EXPERIMENTAL INVESTIGATION ON FULLY REPLACEMENT OF FLY ASH BY M-SAND SLURRY IN LIGHT WEIGHT BRICK

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***Abstract*: M-sand slurry is a raw material which has to be wasted during manufacturing process of m-sand. In our project, the dust powder such a slurry can mixed up with cement, water and with foaming chemical agent to form light weight cement brick. Foaming chemical is an important in this brick for reducing weight and make that light weight when compared to normal brick, m-sand slurry material have more finess and it produced as 40% from m-sand production .As a result this brick has to be produced better compressive strength of about 4N/mm^2. Therefore, this project is more ecofriendly and decrease the pollution caused by dust material during manufacturing process.**

***Keywords*: Cement, M-sand slurry, water, foaming chemical.**

1. INTRODUCTION

1.1 General

M sand slurry is the by product produced during the production of coarse Aggregate. About 40% of slurry is wasted during the production of M-sand in quarries over which 60% has M-sand materials. The potential function of waste slurry for producing a low cost and light weight composite brick can easily available in quarries. Slurry have been reported. To be cheap alternative building material. To have good sound absorption and thermal insulation to be light weighted and fire resistant material.

1.1.1 Project viewpoint
The purpose of present research is to utilize the waste materials like slurry and to replace the costly and rare conventional building brick which satisfies the following characteristics:

- Required
- Environmental friendly
- Less weight
- Inflammable
- Easily available

1.1.2 Accumulation of material
Material collection is the basic and important step in any project. Also, the material which is used in a project should not cause any damage to the environment. In this research, waste materials were used to make building bricks.

1.2 Cement
This standard was first published in 1976 under the title, 'Specification for high strength ordinary Portland cement' and subsequently revised in 1989 and rechristened as 'Specification for 43 grade ordinary Portland cement'. This revision incorporates the experience gained with the use of this specification and brings the stand and in line with the latest developments in this field .Since the first revision of this standard, a large number of amendments were issued from time-to-time in order to modify various requirements based on experience gained with the use of the standard and the requirements of the users, and also keeping in view the raw materials available in the country and found suitable for the manufacture of cement. The important amendments included. use of performance improvers for addition during clinker grindings tag, incorporation of requirement of chloride content for the cement used in structures other than press tress and concrete, permitting use of 25 kg, 10 kg, 5 kg, 2 kg and 1 kg bags for packing of cement, and requirement of packing cement for export. In view of the large number of amendments, the Sectional Committee decided to bring out this second revision of the standard incorporating all these amendments so as to make it more convenient for the users.
Further, following are the other significant modifications incorporated in this revision:
a) Requirement for insoluble residue has been specified as 5.0 percent, maximum irrespective of addition of performance improver(s) or otherwise.
b) An upper limit of compressive strength at 28 days, equal to the minimum requirement plus 15 MPa, has been incorporated.
c) SO3content requirement has been revised to 3.5 percent maximum irrespective of C3 A content, primarily to accommodate use of coal/pet coke as fuel which may have higher sculpture content; subject to the cement conforming to all the requirements of the standard.

d) A clause has been introduced requiring manufacturer to furnish the certificate indicating alkali content if required by the purchaser.
e) Requirement of marking of type and amount of performance improver(s) on the bag has been incorporated.
f) Requirement of testing the cement samples at the earliest but not later than 3 months since the receipt of samples for testing has been included. With the increase in SO3 content limit in this revision, suitable caution needs to be exercised for limiting the sulphates in concrete in accordance with the provision of IS 456 : 2000 'Code of practice for plain and reinforced concrete
For the process of making the compressed stabilized earth blocks the cement as a one of the soil stabilizing agent. The Ordinary Portland cement of 43 grade .It can collect from the market in the Perambalur district. Cement may be prescribed as a material with adhesive and cohesive properties which make it capable of bonding mineral fragments into a compact whole. The definition embraces a large variety of cementing materials.

