A

DISSERTATION

ON

"Utilization of Construction Waste to Produce Eco-friendly Brick"

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF

BACHELOR OF VOCATION

IN

BUILDING TECHNOLOGY

SUBMITTED BY

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UNDER THE GUIDANCE OF

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DEPARTMENT OF BACHELOR OF VOCATION

BHIWAPUR MAHAVIDYALAYA BHIWAPUR

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DEPARTMENT OF BACHELOR OF VOCATION

BHIWAPUR MAHAVIDYALYA

BHIWAPUR, NAGPUR

CERIFICATE

This is certify that the project work entitled " Utilization of Construction Waste to Produce Eco-friendly Brick" is a bonafide work done by student's in the Building Technology section of the Bchelor of Vocation, Bhiwapur Mahavidyalaya, Bhiwapur Nagpur, in partial fulfillment of the requirement for the award of Bachelor of Vocation in "Building Technology"

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DECLARATION

This Project wok entitled "Utilization of Construction Waste to produce Eco-Friendly Brick ", is my own work carried out under the guidance of ---Dr. Swapnil Satone------------------ Assistant Professor in Bachelor of Vocation, Bhiwapur Mahavidyalaya, Bhiwapur, Nagpur. This work in the same form or in any other form is not submitted by me or by anyone else for the award of any degree.

CERTIFICATE

This is to certify that the Project work entitled "Utilization of Construction Waste to produce Eco-Friendly Brick" , is the bonafide work done by Student and is submitted to Bhiwapur Mahavidyalaya, Bhiwapur, Nagpur, for the partial fulfillment of the requirements for the degree of Bachelor of Vocation in ----subject name Building Technology

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CHAPTER 1

INTRODUCTION

1.1 Overview

Brunt clay bricks are being used extensively almost throughout India and are perhaps the most important building construction material. But the unlimited use of clay is harmful to society as all the bricks kilns in India depend of good quality clay available from agricultural fields and presuming a weight of 3 kg. Per brick. The total clay taken out from the agricultural fields per day was over 300 million tonnes for 10,000 Crore bricks. Moreover, clay bricks available in certain regions are poor in quality and costly which have forced engineers to look for better material capable of reducing the cost of construction. At present, India has production capabilities of over 10,000 Crore bricks through around 45,000 local kilns (Bhatta's) in the unorganized sector. So, the use of industrial waste products such as fly ash, for making bricks in ecologically and economically advantageous since apart from saving precious top agricultural soil, it meets the social objective of disposing industrial waste, i.e. fly ash which otherwise is a pollutant and a nuisance, The ever-increasing volume of fly ash quantities in the world has not been remotely matched by its utilization. Autralia is an example where such utilization has been minimal. The most important and popular use of fly ash in Autralia has been in the partial replacement of Portland cement. The use of fly ash in concrete is to the extent of maximum of 25% replacement of Portland cement. This conservatism can be understood in the context of concrete where the ash is mixed raw, and the effects of high-volume replacement are still subject to research.

It is however not quite, justifiable that the brick industry should take similar conservative attitude. Environmental concerns have been raised in some parts of the world where coal is the main power generating resource and where bricks are also the main building material. Such concerns have resulted in legislation to oblige the brick industry to incorporate at least 25 % by weight of fly ash and or bottom or pond ash in the brick making mixture if the industry is within 50 km from a coal power generation plant. Some successful ventures have been reported where fly ash was incorporated in the mixture at the rate of 20 % to 50 % Nevertheless, there is only little evidence that incorporation of fly ash in the brick mixture has exceeded the 30 % by volume, even when the legislation was obeyed. Reasons behind such reluctance are not clear. A most probable reason is the fear of change in many small factories and the ingrained conservatism in the attitude of take holders of the large producers. Added to this is the fact, that with an existing clay brick factory, the incorporation of fly ash is a potential addition of cost. The possible incompatibility of the ash with the clay and shale during the various processes of production including the crucial one of firing may be a legitimate difficulty. At high temperatures beyond 1000 ^{o}C, the temperature and length of time of firing become very sensitive to the type of ash and of course to the clay and shale if in the same mixture. This would be the case as long as the factory still uses the ash as partial replacement to the main flay and shale ingredients. The situation may become completely different when the ash is the only ingredient of the brick's mixture. Compatibility is no more as issue in such a case. So far few attempts at manufacturing bricks from more than 80 % fly ash have been made.

The engineers now believe that fly ash on its own can be an excellent raw material for brick making. this has now been proven and a patent is taken for manufacture of bricks from fly ash. The response of the ash to firing temperature at 1000 ^{o}C and beyond can be accurately controlled even in small factories. The potential savings with this approach are many. Savings in production and transportation costs and producing brick of superior qualities to those of standard clay bricks are in addition to the environment solution that such venture may bring about.

Clay brick have recently been primarily used for all major construction purpose approximately, 40 % of the total expenditure occur in bricks laying and related process. Being the prime component is construction industry it is used up many critical resources. The bricks industry is one of the prime contributors to the air pollution. It amounts to 28.8 % of the total air pollution, Second only to transportation. Emission of huge quantity of toxic elements from bricks kilns in causing serious health hazards.

The bricks kilns emit toxic fumes containing suspended particulate matters rich in carbon partitions and high concentration of carbon monoxides and oxides of sulphur (Sox) that are harmful to eye, lungs, and throats. The oxides of sulphur also cause important monuments to corrode like Taj Mahal which is turning yellow due to pollution. The bricks filled owned have been burning bricks with fire wood. As a result, a large number of trees like Keora, 'Chaila', Sundari, Mehgini, Bain etc. Are being fekked indiscriminately, causing vast deforestation further disadvantage of clay bricks include consumption of natural resources, fertile top soil causing exposure of an unfertile soil which is unsuitable for other purpose as brick manufacturing include burning of clay. Another major drawback of clay bricks is the presence of effloresces dur to wring proportion of material. Since, we cannot be sure about the proposition of materials in the top soil, it sometimes led the higher alkali contain which causes white material to flake out of the bricks.

The principal target waste recycling is to ultimately reduce the amount of waste that gets disposed of causing environmental nuisance. Waste recycling has also been employed to provide alternative materials that facility the reduction in the depletion rate of natural materials, which are getting overexploited. The natural materials used for the making of concrete are some of the materials that get easily depleted in the environment. Concrete is the one material in construction that is generally used, and it requires the utilization of recycled material in the mix. All over the world, sand and gravel account for the highest amount of extracted materials. Of the global quantity of materials explored annually (between 47 to 59 billion tonnes) sand and gravel accounted for 68 % to 85 % of these materials. The building construction and maintenance of civil engineering structures need a large weight of aggregates. A typical concrete mixture has about 90 % by weight of aggregates. Considering, the amount of waste glass generated, a third is utilized in the generation of newly produced glass leaving the opportunity for it to be used in other applications.

Large amounts of glass waste are generated from many industries. Various industries globally reuse glass in different processes and as packaging material or as storage, Table 1. Illustrates the recycling rates of selected countries. Germany showed the highest recycling rates as far back as 2004

Tile powder behaves like admixtures, which can be used to produce Ready Mix Concrete. When crushed tiles replace coarse aggregate, compressive strength increases up to 10 %, but after that it decreases. The authors in further confirm that ceramic waste can be used as coarse aggregate as the properties of ceramic waste coarse aggregate are within the range of the values of concrete making aggregate according to Indian Standard. The use of Crushed Tile Aggregate (CTA) caused a 40 % loss in compressive and splitting tensile strengths.

CTA (Crushed Tile Aggregate) has negatively affected abrasion and freeze thaw durability. According to these result, 100 % replacements of CTA as a coarse aggregate in not appropriate. The use of CTA in concrete has positive effects on the environment and obtaining lower costs. Tiles aggregate concrete is little bit more economical as compared to conventional concete. As an estimate for making 1m3 of concrete by substituting 20 % normal 20 mm aggregates. By addition of ceramic tile waste into concrete, proper effective utilization of ceramic tile waste can be achieved.

