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Floating Concrete by using Light Weight Aggregates and Air Entraining Agent

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***Abstract*— This Project deals with the development of Floating type of concrete by using lightweight aggregate (Pumice stone) and Aluminium powder as an air entraining agent. There are many types of lightweight concrete which can be produced either by using lightweight aggregate or by using an air entraining agent. In this study we have worked on combination of above mentioned types. This concrete is a non-structural concrete. In this study, comparison has be made between plain cement concrete and lightweight concrete having different proportion of Aggregate size and fix quantity of Aluminum content (i.e. 2%) by the weight of cement has been taken into account. It helps to increase volume of concrete and hence reduce the weight.**

Keywords: Floating concrete, Pumice stone, Aluminium powder ,Fly ash, Density, Compressive strength.

I.INTRODUCTION

The present day world is witnessing construction of very challenging and difficult civil engineering structures. Researchers all over the world are attempting to develop low density or lightweight concrete by using different admixtures in concrete up to certain proportions. This study deals with the development of Floating concrete by using lightweight aggregate (Pumice stone) and Aluminum powder as an air entraining agent. Floating concrete is made by introducing air or gas into concrete slurry, so that when the mix sets and hardens, uniform cellular structure is formed. Thus it is a mixture of water, cement and finely crushed sand. We mix fine powder of Aluminum to the slurry and it reacts with the calcium hydroxide present in it thus producing hydrogen gas. This hydrogen gas when contained in the slurry mix gives the cellular structure and thus makes the concrete lighter than the conventional concrete. Pumice stone is a lightweight aggregate of low specific gravity. It is a highly porous material with a high water absorption percentage. In this we do not use the conventional aggregate and replace it by the pumice stone.Pumice is the specimen of highly Porous rocks having density approximately 500-600 Kg/m3. Pumice is produced when super-heated, highly pressurized rock is violently ejected from volcano. The unusual foamy configuration of pumice happens because of simultaneous rapid cooling & rapid depressurization. Pumice has an average porosity of 60-80% and initially floats on water.

II.MATERIALS USED

Cement – Portland Pozzolona cement

Aggregate – Pumice Stones – 10 to 20 mm

Sand - Standard

Other- pumice powder

Admixtures – Aluminium Powder

Water – Tap water

Mixed Procedure – Mixer mixing

Compaction – Table Vibration

Curing practice - Moist curing by pounding

Cube size – 15cm×15cm×15cm

Testing of cubes – Compressive test after 28 days.

III. EXPERIMENTAL PROGRAM

TESTING OF MATERIALS

Cement

Standard Consistency Test

Result of Standard Consistency Test is the percentage by weight with respect to cement to produce standard consistency is 34%

Fineness Test

Data:-

Weight of cement taken (A) =100 gm.

Weight of cement retained on 90µ I.S. Sieve (B) = 05 gm.

Calculation:-

Fineness = (B/A) × 100
= 05%

I.S. requirement for fineness = less than 10%

Fineness = 05%

Fineness value is less than 10%. Hence it could be be used in our study.

Setting Time

Weight of cement = 300 gm.

Water content = 0.85 P. Where P = Standard Consistency
= 0.85 × 34%
= 28.9% of cement

= (28.9÷100) ×300 gm.
= 86.7 gm.
= 86.7 ml

Initial Setting time:-
I.S. requirement = more than 30 minutes (as per I.S 4031-1968)
Initial setting time = 40 minutes
Final Setting time:-
When the test block has attend such hardness that the needle does not pierce through the block more than 0.5 mm, that time is known as final setting time.
I.S. requirement = less than 600 minutes (as per I.S. 4031-1968)
Final setting time = 262 minutes

Aluminium Powder:-

The test is carried out for checking of how many percentage of volume of concrete is increased by using aluminium powder. We have casted one specimen of size 15 cm×15cm×10cm. It has been observed that after 24 hours height of specimen increased by 2.5 cm.