1.3 M-sand slurry

Getting good M-sand slurry free from organic impurities and salts is very difficult in now a day. While adding the M-sand slurry to the mix and the M-sand slurry should be in uniform size i.e., all the M-sand slurry particles should be fine. The M-sand slurry obtained from local resource was used in concrete to cast test bricks.

1.4 Water

Water is an important ingredient of foaming agent as it is involved in the chemical reaction with cement. Potable water should be used for both soaking and mixing of foaming agent. It should be free organic matter and the PH value should be between 6 and 7.

1.5 Eco – friendly

Phenomenal growth in the construction industry depends upon the electable resources of the country. Production of building materials lead to irreversible Environmental impacts. Using eco-friendly materials is the best way to build an eco-friendly building. Eco-friendly, describes a product that has been designed to do the least possible damage to the environment.

In order to achieve the above mentioned, objective study work has been divided into three main parts:
1. Accumulation of material
2. Experimental procedure
3. Results and discussions

1.6 Scope of the study

The review of literature indicates that the building brick enhances its various mechanical properties, dimensional stability and structural integrity. The review also indicates that the addition of paper mill residuals, namely waste paper sludge ash give the desirable strength and durability of brick significantly. In most of these studies, the industrial and natural waste like fly-ash, rice husk-ash, boron waste, blast furnace slag, wood sawdust and limestone dust on the strength and other properties like durability, workability, energy absorption capacity etc. on the concrete blocks above are focused. An attempt has been made in the present investigation to conduct an experimental setup to study the strength and other engineering properties like durability, energy absorption capacity and ductility of fly ash based on slurry building bricks.

2. LITERATURE REVIEW

2.1 General

Masonry is an assemblage of masonry units and mortar. Its properties and behaviour are controlled by the characteristics of masonry units, mortar as well as the bond between them. For the same type of bricks using same proportions of cement and fine aggregate, the strength obtained may be different due to the variation in quality of water, difference in workmanship and on the arrangement of bricks in masonry. Many earthquake damage reports pointed out the devastating damage to masonry buildings including the recent earthquakes. Due to many natural disasters like earthquakes, most rural houses lacking in the proper building structure were damaged in brittle collapse.

Nevertheless, Paulo et al [2006]118 discussed that the brick masonry is the least understood in the aspect of strength and other performance related parameters because of its complex behaviour and its non-homogeneity even in scale measurement. In India about 100 million tons of fly ash is generated each year. The Indian government passed a law in October 2005 stating that a minimum of 25 percent of fly ash must be used in the manufacture of clay bricks for use in construction activities within a 50 km radius of coal burning thermal power plants. There are also restrictions on the excavation of top soil for the manufacture of clay bricks. Consequently, the need for the research in material behaviour of brick masonry in India became evident. The study of previous research work is essential in identifying the problem to be investigated and to detect the research gap in the specified field of study The earlier research works were classified into two different categories: first being the study of physical and mechanical properties of brick masonry and its assemblages; second the effect of in-plane shear behaviour of the masonry wall elements and the wall capacity for un-reinforced and reinforced brick masonry elements with analysis.

Sarangapani et al [2002]125 compared the characterization and properties of local low modulus bricks, table moulded bricks and wire cut bricks, mortars and masonry. Leaner mortars such as 1:6:9 cement – soil mortar showed very ductile behaviour which was indicated as the stress strain curve becoming horizontal after reaching a peak strain value. This indicated that the 9 presence of a significant amount of soil gave rise to ductility with low strength mortars. Stress strain characteristics of masonry were examined through prism tests. The modulus of elasticity of brick masonry was found as 265MPa. Simple analysis was carried out to understand the nature of stresses developed in the mortar joint and brick in the masonry. The results revealed that the bricks made around Bangalore had low module compared to the cement mortar. This led the masonry where mortar joints developed lateral tension while brick developed lateral compression.

Deodhar and Patel et al [1997]28 presented that under compression; mortar deformed more than brick and expanded laterally causing failure of masonry. With the strength of brick and mortar, the compressive strength of brick masonry was evaluated with the constants given. It was found that rich mortar does not improved the strength of masonry but for low strength bricks a mortar ratio 1:4 or 1:5 gave considerably high strength.

