"PARTIAL REPLACEMENT OF CEMENT AND SAND WITH BIOMATERIAL AND GLASS WASTE IN CONCRETE"

A Thesis

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by

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CERTIFICATE

This is to certify that the work which is being presented in the project title **"PARTIAL REPLACMENT OF CEMENT AND SAND WITH BIOMATERIAL(RICE HUSK ASH AND GLASS WASTE IN CONCRETE)"** in partial fulfillment of the requirements for the award of the degree of Master of technology and submitted in Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Akshay singh Thakur** during a period from July 2017 to May 2018 under the supervision of **Mr. Chandra Pal Gautam** Assistant Professor, Civil Engineering Department, Jaypee University of Information Technology, Waknaghat.

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ABSTRACT

This research work was experimentally carried out to investigate the effects of partially replacing Pozzolonic Portland cement (PPC) with our local biomaterial additive {Rice Husk Ash (RHA)} and sand with glass powder waste which is known to be super pozzolanic in concrete at optimum replacement percentage. With this research work, the problem of waste management of this agro-waste will be solved. The compressive strength value at 7,14,21 and 28 days was found to be 20.27, 28.34 ,33.67,37.60N/mm2 at the replacement percentage of 20 % in earlier researches .Glass waste is one of the major problem now days ,as its production is in high rate and the decompose properties are very low. The main motive of this experiment is to decrease the usage of cement as due to the wide rate of construction the exploitation of raw material is increasing and cement production also releases harmful gases(SO2,NOX).

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Today explores everywhere throughout the world are concentrating on methods for using either modern or rural squanders as a wellspring of crude materials for the development business. These squanders use would be temperate, as well as help to make a feasible and contamination free condition. Sugar-stick bagasse is one such sinewy waste-result of the sugar refining industry, alongside ethanol vapor. Bagasse ash principally contains aluminum particle and silica. In this paper, untreated bagasse ash has been mostly supplanted in the proportion of 0%, 10%, 20%, 30% and 40% by volume of fine total in concrete. New solid tests like compaction factor test and droop cone test were embraced alongside solidified cement tests like compressive quality, split rigidity and sorptivity. The outcome demonstrates that bagasse ash can be a reasonable substitution to fine total.

Rice husk ash is an agricultural waste which is produced in millions of tons. Rice husk ash (RHA) is obtained by the combustion of rice husk and has been found to be super pozzolanic. Thus, due to growing environmental concern and the need to conserve energy and resources, utilization of industrial wastes as supplementary cementing materials has become an integral part of concrete construction.

RHA is very rich in silicon dioxide which makes it very reactive with lime due to its non-crystalline silica content and its specific surface. It has about 85-90% silica. Glass is made by melting together several minerals at very high temperatures. Silica in the form of sand is the main ingredient and this is combined with soda ash and limestone and melted in a furnace at temperatures of 1700°C. Other materials can be added to produce different colors or properties. Bagasse is a major by-product of cane sugar production. It has been mainly used as fuel in boilers to raise steam. This practice is as old as the sugar industry when alternate applications of bagasse were not developed .Its use in boilers provided a means of captive consumption. But now days its production is high and waste dumping is an issue now days so it has been experimentally drive out that bagasse ash has Pozzolonic properties.

Concrete is a coupling material, a substance that sets and solidifies autonomously, and can tie different materials together. In old human advancement the coupling materials were of customary kind, for example, jiggery, lead, jute, rice husk and so on, now in present day human progress concrete is primary restricting materials. The utilization of cement containing high volume fly-fiery debris has as of late picked up prevalence as an asset productive, tough what's more, reasonable choice for assortment of solid application. The utilization of fly fiery debris in concrete at extents running from 30 percent to 65 percent of aggregate cementations folios has been considered widely finished the last twenty years. Because of a portion of its disadvantages we have supplanted the concrete by High Volume Fly-Ash And Limestone. These two materials decrease green house gas emanation proportionately and result in a more "green cement", through decrease of vitality

utilizations (vitality required to create concrete) and keep the consumption of common assets. Our point was to accomplish the objective quality of M40 review, supplanting concrete by high volume fly fiery debris and lime according to the typical blend configuration (utilizing 53 review of bond). We have accomplished M40 target quality by supplanting concrete around 75 percent of its mass by fly-cinder and lime.

The Self Compacting Concrete (SCC) was first made in the early 1980’s in Japan. Due to its homogeneous nature and high workability, a relatively impervious concrete was thus formed. At present, the SCC is used in applications where requirements for High Performance Concrete (HPC) and High Strength Concrete (HSC) have to be met. Concrete structures ranging from12m to 15m in height are termed as midrise structures. M25 & M30 concrete grades have been widely used for such midrise buildings. The present study therefore focuses on incorporating SCC characteristics in the normal strength concrete mix with possible addition of ash from agriculture waste such as the Bagasse Ash (BA) and Rice Husk Ash (RHA). India is one of the world's largest producers of sugarcane, second only to Brazil, and its current production stands at around 380 million tons of sugarcane per year, which implies that large quantities of BA are also generated. Previous studies on the SCC suggest that the BA can be used in the SCC production, and that this practice enables safe disposal of BA, and keeps the environment free from pollution . Due to its pozzolanic character, the extent of hydration is lower when compared to that of the conventional concrete . A high early strength can be achieved if up to 20 percent of cement is replaced with the well burnt BA, without any adverse effect on the desirable properties of concrete The fly ash (FA) containing sieved BA has a beneficial effect on both the yield stress and viscosity, which results in lower consumption of Super Plasticizers (SP) when compared to simple mortar [6]. The fineness of BA contributes to a finer pore structure, and this fact is responsible for a reduced chloride permeation and diffusion The incorporation of FA and/or Silica Fume (SF) in SCC is very effective as a means to improve the chloride penetration resistance. India also stands second in rice cultivation, next only to China, producing about 104 million tonnes per year. The production of rice husks is close to about 3.7 million tonnes per year. The addition of RHA enhances the viscosity of concrete, which improves the self-consolidating property. The RHA with a high content of nano SiO_2 decreases the drying shrinkage value of SCC significantly. However, a partial replacement of cement with the Fe_2O_3 nano phase, and with the TiO_2 nano phase, improves the compressive strength of concrete, but decreases its workability. The incorporation of 12 to 15 percent of RHA as a partial cement replacement may be sufficient to control the deleterious expansion due to alkali-silica reaction in concrete, depending on the nature of the aggregate. The workability of concrete mix is proportionate to the quantum of chemical admixtures such as the SP and VMA in the conventional normal strength concrete. It can also be seen from the literature that there is no study involving supplementary addition of agro waste, such as BA and RHA, in the normal strength SCC. Akram et al conclude that, to a certain extent, the

BA and RHA could act as the VMA in the SCC. Since the VMA admixture is comparatively expensive, thus increasing the cost to production of the normal strength SCC, the BA and RHA are considered suitable for partial replacement of VMA in the SCC preparation. In view of the above, this paper is aimed at studying the workability of SCC by partial replacement of cement with the BA and RHA, in order to identify optimum replacement proportions.