In India, thermal power plant is largest source of energy. The 65 % electricity consumed in India is generated by thermal power plant. In India there are 132 thermal plants, from that, 41 thermal plants are in western region, 27 thermal plants in northern region, 36 thermal plants in eastern region and 28 thermal pants are in southern region. The total units in thermal plants are 431. The production of fly ash (FA) depends on thermal power station; there are 431 units for generation of power and ultimately for production of FA. From above information, understood the production of FA is in large quantity. The percentage of fly ash production is increases as developments in country. Following figure I shows that the production of FA in 2010 is 160 million tons in India and the utilization of FA is less than 50 million tons means the uses of FA in our country is nearly 35 % of total fly ash production. The remaining FA is 75 % which is totally waste and wastes are unwanted or unusable materials that are dumped on the open space ground. The dumping of waste pollutes the environments and destroys the cultivated lad hence the engineers are obliged to find sustainable solution for this problem. To overcome this pollution, engineers implement such techniques that FA is used in production PPC cement, construction material such as concrete, mortar, and fly ash bricks.

Fly ash help in increasing the strength of construction material cause fly ash has cementations property, due to property, due to this property FA used in bricks manufacturing.

There are various types of bricks manufactured in India; some of common bricks used in construction are : common burnt clay bricks, clay bricks, sand lime bricks (Calcium Silicate Bricks) engineering bricks, concrete bricks and fly ash clay bricks. From this, normal clay bricks, sand lime bricks, and concrete bricks are commonly used in construction practice. The optimum combination of fly ash to produce good quality of brick was studied. The various parameter of bricks was checked with IS codal provision and recommended test were studied.

Over recent year improvements in living standards and technological development have brought about a significant growth in the consumption of single-use bottles. The consequent increase of waste glass in Turkey, especially from the beverage sector, requires technical solution for recycling that are also economically feasible. the use of waste of waste glass in the production of building materials (such as brick) has been successfully carried out as it can reduce both consumption of natural resources and the cost of waste disposal while protecting the environment from the harmful effect of waste material. Glass has become indispensable in life due to such propertied as its ability to take any shape with ease, its bright surface and resistance to abrasion, and its safety and durability. As the range of uses of glass increase, so does the amount of the waste glass. The United Nations estimates the volume of solid waste disposed of annually over the world to be 200 million tonnes, 7 % of which is made up of glass. For Turkey, this amount approaches 120 000 tonnes, 80 000 tonnes of which are recycled, and it has been reported that in Germany 3 million tonnes of waste of which are recycled and it has been reported that in Germany 3 million tonnes of waste glass are being recycled. Furthermore, unlike other waste products, glass is imperishable and thus detrimental to the environment.

The present trend is towards of glass obtained from waste materials in the fabrication of marketable products such as glass-ceramics, tiles for flowing or lining, foam glass, insulating or reinforcing fibers, and glass or glass – ceramic composites. A nottle recovery system, through which empty bottles are collected, washed and reused, had already been established. In addition, broken bottles and bottles previously containing chemicals cosmetics, etc are melted down to be recycled or crushed and turned into paving material, block material, glass tile, glass fiber, lightweight blowing agents etc. (Seung at al 2004). The glass-ceramic process has been proposed as one real and useful choice to recycle industrial and municipal waste glass, It involves the controlled nucleation and crystallization of glasses through carefully designed heat treatment, producing materials with dense, fine-grained microstructures (Alvarez –Mendez at al 2003) The use of waste glass in the production of building materials has been successfully pursued as it can reduce both the consumption of natural resources and the cost of waste disposal, as well as protecting the environment form harmful effects. As glass is one of the the predominant constituents of vitrified ceramic bodies, many authors have considered this to be the most suitable field for the potential recycling of waste glass. An eco-brick is a plastic bottle packed with used plastic to a set density. They serve as reusable building blocks. Eco-bricks can be used to produce various items, including furniture garden wall and other structures.

Over recent years improvements in living standard and technological have brought about significant growth in the consumption of single-use-bottle. The consequent increase of waste glass in Turkey, especially form the beverage sector, requires technical solutions for recycling that are also economically feasible. The use of waste glass in production of building materials (Such as brick) has been successfully carried out as it can reduce both the consumption of natural resources and the coste of waste disposal while protecting the environment from the harmful effects of waste materials.

1.2 Aim of the Project

Experimental Study of Waste Material to Produce Eco Friendly Bricks.

1.3 Objective of Project

- To develop an efficient way and to effectively utilize the waste glass and waste tiles.
- To reduce the consumption of natural resources such as clay and river Sand for the Manufacturing of bricks.
- To study the material propertied of waste Tiles, waste Glasses.
- To study IS 5454 : 1978 is use to make Brick samples.
- To analyzing which proportion will be suitable for Bricks and procedure of making brick.
- To achieve strength and feasibility.
- To find various test results on brick samples.

CHAPTER 2

LITERATURE REVIEW

2.1 Background Study :

The main goal of researching waste materials is finding the new class of materials with the tactic, considered as a multipurpose material; that give good Strength, creative architecture and construction through sustainability.

With the advent of advanced technology, waste materials are used in various civil engineering application. Waste materials being a relatively new can indeed create high value-added opportunities and has a strong innovative content if well supported.

This literature summaries of the technology, material requirements, classification of smart materials, smart structures and their application. The insights gained by gathering data on smart materials have found a large number of application in civil engineering practice.

Smart materials technology being a comparatively new can indeed create high value- added opportunities and feature a strong innovative content if well supported and exhibit extraordinary ability in performing their design function. Smart materials are capable of sensing their environment and may actuate so as to perform their functions.

2.2 Finding from Literature Review

The literature search includes reviews of published literature. Fields performance reports and other published documents. However, the field performance remains limited. The given table (2.2.1) shows the which materials author used and what is the proportion they used in their project, and shows the result of those material.

Table 2.2.1 Summary of literature review

Sr. No	Author and year	Material used & proportion	Conclusion
1	Samir Ur Rehman S. (July 2018)	Waste paper. 20 % proportion of waste material used	**Result :** 1) Water Absorption was recorded as 34.6 % 2)It was observed that the sample was able to take load of 500 kg of compressive load

			2) Compression test. Sample was made to undergo fire resistance test in an electrical oven as t temperature of 150^0 C. **Conclusion :** work developed a paper brick with the help of waste paper, Portland cement and PET (Polyethylene Terephthalate) bottles. Experiments result show that there is a very vast scope fore developing cost effective alternative building materials.
2	Muhannad Saleem Syed Kazmi saffer Abbas (Sep. 2014)	Sugarcane bagasse ash (SBA) and rice husk ash (REHA) To a proportion of 5,10,15 and mix with water.	**Result :** **1) Compression strength test :** The bricks specimens show the strength of 6.62 & 7.18 Mpa. after incorporating 5% of RHA & SBA. **2)Water absorption test :** It shows that the addition of SBA it gives the 10 % of absorption & without SBA it gives the 17 % of absorption to its own weight. **Conclusion :** Bricks specimens after incorporation of RHA & SBA shoe less compression and flexural strength. 5 % of waste addition is burned clay brick satisfy the building codes of Pakistan.
3	Ismil Demir Mehnat Orhan(May 2003)	Perlite (Volcanic rock) and lime material as a binder with proportion of 30 %	**Result :** 1) Maximum dry shrinkage 5.75 % for the perlite bricks. 2) **Water absorption test :** Average water absorption value in % =24.7 **3)Compression strength test :** Average bulk density of perlite brick = 623.28kg/m3 **Conclusion :** The low unit weight is one of the most important features for the bricks and construction sector. Water absorption of (80.20) brick is lower compare to other brick samples. The less water absorbed by brick the greater its quality.

