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INVESTIGATION OF HOLLOW BLOCK BY USING COPPER SLAG AND SUGARCANE BAGASSE

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ABSTRACT

This study discusses the result of the experimental investigation of hollow block behaviors under compression. Hollow blocks are considered non-structural elements as they do not contribute to the strength of the slab. Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 10% and 15% by weight of cement in hollow blocks and 30% fine aggregate was partially replaced with copper slag. The size of the hollow block is to be 425 x 225 x 225 mm. Tests like Water absorption, the Density of the hollow block and compressive strength at 7 and 14 days were obtained. An experimental investigation was conducted to evaluate the mechanical properties of hollow block mixtures. Therefore, it is possible to use sugarcane bagasse and copper slag as cement replacement materials to improve quality and also to reduce the cost of construction materials such as mortars, and concrete interlocking blocks.

1. INTRODUCTION

1.1 GENERAL

Hollow blocks are one of the best substitutes for conventional burnt clay hollow bricks in the construction industry. Hollow blocks are light in weight and hollow, imparting thermal insulation to the buildings, Cement concrete hollow blocks have a prominent place in the modern building industry. They are cost-effective and better alternatives to burnt clay bricks under their good durability, fire resistance, partial resistance to sound, thermal insulation, small dead load, and high speed of construction. Concrete hollow blocks are usually larger than the normal clay building bricks and less mortar is required, faster construction is achieved. Cement concrete hollow blocks have a prominent place in the modern building industry.

A viable solution to the disposal problem would be the use of SCBA and municipal solid waste incineration (MSWI) bottom ash for civil engineering applications such as raw materials in producing concrete blocks, pavement blocks and kerbs. This will help to reduce disposal costs, preserve landfill capacity, conserve natural resources, and reduce environmental impacts.

1.2 ALTERNATIVE MATERIAL

Alternative materials are used to give high strength and reduce construction costs. Materials used are sugarcane bagasse ash and incineration slag. Sugarcane bagasse ash is a byproduct of sugar factories found after burning sugarcane bagasse which itself is found after the extraction of all economical sugar from sugarcane. Incineration slag consists of mineral components, metal scrap and other unburnt materials. Residue from waste incineration plants and power plants has proven its worth within the construction sector. The slag from incineration is especially significant for the protection of the environment.

1.3 BASIC TERMS

- Concrete
- Sugarcane Bagasse Ash
- Copper Slag

1.3.1 CONCRETE

Concrete is a composite material composed of coarse aggregate bonded together with a fluid cement that hardens over time. Most concrete such as Portland cement concrete or concrete made with other hydraulic cements. Concrete is a building material made from a mixture of broken stone or gravel, sand, cement, and water, which can be spread or poured into moulds and forms a stone-like on hardening.

1.3.2 SUGARCANE BAGASSE ASH

Sugarcane bagasse ash is a residue resulting from the burning of bagasse in boilers in the sugarcane industry. SCBA has an exceedingly high silica concentration and contains aluminum, iron, alkalis, and alkaline earth oxides in smaller amounts. In this work, the properties of sintered ceramic bodies were replaced with non-plastic material.

1.3.3 COPPER SLAG

Copper slag, which is the waste material produced in the extraction process of copper metal in refinery plants, has low cost, and its application as a fine aggregate in concrete production reaps many environmental benefits, such as waste recycling, and solves disposal problems.

Copper slag is a by-product of the copper ore purification process that is produced at various stages. Copper slag is widely used as an abrasive, as well as a construction ingredient in the manufacturing of concrete and paving materials.