Concrete is identified as the source of a nation's infrastructure due to its economic progress and strength, and indeed to the superiority of life. Over 5% of global CO2 emissions can be credited to Portland cement production. To reduce the limitations of cement (OPC), it can be partially replaced with green materials which have pozzolanic characteristics. Number of green materials has been studied for the replacement of cement partially like fly ash, ground nut shell ash, etc. which have been successful. The present paper focuses on the replacement of cement partially with Rice Husk Ash (RHA). India is one of the leading producers of Rice. Globally rice paddy of about 600 million tons is being produced, accounting for an annual production of 120 million tons Rice Husk. In most of the cases, the husk produced during the processing of the rice is either burnt or dumped as waste material. Rice husk ash contains 90%-95% of reactive silica. It is estimated that the world rice harvest is about 588 million tons per year and India is the second largest producer of rice in the world with a production of 132 million tons per year annually. Extensive research has been carried out on the use of amorphous silica in the manufacture of concrete. Most of these studies have been performed in order to find the effectiveness of RHA as a pozzolan by concentrating on the amount of ash present in the mix and on the enhanced characteristics resulting from its use.

1.2 WHY BAGASSE ASH

As sugarcane creation is more than 300 million tons/year that reason around 10 million tons of sugarcane bagasse ash as an un-used and squander material [1,2]. After the extraction of all prudent sugar from sugarcane, around 40-45% stringy deposit is acquired, which is reused in an indistinguishable industry from fuel in boilers for warm age abandoning 8 - 10% ash as waste, known as sugarcane bagasse ash (SCBA)[3]. The SCBA contains high measures of un-consumed matter, silicon, aluminum and calcium oxides. In any case, the ashes got straightforwardly from the factory are not responsive in view of these are singed under uncontrolled conditions and at high temperatures [4]. The ash, subsequently, turns into a mechanical waste and postures Selection and associate audit under duty of Institute of Technology, Nirma University, Ahmedabad. 26 Prashant O Modani and M R Vyawahare/Procedia Engineering 51 (2013) 25 – 29 transfer issues. A couple of studies have been done in the past on the usage of bagasse ash acquired straightforwardly from the businesses to ponder pozzolanic action and their appropriateness as fasteners by halfway supplanting concrete. The present investigation was conveyed to contemplate the utilization of SCBA as an incomplete substitution of fine total in bond concrete since the accessibility of regular sand is on the cry off in the most recent decades because of natural and ecological restrictions. The test contemplate looks at the workability properties of crisp cement, for example, droop and compaction factor and furthermore 7 and 28 days compressive quality, 28 days rigidity and sorptivity coefficients with 10%, 20%, 30% and 40% substitution of fine total with bagasse ash by volume.

1.3 WHY RICE HUSK ASH

Over the previous decades, solid innovation has entered wide based zones of exercises to improve solid execution by introduction of self-compacting concrete (SCC), high quality cement (HSC) or perhaps ultra-high quality cement (UHSC). "Self-compacting concrete (SCC) was first created in 1988 by Professor Okamura expected to enhance the toughness properties of concrete structures. "HSCs are known to have a higher measure of bond fastener in the blend plan properties with low w/b ratio". The high mass of bond content created significant warmth freedom in the solid because of the response between concrete and water, which can prompt splitting. The benefits of minerals intensified with HSC liable to have less measures of bond with specific natural and ecological benefits, improved mechanical markers, cost effective, vitality utilization, bring down levels ofCO2emission(proves one tone of ozone depleting substance to be discharged in to climate per one ton of concrete assembling), requirement for fresh materials, so on. Basic mineral augmentations are granulated impact heater slag, silica rage, fly ash and limestone filler . it ought to be bore as a primary concern that the markers of blend plan, arrangement and final properties of HSC in new and solidified states are absolutely different from that of in like manner cements. At the point when the measure of powder added substance increment, so the workability of cement whether mechanically or synthetically at times definitely enhance in specimen proportions of substitution.

1.4 WHY GLASS POWDER

As Million tons of waste glass is being created yearly everywhere throughout the world. Once the glass turns into a waste it is arranged as landfills, which is unsustainable as this does not decay in the earth. Glass is primarily made out of silica. Utilization of processed (ground)

squander glass in concrete as fractional substitution of bond could be a vital advance toward improvement of manageable (ecologically amicable, vitality proficient and sparing) foundation frameworks. At the point when squander glass is processed down to smaller scale estimate particles, it is required to experience pozzolanic responses with bond hydrates, framing auxiliary Calcium Silicate Hydrate (C– S– H). In this examination compound properties of both clear and hued glass were assessed. Substance investigation of glass and bond tests was resolved utilizing Xray fluorescence (XRF) system and discovered minor contrasts in sythesis amongst clear and shaded glasses. Stream and compressive quality tests on mortar and cement were completed by including 0– 25% ground glass in which water to cover (bond + glass) proportion is kept the same for all substitution levels. With increment in glass expansion mortar stream was somewhat expanded while a minor impact on concrete workability was noted. To assess the pressing and pozzolanic impacts, additionally tests were likewise led with same blend points of interest and 1% super plasticizing admixture dosage (by weight of concrete) and for the most part found an expansion in compressive quality of mortars with admixture. Similarly as with mortar, solid 3D shape tests were arranged and tried for quality (until the point that 1 year curing). The compressive quality test comes about showed that reused glass mortar and cement gave better quality contrasted with control tests. A 20% substitution of concrete with squander glass was discovered persuading thinking about cost and the earth.

