PARTIAL REPLACEMENT OF QUARRY DUST WITH CONSTRUCTION DEBRIS AND CERAMIC WASTES IN FLYASH BRICKS

S.Ranjith[1],V.Selvakumar[2], S.Selvamurugan[3], K.Vijay[4]
Bachelor Of Engineering, Civil Engineering
Muthayammal Engineering College, Rasipuram
Supervisor/Assistant Professor,
Ms. L.S REENA,M.E
Department of Civil Engineering, MuthayammalEngineering College, Rasipuram,Namakkal

ABSTRACT

Brick a homogeneous mixture of clayey soil and water at appropriate proportions. As clayey soil when excavated from ground surface it reduces the ground water table in the nearby surroundings and also to minimize the usage of natural resources, so as an alternative for this problem was fly ash bricks made up of fly ash, quarry dust and cement proves to be an replacement for conventional bricks. Fly ash, an industrial waste is available in greater extent inIndia.Butonly45%offlyasharebeingusedan dsoflyashservesanexcellentreplacement and conserves the natural integrity. The strength of the fly ash bricks are increased by 10% to 20% when compared to conventional bricks. In that, fly ash bricks we are replacing the use of quarry dust by ceramic waste and brick waste powder. This report discuss about the study carried out on the replaced bricks.

Keywords: Bricks, Fly ash bricks, Quarry dust, Cement

1. INTRODUCTION

1.1 BRICKS

A brick is a block or a single unit of a kneaded Clay-bearing soil, sand and lime, or fly ash material ,fire hard enedorair dried,use din masonry construction. Light weight bricks(also called lightweight blocks) are made from expanded clay aggregate. Fired brick are the most numerous types and are laid in courses and numerous patterns known as bonds, collectively known as brickwork, and may be laid in various kinds of mortar to hold the bricks together to make a durable structure. Brick are produced in numerous classes, types, materials, and sizes which vary with region and time period, and are produced in bulk quantities.

Two most basic categories of brick are fired and non-fired brick. Fired brick are one of the longest lasting and strongest building materials sometimes referred to as artificial stone and have been used since circa 5000BC. Air dried bricks have a history older than fired bricks, are known by the synonyms mud brick and adobe, and have an additional ingredient of a mechanical binder such as straw.

Brick is the oldest manufactured building material. The earliest brick, made from mud (sometimes with added straw), was invented almost 10,000 years ago. Clay brick started to appear about 5,000 years ago, when builders borrowed pottery manufacturing techniques to improve its strength and durability. From some of the oldest known structures to modern buildings, clay brick has a history of providing shelter that is durable, comfortable, safe, and attractive.

Primary raw materials for modern clay bricks include surface clays, fire clays, shale’s or combinations of these. Units are formed by extrusion ,molding or dry-pressing and are fired in a kiln at high temperatures to produce units with a wide range of colors, textures, sizes and physical properties. Clay and shale masonry units are most frequently selected as a construction material for their aesthetics and long-term performance.

While brick and structural clay tile are both visually appealing and durable, they are also well-suited for many structural applications. This is primarily due to their variety of sizes and very high compressive strength.

1.1 FLY ASHBRICK

Fly ash brick is a very effective way to make a strong first impression. When people walk up or drive by a home with fly ash brick, second glances are common reactions.

Fly ash brick has more benefits than its striking visual qualities. They deaden exterior noise, providing a buffer from traffic noise, airplanes flying overhead and other various disruptions. Fire protection is another benefit as is reduced maintenance. Finally, fly ash brick walls can improve the thermal mass qualities of exterior walls, thus reducing energy bills.

Fig 1.1: Brick having a molded bark texture face.

Fig 1.2: Bricks are also available with a rough estate texture face.

