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A Study on Hollowcore Foam Concrete Wall

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Abstract **– Now a days the construction time, improving the quality of concrete work, durability and cost of construction of any structure plays important roll to compensate the cost of project. There are number of new technique and innovative method used, hollowcore foam concrete wall is one of them. Foam concrete is either a cement paste or mortar, classified as cellular light weight concrete, in which air voids are entrapped in mortar by suitable foaming agents. In this study, we are carried out mechanical properties of cellular light weight concrete wall, which made from ordinary Portland cement, fly ash, water and foaming agent admixture. This building methodology for low cost housing and economical advantages achieved by its adoption.**

Keywords **– Foamed concrete, Cellular lightweight concrete, Fly ash, Foaming agent, Hollowcore wall, Mechanical properties.**

I. INTRODUCTION

Foamed concrete is produced by the mixing of Portland cement, water and foam. The foam is produced with the help of a foaming generator by using foaming agent. The air content is typically between 30 to 80 percent of the total volume. The bubbles vary in size from around 0.1 to 1.5 mm in diameter.

Hollowcore wall is an environmental-friendly panel which is widely used in wall construction, especially wall partition. It is a new type of non-flammable material made of lightweight materials.

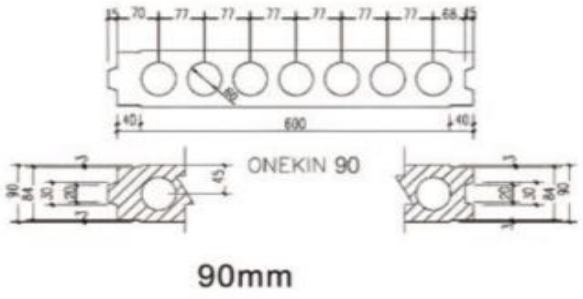

Fig.1. size

When compared with other similar materials, a number of benefits such as completely green material and no asbestos, higher fireproof, sound installation, easier decoration, and lower the total cost of the project.

Fly ash is fine powder that is a byproduct of pulverized in electric generation power plant. Fly ash is pozzoloan, a substance containing aluminous and siliceous material that form cement in the presence of water. When mixed with water and lime, fly ash forms a compound similar to Portland cement. This makes fly ash suitable as a prime material in blended cement, mosaic tiles, and hollow blocks, among other building material. When using concrete mixes, fly ash improves the strength and segregation of the concrete and makes it easier to pump.

1.1Materials:

1.1.1 Cement:

Concrete is the most used material in the world because of its available at cheaper price and large quantity. It is the basic ingredient of concrete, mortar and plaster. Portland cement grade 53 is used in this experimental work.

Fig.2 Cement.

1.1.2 Foaming agent:

Foam is a substance foamed by trapping pockets of gas in liquid or solid. A bath sponge and the head on a glass of beer are example of foam. In most foam, the volume of gas is large, with thin films of liquid or solid separating

the region of gas. Foaming agents is materials that facilitate formation of foam. The role of foaming agents in foamed concrete is to create small and enclosed air bubble by reducing the surface tension of a solution and increasing the stability of air bubble.

1.1.3 Fly Ash:

Fly ash can be a cost-effective substitute for Portland cement in many markets. Fly ash is also recognized as an environmentally friendly material and embodied energy. Fly ash is poorly graded particles, generally spherical in shape and range in size from 0.5 micrometer to 300 micrometers.

Fig.3.Fly Ash.

1.1.4 Fiberglass mesh net:

With high strength, durable service and excellent property against acid and alkali, fiberglass mesh net is the alternative to steel mesh for exterior and interior concrete wall rendering. Fiber reinforcement mesh enjoys easy operation, material saving, long life, it is the ideal energy -saving insulation materials.

1.1.5 Water:

Water is most important material required for concrete. Portable water is used for mixing the material with each other.

1.1.6 Chemical composition and Physical properties of OPC and Fly Ash

Table -I: A typical chemical composition of Portland cement and fly ash.

Chemicals	Portland cement (OPC)	Fly Ash
Chemical composition (% by mass)		
Silicon dioxide	16.39	63.6
Aluminum oxide	3.85	28.19
Ferric oxide	3.48	2.99
Magnesium oxide	0.64	0.54
Calcium oxide	68.48	1.54
Sodium oxide	0.06	0.05
Potassium oxide	0.52	0.003
Sulphur oxide	4.00	0.26
Silicon oxide + Aluminum oxide + Ferric oxide	23.73	94.78
Physical properties		
Loss of ignition (% by mass)	1.7	0.85
Specific gravity	3.2	2.09

1.2 Equipment:

1.2.1. Mounding machine:

The concrete wall panel machine is high degree of automation equipment, hydraulic opening and closing.