The Sscanning Electron Microscopy (SEM) was carried out to find the shape and size of ash particles in dry form. The scanning was done on the ash passing through the 45 µm sieve. The SEM image shows the irregular shape of the BA. Just like the BA, the shape of RHA is also irregular Sieving at the 45 µm sieve reduced the particle size of ashes and decreased the visible black colour of burnt carbon particles, and improved the quality of ashes. The physical properties of cement and other ashes are as per IS code The chemical composition listed in Table 4 is in conformity with properties of cementitious materials as per IS: 4032 – 1985

CHAPTER 2

LITERATURE SURVEY AND OBJECTIVE

2.1 GENERAL:

Over 100 research paper has been reviewed over the effect of substituting cement over bio material and we find that compressive strength of cube has been increased upto 30% . Since it is most researched topic due to its vast application so much literature have been foend regarding this project. Some important parts of literature studies have been represented here in next section 2.2.

2.2 LITERATURE SURVEY

Hana el et (1984).

He use of RHA in civil construction works can scale back environmental pollution, improve the standard of concrete, and scale back its value of production still as finding the matter of agro-waste management by putt into use this domestically found additive (RHA).

Rashad (2003)

He all over from his analysis that the inclusion of 100% glass sand increase the residual compressive strength of concrete once the exposure to fireside up to 700*c. the inclusion of the glass sand within the matrix exaggerated its salt ad oil of vitriol resistance. On a similar line, the inclusion of glass sand (5-20%) improved pervasion resistance at long terms (56and ninety one days), while it weakened carbonation resistance at ages of seven and twenty eight days. Drying shrinkage weakened with increasing glass sand content. This reduction is also associated with low tide absorbtion capability and therefore the impervious properties of glass.

Elsevier (2003)

One another analysis was to guage the incorporation of glass sand powder to interchange natural sand and cement severally they detected a pozzolanic reaction of glass with cement that contributed to the event of compressive strength. The compaction of the inner structure conjointly increase the concrete mixes resistance to chloride penetration.

Vishaliny (2007)

They have reported in their work that tumbler powder concrete will increase the compressive, split tensile and flexural strengths effectively, compared with the waste glass we want to replace fine combination with in the proportions of 1%, 3%, 5%, 10%,15%,20%,25%,30%. Varied properties of checked during this experiment like compressive strength, split lastingness, flexural strength are reviewed during this paper. Additionally silicon oxide fume is adscititious as a partial replacement for cement so as to compensate the strength loss attributable to addition of waste glass.

Management and recycling of waste glass in concrete products: current situation in Hong Kong. They found the fractional approaches to utilize squander glass in planning solid pieces, self compacted concrete and Architectural Improve High-volume normal volcanic pozzloan and limestone powder as incomplete swaps for portland bond in self-compacting and maintainable concrete.K. Celik , M.D. Jackson, 2014 A research facility think about shows that high volume, 45% by mass substitution of portland bond (OPC) with 30% finely-ground basaltic fiery remains from Saudi Arabia (NP) and 15% limestone powder (LS) produces concrete with great workability, high 28-day compressive quality (39 MPa), astounding one year quality (57 MPa), and high protection from chloride entrance. Traditional OPC is delivered by intergrading 95% portland clinker and 5% gypsum, and its clinker factor (CF) along these lines meets 0.95. With 30% NP and 15% LS portland clinker substitution, the CF of the mixed ternary PC measures up to 0.52 so 48% CO2 discharges could be maintained a strategic distance from, while upgrading quality improvement and solidness in the subsequent self-compacting concrete (SCC).

Malhotra et al. (1992)

He Proceedings of the International Symposium on Advances in Concrete Technology. Atthens, Greece. This paper shows a trial ponder on the impacts of the consolidation of rice-husk fiery debris (RHA) in bond glue and cement on the hydration and the microstructure of the interfacial zone between the total and glue. The impact on the compressive quality of cement is talked about and the outcomes are contrasted and those acquired with the control portland bond concrete and cement consolidating silica smolder. With respect to standard portland concrete glue, it was discovered that calcium hydroxide [Ca(OH)2]and calcium silicate hydrates [C-S-H] were the significant hydration and response items for the RHA glue. On account of the pozzolanic response, the glue joining RHA had bring down Ca(OH)2 content than the control portland concrete glue. The fuse of the RHA in concrete lessened its porosity and the Ca(OH)2amount in the interfacial zone; the width of the interfacial zone between the total and the bond glue was additionally decreased contrasted and the control portland bond composite. In any case, the porosity in the interfacial zone of the rice-husk fiery debris composite was higher than that of the silica smolder composite. The joining of the RHA in the concrete glue did not expand its compressive quality contrasted and that of the control. The higher compressive quality of the RHA concrete contrasted and that of the control is expected most likely to the decreased porosity, lessened Ca(OH)2 and diminished width of the interfacial zone between the glue and the total.

Martino et al. (2016)

This paper surveys the practicality of two modern squanders, fly fiery debris (FA) and rice husk slag (RHA), as crude materials for the generation of geopolymeric glues. Three typologies of tests were subsequently delivered: (I) halloysite initiated with potassium hydroxide and nanosilica, utilized as the reference test (HL-S); (ii) halloysite enacted with rice husk powder broke up into KOH arrangement (HL-R); (iii) FA actuated with the basic arrangement acknowledged with the rice husk fiery remains (FA-R). Thick and permeable examples were delivered and described as far as mechanical properties and natural effect. The flexural and compressive quality of HL-R came to around 9 and 43 MPa, separately. Despite what might be expected, the compressive quality of FA-R is altogether lower than the HL-R one, notwithstanding a practically identical flexural quality being come to. In any case, when permeable examples are concerned, FA-R demonstrates tantamount or considerably higher quality than HL-R. Along these lines, the present outcomes demonstrate that RHA is a significant contrasting option to silica nanopowder to set up the activator arrangement, to be utilized either with calcined mud and fly fiery debris feedstock materials. At last, a preparatory assessment of the an unnatural weather change potential (GWP) was performed for the three explored details. With the blend containing FA and RHA-based silica arrangement, a lessening of around 90% of GWP was accomplished as for the qualities got for the reference definition.

Jaturapitakkul (2009)

This paper proposes another cementitious material from a blend of calcium carbide deposit and rice husk cinder. Calcium carbide buildup and rice husk fiery remains comprise essentially of Ca(OH)2 and SiO2, separately. The establishing property was distinguished as a pozzolanic response between the two materials without portland bond in the blend. Properties, for example, setting times of glues, stream, and compressive quality of mortars were researched when calcium carbide deposit and rice husk fiery debris were utilized as cementitious material. The outcomes demonstrate that the setting times of the new solidifying glues are longer than that of the portland bond glue. The proportion of calcium carbide deposit to rice husk slag of 50:50 by weight acquires the most elevated compressive quality of mortar. The compressive quality of mortar could be as high as 15.6 MPa at curing age of 28 days and expanded to 19.1 MPa at 180 days. As indicated by the compressive quality of mortar, the blend from calcium carbide deposit rice husk slag has a high potential to be utilized as an establishing material. Be that as it may, more innovative work particularly on ideal blend configuration, setting times, early quality, and solidness of cement ought to be completed.