Therefore increased in volume = (15 ×15×12.5) – (15 ×15×10)= 562.50 cm^3

% Volume increased = (562.50÷ 2250) ×100 = 25.0 %

Tests on a light weight aggregates by using pumice stone as a light weight aggregate:

For this study, we got pumice stone as big as 50 mm size. So we crushed it to the size of 20 mm & less. The mix design for the first sample is decided based on the studies, and then further samples were made by changing some proportions in previous ones.

Sample1: 3 cubes

Cement: 19.15 kg

Crushed sand: 24.32 kg

Pumice stone (< 20 mm): 9 kg
Water: 10.53 kg
Admixture: Aluminum powder 2%

RESULTS: After 28 days of cube testing

Sp. No.	Wt. (kg)	Density (kg/m^3)	Avg Density (kg/m^3)	Load (KN)	Strength (N/mm^2)	Avg. compStrength(N/mm^2)
1	5.86	1736		287	12.76	
2	5.80	1719	1724.66	267	11.86	11.60
3	5.80	1719		246	10.19	

Sample 2: 3 cubes

Cement: 9 kg

Pumice powder: 1.8 kg

Crushed sand: 3 kg
Pumice stone: M1 (10 to 20 mm): 9.6 kg
M2 (4.75 to 10 mm): 2.4 kg
Water: 5.4 kg
Admixture: Aluminum powder 2%

RESULTS: After 28 days of cube testing

Sp.No.	Wt. (kg)	Density (kg/m^3)	Avg Density (kg/m^3)	Load (KN)	Strength (N/mm^2)	Avg. Strength (N/mm^2)
1	4.84	1434		262	11.64	
2	4.90	1452	1438	284	9.20	10.29
3	4.82	1428		228	10.13	

Sample 3: 3 cubes
Cement: 7.5 kg
Pumice powder: 3.5 kg
Crushed sand: 3 kg

Pumice stone: M1 (10 to 20 mm): 7.5 kg

M2 (4.75 to 10 mm): 3 kg

Water: 6.2 kg.

Admixture: Aluminum powder 2%

RESULTS: After 28 days of cube testing

Sp. No.	Wt. (kg)	Density (kg/m^3)	Avg Density (kg/m^3)	Load (KN)	Strength (N/mm^2)	Avg. comp Strength (N/mm^2)
1	4.14	1227		167	7.42	
2	4.26	1262	1232.66	197	8.76	8.15
3	4.08	1209		186	8.27	

Sample 4: 3 cubes

Cement: 6 kg

Pumice powder: 3 kg

Pumice stone: M1 (10 to 20 mm): 6 kg
M2 (4.75 to 10 mm): 4 kg
Water: 5.8 kg.

Admixture: Aluminium powder 2%

RESULTS: 28 days cube testing

Sp.No.	Wt. (kg)	Density (kg/m^3)	Avg Density (kg/m^3)	Load (KN)	Strength (N/mm^2)	Avg. comp Strength (N/mm^2)
1	3.82	1132		111	4.93	
2	3.94	1167	1141.66	155	6.89	5.52
3	3.80	1126		107	4.76	

Sample 5: 3 cubes

Cement: 6 kg

Pumice powder: 3 kg

Pumice stone: M1 (10 to 20 mm): 6 kg
M2 (4.75 to 10 mm): 4 kg
Water: 5.8 kg.

Admixture: Aluminum powder 2%

RESULTS: 28 days cube testing

Sp. No.	Wt. (kg)	Density (kg/m^3)	Avg Density (kg/m^3)	Load (KN)	Strength (N/mm^2)	Avg. Strength (N/mm^2)
1	4	895		65	2.89	
2	2.98	883	902.66	68	3.02	3.21
3	3.14	930		84	3.73	

Sample 6: 3 cubes

Cement: 6 kg

Pumice powder: 3 kg

Pumice stone: M1 (10 to 20 mm): 6 kg
Pumice stone: M1 (10 to 20 mm): 6 kg
M2 (4.75 to 10 mm): 4 kg
Water: 5.8 kg.
Admixture: Aluminum powder 2%

