PERFORMANCE OF C.L.C BRICKS WITH COIR FIBERS AND PLASTIC FIBERS

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***Abstract*— Now-a-days there are so many technologies involved in the recent development of concrete. Of these, Cellular Lightweight Concrete (CLC) is one of the recent emerging technology in making concrete. By using this type of concrete, we have found so many advantages when compared to the normal conventional concrete. This paper mainly focused on making cellular light weight concrete based on fly ash. Fly ash is considered as one of the waste industrial product that cannot be easily disposed. It solves the problem of disposal of fly ash and at the same time it reduces the cost of the construction. Therefore, fly ash based CLC is considered as environment friendly sustainable material produced with least energy demand. This paper also focused on the innovative idea of using fibers as a partial replacement of cement in fly ash based cellular light weight concrete. The density is considerably reduced by using fly ash based cellular lightweight concrete than normal concrete and at the same time, the strength is not affected by appropriate design mix. When we use this type of concrete we achieve large volume by less amount of concrete. The manufacturing process of this type of concrete does not involve any high cost techniques. Manufacturing process of CLC is similar to normal concrete and in this additionally foam generating machine is used.**

***Keywords*—** CLC, Bricks, Fly ash, Strength, Lightweight

I. INTRODUCTION

Global warming and Environmental pollution is now a global concern. Cellular Light Weight Technology blocks can be used as an alternative to the red bricks, to reduce Environmental pollution and Global warming. It is produced by initially making slurry of Cement + Fly Ash + Water, which is further mixed with the addition of pre-formed stable foam in an ordinary concrete mixer under ambient conditions. The addition of foam to the concrete mixture creates millions of tiny voids or cells in the material, hence the name Cellular Concrete Bricks remain one of the most important building materials in the country. Brick making is a traditional industry in India, generally confined to rural areas. In recent years, with expanding urbanization and increasing demand for construction materials, brick kilns have to grow to meet the demand. It has directly or indirectly caused a series of environmental and health problems. At a local level (in the vicinity of a brick kiln), environmental pollution from brick-making operations is injurious to human health, animals and plant life. At a global level, environmental pollution from brick-making operations contributes to the phenomena of global warming and climate change. Also, extreme weather may cause degradation of the brick surface due to frost damage.CLC blocks are environment friendly. The energy consumed in the production of CLC blocks is only a fraction compared to the production of red bricks and emits no pollutants and creates no toxic products or by products. Based on the trial mixes, it is found that compressive strength of CLC blocks is more than the compressive strength of conventional clay bricks. Light weight foamed concrete has become more popular in recent years growing to the tremendous advantages it offers over the conventional concrete..Modern technology and a better understanding of the concrete have also helped much in the promotion and use of light weight foamed concrete.

II. CLASSIFICATION , SPECIFICATIONS AND ADVANTAGES

GRADE-A :

These are used as load bearing units and have a block density in the range of 1200kg/m3 to 1800kg/m^3

GRADE-B :

These are used as non-load bearing units and have a block density in the range of 800kg/m3 to 1000kg/m^3

GRADE-C :

These are used for providing thermal insulation and have block density in the range of 400kg/m^3 to 600kg/m^3

TECHNICAL SPECIFICATIONS:

- Size: 600*200 mm
- Thickness: 100 / 150 / 200 / 230 mm
- Compressive strength: 3 N/mm2
- Sound absorption: up to 42 dB
- Fire resistance up to: 4 hours
- Colour: light grey
- Raw Material Used: cement, fly ash, foaming agent, plastic fiber, coconut fiber.

Advantages:

1. The most significant property is reduced weight at no sacrifice in strength. This enables reduction of dead load. Weight reduction becomes highly beneficial for structural reasons, for reduced dimensions and substantial saving of steel reinforcement in the foundation.
2. Fly-ash is considered as one of the industrial waste product that cannot be easily disposed. It solves the problem of disposal of fly-ash and at the same time it reduces the cost of the construction.
3. Fly-ash based CLC is considered as environment friendly sustainable material produced with least energy demand