Greepala and Parichartpreecha (2004)

He investigated the potential of utilizing fly ash, rice husk ash, and bagasse ash in the manufacture of lateritic soil-cement stabilized interlocking blocks. The authors investigated the effect of the solid wastes on the compressive strength and water absorption of the blocks. Fly ash was used to replace class I type Portland cement up to 80% by weight, while rice husk ash and bagasse ash were used to replace the same up to 50% by weight in increments of 10%. The blocks were then cured for periods of 7 and 28 days. The results of the test indicated that fly ash was the best replacement for cement by mass with replacement up to 60% by weight. The strength and water absorption of the fly ash replaced block met the standards for hollow load bearing concrete masonry units.

Khobklang et al. (2012)

He investigated the potential of bagasse ash in the replacement of cement in lateritic soil-cement interlocking blocks. Portland cement was replaced with 15%, 30%, and 40% bagasse ash and mixed with lateritic soil, sand, and water for moulding the blocks followed by curing for a period of 90 days. The test results revealed that 15% bagasse ash produced the highest compressive strength when compared to the other replacement contents. It was found that the addition of bagasse ash increased th(2015)e water absorption of the blocks. However, an increase in the water to binder ratio was found to reduce water absorption.

Alavéz-Ramírez et al. (2011)

He investigated the effect of bagasse ash on the durability of lime stabilized soil blocks. Blocks were prepared with 10% lime and combination of 10% lime with 10% sugarcane bagasse ash and cured for 7, 14, and 28 days of curing. The stabilized blocks were then subjected to compression and flexure tests in both dry and saturated states. The tests revealed that addition of bagasse ash to lime stabilized blocks significantly improved the performance of the stabilized blocks. Mineralogical and microstructural investigations were also carried out which revealed a considerable improvement in the stabilized soil matrix due to the formation of CSH and CAH phases.

Lima et al. (1999)

He investigated the potential of modified cement stabilized soil blocks amended with bagasse ash. Two cement contents of 6% and 12% were adopted for making the blocks which were amended with 2%, 4%, and 8% bagasse ash. Compressive strength and water absorption tests were performed on the stabilized blocks. Masonry prisms were also prepared with the stabilized blocks for testing. The blocks produced with 12% cement amended with 8% bagasse ash met the standards for stabilized blocks. The prisms made with modified blocks also produced better performance in axial and diagonal compression tests when compared to blocks without ash.

James et al. (2006)

He investigated the effect of bagasse ash on the potential of cement stabilized soil blocks. Two different cement contents of 4% and 10% were adopted for stabilizing the soil blocks which were amended by 4%, 6%, and 8% bagasse ash. The blocks were all cast to one particular unit weight and moisture content. The blocks were subjected to compressive strength, water absorption, and efflorescence tests. The results of the investigation revealed that addition of bagasse ash resulted in an increase in the performance of the blocks with increased compressive strength and no efflorescence. Addition of bagasse ash resulted in lower cement content of 4% being capable of achieving minimum strength requirements as per standards. However, there was a marginal increase in the water absorption due to addition of bagasse ash. It was also concluded that bagasse ash performed better at lower cement content of 4% when compared to 10%.

James and Pandian (2008)

There in an extension of their earlier work, evaluated the potential of bagasse ash in improving the performance of limeastabilized blocks. The minimum lime content required for stabilizing a locally available soil was determined using the Eades and Grim pH test. The initial consumption of lime was found out to be 6%. The soil was stabilized with 6% lime and amended with 4% to 8% bagasse ash in increments of 2%. They found that the addition of bagasse ash resulted in an increase in the compressive strength of the stabilized block and increased the water absorption of the block. 8% bagasse ash produced the maximum strength but was not enough to meet the minimum strength of class 20 block as per Indian standards. The authors attempted to develop a relationship between the compressive strength and bagasse ash content, based onawhich they concluded a minimum requirement of 9.5% bagasse ash for achieving strength of class 20 block.

Rajkumar et al. (2011)

He investigated the use of bagasse ash paver blocks on low traffic road pavements. The investigation consisted of designing and testing four trial mixes with bagasse ash in accordance with BIS and IRC standards. This was followed by design of a flexible pavement for low volume traffic roads. The paver blocks were designed with 50% bagasse ash addition in the mix. The compressive strength results of the paver blocks as well as cubes revealed that though the strength of the paver blocks with bagasse ash was lower than the control specimens, the strength values were very close to the control. The design of pavement with bagasse ash paver blocks was cheaper than conventional flexible pavement by 24.15%. The authors also cite higher design life for bagasse ash paver block pavement as well as reduced maintenance costs when compared to conventional flexible pavement.

Naibaho et al. (1994)

He investigated the utilization of bagasse ash in reducing the cement content of stabilized bricks. Three bagasse ash contents of 5%, 15%, and 25% were investigated for their performance in increasing the compressive strength and reducing water absorption in achieving a cost-effective stabilized brick. The test results revealed that the addition of 25% bagasse ash produced the highest compressive strength but resulted in an increase in water absorption. The authors concluded that utilization of 25% bagasse ash in manufacture of cement stabilized bricks decreased the production costs by 32.48%.

Ali et al. (2003)

He investigated the effect of bagasse ash on the strength of compressed cement stabilized earth blocks. The soil was amended with 20%, 25%, and 30% bagasse ash as a partial replacement for cement and was cured for periods of 7 days and 28 days. The soil blocks were then subjected to initial rate absorption, density, dimensions, compressive strength, and water absorption tests. 20% bagasse ash was found to be the optimum replacement content for cement in the manufacture of compressed stabilized blocks. The water absorption increased on addition of bagasse ash; however, the increase stabilized beyond 20% bagasse addition. The weight of the block reduced marginally due to the addition of bagasse ash. The authors concluded that further studies on energy consumption and chemical properties need to be conducted before bagasse ash can be adopted in brick manufacture.

Onchiri et al. (2007)

He investigated the partial replacement of cement in self-interlocking blocks with bagasse ash. Silty gravel soil was stabilized using cement and it was amended with bagasse ash with mix proportions of 1.6%, 3.2%, 4.8%, 6.4%, and 8%. The stabilized blocks were then cured for periods of 7 days and 28 days. The results of the compressive strength tests revealed that the maximum compressive strength was achieved at an additive content of 3.2%. The authors concluded that bagasse ash to cement in the ratio of 1 : 1.5 was the optimal dosage as it met the minimum standards for compressed stabilized blocks.