2. LITERATURE REVIEW

2.1 EVALUATION OF CONCRETE SUGARCANE BAGASSE ASH AS REPLACEMENT FOR CEMENT IN WORKS

T. S. ABDULKADIR : This research evaluates the suitability of SCBA as a partial replacement for cement in concrete productions. A total weight of 34.7kg of sugarcane bagasse (SCB) was obtained and burnt at 7000C. A total of 2.71kg of SCBA was obtained after passing the residual through a 45um sieve, a standard size of ordinary Portland cement (OPC). A chemical test was conducted on SCBA to evaluate its percentage composition. It was then used to replace OPC by weight in ratios of 0%, 10%, 20% and 30%. A total of forty-eight pieces of 100mm concrete cubes of design mix ratio1:1.66:2.77 were prepared. The cubes were assessed at 7, 14, 21 and 28 days of curing ages for density and compressive strength. The results showed a decrease in concrete density with an increase in % replacement of SCBA. Average compressive strength of 26.8N/mm2 was obtained for control specimens at 28days (Le 0% SCBA) while 22.3, 20.1 and 17.3N/mm2 compressive strength at 28days were obtained for 10%, 20% and 30% replacement, respectively. Pozzolanic activity index (PAI) of 83.2%,75% and 64,5% were obtained. This showed that only 10% and 20% of replacement of cement by weight of SCBA satisfied ASTM- 595(1985) specification for PAL. It was concluded that SCBA is a low-weight material and 10% replacement of SCBA has the highest PAI. Also, 10% and 20% replacement of SCBA with compressive strengths of 22.3N/mm2 and 20.1N/mm2 are recommended for reinforced concrete.

2.2 EXPERIMENTAL STUDY ON THE USE OF SUGARCANE BAGASSE ASH IN CONCRETE BY PARTIALLY REPLACEMENT CEMENT:

JAYAMINKUMAR A. PATEL & Dr. D.B. RAIJIWALA : India is the second largest major sugar-producing country after Brazil. Due to that, there is an increase in bagasse as a byproduct from the sugar mill. Bagasse is the fibrous residue of sugar cane after crushing and extraction of juice. Sugar cane bagasse ash is the waste product of the combustion of bagasse for energy in sugar factories. Sugar cane bagasse ash is disposed of in landfills and is now becoming an environmental burden. In this experimental research work concrete cubes, beams, and cylinders of M25 grade were cast and assessed to examine various properties of concrete like workability, compressive strength, split tensile strength, modulus of elasticity and flexural strength. Sugar cane bagasse ash was partially replaced with cement at 2, 4,6 and 8% by weight of cement in concrete. From the results, we can conclude that the optimum amount of sugar cane bagasse ash that can be replaced with cement is 6% by weight without any admixture.

2.3 MSWI FLY ASH USED AS SUPPLEMENTARY CEMENTITIOUS MATERIAL:

MARTIN KEPERT : The appropriate utilization of Municipal Solid Waste Incineration (MSWI) residues is a worldwide studied topic over the last decades. One of the possibilities is to use MSWI ashes in concrete production, as it is done with coal combustion products. The bottom ash features the most convenient composition for this purpose, and it is available in the highest amounts among the MSWI ashes. Untreated bottom ash was used as a partial replacement of sand in concrete; strength was not negatively affected up to 10 % replacement, and the prepared concrete had sufficient durability. The longer-time behavior of concrete with bottom ash differed from the control material due to the presence of sulfates and chlorides in bottom ash.

3. OBJECTIVE

The good concrete compacted by high pressure and vibration gives substantial strength to the block. Proper curing increases the compressive strength of the blocks. Low Maintenance, Color and brilliance of masonry withstand outdoor elements. Load Bearing, strength can be specified as per the requirement. Fire Resistant Provide thermal and sound insulation. The air in the hollow of the block does not allow outside heat or cold in the house. So, it keeps the house cool in summer and warm in winter. Economical, Environment Friendly, Fly ash is used as one of the raw materials. Low insurance rates. Only semi-skilled labor is required for this type of construction. It is a faster and easier construction system when compared to the other conventional construction system. It is also found to be cost-effective and Disaster resistant.

4. METHODOLOGY

In the first step of this experimental study, concrete hollow block among the SCBA and Incineration slag dust as the alternatives for the cement and normal fine aggregates was obtained.

- Literature Review
- Study of raw materials
- Collection of raw materials
- Test on raw materials
- Manufacturing process
- Testing of hollow blocks
- Result and discussion
- Conclusion

5. STUDY OF RAW MATERIALS USED

5.1 CEMENT

Cement is a binder. Cement is used with fine aggregate to produce mortar and with coarse aggregate to produce concrete. The grade of cement used is 43. The most common cement is Ordinary Portland Cement which accounts for 80-90 per cent. Many tests were conducted for cement some of them are specific gravity, sieve, setting time etc.,

FIG. NO. 5.1 CEMENT

5.2 FINE AGGREGATE

Fine aggregate is sand from the land or the marine environment. The sand particles should also be packed to give a minimum void ratio; higher void contents lead to the requirement of more mixing water. Aggregate passing the 9.5mm sieve and entirely passing the 4.75mm sieve.