4	Maniah Kothari (June 2021)	Plastic Waste and foundry dust 75 % waste dust mixed and 25 % plastic waste	**Result :** **Compression test shows** that the these bricks are 2.5 times stronger than the normal red clay bricks. **Water absorption test**, in this test these bricks compute the 0% absorption of water. **Conclusion :** The rhino bricks can not only meet industrial pollution but also turns waste into product.
5	Bijakhan Shaffin Hadawlae Kishori Jore Aparna (Feb 2019)	Fly ash, demolished mortar, sludge, demolded bricks.	**Result :-1) Water absorption test** , of these bricks came with 1 15% of its own weight. **2)Compression strength test,** of this brick is 342 N/mm2 **Conclusion :-** the bricks are mainly made of fly ash & stidge and OPC is used as a binder & demolished mortar and demolished bricks is used to reduce the cost and waste to provide the sustainable solution.

2.3 Literature of Review

1. Pravin P. Godling, M.B. Verma, "A review of eco –friendly brick by using fly-ash", Journal of Construction engineering, Technology and management, Vol. 07, April 2018, pp2249-4723

Studied on the reaction between FA and lime and mentions in paper that reaction between FA and lime is exploited for the manufacturing of bricks. he also told that, the FA reacts with lime at normal temperature in presence of moisture and from compound having cementations propertied. In his investigation, the reaction between FA and lime in compacted form was studied and then measuring free lime. CaO remaining in the mix after different periods of curing.

2. mohannad Azhar Saleem syed Minjaj Saleem Kazmi, " clay bricks prepared with sugarcane bagasse and rice husk ash-A sustainable solution", Matec web of conference – 120, 03001, Sep 2014.

It is found that the cement could be advantageously replaced with SCBA up to maximum limit of 10 %. Although, the optimal level of SCBA content was achieved with 1.0 % replacement. Partial replacement of cement by SCBA increase workability of fresh concrete; therefore, use of super plasticized is not substantial. The density of concrete decreases with increase in SCBA content, low weight concrete produced in the society with waste materials (SCBA) [3]. Locally available agro waste ash (BA) was used to replace cement in proportions 5%, 10%, 15, 20% by eight of cement respectively in concrete.

3. Aneke Frank Ikechukwu, Celumusa Shabangu," Critical review on types of bricks types 14 – plastic sand bricks", Case studies in construction materials, Vol-2021, March 2021

Brick is one of the most common masonry units used as building material. Due to the demand, different types of waste have been investigated to be incorporated into the bricks. There has been a considerable imbalance between the availability of conventional building materials and their demand in the recent past. On the other hand, the plastic waste is abundantly available and the disposalof waste plastics is a biggest challenge, as repeated recycling of PET botterls posesa potential danger of being transformed to a toxic material and only a small proportion of plastic wastes are being recycled.

4. Manish Kothari, " Manufacturing and Testing of Plastic Sand Bricks:, Web page June- 2021. (https://www.thebetterindia.com/233190/plastic-waste-bricks-cheap-low-cost-purchase-features-recycle-emngineer-crchitect-anand-gurarat-agn136/)

Plastic is a non-bio-degradable substance which takes thousands of years to decompose that created land as well as water pollution to the environment. The quantity of plastic waste in Municipal Solid Waste (MSW) is expanding rapidly. It is estimated that the rate of usage is double for every 10 years. The plastic usage is large in consumption and one of the largest plastic wastes is polyethylene (PE) The utilization of earth-based clay material of the largest plastic wastes is polyethylene(PE).

5. Ismil Demir, Mehnat Orhan, " An Investigation on the Production of Construction Brick with Perlite Addition", journal of key engineering material, May 2004, Vol-264 pp268:2161

Ismil Demir, Mehnat Orhan (May 2003) studies the manufacturing heat insulation as heat conductivity resistant bricks with clay and perlite. The mixture was constituted from clay and perlite with diverse perlite-clay ratios by weight and water that was incorporated into mixture around 7.4 % of total aggregate weight. Specimens were maintained at room temperature for 24h and then cured at 200^0 C for completion of curing process in an strength.

2.4 Finding from Literature survey :

Based on the previous research work, a comparison of strength and proportion of industrial and construction waste materials are used.

1. Combination of two waste materials waste glass and waste tile.
2. The variation in the proportion of waste glass and waste tile.
3. The sieve size is different for the various proportion.
4. The percentage of the fly ash is used 60 % for the all proportion because when fly ash is added 60 % them it gives the good compressive strength, which is referred from literature "A review of ecofriendly bricks by using fly ash" by Pravin P. Gadling.
5. The percentage of OPC (Ordinary Portland cement) is used 10 % and the percentage of sand is used 10 5 for all the proportion.

CHAPTER NO 3

CODAL PROVISION

Overview :

For the comparative study of the International Building codes namely IS, ACI & UBC/IBC are considered, After studying and analyzing different clauses of these coded comparative discussion has been made along with highlighting some research gaps. These comparisons will facilitate the scope of improvement in building codes after further studies and validation.

Indian Standard Recommendation

The materials selection as per IS codal provision that gives specification of materials used in manufacturing of Bricks.

a) Cement
b) Fly Ash
c) Water
d) Sand

Table No. 3.0 Materials and IS codes

Sr No	Materials	IS code Uded
1.	Cement	IS 8112:2013
2.	Fly Ash	IS 3812 (Part 1) 2003
3.	Sand	IS 2116 (1980)

Cement :

Physical analysis of 43 Grade Portland cement as per IS 8112:2013

Fly Ash :

Fly ash governed by IS 3812 (part 1) 2003. the BIS specification limits for chemical and physical property.

3.1 IS 12894 : 2002 Pulverized Fuel Ash-line Bricks Specification (First Revised)

In this code test of tolerance and dimension for fly-ash brick is given (clause 5.1- and 5.2- page no. 62). The most commonly used and manufactured brick size is the “Imperial Brick”.

It is 230 mm long x wide 71 mm high with a mass between 3 and 5 kg, depending on the materials used, the degree of verification and the perforation provided.

The figure 3.1.1 shows the standard shape, size and frog of non-modular brick.

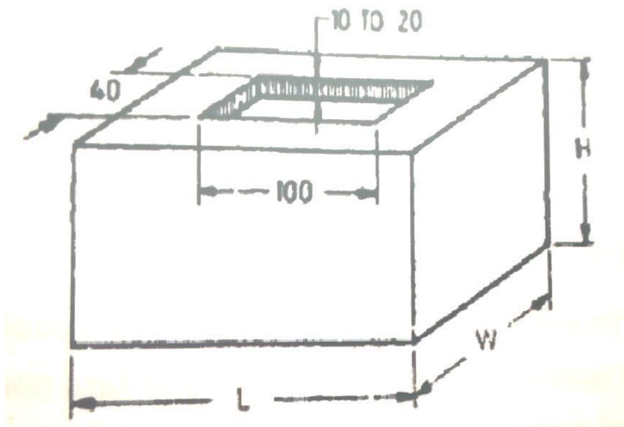

Fig. 3.1.1 Shape and Size of frog in brick

3.2 IS :3495 Method of Testing of Burnt Clay, Building Bricks

1. Determination of Compressive strength (IS 3495-1992 part 1 pg. No Clause No. 4)

Apparatus : A compression testing machine, the compression plate which shall have a ball seating in the form of portion of a sphere, the center of which coincides with the center of the plate, shall be used.

Preconditioning: Remove unevenness observed in the bed faces to provide two smooth and parallel face by grinding. Immerse in water at room temperature for 21 h. remove the specimen and drain out any surplus moisture at room temperature. Fill the frog (where provide) and all voids in the is the bed face flush with cement mortar (1 cement, clean coarse sand of grade 3 mm and down). Store under the damp jute bags for 24 h, followed by immersion in clean water for 3 days. Remove and wipe out any traces of moisture.

Procedure: Place the specimen with flat faces horizontal, and mortal filled face facing upward between two 3-ply plywood sheets each of 3 mm thickness and carefully center between plates of the testing machine. Apply load axially at a uniform, rate of 14N/mm ^{2} (140 kg/cm^2) per minute till failure occurs and note the maximum load at failure. The load at failure shall be the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

$$\text{compressive strength (N/mm2)} = \frac{\text{Maximum load at failure (N)}}{\text{Area of bed Surface (mm2)}}$$

2. Determination of Water Absorption (IS 3495-1992 Part 2 pg. No. 3 Clause No. 4)

Apparatus : A sensitive balance capable of weighing within 1% of the mass of the specimen; and a ventilated oven.

