PROPERTIES OF FAC-F HALLOW MASONRY BLOCKS

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ABSTRACT

Fly ash cement steel fibers (FaC-f) is the product name derived from a cementitious mixture composed of Fly ash (Fa), Cement(C) and steel fibers(F). It is a low-cost and environmental-friendly material. FaC-F in certain proportions, as a building material is an outcome of innovation. Fly ash, cement, Fibers (FaC-F) hollow blocks are one of the best substitutes for conventional burnt clay hollow bricks or concrete hollow blocks in construction industry. FaC -F hollow blocks are light in weight and being hollow, impart thermal insulation to the buildings.

In this paper, a study based on the results of an experimental investigation on FaC-f hollow blocks is presented. The compressive strength, water absorption and weight of FaC-f hollow blocks were determined. The durability of these blocks in terms of gains in compressive strength. It is observed that FaC-F hollow blocks have sufficient strength for their use in general building construction. The properties of FaC-F masonry hollow blocks were determined for different parameters. The experimental results reveal that the FaC-F hollow blocks are suitable to be used for the construction of masonry structures.

The variation in density of fly ash hollow concrete blocks for different mixes was not large. On the basis of present experimental work, fly ash concrete hollow blocks are proposed for the masonry work in buildings. Fly ash concrete blocks are lighter in weight, less porous resulting in better resistance to chemical attack - and have better fire resistance. Hollow fly ash concrete blocks having nearly the same compressive strength as ordinary concrete grade A, hollow blocks were found to be cheaper.

Keywords: Durability, environment, fly ash, steel fibers, waste management, thermal insulation, Hollow Block compressive strength, water absorption.

I. INTRODUCTION

One of the basic requirements of human being to sustain in the world is shelter. After the evolution of human being, the need of shelter meant for safety arises. In ancient times, man started taking shelter in caves, excavated below ground level and under hanging mountain cliffs and this type of shelter just provided safe place from environmental extremities the concept of stability and safety as per structural features of shelter were completely out of mind. With the development and maturity of human mind, man began to modify the structural formation of shelter so as to address the increasing needs and facilities which an optimum shelter design possessed. After achieving a feat by the use of easily available material like mud in constructing walls and then the technique of burnt clay brick masonry to form structural part of shelter, there was still a long journey in coming out for the best possible structural material for construction of stable and safe structural units of shelter. The desire for search of safe and stable structural materials keeping in view the economy of whole structure, paved way for usage of hollow concrete blocks in masonry.

Every moment the emission of carbon dioxide into the atmosphere is being increased gradually. Considerable amount of fossil fuel, coal and oil are burnt to satisfy the human needs. This weakens the heat–trapping blanket that surrounds the planet and causes global warming. Different alternatives can be considered to protect the planet. The rapid increase in the capacity and number of thermal power generation has resulted in the production of a huge quantity of fly ash. The prevailing disposal methods are not free from environmental pollution and other hurdles. On the other hand, the production of each ton of cement releases equal amount of carbon dioxide to the atmosphere. The usage of cement can be reduced by using the other possible alternative cementing materials without compromising the properties. The most basic building material for construction of houses is the usual burnt clay brick in many countries. A significant quantity of fuel is utilized in making these bricks. Also, continuous removal of topsoil, in producing conventional bricks creates lot of environmental problems. There is strong need to adopt cost effective sustainable technology using local materials. Different methods are adopted to produce the building blocks using cement-fly ash, lime-fly ash, lime-slag bindings and other materials.

There is a need to develop simple and effective technologies for producing the masonry units. The need to produce more building materials for various elements of construction and the role of alternative options would be in sharp focus. The possibility of using innovative building materials and technologies, using waste material like fly ash, Cement steel fibers has been considered in this paper. FaC-F in certain proportions, as a building material, is an outcome of innovation to promote the utilization of fly ash by Bhanumathidas and Kalidas. It gains strength like any other hydraulic cement, in the presence of water, and is water resistant with time. Large amounts of materials like steel fibers and fly ash are available at steel manufacturing plants and thermal power plants, respectively.