FIG. NO. 5.2 SAND

5.3 COARSE AGGREGATE

Aggregates are the most mined materials in the world. The maximum size of coarse aggregate that may be used in cement concrete hollow blocks is 6mm. However, the particle size of the coarse aggregate should not exceed the one-third thickness of the thinnest web of the hollow blocks.

FIG. NO. 5.3 COARSE AGGREGATE

5.4 SUGARCANE BAGASSE ASH

Sugarcane bagasse ash is an industrial waste which is used worldwide. Bagasse ash is a by-product from sugar industries which is burnt to generate the power required for different activities in the factory. The burning of bagasse leaves bagasse ash as waste, which has a pozzolanic property that could potentially be used as a cement replacement material.

FIG. NO. 5.4 SUGARCANE BAGASSE ASH

5.5 COPPER SLAG

Copper slag is a by-product of the copper ore purification process that is produced at various stages. Copper slag is widely used as an abrasive, as well as a construction ingredient in the manufacturing of concrete and paving materials.

FIG. NO. 5.5 COPPER SLAG

6. TESTING OF RAW MATERIALS

6.1 SPECIFIC GRAVITY

The density of an object is related to another key factor called Specific Gravity. Specific Gravity symbolized sp gr, expresses the ratio of the density of a solid or liquid to the density of water at standard temperature and pressure, although this specification is less often used. Specific Gravity is a dimensionless quantity that is, it is not expressed in units.

FIG. NO. 6.1 PYCNOMETER

6.1.1 PROCEDURE FOR SPECIFIC GRAVITY

First, weigh a clean and dry Le Chatelier Flask or Specific Gravity Bottle with a stopper(W_1). Place a sample of cement up to half of the flask and weigh it with its stopper(W_2). Add kerosene (polar liquid) to cement in the flask till it is about half full. Mix thoroughly with a glass rod to remove entrapped air. Continue stirring and add more kerosene till it is flush with the graduated mark. Dry to outside and weigh(W_3). Entrapped air may be removed by a vacuum pump, if available. Empty the flask, clean it refills it with clean kerosene flush it with the graduated mark wipe dries the outside and weigh(W_4).

6.1.2 SPECIFIC GRAVITY OF CEMENT

Weight of empty bottle (W_1) = 0.234Kg

Weight of bottle + cement (W_2) = 0.315Kg

Weight of bottle + cement + kerosene (W_3) = 0.485Kg

Weight of bottle + kerosene (W_4) = 0.430Kg

CALCULATION:

$$\text{SPECIFIC GRAVITY} = \frac{(W2-W1)}{(W2-W1)-(W3-W4)}$$

$$= \frac{(0.315-0.234)}{(0.315-0.234)-(0.485-0.430)}$$

$$= 3.11$$

6.1.3 SPECIFIC GRAVITY FOR SUGARCANE BAGASSE ASH (SCBA)

Weight of empty bottle (W_1) = 0.646Kg

Weight of bottle + SCBA (W_2) = 1.132Kg

Weight of bottle + SCBA + kerosene (W_3) = 1.59Kg

Weight of bottle + kerosene (W_4) = 1.44Kg

CALCULATION:

$$\text{SPECIFIC GRAVITY} = \frac{(W2-W1)}{(W2-W1)-(W3-W4)}$$

$$= \frac{(1.132-0.646)}{(1.132-0.646)-(1.59-1.44)}$$

$$= 2.77$$

6.1.4 PROCEDURE FOR SPECIFIC GRAVITY

Specific Gravity is defined as the ratio of Weight of Aggregate to the Weight of equal Volume of water. The specific gravity of an aggregate is a measure of strength or quality of the material. Aggregates having low specific gravity are generally weaker than those with high specific gravity. This property helps in a general identification of aggregates.