Choubey et al [1993]18 had done the experiment with brick masonry specimens for flexural tensile strength. The effect of various parameters such as suction rate, type of sand, mortar grade, joint thickness and slenderness ratio on flexural tensile strength of brick masonry were investigated. In the first two minutes, decrease in suction rate was very fast and it became almost constant after an immersion time of five minutes. Maximum strength was obtained by immersion of bricks in water for ten minutes before use which influenced the flexural tensile strength. The behaviour was almost similar for all panel specimens irrespective of the type of mortar (1:3, 1:4.5, and 1:6) and size of panel. But the specimens made of richer mortar mixes showed lesser deflections.

Deodhar and Patelet al [1996]27 discussed the strength of brick masonry with respect to the strength of the brick and strength of the mortar. Frog in bonding the brick work, shape and size of frog affect the strength of brick masonry. The mortar joint of size 5mm to 10mm gave the maximum strength. The ratio of cement to sand ratio of 1:6 gave reasonably high compressive strength of brick masonry. For mortars richer than 1:6 ratios, though the increase in strength is considerable, the adhesion of cementing materials is very high compared to the benefit of increase in the crushing strength.

Deodhar and Patelet al [1995]29 obtained a mathematical model to
ascertain compressive strength of brick masonry with that of brick known. The crushing strength of brick prism reduced with the 10 increase of the cement to sand ratio. A mathematical model in the form of straight line was setup to relate brick strength to brick masonry prism strength as, compressive strength of
bricks in N/mm2 and r – sum of ratio of mortar mix. Cement to sand ratio of 1:6 was most feasible for mortars in brick masonry. However, the use of 1: 8 cement–sand ratios also recommended in framed structure where masonry works as a filler material.

Dayal et al [1995]24 described that the fly ash has good shear strength properties and relatively less compressibility. He suggested the usage of fly ash in various modes. With respect to the fly ash bricks, there are two types of bricks which are manufactured from fly ash. The use of fly ash offered a considerable saving of coal consumption which had been found to vary in the range of 3t – 7t of grade I coal per 105 bricks. The percentage of fly ash mixed varied from 10% to 80% and tested for their suitability and 40% by weight of local silt soil found as the optimum percentage of fly ash.

Krishnamoorthy et al [1994]78 investigated the quantum of fly ash added to soil for making good bricks. Fly ash obtained from Vijayawada thermal power station was mixed with the soil in varying ratios such as 0%, 10%, 20%, 30%, 40% and 50% described that the bricks cannot be manufactured with highly swelling soils without additives. The properties of strength and water absorption of bricks made with replacement of soil by 50% of fly ash were reasonably good and the strengths were ranging from 9.8 to 11.5 N/mm2 but for the country brick, it was about 3.5N/mm2 and no marked improvement was there with more addition of fly ash. Mei-In Chou and Fu Chou [2006] 93 reported that the paving bricks with 20 % volume of fly ash and building bricks with up to 40% of fly ash were successfully produced in commercial scale production test. All the final products met the brick plant‘s in-house specifications for marketability and far exceeded the ASTM commercial specifications for the severe weather grade. The results showed that the bricks with the fly ash were introduced into the commercial production without acquiring additional machinery, while concurrently reducing plant operation costs. They also suggested that, similar to the regular commercial bricks, the fly ash containing bricks were environmentally safe construction products that can be used for the construction.

TayfunCicek and Mehmet Tanriverdiet al [2007] 131 experimented the fly ash–sand–lime bricks and obtained the compressive strength, unit weight, water absorption and thermal conductivity under optimum test conditions as 10.25 MPa, 1.14 g/cm3 , 40.5% and 0.34W m-1 K -1 respectively. They suggested that it was possible to produce good quality of light weight bricks from the fly ash of Seyitomer power plant, Turkey. The unit volume weight of the fly ash bricks prepared with quartz sand addition was 1.15 g/cm3, whereas the unit volume weight of the bricks with river sand addition was 1.27 g/cm3. Thus, the unit volume weights of the fly ash bricks were much lower than that of the traditional clay bricks. The water absorption of the fly ash–sand–lime bricks ranged from 30% to 40%. The thermal conductivity of the fly ash–sand–lime bricks was found to be 0.34–0.36 W m-1 K -1 which was lower than that of the traditional clay bricks. The fly ash–sand–lime bricks produced were suitable for use as construction material.