Saranya et al. (1997)

He investigated combinations of bagasse ash and rice husk ash in development of stabilized bricks without any other conventional binder. The investigation involved combinations of bagasse ash and rice husk ash in equal proportions varying from 5% till 30% in increments of 5%. The bricks were tested for their compressive strength and water absorption and checked for density of the cast brick for various combinations. The test programme revealed that 5% bagasse ash with 5% rice husk ash produced the highest strength of all combinations. The water absorption of the blocks also increased with increase in waste content. The authors recommended the combination of bagasse ash and rice husk ash up to 20% in manufacture of the brick with additional advantage of the bricks being their light weight nature.

Prasanth et al. (2004)

He investigated the performance of pressed composite bricks made with different additives including bagasse ash, fly ash, jaggery, quarry dust, lime, and cement. The additives were all added individually and the strength of the composite brick was tested. It was found that 10% cement gave the highest strength of all combinations. However, it was also found that

5% bagasse ash composite earth brick gave strength close to that of 10% lime stabilized earth brick.

Salim et al.(2006)

He investigated the potential of bagasse in the manufacture of sandy loam soil compressed earth block. Sandy loam soil was adopted for the manufacture of the blocks and they were amended with 3%, 5%, 8%, and 10% bagasse ash and were compressed and cast into blocks of 285 mm × 145 mm × 95 mm blocks and cured for periods of 14, 21, and 28 days. Following the curing periods, they were subjected to compressive strength test and shrinkage crack test. The results showed that 10% bagasse ash was able to increase the strength of sandy loam soil block by 65%. There was also a 7% reduction in the shrinkage cracks of 10% bagasse ash amended soil blocks.

Tonnayopas (2008)

He investigated the potential of bagasse ash as an additive in the manufacture of sintered bricks. The bagasse ash content was varied from 10 to 15% by weight of clay used in the manufacture of the brick. As against a conventional stabilized soil block, this investigation involved utilization of bagasse ash in sintered bricks, wherein the modified bricks were fired at a temperature of 1050°C. Bagasse ash was characterized using X-ray fluorescence, X-ray diffraction, and thermogravimetric analyses. The sintered bricks were subjected to compressive strength, water absorption, and density tests. The microstructures of the failed brick specimens were also studied using scanning electron microscopy. The investigation revealed that addition of bagasse ash affected even the performance of sintered bricks with 30% bagasse ash producing the highest compressive strength of close to 43 MPa. Water absorption of all combinations till 30% bagasse ash content was less than 15%. The authors concluded that 30% bagasse ash by weight of clay can be used for forming the brick sintered at a temperature of 1050°C.

Teixeira et al. (2009)

He investigated the manufacture of wollastonite based glass ceramic using bagasse ash as raw material. The glasses were prepared by mixing bagasse ash, limestone, and potassium carbonate as flux. The mixtures were melted at 1400°C using a lift oven, poured into water to form glass frits, dried, milled, and sieved for mineral and thermal analysis. They were then moistened with ethylene glycol and pressed into pellets with a hydraulic press. These pellets were then sintered at varying temperatures to crystalize and vitrify them. The glass ceramics were produced with two different combinations of bagasse ash and limestone. It was concluded that valorisation of bagasse ash in the manufacture of glass ceramics can result in production of wollastonite based ceramics at lower crystallization temperatures of less than 900°C, which significantly reduces production costs.

As mentioned earlier, the effectiveness of utilization of bagasse ash as a pozzolanic will depend upon the purity of the ash, reactiveness of the silica, and pretreatment of ash, if any, to improve its reactivity. Thus, in order to compare all the investigations adopting bagasse ash in stabilized blocks, a comparative table has been generated comparing the temperature of burning or calcination temperature of the ash, which plays a predominant role in the quality of the ash, the loss on ignition, which gives an indication of volatile impurities present, the type of silica present in the ash, crystalline or amorphous based on the details given in the mineralogical investigations by the authors, and, lastly, the treatment/preparation of the ash done before its use in the investigation.

2.3 OBJECTIVE OF STUDY

Going through literature for the topic following objectives have been decided for accomplishment of goals.

a) To check the effect of rice husk ash, bagasse ash and glass powder on concrete when sand and cement are replaced with these materials.
b) To check the compressive strength of replaced concrete sample.

CHAPTER 3

EXPERIMENTAL PROGRAM AND METHODOLOGY

3.1 GENERAL

For this experimental program, we required bagasse ash, rice ash and glass powder. These material are replaced with sand and cement in mortar, along with it water is added for mixing and workability.

Bagasse ash, Rice Husk Ash, Cement, Water, glass powder, Aggregates were mixed at different proportion to increase the strength and to check the effect of these bio gas

3.2 MATERIALS

Bagasse ash- is the fibrous matter that remains after sugarcane or sorghum stalks are crushed to extract their juice. It is dry pulpy residue left after the extraction of juice from sugar cane. Bagasse can be also be used for the generation of elecetricity. Dry bagasse can be burned to produce steam. This steam can be employed for providing energy required for rotating turbines. When 10 tonnes of sugarcane is crushed nearly 3 tonnes of wet bagasse is generated. It is a by-product of sugar industry. Generally 40-50 % of moisture is present in it initially. It can have many uses like as fuel, as steam generation for running the turbines. It is directly related to dust generation thus it affects human health adversely. This side-effect of it can be employed to be seen as a positive point for converting it in some other useable forms. Advanced construction researches have shown that this can be converted to usable forms in construction industry. Fig 3.1 shows picture of bagasse fibers. Here in the figure the small fibers of bagasse can be identified easily.

Fig 3.1 Bagasse ash

Rice Husk Ash (RHA)- Rice Husk Ash is burnt for approximately 72hours in air in an uncontrolled burning process. The temperature is in the range of 400-600 degree C .The ash collected was sieved through standard sieve size 75µm and its colour was grey. Similar to bagasse, it is also a by-product. It is generated by milling of paddy. Milling of paddy generates about 78 % useful rice material while rest 22 % is obtained as husk. However this waste by-product is used as a fuel in rice mills. Every 1000 kilograms of paddy milled about 220 kilograms rice husk is produced. Burning this husk produces ash called Rice Husk Ash, here its abbreviated as RHA. RHA contains excellent pozzolanic properties. Thus has a vide application in modern days construction works. It can also be used as molten metal in tundish, ladle while slab casting with temperatures as 1250 and 1400 degree centigrades respectively. It enhances strength property of concrete. So its been employed in modern works widely along with other improved and advanced materials. Fig3.2 shows Rice Husk Ash. Ash particles can be easily identified from this figure.