1.1.1 DESIGN

The requirements for good performance from a fly ash brick wall include:

1. A foundation which will handle the weight of the brick masonry
2. A well-braced back-up wall which will handle the masonry load
3. Proper attachment to the back-up wall
4. Proper design and detailing of expansion joints, flashing, and drainage
5. Proper use of materials
6. Good workmanship during construction

1.1.2 STYLES

Fly ash brick is manufactured in various colors and patterns. The type of finish is even an option; smooth, sandblasted, stone pattern, etc. The fly ash used to produce the bricks can beanythingfromregularaggregateflyashtovarious mixturesoflightweightaggregates.They are usually colored with iron oxide pigment at the surface, orth epigmentis present throughout the mixture

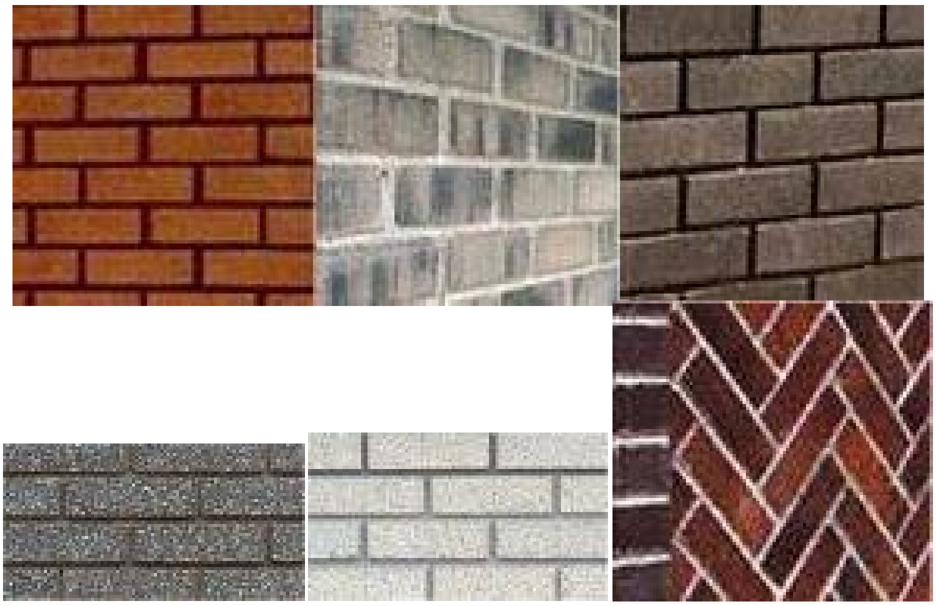


Fig 1.3: Different colour of bricks

As shown by the pictures above ,brick come in many styles. This can help blend a house in with its natural surroundings or neighboring houses.

A new exterior wall system uses fly ash bricks cast in special shapes that require no mortar and can be installed by anyone with basic carpentry skills. The system provides homeowners with the effective look of real brick exteriors.

The dimensions and appearance of the brick faces are similar to traditional split-faced bricks, and like bricks used for conventional masonry walls, they are installed in staggered rows. Hidden from view is the unusual shape of the cast block, which allows shingle-like overlapping. Because the system does not require footings or mortar, it can be used on new or existing buildings. Installers stack the blocks in rows and screw them to vertical furring strips attached to the wall sheathing. The furring strips provide a positive connection and create an airspace, allowing them a sonly surface to breath and providing drainage for any moisture that may penetrate. Thermal insulation characteristics are about the same as common face brick. Because of the interlocking shape of the materials, the system requires no mortar and can be installed by a contractor, handyman or home owner with basic woodworking and layout skills. Like traditional split-face brick,the system is strong and durable and will not dent,chiporfade in color.

1.1.1 TROUBLESHOOTING

Removing grout residue with acidic cleaners is risky for fly ash surfaces. Do not use a sealer as a grout barrier. Prevent grout smears, surface scratching and keep grout residue out of any surface texture characteristics by coating before grouting.