MariarosaRaimondo et al [2009]89 considered the capillarity phenomenon and the suction capacity of brick depends on their micro-structural characteristics, amount, size and shape of pores. Besides some exceptions, the linear relationships between the capillary coefficient Ks and these micro-structural variables substantially confirm the role played by open porosity in increasing the absorption capacities of clay bricks. The capillary coefficient Ks, together with the micro-structural variables and phase composition, finally underwent a statistical procedure that confirmed the influence of porosity, as well as coarser pore dimension (in terms of both radius and percentage of pores greater than 3μm) in increasing the liquid adsorbing rate with the highest statistical significance. In addition, the sintering pattern of products, leading to a different amorphous/crystalline phase ratio, proved to be relevant on the definition of the most suitable microstructure: the higher porosity, promoted by the complete CaCO3 decomposition and the smaller pore size, connected with the low sintering degree of clay bricks.

3. MATERIALS

3.1 Material collection

For the process of making the compressed stabilized earth blocks we are in need of the following materials.

3.1.1 Cement

For the process of making the compressed development of cement bricks the major material of cement collection of the three types of waste material. These are briefly explained as follows: For the process of making the compressed stabilized earth blocks the cement as a one of the soil stabilizing agent. The Ordinary Portland cement of 43 grade and it can collect from the market of the Perambalur district. Ordinary Portland cement is an intimately underground mixture of Portland clinker. The Cement may be prescribed as a material with adhesive and cohesive properties which make it capable of bonding mineral fragments into a compact whole. The definition embraces a large variety of cementing materials.

3.1.2 M-sand slurry waste material

When the production ofM-sand as a raw material from the crushing of stone then the slurry retained during this process. Due to this process,there are 100%of stone material are pulverized where only 60% m-sand is produced.Therefore remaining 40% of waste in slurry produce and it will be used this experimental project.

3.1.3 Water

For the process of making the compressed stabilized earth blocks the water as a one of the soil and cement (or) lime mixing agent. The normal water can collect from the campus of our college.

3.1.4 FOAM CHEMICAL

Foam concrete is a type of porous concrete. According to its features and uses it is similar to aerated concrete.

The synonyms are:

1) Aerated concrete
2) Lightweight concrete
3) Porous concrete

Light weight concrete - or foamed concrete - is a versatile material which consists primarily of a cement based mortar mixed with at least 20% of volume air. It possesses high flow ability, low self-weight, minimal consumption of aggregate, controlled low strength and excellent thermal insulation properties. It can have a range of dry densities, typically from 400 kg/m3 to 1600 kg/m3 and a range of compressive strengths, 1 MPa to 15 MPa .

4. MATERIALS TESTING

4.1 Basic test for cement

In compressed on cement brick production process the Ordinary Portland cement 43 grade is to be used as waste material. The general properties of the cement can find out by using the concrete engineering laboratory equipment's. The various test on cement as briefly explained as follows:

4.1.1 Specific gravity of cement

In a civil engineering field each and every material having the specific gravity value. It may be find out by using the pycnometer method. The specific gravity value of the cement is to be tabulated as follows:

Table no: 4.1.1 Specific gravity test result

Determination	Reading
Mass of pycnometer (m_1) , g	632
Mass of pycnometer + cement (m_2) , g	832
Mass of pycnometer + cement + kerosene (m_3) , g	1743.6
Mass of pycnometer + kerosene (m_4) , g	1607
Specific Gravity	3.154

The specific gravity of the cement is to be find out by using the following relation

$$G = (m_2 - m_1) / ((m_2 - m_1) - (m_3 - m_4))$$

4.1.2 Fineness test on cement

In a civil engineering field each and every material having the fineness value. It may be find out by using the sieve method. The fineness value of the cement is to be tabulated as follows