III. RAW MATERIALS

Optimum properties are achieved when selecting the most suitable raw material (fly ash, Cement). Power-plant fly ash, sieved and with minimum 20% fines. Impurities in fly ash increase the demand for water and cement, without adding to the properties. It also increases shrinkage. A certain, small amount (20%) of fines contributes towards strength. As in conventional concrete (CC), the fly ash should be free of organic material or other impurities. Crushed sand, due to sharp edges may destroy the foam mechanically hence not recommended. Portland cement is preferred over other cements, such as pozzolana. For early stripping and optimum mechanical properties, high-grade (early strength) cement is recommended. Thick walls and when using battery- moulds, excess heat is developing within and might therefore ask for a lesser grade of cement. Remember: The slower the hardening, the better the final quality of concrete. Where economical, fly-ash may be added to the mix to substitute some of the cement. Fly-ash normally will retard hardening though. When used to produce foam, has to be potable and for best performance should not exceed 25°C. Under no circumstances must the foaming agent be brought in contact with any oil, fat, chemical or other material that might harm its function (Oil has an influence on the surface-tension of water). The oil/wax used in moulds will not harm, since the foam by then will be embedded in mortar. Water to prepare the mix has to conform to general requirements for concrete. The containers holding foaming agent must be kept air-tight and under temperatures not exceeding 25°C. This way the shelf-life is guaranteed for 24 months from date of Invoice. Once diluted in 40 parts of potable water, the emulsion must be used as soon as possible.

Through special production process and surface treatment technology, we ensure that it has excellent dispersion in concrete and bond with cement matrix, and good aging resistance. It can be guaranteed long-term effectiveness in concrete. Polypropylene fiber for concrete is chemically stable and has a good affinity with concrete materials. Coconut fiber, is a natural fiber extracted from the outer husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut.

IV. Material Properties

Property	Cement	Fly ash	Plastic fiber (Propylene)	Natural fiber (Coconut fiber)	Foaming agent
Specific gravity	3.1 to 3.16	2.1 to 3.0	0.516	2.63 to 2.65	1.02
Density	1.44 g/cm³	1.9 to 2.9 g /cm3	0.895 & 0.92 g/cm³	1.15 g/cm³	0.5 g/cm³
Size of the particle	0.007 - 0.2 mm	10 - 100 micron	60 nm	8 mm	30, 16.6 µm
Chemical composition	35 to 40 % lime, 40 to 50 % alumina, up to 15 % iron oxides and preferably not more than about 6 % silica	oxide of silicon, aluminum iron & calcium	C3H6	cellulose, hemi-cellulose, and lignin	to be diluted in water and then foam is produced in a concrete foam generator with compressed air
Shape	spherical	Spherical	helical	Longitudinal	hollow- shaped

V. MIX PROPORTIONS

S.No	Materials	Sample – 1 Conventional	Sample – 2 Natural Fiber	Sample – 3 Plastic Fiber
1	Cement	250kgs	250kgs	250kgs
2	Fly Ash	500kgs	500kgs	500kgs
3	Water	200liters	200liters	200liters
4	Foam+ Water	1.2kg+30liters	1.2kg+30liters	1.2kg+30liters
5	Fiber	-	2kgs	2kgs

VI. Specimen preparation & Testing

For manufacturing 1 Cum of CLC bricks approximately 5 bags of OPC 53 Grade Cement and 500 kgs of Fly ash is added into a mixer. Around 1.2 kgs of Foaming agent diluted with 30 ltrs of water is added and mixed thoroughly. Foaming agent allows airs to entrain the mixture making the slurry light weighted. One litre of slurry is collected from the mixer and weighed for density. If the required density is achieved, then the slurry is drained into troly. The slurry is then poured into assembled moulds of bricks of required dimension and is allowed to set for 18 to 24 hours. Finished CLC bricks are taken to the curing area and are allowed to cure for 28 days. Good curing gives strength and dimensional stability to bricks. Steam curing is also used in some cases to reduce the curing period. This is suitable for higher production rates. Steam curing requires less labor, less production cost and better finish. The oiled mould is placed on clean surface preferably in shade avoiding direct sunlight. The prepared foam is then poured slowly in the mould and at the same time the mould is shaken so that the material reaches in every corner of the mould. The mould is filled completely and the extra material top surface is striped out and made plain. The mould is then kept for 24 hours for setting of material. In between pours, the mixer should be kept in motion until it is completely discharged. CLC always should be poured in the shortest possible time. Use aluminum or other straight and sharp-edged screed slats immediately after pouring the CLC. The brick should be positioned upwards on the curing yard, resting on a soft underground - best on a rake or wooden beams. All possible efforts should be taken, in particular in dry and hot climate or more even when windy, to keep the brick damp for at least three, better for more days. It should be preferably kept in shade and in damp condition as the dry condition would absorb the moisture from the brick reducing its strength. A sprinkler will be helpful or gunny bag that is kept wet. Curing compound would be the costly alternative. Standards call for a 24 day curing period for cement- based bricks. Due to reduced weight, more volume of CLC more bricks can be transported at the same (increased pay-load) then of CC. Brick should be kept upright during transport and also on a soft/wooden underground. Unload properly. The average compressive strength test was conducted at age of 28 days for each test.