Preconditioning : Dry the specimen in a ventilated oven at a temperature of 105 to 115^o C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weigh (m1) Specimen, warm to touch shall not be used for the purpose.

Procedure : Immerse completely dried specimen in clean water at a temperature of 27+2^{o}C for 24h. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 min after the specimen has been removed from water. Water absorption, percent by mass, after 24 h. immersion in cold percent in cold percent by mass, after 24 h immersion in cold water is given by the following formula.

$$\text{Water Absorption (\%)} = \frac{M2-M1}{M2} * 100$$

3. Determination of Efflorescence (IS 3495-1992-part 3 pg. No. 5 Clause No. 4)
Apparent : A shallow flat bottom dish containing sufficient distilled water to completely saturate the specimens is used. The dish shall be made of glass porcelain or glazed stoneware and of size 180 mm x 180 mm x 40 mm depth for square shaped and 200 mm x 40 mm depth for cylindrical shaped.

Procedure : Place the end of the bricks in the dish, the depth of immersion in water being 25 mm. Place the whole arrangements in a warm (For example, 20 to 30 ^{o} C) well ventilated room until all the water in the dish is absorbed by the specimens and the surplus water evaporates. Cover the dish containing the brick with suitable glass cylinder so that excessive evaporation from the dish may not occur. Ehen the water has been absorbed and bricks appear to be dry, place a similar quantity of water in the dish is absorbed by the specimens and the surplus water evaporates. Cover the dish containing the brick with suitable glass cylinder so that excessive evaporation from the dish may not occur. Ehen the water has been absorbed and bricks appear to be dry, place a similar quantity of water in the dish and allow it to evaporate as before.

Report : The liability to efflorescence shall be Nil- When there is no perceptible deposit of efflorescence.

Slight – Ehen not more than 10 percent of the exposed area of the brick is covered with a thin deposit salts.

Moderate – When there is a heavier deposit that unaccompanied by powdering or flaking of the surface.

Serious – When there is a heavy deposit of salts accompanied bp powdering and /or flacking of the exposed surfaces.

3.3 Fly –Ash Lime Brick (IS 2180 and IS 1077)

Fly-ash lime brick has weight compressive strength less than 30 N/mm2 approximate 300 kg/cm2 for higher strength.

There are several Indian standard codes for Bricks like IS 5454 on "Code for the Sampling for the fly Ash Brick".

The IS : 5454: 1976 is used for sampling for fly ash brick.

- This standard lays down methods for sampling and criteria for ascertain conformity of solid, hollow and perforated burnt clay building bricks to the relevant specifications.
- A collection of bricks of the same class and side, manufactured under relatively similar conditions of production. For the purpose of sampling, a lot shall contain a maximum of 50 000 bricks. In case a consignment has bricks

more than 50000 of the same classification and size, and manufactured under relatively similar conditions production, it shall be divided into lots of 50000 bricks or part thereof.

- The dimension and tolerances have been specified in various standards for clay buildings bricks. In some standards the dimensions and tolerances have been specified for individual brick. In some other standards the dimensions and tolerances have been specified a group of 20 bricks.

3.4 Bricks Classification

On field practice bricks are classified as first class and fourth class nased on their physical and mechanical propertied.

As per Indian Standard IS: 1077-1957, the bricks are classified as under the various class on their propertied and Compressive strength. Table 3.4.1 shows the class Designation of bricks according to their Average Compressive Strength.

Table of 3.4.1 Classes of Burnt Clay –Fly Ash Bricks

Table 1 Classes of Burnt Clay-Fly Ash Bricks
(Clause 4.1)

Class Designation	Average Compressive Strength Not Less than	
	N/mm^2	kgf/cm^2 (Appox)
30	30.0	(300)
25	25·0	(250)
20	20·0	(200)
17·5	17·5	(175)
15	15·0	(150)
12·5	12·5	(125)
10	10·0	(100)
7·5	7·5	(75)
5	5·0	(50)
3·5	3·5	(35)

CHAPTER NO 4

MATERIAL USED

Traditionally, the term brick referred to a small unit of building material consisting primarily of clay. As the high usage of clay in brick cause the problem of soil erosion and destroying the natural resources. Therefore, the fly ash is best alternative for clay, generally, for making Fly ash bricks OPC, fly ash and sand is required but in finding of higher strength we have added different materials like waste tiles and waste glass.

For making brick samples different type of material are used as follows.

1. Waste glass
2. Fly ash
3. OPC
4. Natural Sand

4.1 Waste Glass

Million tons of waste glass is being generated annually all over the world. Once the glass becomes a waste it is disposed as landfills, which is unsustainable as this does not decompose in the environment. Glass is principally composed of silica. Use of milled (ground) waste glass in concrete as partial replacement of cement could be an important step toward development of sustainable (environmentally friendly, energy-efficient and economical) infrastructure system. When waste glass is milled down to micro size particles, it is expected to undergo pozzolanic reaction with cement hydrated, forming secondary Calcium Silicate Hydrate (C-S-H). In this research chemical propertied of both clear and colored glass were evaluated. Chemical analysis of glass and cement samples was determined using X-ray fluorescence (XRF) technique and found minor differences in composition between clear and colored glasses. Flow and compressive strength tests on mortar and concrete were carried out by adding 0-25 % ground glass in which water to binder (cement + glass) ratio is kept the same foe all replacement levels. With increase in glass addition mortar flow was slightly increased while a minor effect on concrete workability was noted. To evaluate the packing and pozzolanic effects, further tested were also conducted with same mix details and 1 % super plasticizing admixture dose (by weight of cement) and generally found an increase in compressive strength of mortars with admixture. As with mortar, concrete cube sample were prepared and tested for strength (until 1 year curing). The compressive strength test results indicated that recycles glass mortar and concrete gave better strength compared to control samples. A 20 % replacement of cement with waste lass was found convincing considering cost and the environment.

Glass is the background of the daily lives of most people. the potential for glass recycling comes largely from the container and flat glass sectors, because of their dominance in terms of mass and their relatively uniform chemical composition, with soda lime-silica glass accounting for virtually all the contained and flat glass produced.

Fig. 4.1.1 Waste Tiles

4.2 Waste tiles

Ceramic tiles are important construction materials used in almost all building. The production of these tiles normally starts from raw material. Grinding and mixing. Granulating by spray drying pressing, firing and /or polishing and glazing, Waste mid, which the sediment is of washed down particles from these manufacturing processes in approximately 2 % of the final products. This mud which contains both coarse particles (feldspar, quartz, and ground fired tiles) and fine particles (clay minerals such as kaolinite and mice) is far too impure to be re-used in tile production, so it is normally disposed of as waste in landfills. Elimination of this waste mud has become more and more problematic due to the huge amount of this waste produced each year and the increasing cost of disposal one way forward to solve this problem is by utilizing this waste for other proposed. (D. Wattarnasiriwech et al, 2009)

Ceramic wastes are produced as a result of the ceramic processing. These wasted cause soil, air and groundwater pollution. The pollutant of ceramic industry which are mud and tile are coming from the ceramic plant's refinery systems are stored in the waste disposal site of the plant.