II. DEFINATION OF HALLOW BLOCK

Hollow blocks are defined as those blocks which have core wide area greater than 25% of gross area having one or more holes open at both sides. The most commonly used concrete blocks have a nominal length of 40cm, height of 20cm and nominal width of 8, 10, 15 and 20cms.

III. CHARACTERISTICS OF FAC-f HOLLOW BLOCKS

- The standard size of the block is 400mmx200mmx200mm.
- Bricks are manufactured and tested as per IS 2572.
- Fly ash bricks are sound, compact and uniform in shape, size and colour.
- Smooth rectangular faces of the bricks are accompanied with sharp and square corners.
- They are free from visible cracks, wrap age, flaws and organic matter.
- Economical & environment friendly.
- 28% lighter than ordinary clay bricks.
- Compressive strength: 5 N/mm2 on an average.
- Water absorption<8%.

IV.RESULTS AND DISCUSSION

4.1 PROPERTIES OF CEMENT

Table 4.1: properties of cement

S.NO	PROPERTIES OF CEMENT	
1	fineness	9%
2	Initial setting time	30 min.
3	Final setting time	10 hours
4	Compressive strength (28 days)	53 MPa
5	Consistency	30%
6	Soundness test	2.1 mm

4.2 PROPERTIES OF FLYASH

Table 4.2: properties of flyash

S.NO	PROPERTIES OF FLYASH	
1	Fineness	16%
2	Specific gravity	2.468
3	Bulk density (g/cc)	1.19 g/cc

4.3 PROPERTIES OF STEEL FIBERS

Table 4.3: properties of steel fibers

Brand	Dura flex TM Hook end steel fiber
Product code	HKL 50/30
Material	Low carbon drawn wire
Aspect ratio	50
Length (mm)	30mm
Diameter (mm)	0.6mm
Tensile strength	Greater than 1100 MPa
Appearance	Clear, Bright, loose unglued with hook end Anchorage
Conforms to	EN 14889-1, ASTH A820 M04 standards

4.4 MIX DESIGN OF HOLLOW BLOCK

Table 4.4: Mix design of hollow block

S.NO	MIX DESIGNATION	CEMENT (%)	FLY ASH (%)	STEEL FIBERS (%)	WATER (%)
1.	M1	29	70	1	30
2.	M2	39	60	1	30
3.	M3	30	70	0	30