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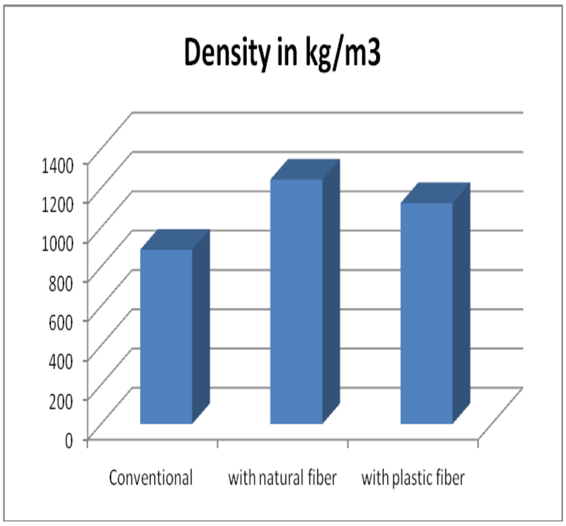
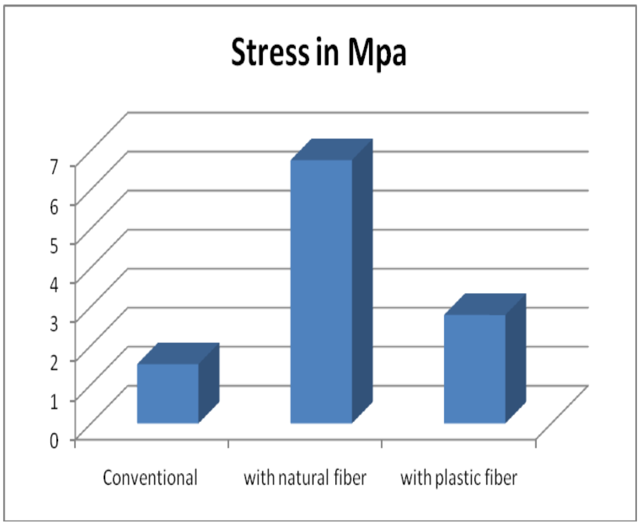
V .RESULT & DISCUSSION

The deliberations above conclusively establish, that air cured fly-ash based Cellular light- weight concrete to be a far superior alternative to factory made aerated concrete or manmade light-weight aggregate blocks. This CLC is even a better alternative to ordinary clay bricks for walling masonry. The long term stability at low temperatures and potential corrosive effects on cellular light weight concrete must be completely understood. The influence of admixtures and aggregates on strength of CLC is of particular interest and is currently being investigated. Moreover, CLC has other diverse applications and properties, some of which cannot be offered by the conventional alternatives Above all, it is an environment friendly and energy efficient material, which is the need of the day. It is therefore, no surprise that more and more builders are progressively opting for this material in their constructions. The following observations and conclusion drawn.

Property	Sample – 1 Conventional	Sample – 2 Natural Fiber	Sample – 3 Plastic Fiber
Density W/V	887.172kg/m3	1244.101kg/m3	1123.981kg/m3
Stress	1.52MPa	6.75MPa	2.78MPa





From the observation, CLC bricks with plastic fiber have 27% more density and 83% more stress carrying capacity than the conventional CLC bricks. CLC bricks with natural fiber have 40% more density and 344% more stress carrying capacity than the conventional CLC bricks. CLC bricks with natural fiber have 10.7% more density and 143% more stress carrying capacity than the CLC bricks with plastic fiber. Final conclusion is CLC bricks with plastic fiber better than conventional CLC bricks and CLC bricks with natural fiber better than both conventional and plastic fiber CLC bricks.

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