Table no: 4.1.2 Fineness test on cement result

Determination	Reading
Mass of taken sample of cement (m_1) , g	100
Mass of cement retained on 90 micron sieve after 15 seconds (m_2) , g	5
Fines of cement	5%

The fineness of the cement is to be find out by using the following relation

$$\text{Fines of cement} = (m_2/m_1) \times 100$$

4.1.3 Initial setting time of cement

Table no: 4.1.3 Initial setting time of cement

SI.no	Time (min)	Reading on the pointer
1	0	0
2	5	2

3	10	3
4	15	4
5	20	5
6	25	6
7	30	7

Result: Initial setting time of cement = 30 minuets

4.1.4 Consistency limit of cement

This test is conducted to determine the percentage of water required for preparing cement pates of standard consistency for setting time test. The consistency test of the cement is to be finding out by using the vicat's apparatus the result as follows:

Table no: 4.1.4 Consistency limit of cement

SI.no	Weight of cement (g)	Water (%)	Water (ml)	Reading on the pointer
1	400	24	96	43
2	400	25	100	40
3	400	26	104	39
4	400	27	108	36
5	400	28	112	34
6	400	29	116	26
7	400	30	120	21
8	400	31	124	18
9	400	32	128	10
10	400	33	132	6

Therefore the normal consistency of the Ordinary Portland Cement as 43%

4.2 Basic test of water

It is the most important and least expensive ingredient of construction materials. A part of the mixing water is utilized in the hydration of cement to from bending matrix in which the inert materials are held in suspension until the matrix hardened. The quantity of water is used should be just sufficient for hydration and suitable workability of concrete.. The presence of calcium chloride in water accelerates setting and hardening of cement. The quantity of calcium chloride is restricted to 1.5% by weight of cement.

4.2.1 Ph value of water

Ph value is the important parameter of the water. That is the value can be determined by using Ph meter of the environmental engineering laboratory.. Here the Ph value below 7 means that is acidic, the Ph value of the liquid exactly 7 means that is neutral and the Ph value above 7 means the liquid is alkalinity. As per WHOM the acceptable range as 6.5 to 7.5. We are testing the Ph value of the samples are tabulated as follows:

Table no: 4.2.1 PH value of water

Samples	Ph value
Sample 1	6.95
Sample 2	7.06
Sample 3	7.02
Average	7.01

5. MIX PROPOTION

5.1 MIX PROPORTION 1 :

cement:

= (21.67/100)x1 =O.212m3

= 0.212X1440 =312.0 kg

quarry dust:

= (51.99/100)x1=0.52m^3

=0.52x1750 =909.8kg

water:

= (26.33/100)x1=0.263m^3

=0.263x1000 =263L

foam:

=0%

Table no: 5.1 Mix proportion 1

MIX PROPORTION 1		
Cement	312 kg/cu.m	21.67 %
Quarry dust	909.8 kg/cu.m	51.99%
Water density	263.3 l/cu.m	26.33%
Foam	0 l	0%

5.2 MIX PROPORTION 2 :

cement:

= (20.67/100) x1 =O.207m^3

= 0.207X1440 =297.0 kg

quarry dust:

= (50.99/100)x1=0.51m^3

=0.51x1750 =892.32kg

water:

= (25.33/100)x1=0.253m^3

=0.253x1000 =253.32L

foam:

= (3/100) x1=0.03M^3

Table no: 5.2 Mix proportion 2

MIX PROPORTION 2		
Cement	297 kg/cu.m	20.67%
Quarry dust	892.32 kg/cu.m	50.99%
Water	253.32 L/cu.m	25.33%
Foam	1 l	3%
Foam water	30 l	

5.3 MIX PROPORTION 3:

cement:

= (20.5/100)x1 =O.205m^3

=0.205X1440 =295.2 kg

quarry dust:

= (50.82/100)x1=0.51m^3

=0.51x1750 =889.35kg

water:

= (25.16/100)x1=0.252m^3

=0.252x1000 =251.6L

foam:

= (3.5/100)x1=0.035M^3

Table no: 5.3 Mix proportion 3

MIX PROPORTION 3		
Cement	295.2 kg/cu.m	20.5%
Quarry dust	889.35 kg/cu.m	50.82%
Water	251.6 L/cu.m	25.16%
Foam	1.1 l	3.5%
Foam water	30 l	

5.4 MIX PROPORTION 4:

cement:

= (20.33/100) x1 =O.203m^3

=0.203X1440 =292.75 kg

quarry dust:

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= (50.65/100)x1=0.506m^3
=0.506x1750 =886.37kg
water:
= (24.99/100)x1=0.25m^3
=0.25x1000 =250 L
foam:
= (4/100)x1=0.04m^3

Table no: 5.4 Mix proportion 4

MIX PROPORTION 4		
Cement	292.75 kg/cu.m	20.33%
Quarry dust	886.37 kg/cu.m	50.65%
Water	250 L/cu.m	24.99%
Foam	1.2 l	4%
Foam water	33 l	

6. RESULT& DISCUSSION

6.1 Compressive strength test on bricks

This test is done to know the compressive strength of bricks. It is also called crushing strength of brick. Generally 5 specimens of bricks are taken to laboratory for testing and tested one by one for every 7,14,28 days. In this test a brick specimen is put on universal testing machine and applied pressure till it breaks. The ultimate pressure at which brick is crushed is taken into account. All brick specimens are tested one by one and average result is taken as brick's compressive strength.The compressive strength of compressed testing on cement bricks. (i.e. the amount of pressure they can resist without collapsing). Maximum strengths (described in MN/m2) are obtained by proper mixing of suitable materials and proper compacting and curing. In practice, typical wet compressive strengths for cement bricks. Units and load bearing fired clay bricks, and of5.2N/m2 for bricks. Where building loads are smal (e.g. in the case of single story constructions), a compressive strength of 1-4MN/m2 may be sufficient. Many building authorities around the world recommend values within this range. The test results are to be tabulated as follows:

Fig. No.6.0 compression testing on brick

Table no: 6.1 Compressive strength of bricks

7 th day test :

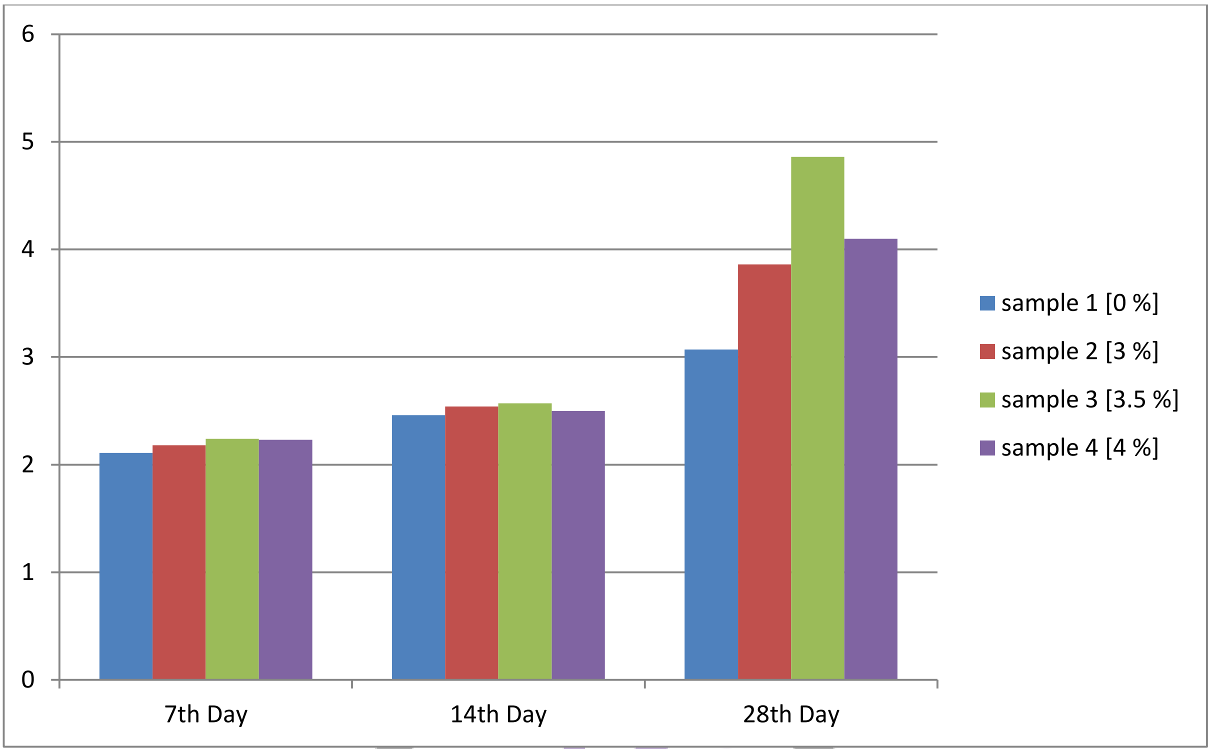
Mix proportion Of foam	Compressive loading (KN)			Average compressive load (P) KN	Compressive stress (N/mm2)
	Sample1	Sample 2	Sample 3		
0%	50	50.5	49.5	50	2.11
3%	52.1	52.2	50	51.4	2.18
3.5%	52.8	53	53	52.9	2.24
4%	52.7	52.8	52.7	52.7	2.23