There is a high concentration of Zn in the refinery mud coming from the unit of glaze plant. Tile waste foes not pollute the environment. There are number of hazardous wastes used in stabilization/solidification (S/S) technique. These techniques are used in the industry for different types of wastes materials. Stabilization is the process of modifying the mechanical, chemical and hydraulic propertied of a waste residue to produce a more environmentally safe, economical and low maintenance waste disposal waste disposal sites (H. Koyuncuetal, 2004)

The amount of tile waste on earth is enough for use as an aggregate in concrete. Tile is produced from natural material sintered at high temperatures. There are no harmful chemicals in tile. Waste tiles cause only the apparition of pollution. However, some parts of tiles are used in cotto as flooring and also flooring in tennis courts, walkaways, cycling paths and gardens as a ground material. Therefore, waste tiles are stores in factory fields because of their economic value Nevertheless, each year approximately 2500, 000 tins if tiles are worn out, while 100 million tiles are used for repairs. These waste materials can be recycled to save money (I.B Topcu and M. Canbaz, 2007)

Ceramic waste can be transformed into useful coarse aggregate. The properties of ceramic waste coarse aggregate are well within the range of the values of concrete making aggregates.The properties of ceramic waste coarse aggregate concrete are not significantly different from those of conventional concrete. The use of ceramic waste coarse aggregate concrete has increased because it has various advantages over other cementations materials (H Bincici, 2007)

It has been estimated that about 30 % of the daily production in the ceramic industry goes to waste. This waste is not recycled in any form at present. However, the ceramic waste is durable, hard and highly restart to biological, chemical and physical degradation forces. As the ceramic waste is piling up every day there is pressure on the ceramic industries to find a solution for its disposal. Meanwhile conventional crushed stone aggregate reserves are residual products in making concrete will lead to sustainable. Concrete design and greener environment (RM Senthamarai and P.D Manoharan, 2005)

Fig.4.2.1. Waste Tiles

4.3 Fly Ash :

Fly ash is heterogeneous y product material produced in the combustion process of coal used in power stations. It is fine grey colored powder having spherical glassy particles that rise with flue gases. As fly ash contains pozzolanic materials components which reach with lime to from cementations materials. Thus, fly ash is used in concrete, mines, landfills and dams.

Fly ash or flue ash, also known as pulverized fuel ash, or coal combustion residuals (CCRs), is a coal combustion product that is composed of the particulates (fine particles of burned fuel) that are driven out of coal- fired boilers together with the flue gases. In modern coal-fired power plants, fly ash is generally captured by electrostatic precipitators or other particle filtration equipment's before the flue gases reaches the chimneys. Depending upon the source and composition of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amount of silicon dioxide ($SiO2$) b (both amorphous and crystalline), aluminum oxide ($A12O3$) and calcium oxide (CaO) the main mineral compounds in coal bearing rock strata.

In the past, fly ash produced from coal combustion was simply entrained in flue gases and dispersed into the atmosphere. This created environmental and health concerns that prompted laws that have reduced fly ash emissions to less than 1 % of ash produced. Worldwide, more that 65 % of fly ash produced from coal power stations is disposed of in landfills and ash ponds. The current fly ash scenario in India is given below which is referred from the literature "A review of ecofriendly bricks by using fly ash" by Pravin P. Gadling et and all.

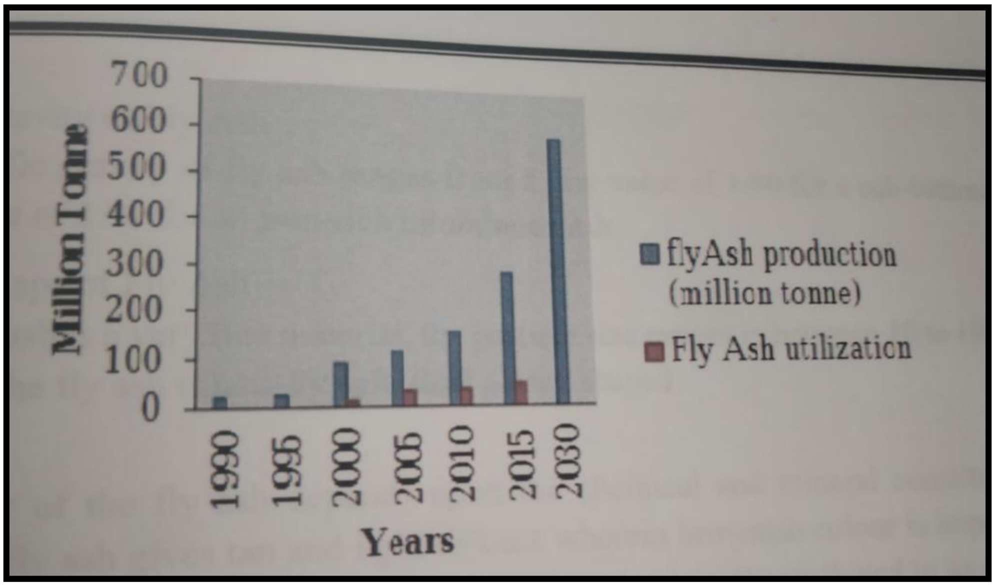

Fig.4.3.1 Current fly ash scenario in India

Chemical Composition of Fly Ash

The chemical composition of fly ash depends upon the type of coal used and the methods used for combustion of coal. the below table 4.3.1 shows the chemical composition of fly ash of different coals. the chemical composition which is referred from

Table 4.3.1 Chemical composition of fly ash of different coals.

Component	Bituminous Coal	Sub bituminous Coal	Lignite Coal
SiO2 (%)	20-60	40-60	15-45

A12O3 (%)	5-35	20-30	20-25
Fe2O3 (%)	10-40	4-10	4-15
CaO (%)	1-12	5-30	15-40
LOI (%)	0-15	0-3	0-5

Description :-

The physical propertied of fly ash are,

1. **Fineness of Fly Ash :-**

   As per ASMT, the fineness of the fly ash is to be checked in both dry n wet sieving. The fly ash sample is sieved in 45-micron sieve and the percentage of retained on the 45-micro sieve is calculated. Further fineness is also measured by Le Chatelier method and Blaine Specific Surface method.

2. **Specific Gravity of Fly Ash :-**
   The specific gravity of Fly ash ranges from a low value of 1.90 for a sub bituminous ash to a high value of 2.96 for an iron-rich bituminous ash.
3. **Size and Shape of Fly Ash :-**

   As the fly ash is very fine material, the particles size ranges in between 10 to 100 microns. The shape of the fly ash is usually spherical glassy shaped.

4. **Color :-**

   The color of the fly ash depends upon the chemical and mineral constituents. Lime content in the fly ash gives tan and light colours wheras brownish colour is imparted by the presence of iron content. A dark grey to black colour is typically attributed to an elevated un-burned content.

Classification of Fly Ash

The classification of fly ash is done differently as per codes uded. They are

1. Type of Fly Ash as per IS Codes (IS 3812-1981)

A. **Grade I**

This grade of Fly as is derived from bituminous coal having fraction SiO2+A12O3+Fe2O3 greater than 70 %.

B. **Grad II**

This grade of Fly ash derived from lignite coal having fractions SiO2+Fe2O3 grater then 50 %.

1. **Type of fly ash as per American Society for Testing and Materials (ASTM C618)**

Depending on the type of coal and the resultant chemical analysis, ASTM has classified fly ash.

A. Type C

Type C fly ash is produced from the combustion of lignite or sub bituminous coals, contains CaO higher than 10 percent and possessed cementitious propertied in addition to pozzolanic properties.

B. Type F

Type F fly ash is produced from the combustion of bituminous or an anthracite coal contains CaO below 10 percent and possesse pozzolanic properties.

Fig.4.3.2 Fly Ash

Property :

- Fitness of Fly Ash-As per ASTM, The fineness of the fly ash is to be checked in both dry n wet sieving. The fly ash sample is sieved in 45- micron sieve and the percentage of retained on the 45-micron sieve is calculated. Further fineness is also measured by Le Chaterlied method and Blaine Specific Surface method.
- Specific Gravity of Fly Ash- The specific gravity of fly ash ranges from a low value of 1.90 for a sub-bituminous ash to a high value of 2.96 for an iron-rich bituminous ash.
- Size and shape of Fly Ash-As the fly ash is a very fine material, the particle side ranges in between 10 to 100 microns. The shape of the fly ash is usually spherical glassy shaped.

Application :

- Concrete production, as a substitute material for Portland cement, sand.]
- Fly –ash pellets which can replace normal aggregate in concrete mixture.
- Embankments and other structural fills (Usually for road construction)
- Grout and Flow able fill production
- Waste stabilization and solidification.
- Cement clinker production – (as a substitute material for clay)
- Mine reclamation
- Stabilization of soft soils
- Road sub base construction

As aggregate substitute material (e.g. for brick production)

Advantages :

- It is highly economical.
- Use of Fly Ash is environmentally friendly as the waste materials from industries are effectively being used to create quality building materials.

