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# Partial Replacement of Fly ash by Crushed Glass powder in Foam Concrete

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**Abstract :-** Cellular Lightweight Concrete (CLC) which is also known as Foamed concrete, is one of the most critical kind of cement utilized for development purposes because of its different favorable circumstances and uses over customarily created concrete. Cellular light weight concrete consists of blended Portland concrete, including fly ash and stable foam. Density of this cube is impressively low (300kg/m3 to 1850 kg/m3) when compared with ordinary cement. Cellular Lightweight Concrete has been effectively utilized and it has picked up prominence because of its lower density and near quality compared to ordinary block. In this experiment four different types of mixes with partial replacement of fly ash with crushed glass by 0%, 10%, 20%, 30% were conducted. The foam contains detached air bubbles, which makes millions of detached little voids in the blend making the concrete light in weight. Further we have examined the economical savings in structural design necessities, according to the finding, dead load of the entire structure can be decreased by using light weight or low density concrete wherever possible, so this additionally incorporates a general capital decrease.

**Keywords: -** Crushed glass, Economical, Fly ash, Foam concrete, light weight concrete, voids.

## I. INTRODUCTION

Glass is the component which is normally used by every person in day to day life, it also have certain contribution to Indian economy but unfortunately 70% of glass production sector is unorganized and is contributed by Firozabad glass industry. About 21 million metric tons of waste glass is produced every year by the consumer products and industrial waste. According to a survey it is found that around 45% of glass is recycled every year in India. In construction industry, dead load of structure plays an important role, so using light weight concrete in structures wherever possible such as partition wall, insulation, non-load bearing elements, etc. The glass industry consists of some major segments: Container glass which includes bottles, jars, etc.; Flat glass(windows, windshields, mirrors, etc.); and specialty glass(Cookware, Flat panel displays, Light bulbs, Fiber optics, medical equipment, etc.) etc. The waste glass which is not recycled can be introduced in the foam concrete as a fly ash replacement. Glass has the property that it does not lose its quality which will be very helpful in case of construction material

## II. OBJECTIVES OF STUDY

I. To study the effect of crushed glass on foam concrete.
II. To study the strength properties of partial replacement of fly ash with crushed glass in foam concrete mix.
III. To properly utilize the waste glass in construction industry.
IV. Conversation of natural resources in general; sand in particular.

## III. ADVANTAGES OF FOAM CONCRETE

i. It helps to reduce the dead load of concrete structures where required as compared with normal concrete which imparts high dead load.
ii. Foamed concrete are helpful for roof and floor screeds in high temperature areas.
iii. It helps to improve the fire rating of solid structure i.e. provide good insulation.
iv. It can be used for partition wall, pit filling at site, etc.
v. Due to the cellular structure in foam concrete water absorption in less than the normal dense concrete.
vi. Thermal conductivity of foam concrete is impressively less than the normal concrete.

## IV. MATERIAL AND METHODOLOGY

### 1. MATERIAL

The materials used and their properties are as follows:

**1.1 Crushed glass-** Crushed glass powder of size 300 micron is used in the concrete to enhance the properties like strength, durability of concrete and use the waste glass in a proper way. The main constituents of glass are Silica, Sodium or Potassium carbonate, Lime, Manganese Dioxide. Percentages of chemical composition as per Metro performance glass are as follows:

**Table 1: Chemical composition of glass**

| Constituent | Percentage |
|---|---|
| SiO2 | 69-74 |
| CaO | 5-12 |
| Na2O | 12-16 |
| MgO | 0-16 |
| Al2O3 | 0-5 |

**1.2 Cement-** The cement utilized for the creation of foam concrete is 53 grade Ordinary Portland Cement (OPC). The compounds in cement responsible for early and further strength as well as heat of hydration are Dicalcium Silicate ($C_2S$), Tricalcium Silicate ($C_3S$), Tricalcium Aluminate ($C_3A$), Tetracalcium Aluminoferrite ($C_4AF$).

| Compound | Formula | Shorthand form | % by weight |
|---|---|---|---|
| Tricalcium aluminate | $Ca_3Al_2O_6$ | $C_3A$ | 8-12 |
| Tetracalcium aluminoferrite | $Ca_4Al_2Fe_2O_{10}$ | $C_4AF$ | 6-10 |
| Dicalcium silicate | $Ca_2SiO_5$ | $C_2S$ | 20-45 |
| Tricalcium silicate | $Ca_3SiO_4$ | $C_3S$ | 30-50 |