14 th day test :

Mix proportion Of foam	Compressive loading (KN)			Average compressive load (P) KN	Compressive stress (N/mm2)
	Sample 1	Sample 2	Sample 3		
0%	58	58.5	58.2	58.23	2.46
3%	60.1	60.2	60	61.1	2.54
3.5%	60.5	61	60.8	60.77	2.57
4%	60	60.3	60.1	60.3	2.54

28 th day test :

Mix proportion Of foam	Compressive loading (KN)			Average compressive load (P) KN	Compressive stress (N/mm2)
	Sample 1	Sample 2	Sample 3		
0%	72	78	68	72.67	3.07
3%	89	95	90	91.33	3.86
3.5%	115	105	125	115	4.86
4%	94	100	95	95.33	4.1



Figures: 6.1 Graph for compressive strength in 7,14 and 28 days test on cement bricks

6.2 Water absorption test on bricks

In this test blocks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion those are taken out from water and wipe out with cloth. Then bricks is weighed in wet condition. The difference between weights is the water absorbed by brick. The percentage of water absorption is then calculated. The less water absorbed by brick the greater its quality. Good quality brick doesn't absorb more than 20% water of its own weight.

Table no: 6.2 Water absorption test on bricks

Sl.no	% of concrete foam	Dry weight of bricks	Wet weight of bricks	Percentage of water absorption (%)
1.	0%	3.6	3.9	10.8
2.	3%	3.4	3.6	10.6
3.	3.5%	3.3	3.6	10.9
4.	4%	3.2	3.4	10.6

Water absorption test on bricks

6.3 Efflorescence test

The presence of alkalis in bricks is harmful and they form a gray or white layer on brick surface by absorbing moisture. To find out the presence of alkalis in bricks this test is performed. In this test a brick is immersed in fresh water for 24 hours and then it's taken out from water and allowed to dry in shade. If the whitish layer is not visible on surface it proofs that absence of alkalis in block. If the whitish layer visible about 10% of brick surface then the presence of alkalis is inacceptable range. If that is about 50% of surface then it is moderate. If the alkalis' presence is over 50% then the brick is severely affected by alkalis.

Fig no.6.3 Efflorescence test

6.4 Hardness test on bricks

In this test a scratch is made on brick surface with a hard thing. If that doesn't left any impression on bricks then that is good quality.

Table no: 6.4 Hardness test on bricks

Sl.no	Type of bricks	Hardness
1	7 days	Low
2	14days	Moderate
3	28days	High

6.5 Size, shape & colour test on bricks

In this test randomly collected 40 bricks are staked along lengthwise, width wise and height wise and then those are measured to know the variation of sizes as per standard. Bricks are closely viewed to check if its edges are sharp and straight and uniform in shape. A good quality brick should have bright and uniform colour throughout.