Speification:

Annual output	20 panels per moulds(90mm)
Hydraulic power	4 KW
Hydraulic pressure	5 Mpa
Machine size	3.7*3.3*1.2m
Machine weight	4500kg
Product width	600mm
Partition steel plates	Q235, thickness 4mm
Steel plates leveling tolerance	≤1mm
Product length	Can be adjustable within 3m
Moving motor power	4KW

Fig.4 . ulding machine

1.2.2. Foam generator machine:

One of the most ingredient required to produce foamed concrete is the aqueous stable foam. The foaming generator acts as a medium which transforms the liquid chemical into stable foam.

1.2.3. Overhead crane

To move extremely heavy or bulky loads through the overhead space in a facility, instead of through aisles or on the floor, on overhead crane.

II. LITERATURE REVIEW

2.1 Roz-Ud-Dia Nassar and Shazim Ali Memon et.al (2018) [1] has submitted thesis on "Characteristics of foam concrete produced from Detergent used as foaming agent."

In this study, the possibility of production of low-cost foam concrete using locally manufactured detergent powder was experimentally investigated.

They concluded that, the production of low-cost foam concrete using locally manufactured detergent as replacement of commercially available FA is a feasible practice. Strength and durability characteristics of foam concrete mixers produced with detergent as foaming agent are quite comparable to that of control foam concrete mixers produced with FA as the air-entering agent.

The result of the study is encouraging and various properties of the foam concrete produced with detergent as air-entraining agent can be further improved by fine-tuning the mix proportioning.

2.2 Vidya jose and Dr. P. Rajeev kumar et.al (2014) [2] has submitted thesis on "Hollow Core Slabs in Construction Industry."

A hollow core slab is precast prestressed concrete member with continues voids provided to reduce weight and cost. They are primarily used as a floor deck system in residential and commercial buildings as well as in parking structures because they are economical, have good fire resistance and sound insulation properties, and are capable of spanning long distance with relatively small depths.

Hollow core slabs can make use of prestressing strands, which allow slabs with depths between 150 to 260 mm to span over 9 meters. The small gap that is left between each slab is usually filled with a non-shrink grout.

Hollow core slabs are used for a variety of applications in low and high-rise commercial, residential and industrial buildings. It provides an answer to most of the present market
demands and challenges for the building industry: structural efficiency, low material consumption, highly automated an environment friendly production process, high concrete strength, slender floor thickness, and possibilities for reuse and recycling at the end of the life cycle.

2.3 R. Yuvanesh Kumar, K. Vinobalaji and M. Naveen Prasad et.al (2018) has submitted thesis on "Experimental investigation of hollow core slab using different fiber.

Total weight of the building mainly depends on the reinforcement concrete. Large portion of buildings weight caused due to dead load. In order to reduce the self-weight, hollow core slabs are used. Hollow core slab makes the slab much lighter than the massive solid concrete floor slab of equal thickness and strength. Concrete bring brittle is strong in compression but very week in tension, the weakness make it to crack at the tensile end. The tensile property can be induced by adding fibers.

Fibers have the ability to arrest cracks, increase the extensibility and tensile strength. Fibers are able to the matrix together even after extensive cracking. Glass fiber which improves the flexural and split tensile strength of concrete. By adding the fiber to the mix will have ductile failures.

Hollow core slab reduces the dead weight to a great extent. It is observed that compressive strength increases up to 12.95 % with addition of 0.06% glass fiber to the volume of concrete. Flexural strength increases up to 6.96% with addition of 0.06% glass fiber.

2.4 K. M. Monisha, G. Srinivasan et.al (2017) has submitted thesis on "Experimental behaviour of prestress hollow core slab, Rc hollow core slab and normal Rc solid slab.

The project consists of experimental behavior of hollow core slabs and comparison of this result with different makes and casting. Reinforced hollow slab is casting by making the hole in mold then the prestress hollow core slab is casted with zero slump concrete in factory. The slab has dimension of 1 cubic meter.

The load test is done in this slab by loading frame. Reinforced hollow core slab, prestress hollow core slab is tested and ultimate load, cracking load and efficiency of slab is tabulated. Cost efficiency of prestress hollow core slab is high compare to reinforced concrete hollow core slab. Load caring capacity of slab is 20% less when compare to prestress hollow core slab.

Hollow core slab is precast, prestress concrete element that are generally used for flooring. A hollow core slab consist of continues voids provided to reduce weight and cost. This hollow core slab are primarily used as a floor deck system in residential and commercial buildings as well as in parking structures because this slabs are more economical, have good fire resistance and sound insulation properties and also capable of spanning long distances with relatively small depths.