Fig.3.2 Rice husk ash

Glass powder- Glass is a non-crystalline amorphous solid that is often transparent and has widespread practical, technological, and decorative usage in, for example, window panes, tableware, and optoelectronics. As we all know that cement production emits green house gases which are major cause of global warming. The glass powder can be used for replacing cement. Finely powdered glass can be used for such a purpose. Use of glass powder also enhances the aesthetics appeal of concrete in work. So it is the best choice against cement. Fig 3.3 shows glass powder figure.

Fig.3.3 Glass powder

Cement- Pozzolonic Portland cement (PPC) of 43 grade was used in which the composition and properties is in compliance with the Indian standard organization.

Water- Water plays an important role in concrete production (mix) in that it starts the reaction between the cement, pozzolana and the aggregates. It helps in the hydration of the mix.

Aggregates- coarse aggregates have size in the range of 6-10 mm and fine aggregates (i.e. glass powder) having size less than 4.75mm (in the range of 2-4 mm).

RATIO OF MATERIALS

1. CEMENT -: 1

2. COARSE AGGRIGATE -: 1

3. FINE AGGRIGATE -: 2

4. WATER CEMENT RATIO -: 0.45

   RATIO -: 1:1:2:0.45

5. Replacement of cement – 5%,10%,15% by its weight with rice husk ash and bagasse ash

6. Replacement of sand – 5%,10%,15% by its weight with glass powder waste

Table 3.1 shows properties of materials that are RHA, bagasse, PPC, glass powder. Here in this table specific gravity and bulk density are represented along with units.

Table 3.1 Properties of material

Materials	**Specific gravity**	**Bulk density (g/cc)**
Rice husk ash	2.14	0.781
Bagasse ash	2.84	1.95
PPC	3.15	3.1
Gp	2.62	0.53

Table 3.2 shows sieve analysis of fine aggregates as per IS 383. Sand sive analysis is shown in the table.

Table 3.2 Sieve Analysis of fine Aggregates as per IS383

SIEVE ANALYSIS OF SAND

Sieve size	Weight retained	% Retained	% Passing
6.3		0	100
5.0		0	100
2.36	5	0.33	99.67
1.18	130	8.7	90.97
600	429	28.6	62.37
425	345	23.0	39.37
300	338	22.5	16.87
212	126	8.4	8.47
150	80	5.3	3.17
63	43	2.9	0.27
PAN	4	0.27	0

Tests conducted comprises compressive strength test. Compressive strength test, which is mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of cube, prism, 26or cylinder, is compressed between the platents of a compression testing machine by a gradually applied load.

3.3 MOULDS

1. The standard size of cube is 150 mm.
2. Cubes of 100 mm size are not suitable for concrete having a nominal maximum aggregate size exceeding 20 mm. Cubes of 150 mm size are not suitable for concrete having a nominal maximum aggregate size exceeding 40 mm.
3. The moulds for the specimens must be made of cast iron or cast steel. The inside faces must be machined plane. The cube mould is normally made in two halves to facilitate removal of the concrete cube without damage. Each mould has a base, which is a separate metal plate, preferably fastened to the mould by clamps or springs. When assembled, all the internal angles of the mould must be right angles.
4. To comply with CS 1:1990, moulds are required to be within specified tolerances for dimensions, square and parallelism. These are covered in Section 7 of CS 1.

3.4 METHODOLOGY

1. Other materials are rice husk ash, bagasse ash and glass powder were mixed at different proportion
2. The cement we using in this experiment is PPC.
3. Bagasse were completely mixed with weter and cement with a strength of M25
4. The ratio of materials is shuffled by the weight percentage as given in figure below (table 4.1).
5. Each bio material is used in the partial replacement with cement.
6. Glass powder is partially replaced with sand.
7. Cubes are been casted through these materials in the ratio of M25
8. The cubes are tested under compression testing machine.