- Fly ash has very small particles which makes the concrete highly dense and reduce the permeability of concrete, it can add greater strength to the building.
- The concrete mixture generated a very low heat of hydrations which prevents thermal cracking.
- Fly Ash concrete is resistant to acid and sulphate attacks.

Disadvantage

- The quality of fly ash can affect the quality and strength of Cement concrete. Poor quality fly ash can increase the permeability of the concrete and cause damage to the building.

4.4 Ordinary Portland Cement:

Properties of Ordinary Portland Cement:

(1) Chemical Propertied

Portland cement c onsists of the following chemical compounds.

a) Tricalcium Silicate [3 caO.SiO2 (C3S)] %
b) Dicalcium Silicate [2CaO.SiO2 (C2S)] 30 %
c) Tricalcium aluminate [3CaO.A12O3 (C3A)] 11 %
d) Tetra calcium aluminate [4CaO.A12O3. Fe2O3 (C3AF)] 11 %

There may be small quantities of impurities present such as calcium oxide (CaO) and magnesium oxide (MgO)

When waters added to cement, C3A is the first to react and cause initial set. It generated great amount of heat. C3S hydrates early and develops strength in the first 28 days. It also generated heat. C2S us the next hydrate. It hydrated slowly and is responsible for increase in ultimate strength. C4AF is comparatively inactive compound.

(II) Physical Propertied

The following physical propertied should be checked before selecting a port land dement for the civil engineering works. IS 2691967 specifies the method of testing and prescribes the limits.

(a) Fineness (b) Setting time

(b) Soundness (d) Crushing strength

(a) Fineness : It is measured in terms of percentage of weight retained ager sieving the cement through 90-micron sieve or by surface area of cement in square centimeter per gram of cement. Accourding to IS code specification weight retained on the sieve should not be more than 10 percent. In terms of specific surface should not be less than 2250 cm2/gm.

Fig.4.4.1 Ordinary Portland cement

(b) Setting time : A period of 30 minutes as minimum setting time for initial setting and a maximum period of 600 minutes as maximum setting time specified by IS code, provided the tests are conducted as per the procedure prescribed by IS 269-1967.

(c) Soundness : Once the concrete has hardened it is necessary to ensure that no volumetric changes take place. The cement is said to be unsound, if it exhibits volumetric instability after hardening. IS code recommending test with Le

Chatelier mould for testing this property. At the end of the test, the indicator of Le Chatelied mould should not expand by more than 10 mm.

(d) Crushing Strength: For this mortar cubes are made with standard sand and tested in compression testing machine as per the specification of IS code. The minimum strength specified is 16 N/mm2 after 3 days of curing.

Advantages of ordinary Portland cement:

- OPC has great resistance to cracking and shrinkage.
- The initial setting of OPC is faster that that PPC.
- The treatment period of OPC is shorter than PPC hence the cost of treatment is reduced, therefore recommended where the cost-prohibitive treatment will occur.

Disadvantage of ordinary Portland Cement :

- It cannot be used for large-scale concreting because it has a higher heat of hydration than PPC.
- The durability do OPC is lower than the PPC.
- It produces relatively less solid concrete than PPC, so pumping the concrete becomes a bit difficult.
- The OPC is finer hence higher permeability and consequently lower durability.
- OPC is expensive than PPC.

4.5 Natural Sand :

Sand is a granular material composed of finely divided rock and mineral particles, Sand has various compositions but is defined by its grain size. Sand grains are smaller than gravel and coarse than silt. Sand can also refer to textural class of soil or soil or soil type; i.e. a soil containing more than 85 percent sand –sized particles by mass. The composition of sand various, depending on the loca rock sources and conditions, But the most common constituent of sand in iland continental setting and non-tropical coastal settings is silica (silicon dioxide, or SiO_2) usually in the form of quartz.

Fig.4.5.1 Natural Sand [River Sand]

Calcium carbonate is the second most common type of sand, for example, aragonite, which has mostly been created, over the past 500 million years, by various forms of life, like coral and shellfish. For example, it is the primary form of sand apparent in area where reefs have dominated the ecosystem for million of years like the Caribbean. Somewhat more rarely, sand may be composed of calcium sulphate, such as gypsum and selenite, as is found in place like White Sands National Park and Salt Plains National Wildlife Refuge in the U.S

Sand is a non-renewable resource over human timescales, and sand suitable for making concrete is in high demand. Fig. 4.5.1 shows the natural sand from river basin of "Bawanthadi", Desert sand, although plentiful, in not suitable for concrete. 50 billion tons of beach sand and fossil sand is used each year for construction.

Composition :

The exact definition of sand varies. The scientific Unified Soil classification System used in engineering and geology corresponds to US Standard Sieves, and defines sand as particles with a diameter of between 0.074 and 4.75 millimeters. By another definition, in terms of particle size as used by geologists, sand particles range in diameter from 0.0625 mm a volume of approximately 4.2 cubic millimeters, the difference in volumes being 34,688 measures difference. Any particle falling within this range of sizes is termed a sand grain. Sang grains are between gravel.

Sources :

Rocks erode or weather over a long period of time, mainly by water and wind, and their sediments are transported downstream. These sediments continue to break apart into smaller pieces until they become fine grains of sand. the type of rock the sediment originated from and the intensity of the environment five different compositions of sand. The most common rock to from sand is granite, where the feldspar minerals dissolve faster than the quartz, causing the rock to break apart into small pieces. In high energy environments rocks barks apart much apart much faster than in more calm setting. In granite rocks this results in more feldspar minerals in the sand because they don't have as much time to dissolve away. The term for sand formed by weathering is "epiclastic".

Uses :

Abrasion : Before sandpaper, wet sand was used as an abrasive element between rotating devices with elastic surface and hard materials such as very hard stone (making of stone vases), or metal (removal of old stain before re-staining copper cooking posts)

Agriculture : Sandy soil are ideal for crops such as watermelons, peaches and peanuts, and their excellent drainage characteristics make them suitable for intensive dairy farming.)

Air filtration : Finer sand particles mixed with close was commonly used in certain gas mask filter designs but have largely been replaced by microfibers.

Aquaria : Sand makes a low-cost aquarium base material which some believe is better than gravel for home use. It is also a necessity for saltwater reef tan, which emulate environment composed largely of aragonite sand broken down from coral and shellfish.

Artificial reefs: Geotextile nagged sand can serve as the foundation for new reefs. Artificial islands in the Persian Gulf.

Beach nourishment : Governments move sand to beaches where tides, stroms, or deliberate changes to the shoreline erode the original sand.

Cob : Coarse sand makes up as much as 75 % of cob.

Bricks : Manufacturing plants add sand to mixture of clay and other materials for manufacturing bricks.

Concrete : sand is often a principal component of this critical construction material.

Glass : Sand rich in silica is the principal component in common glasses.

Landscaping : Sand makes small hills and slopes (Golf courses would be an example)

Mortar : Sand is mixed with masonry cement or Portland cement and lime to be used in masonry construction.

Paints : Mixing sand with paints produces a textures finish for walls and ceiling or non-slip floor surfaces.

Railroads : Engine drives and rail transit operators use sand to improve the traction of wheels on the rails.

Recreation : Playing with sand is a favorite beach activity. One of the most beloved uses of sand to make sometimes intricate, sometimes simple structures known as sand castles, proverbially implement. Special play areas for children enclosing a significant area of sand and known as sand box, are common on many public playgrounds, and even as some single-family homes. Sand dunes are also popular among climbers, motorcyclists and beach buggy drivers.

Roads : Sand improves traction (and thus traffic safety) in icy or snowy conditions.

Sand animation: Performance artists draw images in sand. Makers of animated films use the same term to describe their use of sand on front lit or backlit glass.