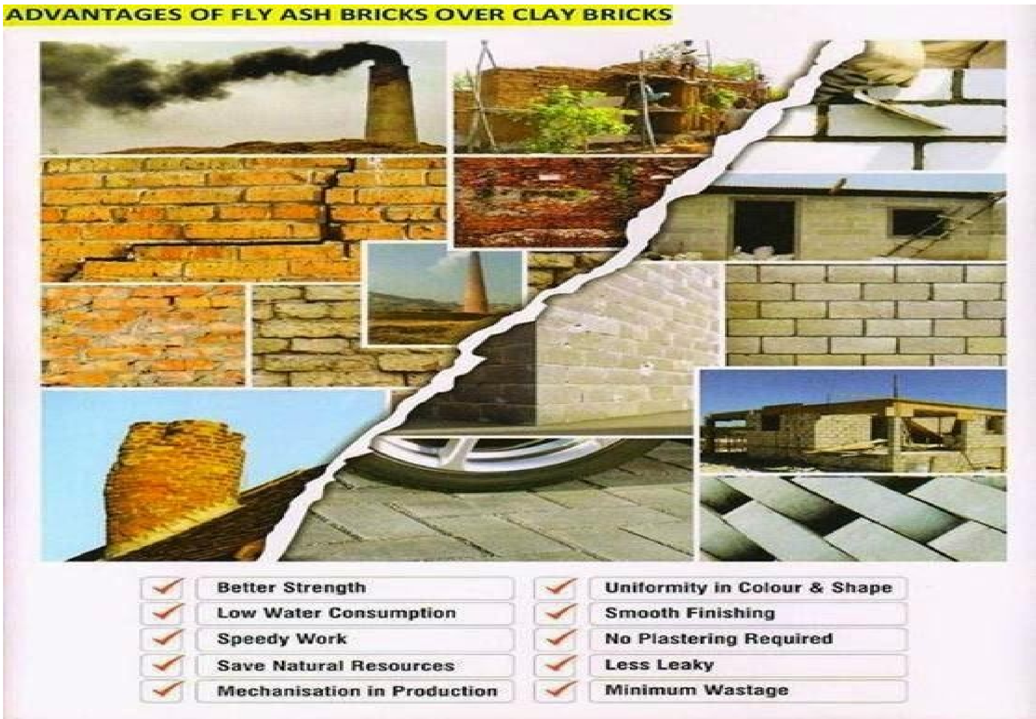
Efflorescence (subsurface originating white powdery stains) and scuffing can occur.
However, this is easily cleaned. If it is a concern, choose a penetrating sealer.

Colors can fade. It's the iron oxide pigments used in fly ash products that do not fade. The appearance of fading is actually from light efflorescence and can be stopped by sealing with the appropriate sealer.

All fly ash products are subject to damage from acids. However, the appropriate sealer helps prevents this.

FLY ASH BRICKS VS CLAY BRICKS

Fig 1.4: Difference between clay bricks and fly ash bricks.



- Better strength
- Low water consumption
- Speedy work
- Save Natural Resources
- Mechanization in production
- Uniformity in colour and shape
- Smooth finishing
- No plastering Required
- Less Leaky.
- Minimum Wastage.

1.2 THE ADVANTAGES OF FLY ASHBRICKS:

Fly ash bricks have many advantages, making them a good choice for construction across many environments and applications. In the home environment, fly ash bricks can be used to build homes as well as garden structures such as retaining walls, and driveway and walk way paving. Further more, they are frequently used in the construction of low-cost housing for the numerous reasons listed below.

Bricks manufactured using fly ash are typically cheaper than clay bricks, both to make and to build with, and are much stronger than ordinary bricks. The crushed stone that goes into the manufacture of cement bricks is often what gives them their strength. They are also highly durable and low maintenance. Often, the fly ash continues to cure even after manufacture thus making the cement bricks even stronger.