**Table 2: Chemical composition of cement**

**1.3 Fly ash-** Fly ash is the byproduct abundantly available after the burning of pulverized coal mostly in industries and power plant. It can be used in concrete to reduce the weight as it is light in weight. The chemical composition of fly ash is as follows.

| Component | % Weight |
|---|---|
| $SiO_2$ | 46.93 |
| $Al_2O_3$ | 27.11 |
| $Fe_2O_3$ | 6.18 |
| CaO | 9.07 |
| MgO | 3.18 |
| $K_2O$ | 1.49 |

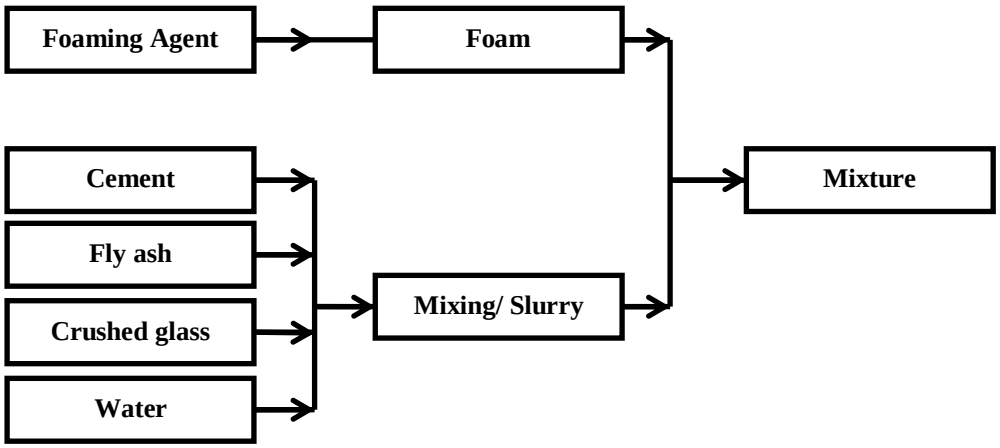
**Table 3: Chemical composition of fly ash**

**1.4 Foam-** Synthetic foaming agent is used in the Cellular Light weight Concrete for the formation of foam. Synthetic foaming agents are the chemicals which reduce the surface tension of liquid and commonly used globally to make blocks, bricks, CLC concrete, etc. where the low density is needed and it requires less energy for formation as compared to other foaming agents. The important chemical reagent in synthetic foaming agent is Sodium laureth sulphate, having chemical formula as shown in formula 1.

$$CH_3(CH_2)_{10}CH_2(OCH_2CH_2)_nOSO_3Na \quad \text{....Formula 1}$$

## 2. METHODOLOGY

The raw material, cement, fly ash and water were blended to form slurry in a foam concrete blender then pre-shaped stable synthetic foam was brought into the concrete lattice and mixed in a similar blender. The crushed glass were mostly supplanted with fly ash and combined. Foaming agent was made in the proportion of 1:20 with the water and both were filled the air compressor machine under the strain to get foam. The foam got by blending under pressure was poured onto blender to get foam concrete. When the Foam was totally mixed, the foam concrete was prepared for pouring. The foam concrete was put physically. The foam concrete once poured was kept in mould for 24 hours. Then after unmould, water curing was done for 28 days and compressive test was performed.




**Flow chart**

**Image: Foam concrete mixing**

## V. RESULTS

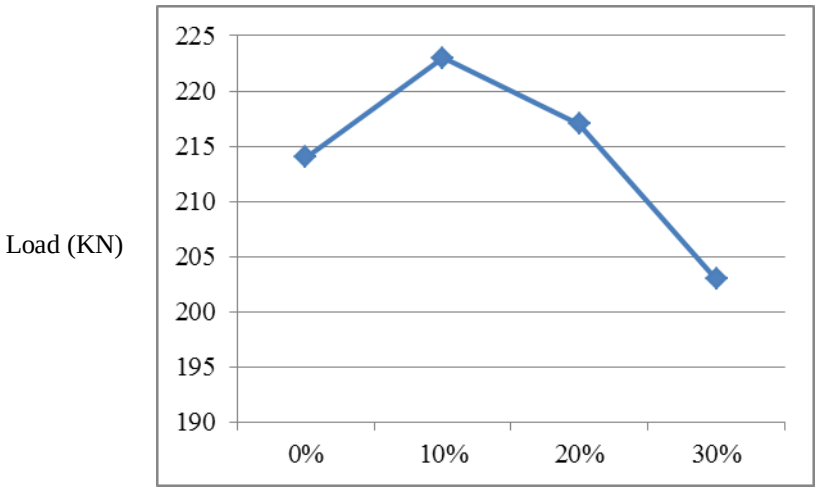
### Compressive strength test results

The experimental investigations conducted and results are summarized below:

| Sr no. | Batch (% crushed glass) | Load (in KN) | 28 days compressive strength |
|---|---|---|---|
| 1 | 0% | 214 | 9.5Mpa |
| 2 | 10% | 223 | 9.91Mpa |
| 3 | 20% | 217 | 9.64Mpa |
| 4 | 30% | 203 | 8.93Mpa |