RESULTS: 28 days cube testing

Sp.No.	Wt. (kg)	Density (kg/m^3)	Avg Density (kg/m^3)	Load (KN)	Strength (N/mm^2)	Avg. Strength (N/mm^2)
1	3.84	1137		202	8.97	
2	3.65	1081	1102.66	196	8.71	8.61
3	3.68	1090		184	8.17	

IV.RESULTS AND DISCUSSION

sample1 gives average compressive strength 11.60 N/mm^2, which is good for lightweight concrete. Also it gives average density 1724.66 kg/m^3, but we have to reduce the density of concrete to nearly equals to density of water, so it is to be required that reduce the quantity of crush sand and that's why we reduced the quantity of crushed sand and also replaced it with pumice sand passing through IS sieve of size 4.75 mm. in next sample. Also we used two fractions of Aggregate i.e. M1 (10mm to 20 mm) and M2 (4.75 mm to 10 mm).

sample 2 gives the improved results having average density 1438 kg/m^3 and average compressive strength 10.29 N/mm^2, but average density of concrete is not nearly equals to the density of water. Also the quantity of cement is high, so we discussed this situation with our guide. He told us that if you reduce the quantity of cement it will help us to reduce the density as well as to achieve economy. Therefore in next sample we reduced the cement quantity and increased the pumice sand.

sample 3 gives the improved results having average density 1232.66 kg/m^3 and average compressive strength 8.15 N/mm^2. We reduced the quantity of cement in this sample, but average density of concrete is still not nearly equals to the density of water. Therefore in next sample we again reduced the cement quantity and increased the pumice sand.

Sample 4 gives lightweight concrete having average compressive strength 5.52 $N/mm^2$and average density 1141.66 kg/m^3, which is nearly equal to the density of water hence the concrete may be float on the water. It was light as desired but its finishing was not good. It happens because of the large sized aggregate. So we have decided to eliminate large size aggregate completely from concrete & also replace 30% cement by fly ash to achieve economy.

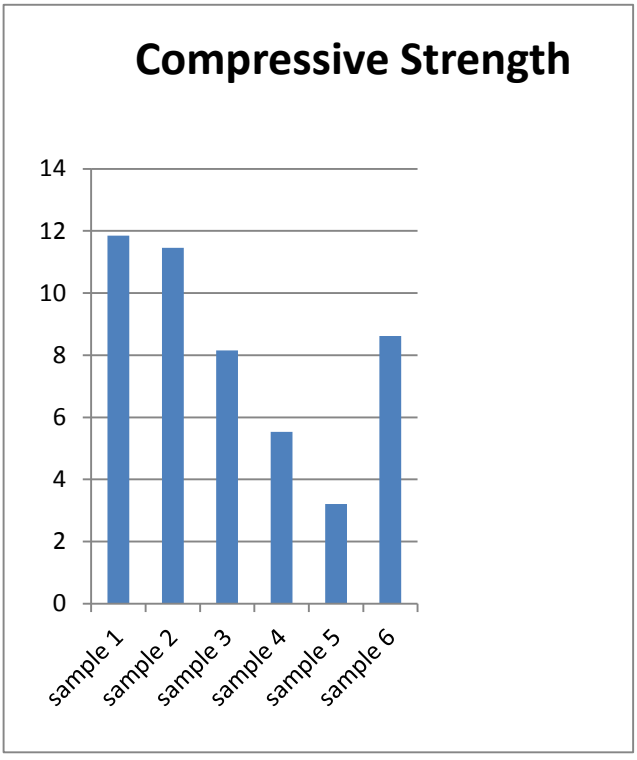
Sample 5 gives lightweight concrete having average compressive strength 3.21 $N/mm^2$and average density 902.66 kg/m^3. Which is less than the density of water hence the concrete cube floating on the water. Figure 3 shows the cube floating on water. It was light as desired but its finishing was not good. It happens because of the large sized aggregate. So we have decided to eliminate large size aggregate completely from concrete & also replace 30% cement by fly ash to achieve economy.