6.1.5 SPECIFIC GRAVITY OF FINE AGGREGATE (FA)

Weight of empty bottle (W_1) = 0.646Kg

Weight of bottle + F.A (W_2) = 1.137Kg

Weight of bottle + F. A+ water (W_3) = 1.776Kg

Weight of bottle + water (W_4) = 1.451Kg

CALCULATION:

$$\text{SPECIFIC GRAVITY} = \frac{(W2-W1)}{(W2-W1)-(W3-W4)}$$

$$= \frac{(1.137-0.646)}{(1.137-0.646)-(1.776-1.451)}$$

$$= 2.96$$

6.1.6 SPECIFIC GRAVITY OF COPPER SLAG (CS)

Weight of pycnometer (W_1) = 0.646

Weight of pycnometer + CS (W_2) = 1.11

Weight of pycnometer + CS+ water (W_3) = 1.71

Weight of pycnometer + water (W_4) = 1.42

CALCULATION:

$$\text{SPECIFIC GRAVITY} = \frac{(W2-W1)}{(W2-W1)-(W3-W4)}$$

$$= \frac{(1.11-0.646)}{(1.11-0.646)-(1.71-1.42)}$$

$$= 2.66$$

6.2 SIEVE ANALYSIS OF FINE AGGREGATE

Sieve analysis helps to decide the particle size distribution (also called gradation) of a granular material. The size distribution is often of critical importance to the way the material performs in use. A sieve analysis can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, soil, a wide range of manufactured powders, grain, and seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is the most common. This is done by sieving the aggregates as per IS:2386(part 1)-1963. In this, we use different sieves as standardized by the IS code and then pass aggregates through them and thus collect different-sized particles left over different sieves. The sieve sets are A set of IS sieves of sizes - 4.75mm, 2.36mm, 1.18mm, 600µm, 450µm, 300µm, 150µm, 75µm.

FIG. NO. 6.2 SIEVE ANALYSIS

Table 6.2 Sieve Analysis Of Fine Aggregate

Sieve Size	Wt. Of Soil Retained	% Wt. Soil Retained	Cumulative Reading (%)	% Finer (100-CR)
4.75	0	0	0	100
2.36	0.018	1.8	3.7	96.3
1.18	0.153	1.53	5.5	94.5
600	0.264	2.64	31.9	68.1
450	0.138	1.38	45.7	54.3
300	0.63	1.63	62	38
150	0.083	8.3	70.3	29.7
75	0.270	2.7	97.3	2.7
PAN	0.027	27	0	0

6.3 AGGREGATE IMPACT TEST

The aggregate impact value is a measure of resistance to sudden impact or shock, which may differ from its resistance to gradually applied compressive load. The test is done to decide the aggregate impact value of coarse aggregates as per IS:2386 (part IV) -1963. For deciding the aggregate impact value of a coarse aggregate the apparatus used is sieves of sizes 12.5mm, 10mm, and 2.36mm. A cylindrical metal measure of 75mm in diameter and 50mm in height. A Tampering rod of 10mm circular cross-section and 230mm length, rounded at one end.

FIG. NO. 6.3 AGGREGATE IMPACT TEST

Table 6.3 Aggregate Impact Value

Wt. Of Sample A (gm)	Wt. Of Sample Passed 2.36mm Sieve. B (gm)	Wt. Of Sample Retained 2.36mm Sieve. C (gm)	Impact Value (%)	Type Of Aggregate
342	48	294	14.04	Fair
352	46	306	13.07	Fair
341	30	311	8.8	Good

CALCULATION:

IMPACT VALUE $= \frac{(S1+S2+S3)}{3}$

$= \frac{(14.04+13.07+8.8)}{3}$

$=$ 11.97%

TYPE OF AGGREGATE = GOOD

7. MANUFACTURING PROCESS

The process of manufacturing of cement concrete hollow block involves the following steps.

- Proportioning
- Mixing
- Compacting
- Curing
- Drying

7.1 PROPORTIONING

The process of relative proportions of cement, sand, coarse aggregate, and water, to obtain a concrete of desired quality is known as the proportioning of concrete. The proportions of coarse aggregate, cement and water should be such that the resulting concrete has the following properties:

When concrete is fresh, it should have enough workability so that it can be placed in the formwork economically. The concrete must process maximum density or in other words, it should be strongest and most watertight. The cost of materials and labour needed to form concrete should be minimum.