Figure 4.1 Hollow Block Cube of400×200x200mm Size

4.5 MIX DFESIGN RESULTS

4.5.1 Compressive strength for a 60% of Fly Ash & 1% of steel fibers

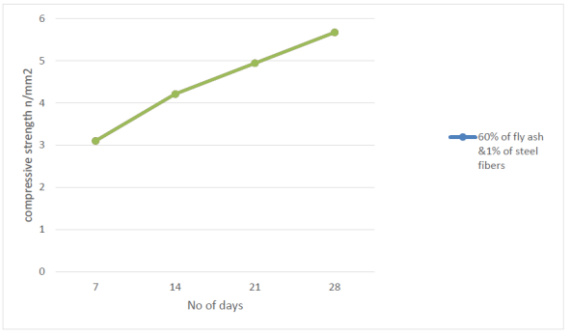

Figure 4.2 Compressive strength for a 60% of Fly Ash & 1% of steel fibers

4.5.2 Compressive Strength for 70% of Fly Ash& 1% of steel fiber

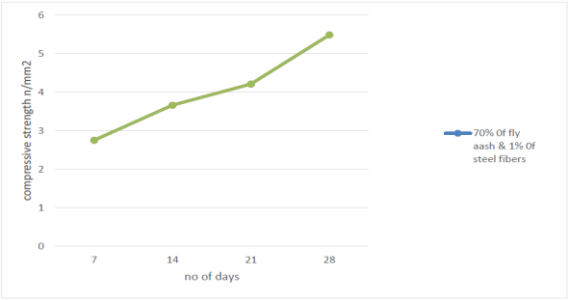

Figure 4.3 Compressive Strength for 70% of Fly Ash& 1% of steel fiber

4.5.3 Compressive Strength of 70% fly ash & 0% steel fibers

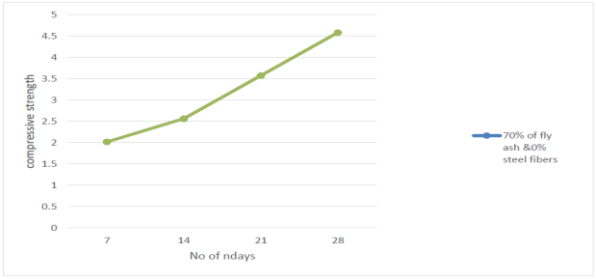

Figure 4.4 Compressive Strength of 70% fly ash & 0% steel fibers

4.5.4 Compressive strength for 7 days

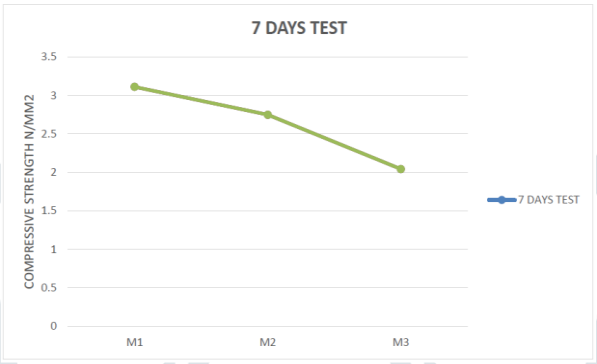

Figure 4.5 Compressive strength for 7 days

4.5.5 Compressive strength for 14 days

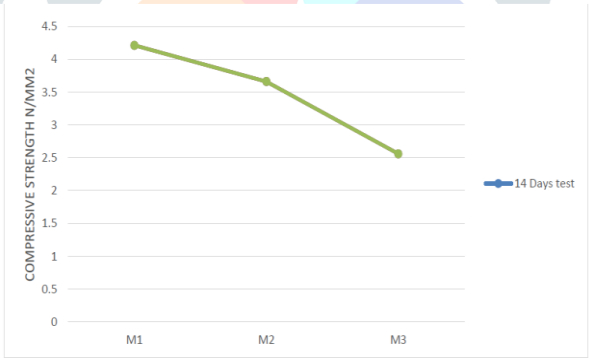

Figure 4.6 Compressive strength for 14 days

4.5.6 Compressive strength for 21 days

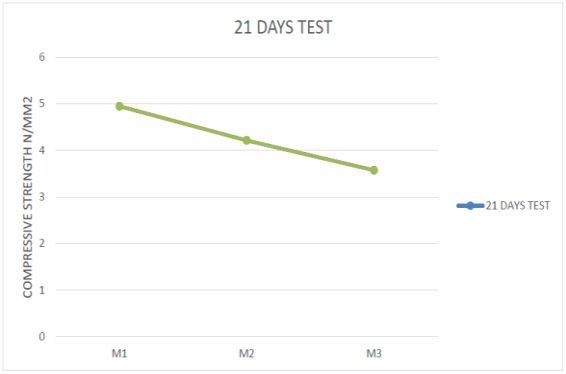

Figure 4.7 Compressive strength for 21 days

4.5.7 Compressive strength for 28 days

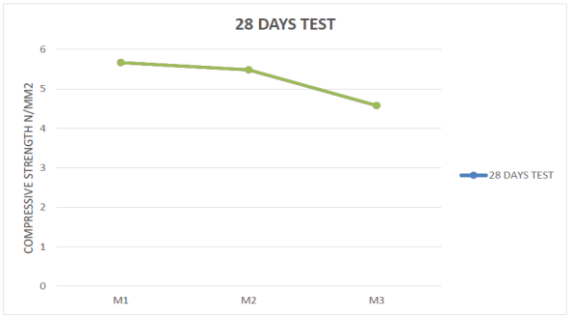

Figure 4.8 Compressive strength for 28 days

Table 4.5 Water absorption

S.NO	Weight (dry) gm	Weight (wet after 24 hr.) gm	% of water absorption
M1	16800	17674	5.202
M2	17012	17998	5.795
M3	17116	18122	5.877