Fig.1: Cube showing rough surface

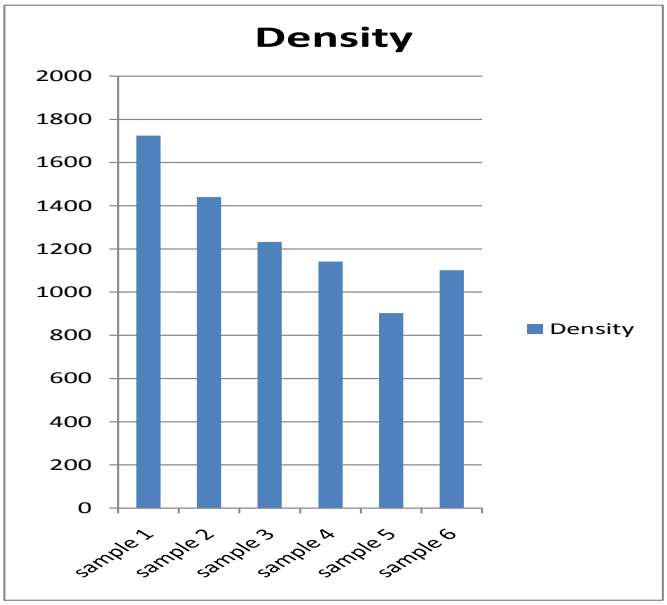
Sample 6 gives lightweight concrete having surface flat & smooth and showing a good finish. Its average density 1102.66 kg/m3 and average compressive strength 8.61 N/mm^2. From the above results it seems that the compressive strength is increased even if the density is nearly same as the previous sample. So this sample is perfect for the mix proportion.

Fig.2: Cube showing smooth surface

Fig.3: Cube floating on water



Graph 1: Average Compressive Strength of Different Samples



Graph 2: Average density of Different Samples

V. CONCLUSION

In this study, the influences of aggregate types and the amount on the compressive strength of concrete were investigated. Using different aggregate proportions (pumice) and five different lightweight concrete mixtures were produced with a satisfied strength. The result of the investigation showed that aggregate size and proportion influenced the unit weight and compressive strength of concrete. Moreover, the result showed that it is possible to produce a Floating and satisfied strength concrete by using pumice as aggregate. It was also seen that, using light weight aggregate in the concrete mixture can reduce the dead load but decreases the concrete strength. However for the sample 6 it is Reverse, because this proportion gives compressive strength 8.61 N/mm^2, which is good for the light weight concrete having density 1102.66 kg/m^3. From cost analysis it is proved that the cost of our project is less than that of brick masonry. The study showed that using pumice aggregate as a commixture enable to produce different strength grade lightweight concrete with different unit weight. These concrete does not satisfies the strength requirements for load bearing structural elements. In this study only strength and unit weight were considered, other properties including carbonation and drying shrinkage, thermal conductivity and sound insulation properties can be investigated as a further study.

VI. REFERENCES

1) Dhawal Desai, "Development of Light Weight Concrete", Civil Engineering Portal, 2014.
2) T. Parhizkar, M. Najimi and A.R. Pourkhorshidi, "(Application of pumice aggregate in structural lightweight concrete", Asian journal of civil engineering (building and housing) VOL. 13, NO. 1 (2012) PAGES 43-54.
3) N. Sivalinga Rao, Y.Radha Ratna Kumari, V. Bhaskar Desai, B.L.P. Swami, "Fibre Reinforced Light Weight Aggregate (Natural PumiceStone) Concrete",International Journal of Scientific & Engineering Research Volume 4, Issue 5, May-2013 ISSN 2229-5518.
4) Lakshmi Kumar Minapu1, M K M V Ratnam2, Dr. U Rangaraju, " (Experimental Study on Light Weight AggregateConcrete with Pumice Stone, Silica Fume and Fly Ash as a Partial Replacement of Coarse Aggregate)", International Journal of Innovative Research in Science, Engineering and Technology Vol. 3, Issue 12.
5) Kılıç1, C. D. Atis, A. Teymen, O. Karahan and Kamuran Arı (2009), (The effects of scoria and pumice aggregates on the strengths and unit weights of lightweight concrete), Scientific Research and Essay Vol.4 (10), pp. 961-965.