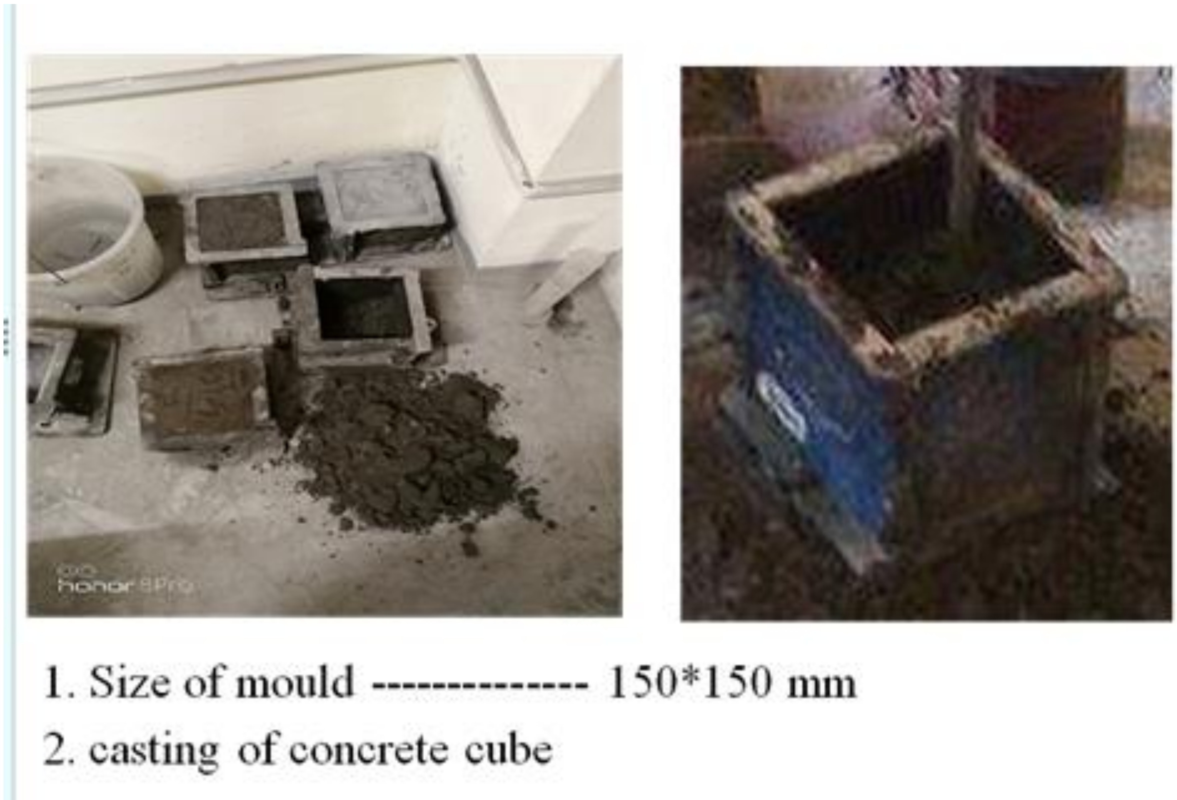

Fig 3.4 moulding process

Fig 3.4 shows moulding process conducted at laboratory. Here the mould size taken is 150x150 mm. Casting of these cubes is also shown in right side of this figure. Temping rod employed is 100mm of length. On an average 25 tempings are done over each layer. Mixture is placed in mould in 4 layers with same number of tempings over each layer. Testing and other methedology has been discused later in section 3.5.

3.5 TESTING

50 cubes have been casted and tested for different material ratios. Deflection values while applying loads have been noted down. These values are taken from following procedures and tests.

Universal testing machine

Universal testing machine is used to test the tensile stress and compressive strength of materials. It is named after the fact that it can perform many standard tensile and compression tests on materials, components, and structures.

Types of test

Tensile Test: Clamp a single piece of anything on each of its ends and pull it apart until it breaks. This measures how strong it is (tensile strength) how stretchy it is (elongation), and how stiff it is (tensile modulus).

Compression Test

The exact opposite of a tensile test. This is where you compress an object between two level plates until a certain load or distance has been reached or the product breaks. The typical measurements are the maximum force sustained before breakage , or load at displacement or displacement at load .

Slump test

Slump is a mean of assassin the consistency of fresh concrete. It is used, indirectly, as a means of checking that the correct amount of water has been added to the mix. The test is carried out in accordance with BS EN 12350-2-2009, testing fresh concrete. As the water used for the partial use of rice husk and bagasse ash in cement is slightly more than the normal concrete. Value of slump test = 40-60 mm

Table 3.3 Mix Proportion

Rice Husk (%)	SCBA (%)	Cement (%)	GP (%)	Sand (%)	Rice Husk/Cement	SCBA/Cement	GP/sand
0	0	100	0	100	0	0	0
0	0	100	30	70	0	0	0.428571
2.5	2.5	95	25	75	0.026315789	0.026315789	0.333333
5	5	90	20	80	0.055555556	0.055555556	0.25
7.5	7.5	85	15	85	0.088235294	0.088235294	0.176471
10	10	80	10	90	0.125	0.125	0.111111
12.5	12.5	75	5	95	0.166666667	0.166666667	0.052632
15	15	70	0	100	0.214285714	0.214285714	0

In table 3.3. various percentage of mix proportions have been shown. This percentage is with respect to the ratio of M25 concrete. As every single material has been assigned and treated as 100 %. For example cement:sand:aggregate ratio for M25 is 1:1:2. So partial replacement is taken as for cement = 100% when partially replaced with 5% RHA and 5% SCBA will give 90 % cement content. Thus every percentage has been treated as 100 % irrespective of their overall ratio for M25 concrete i.e 100% ratio for whole of the concrete.

Table 3.4 dimensions of slump cone

S NO.	DISCRIPTION	DIMENSSION
1	Diameter of metallic mould	200 cm
2	Top diameter of metallic mould	100 mm
3	Height if cone frustum	300 mm
4	Thickness of sheet	1.60 mm

Table 3.4 shows the dimensions of slump cone apparatus which has been used. The units for the same have been represented and taken as mm. These are the standard slump cone apparatus dimensions as provided in Indian Standards.

CHAPTER 4

RESULTS AND DISCUSSION

Around 50 cubes are casted and cured for 7 days and 28 days and cured by covering concrete surfaces with immersing in the water tank and results obtained are shown in this section. 50 cubes are casted with different quantities of materials taken complying with the ratios required for M25 concrete. The quantities taken for materials are according to as provided in Table 3.3 Mix Proportions. The results obtained are shown in tabular data as well as graphical comparison of results has also been provided. Table 4.1 also provides the mix proportions along with the results obtained for compressive strength for 7 days and 28 days. Various percentages of mix proportions can be known from Table 3.3 while actual amount in kilograms which has been used can be known from Table 4.1. The variation in the results has been represented graphically in Fig 4.1. Graph shows the variation of compressive strengths in 7 days and 28 days and also comparisons can be done between different mix proportion samples can be done along with the comparison between conventional M25 and partially replaced M25 concrete.

Table 4.1 compressive strength results for mixed proportion of different materials.

S.no	**Designation**	**Mix Ratio**						
		Rise Husk (kg)	**SCBA Kg)**	**Cement (Kg)**	**GP (Kg)**	**Sand (Kg)**	**7 Days (Mpa)**	**28 Days (Mpa)**
1	**Mix 1**	0	0	5	0	5	17.8	27.8
2	**Mix 2**	0	0	5	1.5	3.5	15.31	27.11
3	**Mix 3**	0.125	0.125	4.75	1.25	3.75	19.90	29.56
4	**Mix 4**	0.25	0.25	4.5	1.25	3.75	20.48	33.40
5	**Mix 5**	0.35	0.35	4.25	0.5	4.5	21.35	36.01
6	**Mix 6**	0.5	0.5	4	0.5	4.5	23.28	36.47
7	**Mix 7**	0.625	0.625	3.75	0.25	4.75	21.08	34.01
8	**Mix 8**	0.75	0.75	3.5	0	5	19.70	32.62