Flyash bricks are available on the market in a number of shapes, textures and sizes and standard cement bricks come in two types: solid and hollow. Whether solid or hollow cement bricks are used depends on the purpose of the construction. Hollow fly ash bricks are lighter and therefore easier to handle, and whilst it may seem that solid cement bricks might seem to be stronger ,hollow bricks can be filled with cement during construction for additional strength. Hollow fly ash bricks tend to be fairly large (sometimes as big as 4.5 ordinary clay bricks combined) so they are quicker to build with.

Another advantage of fly ash bricks is that they can be molded into a variety of decorative shapes to suit the purpose for which they are to be used. Some are even made to interlock which means that they do not require fly ash to ‘glue’ them together. Fly ash bricks to be used for exterior paving and walls are often coloured and placed in interesting patterns but the fly ash bricks used in structural wall construction ,however, are typical raw and require plastering and painting.

It can be said that clay bricks are lower maintenance than cement ones because they do not require painting like cement bricks. However, clay bricks are more permeable and tend to absorb more water than their cement counterparts. Thus the only obvious disadvantage of standard raw fly ash bricks is that they are rather unsightly but this is easily remedied with plastering and painting the plaster in an attractive colour, making cement bricks an all-round winner in the masonry production and construction industries. Fly ash bricks are an alternative Building Material. Fly ash bricks are masonry units that are used in the construction of buildings. They are considered to be a part of good and affordable building materials. They contain Class C fly ash and water.

Fly ash bricks are made by compressing Class C fly ash and water at 4000psi and then curing is carried on for 24 hours at a temperature of 66 degrees Celsius steam bath. Air entrainment agent is used to toughen the bricks.

1.4 FLY ASH BRICKS

Since the concentration of calcium oxide is very high in class C fly ash, the brick is described as self cementing.

It is considered to be a good alternative to traditional mud bricks since the method of manufactureofflyashisenergyefficientthatisithel pssaveenergy,brings about reduction of mercury pollution and plus it is cost effective.

1.4.1 RAW MATERIALS USED FOR THE MANUFACTURE OF FLY ASHBRICKS:

- Fly ash – which is the primary ingredient
- Sand or Stone dust – as fine aggregate
- Lime – source of calcium carbonate which results in the bricks being called "Self- cementing bricks".
- Gypsum – to enhance the fineness of the shape of the bricks
- Cement – to increase bonding and strength

1.4.2 GENERAL CHARACTERISTICS OF FLY ASHBRICKS:

• The standard size of the brick is230x110x70

• Fly ash bricks are sound, compact and uniform in shape, size and colour. Smooth rectangular faces of the bricks are accompanied with sharp and square corners.

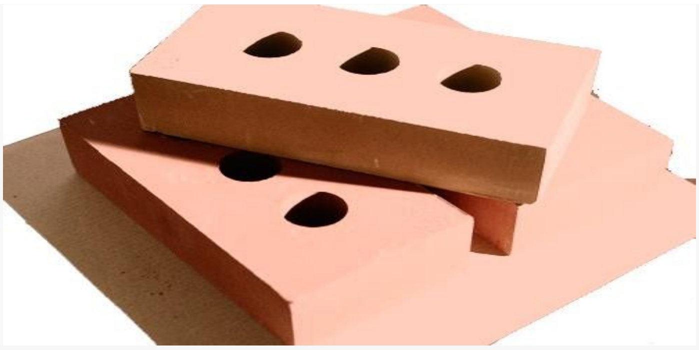


Fig 1.6: Coloured fly ash bricks.

Fly ash bricks are available in various colours and shapes.The above picture shows the bricks in dark peach colour with three holes on it. These holes are used for grouting. The mortar is poured into these holes for proper bonding in between the bricks.

