A REVIEW ON GENERATION AND DEVELOPMENT OF FOAM CONCRETE

Er.G.V.V.S.P.Anvesh[1], Dr. G.V.V.Satyanarayana[2]
Assistant Construction Manager, Professor of Civil Engineering
M/s L&T, Chitradurga (Karnataka), Gokaraju Rangaraju Institute of Engineering & Technology, Hyderabad (Telangana)

Abstract: This paper presents review on generation and developments of foam concrete. Majorly focused on reliable advantages and properties of foam concrete. Also pointed out the key points in strength development of foam concrete using with different filler materials such as, river sand, sea sand and quarry dust (stone dust), fly ash, GGBS etc., with cement. Discuss the effects on foam concrete when several foaming agents are used. A sample calculation of foam concrete mix design also present.

Key Words: FC- Foam concrete.

1.0 Introduction:

Now days foamed concrete become a popular structural material due to reduced density concrete and light in weight (Unit weight) and utilisation of sustainable materials. [1]

Dr.G.Balamurugan et al and [2] Ankit Rai and Manoj Kumar investigated stone dust is best substitution material for river sand. This concrete also known as foamcrete (Trade name). [3] Prakash T M showed the reduction of self-weight and cost reduction of foam concrete. The unit weight of foamed concrete is reduced due to the absence of coarse aggregate. This concrete is producing with a cement based slurry with a minimum of 20% (per volume) foam entrained into the plastic mortar. The foaming agent is diluted with water and aerated to create the foam. The cement paste or slurry sets around the foam bubbles and when the foam being to degenerate, the paste has sufficient strength to maintain its shape around the voids. The physical properties of foam concrete can be enhanced with suitable fibre content. [4] Dr. Eethar Thanon Dawood and Ali Jihad Hamad showed the improvement in compressive strength and flexural strength of foam concrete using glass fibres in their investigation.

The history of foam concrete is started in 1950's and 1960's. Later on several developments were made by usage of different mineral admixtures for improving its properties. Foam is the major constituent used in foamed concrete in reduction of its self-weight. [5] Anju P Rajan and Aneeta Anna Raju achieved required density of foam concrete by varying the proportion of foam by the weight of cement**.** The generation foam and mixing with cement slurry in proper proportion is a major role for production of foam concrete. [6] Shibi Varghese discussed on synthetic and natural foaming agents about their availability and cost effectiveness in generation of foam. Generally protein or synthetic based foaming agent are using in production of foam concrete in addition with water and passed in air generator. The Protein based foaming agent is prepared with raw material in presence of $Ca(OH)_2$ and a small portion of $NaHSo_3$. The Synthetic foaming agent are such chemicals which reduce the surface tension of liquid and commonly used in manufacturing of cement blocks, bricks etc.

Foam concrete become popular because it can be produced with ease of production at any location with simple equipment, inexpensive materials and relative simple techniques. [7] Prakash T M et al has endeavoured the advantages of foam over nominal concretes against water absorption etc., Many researchers and construction industry focussed on betterment in reduction of overall cost and improvement other properties such as sound and heat insulation etc., [8] Eva Namsone et al studied the durability properties of foam concrete under different environmental conditions and proved better performance High Shrinkage and decreased strength is a basic problem to FC when comparing to aerated autoclaved concrete. In the case of wet and cold climate, durability also plays in an important role but this problem can be minimized by usage of modifying micro admixtures.

1.0 Characteristics (Or) Properties of Foamed Concrete

1) **Light weight**: In general the density of FC is low than ordinary concrete about 50%-80%, and its apparent density is usually maintained at 300-1200kg/m³.
2) **High resistance against fire and sound**: FC has the good fire resistance because of the existence of many closed pores and it possess good sound insulation also.
3) **Drying shrinkage:** FC possesses high drying shrinkage due to the absence of aggregates about 10 times greater than normal weight concrete.
4) **Heat resistance**: FC is a kind of heat preservation and insulation material which is due to uniform pores and which control the air in a large part and prevent from the cold and the heat exchanging.
5) **Well-Bonded Body**: FC forms a rigid, well-bonded body after hydrating. It forms monolithic structure and once hardened and does not impose lateral loads on adjacent structures.
6) **High Durability**: FC is high durable against freezing and thawing action due to porous structure, foamed concrete has good frost-resisting property and corrosion resistance.
7) **Economy**: The overall cost of production is low due to use large quantities of industrial waste and other materials.
8) Shilled Labour: Specific skilled labour is not required in production of FC.
9) Workability: FC is highly workable due to presence of foam and can be easily moulded without external vibration.
10) FC is good environment and Eco friendly material.

2.1 Advantages of Foam Concrete:

There following are so many advantages with foam concrete:

1) Generally FC is used for partition walls and all-round masonry walls due to its low unit weight and good heat and sound insulation.
2) The FC walls allows nails and screws readily, which helpful for conduit electrical wiring and plumbing etc.,
3) Usage of FC blocks as masonry units is economical due to having high dimensional accuracy, because 10 mm mortar joint is sufficient to lay blocks.
4) FC blocs are used not only exterior but also interior partition walls, due to less in self weight.
5) Maintenance free.
6) FC is highly durable i.e., resistant to freeze-thaw cycle (1000 cycles of -180°c to +200°C).
7) FC can be in used sufficiently in waterlogged areas also due to low water absorption over time.
8) Enables fast work due to high workability.