Sand casting : Casters moisten or oil moulding sand, also known as foundry sand and then shape it into moulds into which they pour molten material. This type of sand must be able to withstand high temperatures and pressures, allow gases to escape, have a uniform, small grain size, and be non-reactive with metals.

Sandbags : These protect against floods and gunfire. The inexpensive bags are easy to transport when empty, and unskilled volunteers can quickly fill them with local sand in emergencies.

CHAPTER NO. 5

METHODOLOGY

5.1 Collection of material :

For preparation of brick samples various materials are used which are waste glass, waste tiles, natural sand, ordinary Portland cement. Where, waste tile was collected from "Kach Company", waste tiles were collected from construction site. Fly ash was collected from the thermal power plant which is "Adani Power plant – tirora" and natural sand was collected from "Bawanthadi" river.

Glass :

The waste glass is collected from the glass factory, glass which are broken in small pieces while cutting the glass fir various shapes for wind shield purpose. Waste glass can also be collected from demolished waste. We have collected 15 kg of waste glass and sieved it from 2.36mm and 4.75 mm. to make it in fine powder as in to be worked in brick formation. The below figure 5.1.1 shows the Waste Glass.

Fig.5.1.1 Waste Glass

Waste tiles :

The waste tiles were collected from the demolished construction waste. These tiles have high tensile strength, as it is use for staircase decorative purpose. We have used 15 kg of waste tiles in it and cost us the transportation only, but in practical purpose of modelling it charges 30 paise for construction of model. We have crushed the big pieces of glass and tiles in standard size manually, so that can be crushed in impact testing machine into micron pieces. The below figure 5.1.2 show the Waste tiles in before and after Crushing and sieved from.

5.2 Preparation of materials :

First the waste tiles break into small chunks from hammer and then that small chunks put in a 'Impact Testing Machine' to make fine powder. Then the crushed tile and glass powder sieve through two different size of sieve, first sieve form 2.36mm sieve which is passing from 2.36mm sieve and then we sieve the crushed waste materials which is passing from 2.75mm sieve and retaining from the 2.36mm sieve size. Same procedure dine for glass and tile. The below figure 5.2.1. show the Manually crushing and sieving the tiles and glass.

5.3 Making of Bricks :

The main and most important phase for making fly ash brick in to mix the raw material as well. The quality and strength depend on the mixing process. These are the different types of material that will be mixed in the following ideal materials Fly ash, sand, waste tiles, waste glass.OPC (Ordinary Portland cement), and water. These all material can be used in fly ash brick making machine. In this mixing process, after adding waste glass, waste tikes, and fly ash with some water, It is suggested to mix well appropriately, After that add a oration of sand and cement as above-mentioned table. And mixed it for some time till is is not mixed properly. With these or basic raw material manufacturing process comes to an end.

Fly ash bricks (230 x 110 x 80) mm were manufactured using as semi-automatic operated machine. The following steps were followed in manufacture incompacted fly ash bricks.

1) Fly ash and sand (60 % fly ash : 10 %sand, by weight) were mixed in dry state. Required amounts of line and gypsum were added to the dry mixture. Both these operations were carried out in a mechanical mixer (for 5 minutes) such that a uniform mixture of fly ash-sand-stabilizer was obtained. Figure 5.4.1 shows the manually mixing of material for brick sample.

2) Uniform mixture of fly ash-sand-stabilizer was spread into a thin layer (100 mm thickness). Using a garden rose-can required amount of water (10 % for FAL 10 and FALG 10 brick, and 12 % for FAL 17 and FALG 17 bricks) was sprinkled and mixed manually with the aid of a spade in order to ensure that moisture is uniformly distributed in the mixture.
3) Known amount of the fresh mixture was weighed and poured into the machine mound. Shows the filled mould really for compaction. After closing the lid, the compaction is carried out through the movement of pastor attached to the toggle lever.
4) After compaction stroke the lid is opened and the brick is ejected out and kept in a stack for curing. The fig. 5.4.2 shows the mechanical procedure for making brick. The Stack of fly ash bricks was covered with wet gunny cloth and water is sprinkled three to four times daily such that the entire stack is moist. The bricks were cured for 28 days and then were allowed to dry in the open atmosphere for four weeks and then used for testing.
5) After the brick goes through by mixing and pressing processed, now it turns to do cure and dry the bricks. When bricks made it is stored in very safe chamber and placed through palled truck. (Figure 5.4.3) is the final brick for construction use after drying and curing of the bricks for around 10 -15 days in the sun light. So. This is the whole process the bricks are made. This process is not tactic and difficult as you go accordingly and wisely.

CHAPTER NO 6

RESULT & DISCUSSION

Various Test Performed on Bricks

Bricks are the oldest and useful construction materials used all over the work for masonry construction. Due to the immense importance of bricks in such types of the bricks in such types of construction, it is necessary to determine the suitability and quality of bricks.

Field Test	Laboratory Test
1. Shape and Structure Test 2. Soundness Test 3. Dimension Test 4. Hardness Test 5. Strength Test	1. Water Absorption Test 2. Crushing Strenght Test 3. Effloresces Test 4.

6.1 Field test of bricks :

It is necessary to check the quality of brick before using it in construction activity. There are some field tests that we can conduct in the field on order to check the quality of bricks. These tests are as follows.

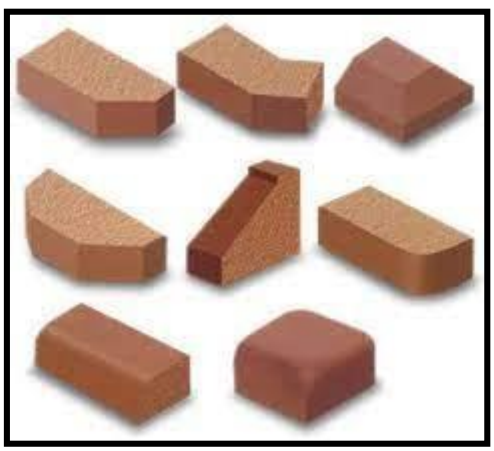

Fig.6.1.1 Shapes of Bricks

1. **Shape and Structure Test :**

Shape and size of brick are very important consideration. All bricks used for construction should be of same size. The shape of brick should be purely rectangle with sharp edged. In this test, a brick is closely inspected. It should be of standard size and its shape should be rectangular worth sharp edged. Fig.

6.1.1 shows Shape of brick. For this purpose, 20 bricks of standard size (230mm x 75mm) are selected at random and they stacked lengthwise, along the width and along the height. For good quality bricks, the results should be within the permissible limits.

That test is done to examine the structure of the brick when the brick in broken. It is seen that the structure of the brick is homogeneous, compact and free from any defect such as holes, limps etc. or not. Mainly the defects such as holes, lumps should not be there.

2. **Soundness Test :**

   Soundness test of brick carried out to check the nature of brocks when it connects with sudden impact load. 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 beaks then those are good quality bricks. Soundness test bricks shows the nature of bricks shows the nature of bricks against sudden impact. In this test, 2 bricks arte chose randomly and struck with oneanother.

3. **Dimension Test :**

   The test on brick as per (IS : 1077) is available for guidance for the dimension test of bricks procedure.

   This test helps us to find the dimension of our bricks and also whether the brick we are using is standard size or not.

   20 Pieces out of selected pieces are taken and are laid flat as shown in Fig. 6.1.3 the to clearance (Section)on the sizes of bricks are fixed by giving maximum and minimum dimensions, Not on individual bricks but on batches of 20 bricks chosen at random. It folloes from this method of measurement that batches are likely to contain, bricks outside the prescribed limits of tolerance. Such lots should be rejected to avoid complaints about the variation of prepends.

Fig.6.1.2 Soundness of Briks

Due to the standard size of the selected bricks. It is suitable for the construction of masonry work.

The dimension of brick 230mm x 110mm x 80 mm

Same number of bricks will cover more area.