As per Indian Standard specifications, the combined aggregate content in the concrete mix used for making hollow blocks should not be more than 6 parts to 1 part by volume of Portland cement. Cement ratio is taken in terms of weight basis this may average at 1:7 (cement: aggregate). However, there have been instances of employing a lean mix of as high as 1:9 by manufacturers where hollow blocks is compacted by power-operated vibrating machines. The water-cement ratio of 0.62 by weight basis can be used for concrete hollow blocks.

FIG. NO. 7.1 MOULD

7.2 MIXING

The aim of the thorough mixing of aggregates, cement and water is to ensure that the cement-water paste completely covers the surface of the aggregates. All the raw materials including water are collected in a concrete mixer, which is rotated for about 1 ½ minutes. The prepared mix is discharged from the mixer and consumed within 30 minutes. Mixing concrete is simply defined as the complete blending of the materials which are needed to produce a homogeneous concrete. This can vary from hand to machine mixing, with machine mixing being the most common. A concrete mixer is a device that homogeneously combines cement, aggregates such as sand or gravel, and water to form concrete. A typical concrete mixer uses a revolving drum to mix the components. An alternative to a machine is mixing concrete by hand. For smaller volume works portable concrete mixers are often used so that the concrete can be made at the construction site, giving the workers ample time to use the concrete before it hardens. An alternative to a machine is mixing concrete by hand. This is usually done in a wheelbarrow. However, several companies have recently begun to sell modified container for this purpose. Many components of mixing need to be considered to ensure that a uniform concrete mixture can be achieved. Location, shape and angle of the mixing blades, shapes of the mixing chamber, speed of rotation, and horsepower must all be considered. It is paramount that each batch is consistently mixed to design specifications, so the concrete's final strength is not compromised.

7.3 COMPACTING

The purpose of compacting is to fill all air pockets with concrete without movement of free water through the concrete. Excessive compaction would result in formation of water pockets or layers with higher water content and poor quality of the product. Semi-automatic vibrating table type machines are widely used for making cement concrete hollow blocks. The machine consists of an automatic vibrating unit, a lever operated up and down metallic mould box and a stripper head contained in a framework.

FIG. NO. 7.2 CASTING

Wooden pallet is kept on the vibrating platform of the machine. The mould box is lowered on to the pallet. Concrete mix is poured into the mould and evenly levelled. The motorized vibrating causes the concrete to settle down the mould by approximately 1 ½ to 1% inches. More of concrete is then raked across the mould level. The stripper head is placed over the mould to bear on the levelled material. Vibration causes the concrete to come down to its limit position. Then the mould box is lifted by the lever. The moulded hollow blocks resting on the pallet is removed and a new pallet is placed, and the process repeated. The machine can accommodate interchangeable mould for producing blocks of different sizes of hollow or solid blocks.

7.4 CURING

Hollow blocks removed from the mould are protected until they are sufficiently hardened to permit handling without damage. This may take about 24 hours in a shelter away from sun and winds. The hollow blocks thus hardened are cured in a curing yard to permit complete moisturisation for at least 21 days. When the hollow blocks are cured by immersing them in a water tank, water should be changed at least every 4 days. The greatest strength benefits occur during the first three days and valuable effects are secured up to 10 or 14 days. The longer the curing time permitted the better the product.

7.5 DRYING

Concrete shrinks slightly with a loss of moisture. It is therefore essential that after curing is over, the blocks should be allowed to dry out gradually in the shade so that the first drying shrinkage of the blocks is completed before they are used in the construction work. Hollow blocks are stacked with their cavities horizontal to ease thorough passage of air. A period of 7 to 14 days of drying will bring the blocks to the desired degree of dryness to complete their first shrinkage. After this, the blocks are ready for use in construction work.

FIG. NO. 7.5 DRYING

8. TESTING OF HOLLOW BLOCKS

8.1 WATER ABSORPTION

Water absorption test is used to decide the moisture content of the soil as a percentage of its dry weight. The sample is weighed, dried outside using sun heat, and then reweighed under standard conditions. The amount of water absorbed by a material under specified test conditions is commonly expressed as a weight per cent of the test specimen. This test is a rapid procedure for field deciding the percentage of free or surface moisture in both fine and coarse aggregate, and for deciding the percentage of water absorption for a coarse aggregate of less than saturated surface dry condition.