3.0 Applications of Foam Concrete:

- Lightweight foamed concrete generally used in panels and partition walls of various dimensions in high-rised structures where self weight of structures should be reduced.
- Lightweight foamed concrete includes in structural elements and non-structural partitions.
- Another important applications is used in all types of insulation works, including cavity walls, in roofing and ceiling panels and in sound proofing applications.
- It is used in construction of in crash barriers, road side tracks, kerbs, as road sub bases etc.,

4.0 Steps involved in production of foamed concrete

4.1 Materials and Mix Proportions:

Every material used in preparation of foam concrete should be tested and conform as per IS standards before mix design. mix up the material proportions of foam concrete as per such as cement, Fly ash, sand and quantity foam by trial and error process with different water cement ratios ranging from 0.5 to 0.8, until achieve required density.

4.2 Foam Generation:

4.2.1 Preparation of Natural Foam:

In generally Soap nuts are used to generate natural foam which is cheap and eco-friendly material. Take sufficient quantity of soap nuts and boiled up to 110°C afterwards cool down up to 70°C and it is it is maintained for 30 minutes, then cool down to room temperature. This entire process is used in preparation of natural foam.

4.2.2 Preparation of synthetic Foam:

In generally protein based materials are used to generate synthetic foam. Whatever foam produced with synthetic materials should not cause any reaction with concrete and nontoxic in nature but it serves as a layer which is air trapped and improves the concrete while casting in forms. Protein based foaming agents requires comparatively more energy to make foam. It is prepared with raw material in presence of Ca(OH)2 and a small portion of NaHSo3. For improving the stability of foaming agent it is modified with the addition of several kinds of gel and surfactants like shampoos. Sometimes Alkyl Benzene Sulfonate's are used improve the workability of foaming agent as admixture.

4.3 Mixing of materials:

Initially batched materials as per mix requirement then placed in mortar mill or other mill to mix the materials intimately to get required consistency at suitable proportion of foam. After completion of mixing of materials check the workability of foam concrete on flow table. At least 450 – 500 mm average spreading is required. To improve workability use suitable chemical admixtures at small dosages only. Afterwards check wet density of foam concrete.

4.4 Casting and testing of foam concrete:

Fill the workable foam concrete in moulds after inside lubrication. Generally 150 × 150 ×150mm moulds are used to assess compressive strength of foam concrete. Similarly 150 mm ϕ and 300 mm in length cylinders are used to assess the split tensile strength. After one day remove the specimens from moulded carefully and keep in curing tank at room temperature. Remove the specimens from curing tank after 3, 7 and 28 days for testing dry density, compressive strength and split tensile strength.

5. CONCLUSIONS

The following conclusions can be drawn with different literature reviews on foam concrete

1) The self-weight can reduced by using of foam concrete.
2) By usage of foam concrete sound insulation and thermal insulation structures can be constructed.
3) It can be moulded where easily even structural elements are very thin due to high workability.
4) The natural foaming agents are more easily available and are less expensive.
5) The compressive strength of foam can be increased with suitable mineral admixtures.
6) The split and flexural strength of foam can be increased with suitable fibres.
7) The fresh and dry density of foamed concrete increased with the addition of fibres.
8) Eco-friendly materials are used in generation of foam concrete so it is a sustainable material.

6. References

[1] Dr.G.Balamurugan et al " Experimental study on light weight foam concrete bricks", International Research Journal of Engineering and Technology, 2017, volume No.04, Issue No.04, pp. 677-686

[2] Ankit Rai and Manoj Kumar "Experimental study on compressive and split tensile strength of foamed concrete using stone dust', International Research Journal Engineering and Technology, 2017, volume No.4, Issue No.05, pp. 1377-1382
[3] Prakash T M et al "Properties of Aerated (Foamed) Concrete Blocks", International Journal of Scientific & Engineering Research, 2013 Volume No.4, Issue No. 1
[4] Dr. Eethar Thanon Dawood and Ali Jihad Hamad" Effect of Glass Fibers on Tensile Strength of High Performance Lightweight Foamed Concrete", International Journal of Enhanced Research in Science Technology & Engineering, 2013, volume No.2, Issue No.12, pp.161-168
[5] Anju P Rajan and Aneeta Anna Raju, "Experimental study on strength of foam concrete by varying foam content", International Research Journal of Engineering and Technology, 2019, volume No.06, Issue No.04, pp. 4454-4456
[6] Shibi Varghese et al "A study on properties of foamed concrete with natural and synthetic foaming agent", International Research Journal of Engineering and Technology, 2017, volume No.4, Issue No.03, pp. 2009-2011
[7] Prakash T M et al "Properties of Aerated (Foamed) Concrete Blocks", 2013, International Journal of Scientific & Engineering Research, Volume 4, Issue 1, volume No.4, Issue No.01, pp. 1-5
[8] Eva Namsone et al "Durability Properties of High Performance Foamed Concrete", 2017 Procedia Engineering 172, pp.760 – 767