- They are free from visible cracks, war page, flaws and organic matter.
- Compressive strength: 7.5N/mm2 on an average
- Water absorption:<8%

1.4.3 PROCESS OF MAKING FLY ASHBRICKS:

The process for manufacturing fly ash – cement/lime brick requires fly ash, sand/stone dust, and cement/lime and gypsum which are mixed in proper proportion. Firstly lime and gypsum mixed in pan-mixer with optimum quantity of water. Then fly ash and sand/stone dust are further mixed into pan-mixer to form homogeneous mixture .In the place of lime and gypsum if cement is used, initially in pan-mixer fly ash and sand/stone dust are mixed and after this cement is added into pan-mixer to form homogeneous dry mixture. The optimum quantity of water added into pan-mixer until homogeneous dry mixture of fly ash, sand/stone dust and cement are achieved. The mixture is then transferred to the molding machine via belt conveyor and is pressed or compacted. If hydraulic press is used, the bricks are formed at a pressure of 150-200 kg/cm2 . The pressed bricks are taken out manually and are laid on wooden pallet in 4-5 layers. The brick laden pallets are transported on hydraulic trolley from press area to stack yard. If vibratory press is used, the mix is manually brought from the pan-mixer and filled into the moulds. The table, on which the moulds are kept, is vibrated. The mix is also pressed lightly. The pallets from the table with the bricks are taken manually to stack yard. The bricks are air dried for about1 to 2 days and then cured at least for 14 days to achieve its required strength. The curing is carried out by sprinkling water manually or by any other means. It is recommended that the curing period may be extended during cold/wet weather.

1.4.4 ADVANTAGES OF FLY ASHBRICKS:

- They have high strength which is their primary benefit to be used for construction.
- Due to uniform size and thickness of joints, plaster consumption is minimized compared to clay bricks, thereby saving cement to the extent of 25% to30%.
- Due to lesser water absorption, there is no dampness in walls.
- Gypsum plaster, Plaster of Paris can be applied directly without the basecoat of plaster.
- Wastage is very less as compared to clay brick.
- The bonding between the bricks is excellent since there is high concentration of calcium oxide in it.

1.4.5 USES OF FLY ASHBRICKS:

Fly ash bricks are used for the construction of various types of buildings such as:

- Factories
- Warehouses
- Power plants
- Homes
- High rise structures

Basically, they are used in every kind of construction that can be possibly executed with the help of traditional bricks.

1.5 CLAYBRICKS:

Clay bricks are known to be fired bricks. Fired bricks are burned in a kiln which makes them durable. Modern, fired, clay bricks are formed in one of three processes – soft mud, dry press, or extruded.

Normally, brick contains the following ingredients:

1. Silica (sand) – 50% to 60% by weight
2. Alumina (clay) – 20% to 30% by weight
3. Lime – 2 to 5% by weight
4. Iron oxide – ≤ 7% by weight
5. Magnesia – less than 1% by weight

The soft mud method is the most common, as it is the most economical. It starts with the raw clay, preferably in a mix with 25–30% sand to reduce shrinkage. The clay is first ground and mixed with water to the desired consistency. The clay is then pressed into steel moulds with a hydra ulic press. The shaped clay is then fired ("burned") at 900–1000 °C to achieve strength.

1.6 NEED FORALTERNATIVES

Traditionally and widely adopted materials for manufacturing bricks are clay, cement, fly ash, and dust. There are few disadvantages of using these materials for manufacturing bricks.

- There is huge demand for clay these days as the availability of clay in nature is limited.

- Cost of cement is high as considering the economy factor we have chosen debris powder and ceramic waste as an alternatives.

1.7 OBJECTIVE OF THEPROJECT

- Fly ash bricks are most widely used in construction practices now a days a san economic alternative for clay bricks.
- To make it more economical we have come out with an idea of replacing the proportionate usage of the raw materials fly ash and dust respectively by ceramic powder and debris powder.
- In addition we have found that this concept of bricks provides relatively higher strength.