CALCULATION:

Wet mass of hollow block, A = 12kg

Dry mass of hollow block, B = 10kg

Absorption percent $= \frac{(A-B)}{B} X\ 100$

$= \frac{(12-10)}{10}$ X 100

= 20%

8.2 BLOCK DENSITY

8.2.1 Block Density @ 7 Days Test On Hollow Block

Table 8.2.1 0% OF SCBA & Copper Slag

S. No	Wt. of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	9.64	0.008	1205
2	9.12	0.008	1140
3	10.43	0.008	1304

Table 8.2.2 5% OF SCBA & 30 % Of Copper Slag

S. No	Wt. Of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	12.03	0.008	1504
2	10.5	0.008	1313
3	11.67	0.008	1460

Table 8.2.3 10% OF SCBA & 30 % OF Copper Slag

S. No	Wt. Of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	11.3	0.008	1413
2	10.61	0.008	1326
3	10.36	0.008	1295

Table 8.2.4 15% OF SCBA & 30 % OF Copper Slag

S. No	Wt. Of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	11.2	0.008	1400
2	12.2	0.008	1525
3	9.81	0.008	1226

8.2.2 Block Density @ 14 Days Test On Hollow Block

Table 8.2.5 0% OF SCBA & Copper Slag

S. No	Wt. Of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	9.32	0.008	1165
2	10.3	0.008	1288
3	9.55	0.008	1194

Table 8.2.6 5% OF SCBA & 30% Copper Slag

S. No	Wt. Of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	12.5	0.008	1563
2	10.25	0.008	1281
3	11.3	0.008	1413

Table 8.2.7 10% OF SCBA & 30% Copper Slag

S. No	Wt. Of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	11.3	0.008	1413
2	10.51	0.008	1314
3	10.5	0.008	1313

Table 8.2.8 15% OF SCBA & 30% Copper Slag

S. No	Wt. Of the Specimen (kg)	Volume of the Block (m^3)	Block density (kg/ m^3)
1	11.21	0.008	1401
2	12.33	0.008	1541
3	9.64	0.008	1313

8.3 COMPRESSIVE STRENGTH

Compressive strength is the ability of a material or structure to withstand loads tending to reduce the size, as opposite to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression while tensile strength resists tension. In the study of the strength of materials, tensile strength, compressive strength, and shear strength can be analysed independently. Some materials fracture at their compressive strength limit, and others deform irreversibly, so a given amount of deformation may be considered as the limit for a compressive load. Compressive strength is a key value for the design of structures. Compressive strength is often measured on a universal testing machine or compression testing machine. The maximum compressive stress that under gradually applied load a given solid material will sustain without fracture.

Compressive strength is a limited state of compressive stress that leads to failure in a material in the manner of ductile failure or brittle failure. The compressive strength of concrete is given in terms of the characteristic compressive strength on cubes or blocks evaluated at 14 days. Compressive strength is defined as the ratio of load applied on the blocks to the area of the blocks. It is expressed in terms of N/mm^2. The test requisites differ from country to country based on the design code.

8.3.1 COMPRESSION STRENGTH TEST @ 7 DAYS TEST ON HOLLOW BLOCK

TABLE 8.3.1 0% OF SCBA & 30% COPPER SLAG

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	9.64	3.63	9.07
2	9.12	355	8.87
3	10.43	370	9.25
		AVERAGE	9.0

TABLE 8.3.2 5% OF SCBA & 30% COPPER SLAG

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	12.03	313	7.82
2	10.5	261	6.62
3	11.67	329	8.22
		AVERAGE	7.55

TABLE 8.3.3 10% OF SCBA & 30% COPPER SLAG

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	11.3	347	8.67
2	10.61	370	9.25
3	10.36	345	8.62
		AVERAGE	8.86

TABLE 8.3.4 15% OF SCBA & 30% COPPER SLAG

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	11.2	206	5.15
2	12.2	227	5.67
3	9.81	198	495
		AVERAGE	5.25

