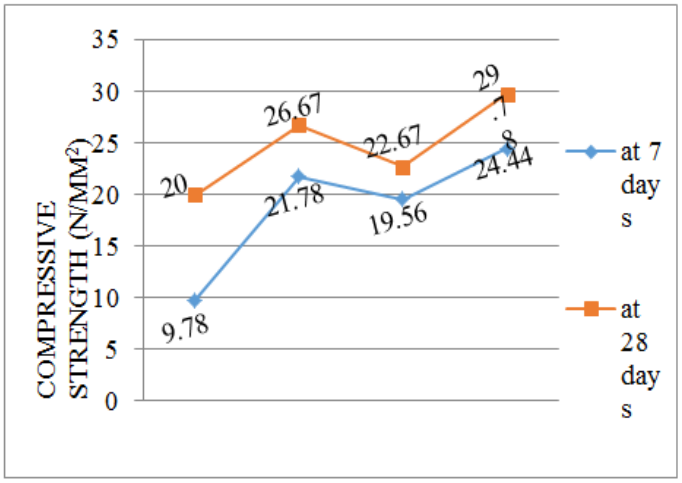


Chart – 1 compressive strength at7 and 28 days of mortar specime



Graph-1 Compressive strength at 7 & 28 days

8. SPLIT TENSILE STRENGTH FOR 7 AND 28 DAYS

Table 2 split tensile strength for 7&28 days

mix	7days (N/mm²)	28 days (N/mm²)
Conventional cylinder	5.6	6.79
Mix 1	6.47	8.5
Mix 2	8.49	9.34
Mix 3	9.4	9.6

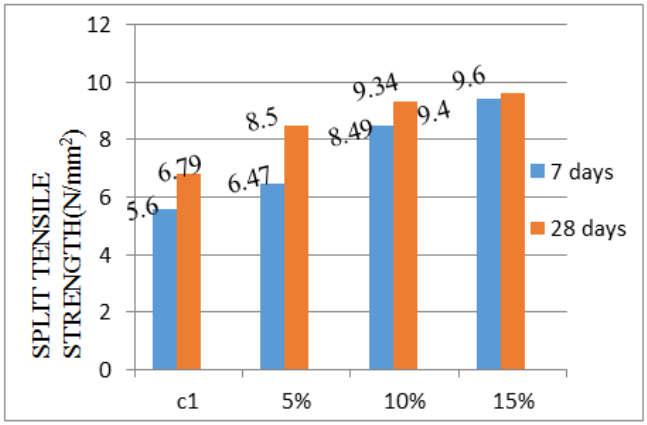
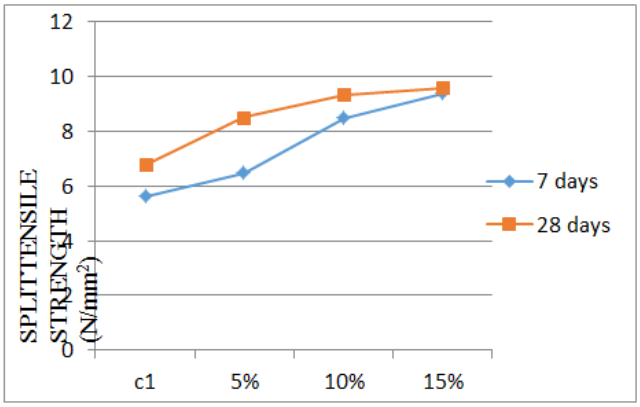


Chart-2 Split tensile strength at 7 & 28 days of mortar specimen



Graph - 2 split tensile strength at 7 and 28 days

9. SUMMARY AND CONCLUSION

- The effective utilization of steel dust as partial replacement of fine aggregate in foam concrete, in this thesis.
- Due to the steel dust in foam concrete, it proved to be ensure for good cohesiveness in the mortar and also sustainable for all atmospheric changes.
- In this study, the steel dust was replaced for 5%, 10% and 15% percentages.

The compressive strength and split tensile strength of foam concrete for 1:2 proportions with steel dust as partial replacement of fine aggregate were found to be comparable with the river sand.

- From this test, replacement of steel dust provides maximum compressive strength and split tensile strength in foam concrete when compared with conventional foam concrete.

REFERENCES

- Mahesh kumar h. Thakrele . ET. Al., **EXPERIMENTAL STUDY ON FOAM CONCRETE,** international journal of civil, structural, environmental and infrastructure engineering research and development, vol.4, issuse 1, Feb. 2014,145-158

- Rajesh LalsingShirale .ET .Al., **EFFECT OF STEEL SLAG AND BAGASSE ASH ON STRENGTH OF CONCRETE,** Journal of Experimental & Applied Mechanics ISSN: 2230-9845 (Online), ISSN: 2321-516X(Print) Volume 8, Issue 1

- Rafat Siddique .ET .Al. ,**UTILIZATION OF INDUSTRIAL BY-PRODUCTS IN CONCRETE,** 2nd International Conference on Sustainable Civil Engineering Structures and Construction Materials 2014 (SCESCM 2014)