LITERATURE REVIEW

Patel et al., 2013 carried out Experiments with several materials like Fly ash, lime, sand, Kheda dust, Glass fibre for the manufacturing of the brick. The fly ashes of ‘F’ category were used as a raw material for making fly ash bricks. The combination of fibre fly ash brick have different percentage of the Glass fibre adding like 0.2%, 0.4%, 0.6%, 0.8%, 1.0%. In the testing of the fibre fly ash brick two type of the testing was done compressive strengthte stand water absorption test after 7, 14, 21days. With changes in the percentage of the Glass fibre the compressive strength of the fibre fly ash brick increased and water absorption was found to decrease.

Rushad et al., 2011 investigated the strength and water absorption characteristic of fly ash bricks made of lime (L), local soil (S) and fly ash (FA). The experiments were conducted both on Hand moulded and Pressure moulded fly ash bricks. It was observed that none of the L-S-FA bricks satisfy all the requirements of standard codes. While some of the bricks satisfy the provisions in respect of strength only the L-FA (40: 60) bricks satisfy the requirement of Indian Standard Code in respect of strength as well as water absorption characteristics.

Samander et al., 2013 investigation was done to study of the effect of silica fume on fly ash cement bricks. The experiments were conducted in two phases to observe the variation in properties i.e. compressive strength, density and water absorption of fly ash–cement brick. In first phase the fly ash, stone dust percentage are kept constant and cement is replaced with silica fume in different proportion, where as in second phase ,silica fume is added as a mixture in same proportion of weight of cement. The fly ash cement - bricks are tested after 7 days,14 days and 28 days curing in fly ash material testing laboratory of the institute. The experimental results showed that in the compressive strength of fly ash cement brick decreases with increase in content of silica fumes as replacement of cement where as increases with increase in content of silica fume as addition. The water absorption % in first phase of experimentation increases whereas in second phase of experimentation decreases.

CONCLUSION:

From the above literatures we found that the fly ash bricks are commonly used as an alternative for clay bricks and the study conducted for the addition of glass fibre resulted in increased strength and there are scopes for replacement of the use of quarry dust with similar other materials can result in minimizing cost.

DESCRIPTION OF MATERIALS

Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash that does not rise is called bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal.

Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash.

Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide(SiO_2) (both amorphous and crystalline) and calcium oxide (CaO), both being endemic ingredients in many coal-bearing rockstrata.

Constituents depend upon the specific coal bed makeup, but may include one or more of the following elements or substances found in trace quantities (up to hundreds ppm): arsenic, beryllium, boron, cadmium, chromium, hexa valent, chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, and vanadium, along with dioxins and PAH compounds.

In the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated in recent decades now requires that it be captured prior to release. In the US, fly ash is generally stored at coal power plants or placed in landfills. About 43% is recycled, often used as apozzolan to produce hydraulic cement or hydraulic plasterora partial replacement for Portland cement in fly ash production.

Component	Bituminous	Sub-bituminous	Lignite
SiO_2(%)	20-60	40-60	15-45
Al_2O_3(%)	5-35	20-30	20-25
Fe_2O_3(%)	10-40	4-10	4-15
CaO(%)	1-12	5-30	15-40
L.O.I(%)	0-15	0-3	0-5

TABLE 3.1 Chemical composition and classification of fly ash.

3.2 CERAMICWASTE

Ceramic materials are special because of their properties. They typically possess high melting points, low electrical and thermal conductivity values, and high compressive strengths. Also they are generally hard and brittle with very good chemical and thermal stability. Ceramic materials can be categorized as traditional ceramics and advanced ceramics. Ceramic materials like clay are categorized as traditional ceramics and normally they are made of clay, silica, and feldspar. As its name suggests, traditional ceramics are not supposed to meet rigid specific properties after their production, so cheap technologies are utilized for most of the production processes.