Table no. 6.5 Size, shape &colour test on bricks

Sl.no	Test of bricks	Size (cm)	Shape	Colour
1	7days	23×11×8	Rectangular	Bright
2	14days	23×11×8	Rectangular	Bright
3	28days	23x11x8	Rectangular	Bright

6.6 Soundness test on bricks

In this test two bricks are held by both hands and struck with one another. If the bricks give clear metallic ringing sound and don't break then those are good quality bricks.

Table no: 6.6 Soundness test on bricks

Sl.no	Test of bricks	Soundness
1	7days	Poor
2	14days	Moderate
3	28days	Good

6.7 Structure test on bricks

In this test a brick is broken or a broken brick is collected and closely observed. If there are any flows, cracks or holes present on that broken face then that is not good quality brick.

Table no: 6.7 Structure test on bricks

Sl.no	Test of bricks	Structure
1	7days	Holes present
2	14days	No cracks
3	28days	No cracks

6.8 Nailing test

Fibrous concrete bricks are less hard as compared to conventional clay bricks. Therefore, this test was performed to find out whether these bricks can hold the nails or not. A nail was hammered in the brick and a screw was also screwed into the brick. From this test it was observed that fibrous bricks can sufficiently hold the nail. Also a screw worked well and holds a considerable weight.

Fig. No.6.5 Nailing test

6.9 Cutting and glue

A lot of bricks are wasted on site during the process of cutting only. The labors could not able to cut the bricks exactly what they want. But M-sand slurry bricks can be cut into exactly two parts by using conventional saw blades. Many cut bricks are wasted in now a day. But the two fibrous concrete brick pieces can be hold together by putting a medium amount of glue on the bottom piece. Hence M-sand slurry bricks could be employed in the application of calling for quick assembly by cutting the parts required to size in advance and letting the user simply glue them together.

Fig. No.6.6 Cutting and glue

6.10 Fire test

A brick, which is employed for construction should not flammable in an exposed fire, so this test was carried out for the bricks. This test was conceded out only for fibrous concrete bricks and not for adobe brick. From the above test, it was observed that the fibrous concrete bricks did not burn with an open flame. They fumed like charcoal. But these brick would be reduced to ashes after burning several hours. If the interior plaster and exterior stucco is provided on the fibrous concrete bricks, the bricks won't burn. The only weak spot is inside the block, near electrical outlets, switches and other situations where wires gives through walls, into boxes etc. Properly wired places never cause a fire. If we apply the plaster without any hole or leakage on the bricks, it won't burn or fume inside because there will be a lack of oxygen for combustion.

Fig. No.6.7Fire test

CONCLUSION

The present study, we done a comparison of compressive strength of cement bricks by using waste materials easily available in everyday life. From the results obtained, the following conclusions were made: Considering the desirable compressive strength shown by the tested specimen, it is clear that paper pulp have the ability to provide an eco friendly, light weight concrete block with the use of less number of natural resources. Though the results obtained during compression test showed that paper pulp bricks are acceptable for non-load bearing walls only. As per research the bricks should not absorb water more than 10.5%. The water absorption capacity of M-sand slurry was found to be more than 10.5%, which makes it not suitable for water logging and external walls. However, by providing a waterproof coating (Geodon or silicon based waterproofing) it can also be used as external wall. The weight of the M-sand slurry was 1/3rd to 2/5th lesser than the conventional clay brick. Due to less weight of M-sand slurry the total dead load of the building will be reduced. Due to lesser weight and more flexibility, these bricks are potentially ideal material for earth quake prone regions. It has a high fire resistance, good sound absorbent, good thermal resistance with an R value between 2 to 3 per inch. In walls 12 to 16 inches thick, the long energy having of brick will be a great advantage for the house owner and environmental. These brick does not expand nor shrinks hence, sheets of glass or glass block can be fixed. Since, M-sand slurry brick mainly consists of waste material; it will reduce the landfills and pollution. Hence, the overall cost is very low as compared to conventional brick.

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