4. **Hardness Test :**

The hardness test of bricks is used to determine the resistance of bricks to abrasion. In the hardness test of the bricks or scratches made on the exposed surface of the bricks, if there is any impression is left on the brick, then the brick is not sufficiently hard to ward. There should not be any impression left on the brick after scratching it with nails. The hardness test for model as conducted, test brick was taken and scratch was made on bricks surface with the help of finger mail and found no impression after scratching on it.

5. **Impact Test :**

Impact test of brick perform on anymore on- site or laboratory.

Procedure for impact test.

1. Take the brick
2. Drop it freely from a 1 meter height on a hard surface.
3. Inspect the dropped brick any damage has occurred or not.
4. If the bricks broke or crack its means that the bricks impact value is lower so rejects those brick.

The Impact test on model was conducted, test bricks was fall from 1 meter height there was damage found on the corner of brick. It means the bricks can be used for the masonry work.

Fig.6.2.2 Making Bricks

Lab test on Bricks :

To produce good quality of structure, good quality materials are required. To decide the quality of materials some test are to be conducted on bricks. The tests which are required to find the suitability of brick of construction purpose are discussed in below test.

a. Water Absorption Test
b. Crushing Strength Test
c. Effloresces Test

Water Absorption Test: The on bricks as per IS code (Brick water Absorption test is code is (1077-1992) is available for guidance for the water absorption from the water absorption test of bricks.

This test is carried out to determine the amount of water absorption by the brick. When immersed in water for a period of 24 hr. It should not in any case. Exceed 20 % of weight of dry brick. This test is carried out for all the sampled of fly ash bricks & clay bricks.

Formula for water absorption test :

Ww-Wd

$$WA = \frac{\text{...}}{wd} \times 100$$

Where,

W_d – is dry weight of brick

W_w – is the weight after immersion of brick in water for 24 hours.

Absorption test :

- The average absorbed moisture content of fly ash bricks is found to be 9.77 %
- A test to determine the moisture content of fly ash as a percentage of its dry weight
- The brick which is made by Glass and Tile, it absorbed 2.21 % water.

Table 6.2.1 Tabular observation of Water Absorption Test

This below table 6.2.1 shows the result of average water absorption in percentage (%) of each sample.

Fly ash brick :					
Sr. No	Dry Weight (kg)	Wet Weight (kg)	Water Absorption (gm)	Water absorption (%)	Average Water absorption (%)
Sample no. A [Fly ash-60 %, OPC-10 %, Sand 10 %, Waste tile- 5%,(2.36mm), waste Glass-15 %(2.36mm)]					
A1	3.45	3.54	90	2.60	3.77
A2	3.38	3.50	140	3.90	
A3	3.32	3.48	160	4.81	
Sample no. B [Fly ash-60 %, OPC-10 %, Sand 10 %, Waste tile- 10%,(4.75mm), waste Glass-10 %(4.75mm)]					
B1	3.43	3.54	110	3.20	2.69
B2	3.46	3.54	80	3.21	
B3	3.51	360	90	2.56	
Sample no. C [Fly ash-60 %, OPC-10 %, Sand 10 %, Waste tile- 10%,(4.75mm), waste Glass-10 %(4.75mm)]					
C1	3.41	3.47	60	1.76	2.21
C2	3.49	3.56	70	2.00	
C3	3.45	3.55	100	2.80	

Sample no. D [Fly ash-60 %, OPC-10 %, Sand 10 %, Waste tile- 10%,(4.75mm), waste Glass-10 %(4.75mm)]					
D1	3.43	3.59	162	4.66	3.58
D2	3.46	3.61	150	4.33	
D3	3.49	3.63	138	4.01	
Sample no. E [Fly ash-60 %, OPC-10 %, Sand 10 %, Waste tile- 10%,(4.75mm), waste Glass-10 %(4.75mm)]					
E1	3.42	3.53	110	3.21	3.58
E2	3.50	3.64	140	4.00	
E3	3.47	3.47	123	3.54	
Sample no. F [Fly ash-60 %, OPC-10 %, Sand 10 %, Waste tile- 10%,(2.36mm), waste Glass-10 %(4.75mm)]					
F1	3.43	3.52	90	2.62	2.88
F2	3.41	3.53	120	3.51	
F3	3.46	3.54	87	2.60	

Description :

These tables show the percentage water absorption of various proportion for all bricks sample. We tale 6 sample of bricks , in each sample for water absorption test, we take 3 number of bricks. All the bricks have same proportion of fly ash, OPC and sand. i.e, Fly ash 60 %, OPC 10 % and sand 10 %. The variation only in the proportion of waste tile and waste glass and sieve size.

For the first sample, we taken 5 % of waste tiles and 15 % waste glass and sieve size 2.36 mm give the result of 3.77 of water absorption. Addition of this proportion give highest water absorption.

The addition of 10 % of waste tiles and 10 5 of waste glass and sieved it form 2.36mm sieve size give the 2.69% of water absorption.

For third sample 5 % of waste glass and here we changed the sieve size for each. We sieved waste tiles from 2.36mm sieve and waste glass.

Compression test :

Fig.6.2.3 Bricks Machine

This is a key test performed to determine the suitability of a brick for construction work an d to determine the load carrying capacity of bricks under compression. Fig.6.2.2 shows the test is performed with the help of ca compression testing machine.

The crushing strength of brick is found out by placing it is "Compression Testing Machine" . It is press till it breaks as per BIS :1077 -1957, the minimum crushing strength of brick is 3.5N/mm2.

Table of 6.2.1 Tabular observation of Water Absorption Test

This below table 6.2.1 shows the result of average water absorption in percentage (%) of each sample.

Fly ash brick					
Sr. No	Dry Weight	Wet Weight (kg)	Water Absorption (gm)	Water absorption (%)	Average water absorption (%)
Sample No. A [Fly ash -60%, OPC-10 %, Sand-10 %, Waste tiles- 5%, (2.36mm), Waste Glass- 15%(2.36mm)					
A1	3.45	3.54	90	2.60	3.77
A2	3.38	3.50	140	3.90	
A3	3.32	3.48	160		
Sample No. B [Fly ash -60 %, OPC-10 %, Sand-10 %, Waste tiles- 10 %, (4.75mm), Waste Glass- 10 %(4.75mm)					
B1	3.43	3.54	110	3.20	2.69
B2	3.46	3.54	80	2.31	
B3	3.51	3.60	90	2.56	
Sample No. C [Fly ash -60 %, OPC-10 %, Sand-10 %, Waste tiles- 10 %, (4.75mm), Waste Glass- 10 %(4.75mm)					
C1	3.41	3.47	60	1.76	2.21
C2	3.49	3.56	70	2.00	
C3	3.45	3.55	100	2.80	
Sample No. D [Fly ash -60 %, OPC-10 %, Sand-10 %, Waste tiles- 10 %, (2.36mm), Waste Glass- 10 %(2.36mm)					
D1	3.43	3.59	162	4.66	3.58
D2	3.46	3.61	150	4.33	
D3	3.49	3.63	138	4.01	

Sample No. E [Fly ash -60 %, OPC-10 %, Sand-10 %, Waste tiles- 10 %, (4.75mm), Waste Glass- 10 %(4.75mm)					
E1	3.42	3.53	110	3.21	3.58
E2	3.52	3.64	140	4.00	
E3	3.47	3.47	123	3.54	

Description:

These tables show the percentage water absorption of various proportion for all bricks sample. We take 6 samples of bricks; in each sample for water absorption test, we take 3 number of bricks. All the bricks. All the bricks have same proportion of fly ash, OPC and sand I.e Fly ash 60 %, OPC 10 % & sand 10 %. The variation only in the proportion only in the proportion of waste tile and waste glass and sieve size.

For the first sample, we taken 5 % of waste tiles and 15 % of waster glass and sieve size 2.36 mm give the result of 3.77 of water absorption. Addition of this proportion give highest water absorption.

The addition of 10 % of waste tiles and 10 % of waste glass and sieved it from 2.36 sieve size give the 2.69% of water absorption.

For third sample 5% of waste tiles and 15% of waste glass and here we changed the sieve size for each, we sieved waste tiles from 2.36mm sieve and waste glass.