Table 4.1 shows the designation for Mix proportions in column 2 and various amounts of RHA, SCBA, Cement, GP, Sand along with 7 days and 28 days strength in subsequent columns of table. It is clear from the values obtained in this table that for Mix 1, 5 Kg of cement has been taken along with 5 Kg of sand. The water cement ratio has been taken equal to 0.45. And the value for 7 days compressive strength is 17.8 MPa while for 28 days strength has been increased beyond 25 MPa, and value at 28 days is equal to 27.8 MPa. For Mix 2, cement is 5 Kg while sand taken has been reduced in quantity as compared to Mix 1

and taken equal to 3.5 Kg along with GP equal to 1.5 Kg. The results for 7 days strength shows as decrease as compared to Mix 1, and value is 15.31 MPa. While for 28 days strength values shows an increase from 27.8 MPa to 27.11 MPa. Mix 3, cement is 4.75 Kg along with rice husk ash and SCBA equal to 0.125 Kg each, while sand taken has been reduced in quantity as compared to Mix 1 and increased as compared to Mix 2 and taken equal to 3.75 Kg along with GP equal to 1.25 Kg. The results for 7 days strength shows as increase as compared to Mix 1 and Mix 2, and value is 19.90 MPa. While for 28 days strength values shows an increase and value obtained is 29.56 MPa. For Mix 4 rice husk ash , SCBA, cement are taken equal to 0.25 Kg, 0.25Kg, 4.5 Kg respectively. While sand content is 3.75 Kg and GP is 1.25 Kg. The results for Mix 4 shows 7 days strength as 20.48 MPa and 28 days strength as 33.40 MPa. Thus these values have shown an increase till now. For Mix 5 rice husk ash, SCBA, cement , GP, sand quantities are 0.35 Kg, 0.35 Kg, 4.25 Kg, 0.5 Kg, 4.5 Kg respectively. The results for this mix proportion is for 7 days compressive strength obtained is 21.35 MPa and 28 days compressive strength is 36.01 MPa. This has also increased strength for both the cases of 7 days and 28 days strength as compared to previous mix proportions. For Mix 6 rice husk ash, SCBA, cement , GP, sand quantities are 0.5 Kg, 0.5 Kg, 4.0 Kg, 0 .5 Kg, 4.5 Kg respectively. The results for this mix proportion is for 7 days compressive strength obtained is 23.28 MPa and 28 days compressive strength is 36.47 MPa. This has also increased strength by a small amount for both the cases of 7 days and 28 days strength as compared to previous mix proportions. . For Mix 7 rice husk ash, SCBA, cement , GP, sand quantities are 0.625 Kg, 0.625 Kg, 3.75 Kg, 0.25 Kg, 4.75 Kg respectively. The results for this mix proportion is for 7 days compressive strength obtained is 21.08 MPa and 28 days compressive strength is 34.01 MPa. This shows a decreses strength for both the cases of 7 days and 28 days strength as compared to previous mix proportion Mix 6 and Mix 5. For Mix 8 rice husk ash and SCBa are taken in equal proportion equal to 0.75 Kg each. Cement taken is 3 Kg while sand is taken 5 Kg and no replacement for sand has been done for this mix. Results show that 7 and 28 days compressive strength for this case has also decreased as compared to Mix 7. These strength are 19.40 for 7 days and 32.62 for 28 days. Thus there is an increase in strength for initial mixes while for later ones the strength decreases.

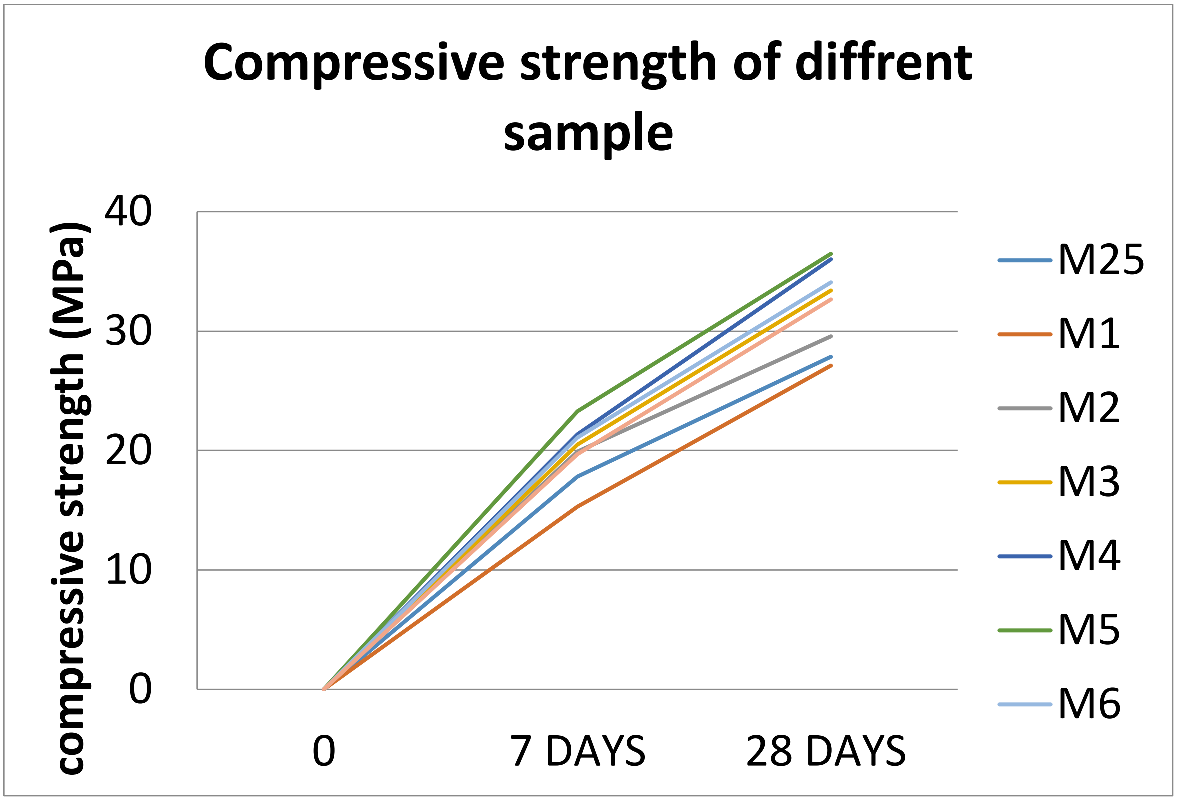

Figure 4.1 compressive strength graphs

Graph shows the constant variation of compressive strength of mix upto 20MPa

And then a slight decrease in slope of graph occurs. Only M5 has greater strength than M25 . others have strength less than M25.

CHAPTER 5

CONCLUSIONS

Through this practical study we concluded that the partial replacement of biomaterials (bagasse and rice husk) with cement and glass powder with sand gives the strength which is capable for the construction load for certain limit, as the mould we casted were M25.

Maximum compressive strength was attained in mix 5.

The replacement of cement by 0.35% of rice husk ash and 0.35% of bagasse gives the maximum strength among all proportions.

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