III. METHODOLOGY

1. Collection of literature about foamed concrete and fly ash
2. Material procurement and collection: Cement, Foam, and fly ash
3. Testing: Specific gravity, Absorption test etc.
4. Concrete mix design
5. Experimental set up
6. Wall Casting, Curing and testing of walls
7. Observation
8. Result and Discussion
9. Conclusion and Future work

Step 1 – Raw Material Preparation- hollowcore wall manufacturing process starts with raw material preparation. List of raw materials and relevant details are mentioned below-

- Pouring Mixture
- Blocks Casting on Mould
- Demoulding
- Steam Curing for 12 Hours
- Hollowcore Wall Ready For Sale

Cement- 53-grade Ordinary Portland Cement (OPC) from r manufacturer is required for manufacturing hollowcore wall.

Fly ash – Fly ash is mixed with water to form fly ash slurry.

Foaming agent - Foam is a substance foamed by trapping pockets of gas in liquid or solid. A bath sponge and the head on a glass of beer are example of foam. In most foam, the volume of gas is large, with thin films of liquid or solid separating the region of gas. Foaming agents is materials that facilitate formation of foam. The role of

foaming agents in foamed concrete is to create small and enclosed air bubble by reducing the surface tension of a solution and increasing the stability of air bubble.

Fiberglass mesh net- With high strength, durable service and excellent property against acid and alkali, fiberglass mesh net is the alternative to steel mesh for exterior and interior concrete wall rendering. Fiber reinforcement mesh enjoys easy operation, material saving, long life, it is the ideal energy -saving insulation materials.

Step 2 – Dosing and Mixing- After raw material preparation, next step of wall manufacturing process is dosing and mixing. Process of dosing and mixing means the quality of final products. A dosing and mixing unit is used to form the correct mix to produce hollowcore wall. Fly ash is pumped into a container. Once the desired weight is poured in, pumping is stopped. Foaming agent is mixed with fly ash by using foam generated machine. Dosing unit releases this mixture as per set quantities into molds.

Step 3 – Casting, Rising and Curing- Once mix of raw materials is ready, it poured is in molds. High degree of automation equipment, hydraulic opening and closing Simple operation and high efficiency, low labor intensity. The machine can also be equipped with vibrator system for thick mortar. Using Q235 steel, thickness 4mm, it will be welded on Horizontal worktable with pressing system to leveling tolerance ≤1mm. The leveling tolerance after all the Q235 steel plates after assembling will be ≤3mm.The bottom steel plate for tongue, the aluminium part with plastic coating for tongue profile to guarantee the precision of tongue. The aluminum part will be fixed on 6mm steel plates. Mound layer for top groove, the aluminium part with plastic coating for tongue profile to guarantee the precision of top groove. The Pipes, using steel pipes inside. PVC pipe fixed outside.

Step 4 – Demoulding and Cutting –After 2 days, it is ready to be demoulded and cut as per requirements. Once a mould is out of pre-curing room, it is lifted by a crane for demoulding operation. While all previous processes like raw material preparation, dosing & mixing and casting are pretty much same across all technologies, demoulding and cutting process vary vastly depending on technology provider. Differences in demoulding and cutting process are also evident from different types of molds required by different technology provider.

Flow chart -

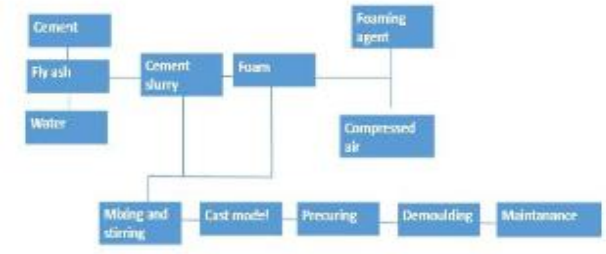

Fig.5 Flow chart of Hollowcore foam concrete.

IV. RESULT AND DISCUSSION

Test result of hollow core foam concrete wall having size (2800x600x100 mm), weight (45kg), Density (1400kg/cubic meter)

No.	Particulars	Result	Unit
1.	Compressive strength	5.56	mpa
2.	Flexural strength	0.492	mpa
3.	Sound insulation	40	dB
4.	Thermal conductivity	0.1739	w/ mk
5.	Cost reduces	30	%

V. CONCLUSION

1. The light weight concrete wall is suitable for sound and heat insulation.
2. Most important advantages of light weight concrete for the wall panel construction to form any shape and size.
3. The cost of the light weight concrete panel wall is very low as compare to normal wall.
4. The raw material for our panel is green material it's without asbestos and no radioactivity.
5. It is easy to install any storied building.
6. It is very economic, construct in less time.

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