By comparing it with normal concrete (7 days)

Normal Hollow block =9.06 N/mm² (100%)

5% SCBA & 30% of copper slag =7.55 N/mm²

= (7.55/9.06) x 100

= 83%

10% SCBA & 30% of copper slag =8.86

= (8.86/9.06) x 100

= 97.79%

15% SCBA & 30% of copper slag =5.25

= (5.25/9.06) x 100

= 57.94%

8.3.2 Compression Test @ 14 Days Test On Hollow Block

Table 8.3.5 0% OF SCBA & 30% Copper Slag

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	9.32	511	12.77
2	10.3	525	13.12
3	9.55	523	13.07
		AVERAGE	12.98

Table 8.3.6 5% OF SCBA & 30% Copper Slag

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	12.5	436	10.9
2	10.25	369	9.22
3	11.3	438	10.95
		AVERAGE	10.35

Table 8.3.7 10% OF SCBA & 30% Copper Slag

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	11.3	508	12.7
2	10.51	461	11.52
3	10.5	517	12.92
		AVERAGE	12.38

TABLE 8.3.8 15% OF SCBA & 30% COPPER SLAG

S. NO	Weight (Kg)	Applied Load (KN)	Compressive strength (N/mm3)
1	11.21	280	7.0
2	12.33	314	7.85
3	9.64	275	6.87
		AVERAGE	7.24

By comparing it with normal concrete (14days)

Normal Hollow block = 12.98N/mm² (100%)

5% SCBA & 30% of copper slag = 10.35 N/mm²

= (10.35/12.98) x 100

= 79.73%

10% SCBA & 30% of copper slag =12.38

= (12.38/12.98) x 100

= 95.37%

15% SCBA & 30% of copper slag = 7.24

= (7.24/12.98) x 100

= 55.77%

TABLE 8.3.9 COMPRESSIVE STRENGTH TEST OF HOLLOW BLOCKS

SPECIMEN WITH 30% SLAG	7 DAYS(N/mm²)	14 DAYS(N/mm²)
0%	9.06	12.98
SCBA=5%	7.55	10.35
SCBA=10%	8.86	12.38
SCBA=15%	5.25	7.24

9. CONCLUSION

The main aim of the study is to use Sugarcane Bagasse Ash and Copper Slag in the Hollow Concrete Blocks for constructing various structural elements., Based on the observations discussed in these case studies The maximum compressive strength was found at 10% replacement level of Sugarcane Bagasse Ash and 30% of Copper Slag, being light in weight HCBS provide economy in design of sub- structure due to reduction of the loads. Laying of blocks saves mortar as compared with ordinary brick work. There is saving in mortar plaster work too. Cavity of blocks helps achieving insulation of walls and provides energy saving for all times. Hollowness results in Sound Insulation. There is no problem of appearance of salts thereby saving in maintenance of final finishes to the walls.

REFERENCE

1. Global shelter cluster, shelter cluster.org
2. Khalaf, KM -1992. 'IS 2185 (PARTI) Concrete masonry units, Hollow and solid concrete blocks. Elastic modulus and strength of hollow blocks'
3. ASTM C652-15 Standard Specification for hollow brick
4. Srinivasan, R 'Experimental study on bagasse ash in concrete, international journal service learning in Engineering.' Vol.5 NO.2, PP, 60-66.
5. Ariz 211e. A modification of AASHTO Designation T84, Specific gravity and absorption of fine aggregate.
6. Committee Board of sugar cane and sugar (2004). Summary of sugar cane and sugar industry in Thailand in 2003/2004, Division of sugar cane and sugar industry Policy, Ministry of Industry, Vol.2 Bangkok Thailand (in Thai).
7. Paya, J., et.al., 'Sugarcane bagasse ash (SCBA): studies on its properties for reusing in concrete production', Journal of Chemical technology and biotechnology, (2002)77,321-325.
8. Bronius Jonaitis, Robertas Zavalis, 'Experimental Research of Hollow Concrete Block Masonry Stress Deformations.'
9. Revista Ibracon de estruturas e materials., 'Strength and deformability of hollow concrete blocks'
10. http://google.com.