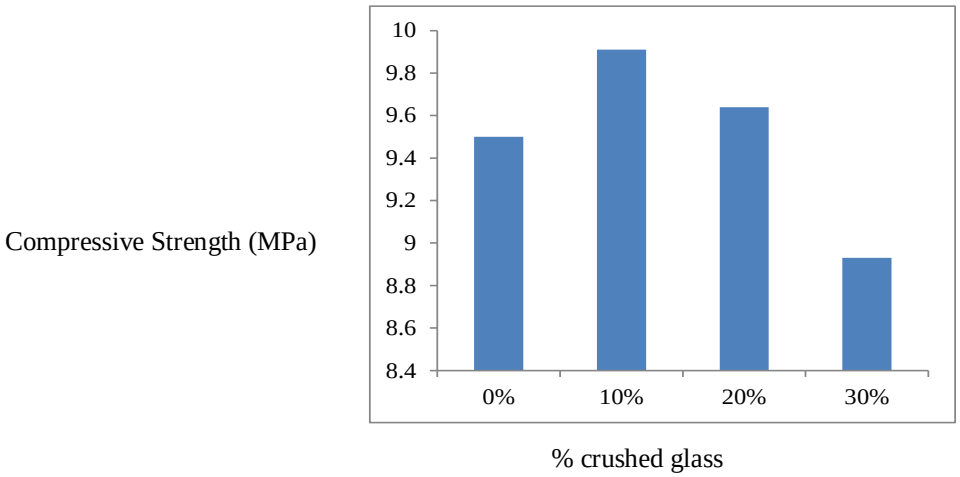
**Table 4: Compressive strength results**

Graphical representation of percentage crushed glass and load is shown below.



**Graph 1: Percentage crushed glass vs Load**

Graphical representation of percentage crushed glass and Compressive Strength is shown below.




**Graph 2: Percentage crushed glass vs Compressive Strength**

## VI. CONCLUSION

1. Partial replacement of fly ash by 0%, 10%, 20%, 30% crushed glass was conducted. Out of which the 10% replacement specimen was found to give more compressive strength than the other specimen.
2. This study shown that the density of foam concrete is less than the normal concrete.
3. Foam concrete can be used for construction of partition wall, gap filling, thermal insulation, etc. but it is not applicable for load bearing walls as it is not capable of resisting the load of building.

## REFERENCES

[1] Akshay ReddyB, Punith A, Mrs Kalyani Dongarkar, Effect of Flyash on Strenfth properties of foam concrete, *International Journal of latest Engineering Research and Application, 2017, 2455-7137.*

[2] Hemant K. Sarje, Amol S. Autade, Study of Performance of Lightweight Concrete, *International Journal of Latest Trends in Engineering and Technology, Vol. 4 Issue 4 November 2014, ISSN: 2278-621X*

[3] Anik Gupta, Mukul Rathore,Comparative Study and performance of cellular lightweight Concrete, *International Interdisciplinary Conference on Engineering Science India. ISBN: 9788193137383*

[4] Dr Padmalatha N A , Prabhish Shresta, Impact of recycling in a glass industry: a project management study, *BIMS International Journal of Social Science Research, ISSN 2455-4839*

[5] Z. Huang, T. Zhang, and Z. Wen, "Proportioning and characterization of Portland cement-based ultra-lightweight foam concretes," Construction and Building Materials, vol. 79, pp. 390–396, 2015.

[6] MD Jalal*, Aftab Tanveer, K Jagdeesh and Furqan Ahmed, Foam Concrete, *International Journal of Civil Engineering Research. ISSN 2278-3652 Volume 8, Number 1 (2017), pp. 1-14*

[7] Ufafa Anggarini, Suninar pratapa, Victor Purnomo, Ndaru Candra Sukmana, A comparative study of the utilization of synthetic foaming agent and aluminum powder as pore-forming agents in lightweight geopolymer synthesis, *DE GRUYTER, Open Chem, 2019;17:629-638*