V. CONCLUSION

The experimental investigations reveal the following

A study of hollow block strengthened with steel fibre was performed in this present work. The study showed that the block with a sufficient surface finish provides considerable strength and reduces the cost of construction. The extra cost of steel fibres can be compensated by saving time of construction, avoiding plastering of walls and minimizing the quantity of bonding mortar. The block also provides provisions for concealing plumbing and electrical conduits. The conclusions derived from this work are listed below

- Fac-f compressed masonry hollow blocks can be conventionally prepared economically by using industrial wastes like fly ash.
- It was found that the dry density, and water absorption of Fac-f compressed bricks were in the range of 1.27 to 1.450 g/cc., 5.202 % respectively.
- Fac-f blocks attained considerable strength around 5.5 MPa at the age of 28 days to use them as masonry units with adequate modulus of elasticity.
- Hollow blocks (HB) failed due to splitting of webs whereas in the case of reinforced Hollow blocks cracks and failure were developed through face shells. Failure of solid block was due to the crushing and in most of the cases cracks developed through the centre of the block
- In view of the above, it can be concluded that Fac-f masonry units can effectively replace conventional masonry units.
- Due to lower water penetration seepage of water through blocks is considerably reduced.
- Due to uniform size of blocks mortar required for joints & plaster reduces almost by 50% and because of high strength, practically there will be no breakage during transport & use.
- The results show the Fac-f blocks are more safe, economical and having higher strength compare to conventional bricks.
- It can be understood that fly ash hollow blocks are better alternative to conventional burnt clay bricks in structural, functional and economic aspects, by use of this aspect we can convert waste into wealth.
- Maintenance cost of hollow concrete block masonry is less than brick masonry because of efflorescence in brick masonry wall.
- Sound insulation property of hollow concrete masonry is more than that of brick masonry.
- Hollow concrete masonry construction presents a faster construction system as compared to brick masonry construction.
- Thermal insulation property of hollow concrete masonry is more than that of brick masonry due to presence of air in hollow concrete units.
- Compressive strength of brick units and brick masonry wall came out to be more than compressive strength of hollow concrete block units and hollow concrete wall masonry.

- In case of brick masonry wall failure occurs by crack formation along one side face throughout the height of wall, while as in hollow block masonry failure occurs by crushing of top layer only.
- The cost of block walls per metre3 of masonry comes out to be 17.78%less than that of brick walls. So, block masonry is economical than brick masonry.
- Hollow concrete block masonry is environmentally ecofriendly because in hollow concrete block unit's constituents can be substituted by waste products like fly ash.
- Hollow concrete block masonry presents better architectural view as compared to brick masonry.
- 28-day compressive strength of steel fibre reinforced hollow block was 5.68 N/mm2 which is 14% and 68% greater than that obtained for locally available solid and hollow blocks, respectively.
- Steel fibre reinforced hollow block reduces the dead load by 28% and 11% compared to locally available solid and hollow block. On the basis of results obtained, following conclusions can be drawn.

FUTURE SCOPE

The simple concrete block will continue to evolve as architects and block manufacturers develop new shapes and sizes. These new blocks promise to make building construction faster and less expensive, as well as result in structures that are more durable and energy efficient. Some of the possible block designs for the future include the biaxial block, which has cavities running horizontally as well as vertically to allow access for plumbing and electrical conduits; the stacked siding block, which consists of three sections that form both interior and exterior walls; and the heat soak block, which stores heat to cool the interior rooms in summer and heat them in winter. These designs have been incorporated into prototype house, called Lifestyle 2000, which is the result of a cooperative effort between the National Association of Home Builders and the National Concrete Masonry Association.

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