The principle waste coming into the ceramic industry is the ceramic powder, specifically in the powder forms. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15 to 30% waste are produced of total raw material used, and although a portion of this waste may be utilized on-site, such as for excavation pit refill, The disposals of these waste materials acquire large land areas and remain scattered all around,spoilingtheaestheticoftheentireregion.Itis verydifficulttofindauseofceramic waste produced. Ceramic waste can be used in fly ash to improve its strength and other durability factors.Ceramicwastecanbeusedasapartialreplacementofcementorasapartial replacement of fine aggregate sand as a supplementary addition to achieve different properties of fly ash.

Fig 3.1 CERAMIC WASTE

TABLE3.2 CHEMICAL PROPERTIES OF CERAMIC WASTE

CONSTUTIENTS	PERCENTAGE (%)
SiO_2	63.29
Al_2O_3	18.29
Fe_2O_3	4.32
CaO	4.46

MgO	0.72
P_2O_5	0.16
K_2O	2.18
Na_2O	0.75
SO_3	0.10
CL^-	0.005
SrO_2	0.02
TiO_2	0.61
Mn_2O_3	0.05
L.O.I	1.61

3.3 DEBRIS (BRICK WASTEPOWDER)

Bricks have a lifespan of more than 200 years. You can reclaim or recycle bricks and blocks which have previously been used in the construction of buildings, walls, paving and infrastructure, such as bridges and sewers. These include:

- Claybricks
- Fly ashprecast
- Aeratedblocks
- Stone blocks

Fig 3.2 BRICK WASTE POWDER

TABLE 3.3 CHEMICAL PROPERTIES OF DEBRIS (BRICK WASTE POWDER)

CONSTUTIENTS	PERCENTAGE (%)
SiO_2	46.52%
Al_2O_3	10.62%
Fe_2O_3	4.29%
CaO	24.48%
Na_2O	1.02%
K_2O	1.84%
MgO	8.56%
TiO_2	0.514%
MnO	0.079%
P_2O_5	0.199%
SO_3	0.895%
L.O.I	0.66%
CL	108ppm

3.4 QUARRYDUST

Crushed rock aggregate quarrying generates considerable volumes of quarry fines, often termed as “quarry dust”. The finer attraction is usually smaller than 5mm in size. The useofquarrydustinflyashisdesirablebecauseofthe benefitssuchasusefuldisposalofaby- product, reduction of river sand consumption and increase in strength. Quarry dust has rough, sharp and angular particles and as such causes a gain in strength due to betterinterlocking.

TABLE 3.4 CHEMICAL COMPOSITIONS OF QUARRY DUSUT

CONSTITUENTS	PERCENTAGE (%)
SiO2	**62.48**
Al2O3	**18.72**
Fe2O3	**6.54**
CaO	**4.83**
MgO	**2.56**
Na2O	**-**
K2O	**3.18**
TiO2	**1.21**
L.O.I	**0.48**

TESTS CONDUCTED

4.1 TESTS ON RAWMATERIALS

- Sieve analysis
- Water absorption test
- Specific gravity test

4.2 TESTS FORBRICK

Compressive strength test

4.3 SIEVEANALYSIS

Asieve analys is or gradation test is a practice or procedure use dt oassess the particles ize distribution of a granular material. Asieve analys is can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, and soil, a wide range of manufactured powders, grain and seeds, down to a minimum size depending on the exact method.

PROCEDURE

- A gradation test is performed on a sample of quarry dust in a laboratory. A typical sieve analysis involves a nested column of sieves with wire mesh cloth (screen). See the separate Mesh (scale) page for details of sieve sizing.
- A representative weighed sample is poured into the top sieve which has the largest screen openings. Each lower sieve in the column has smaller openings than the one above. At the base is a round pan, called the receiver.
- The column is typically placed in a mechanical shaker. The shaker shakes the column, usually for some fixed amount of time. After the shaking is complete the material on each sieve is weighed. The weight of the sample of each sieve is then divided by the total

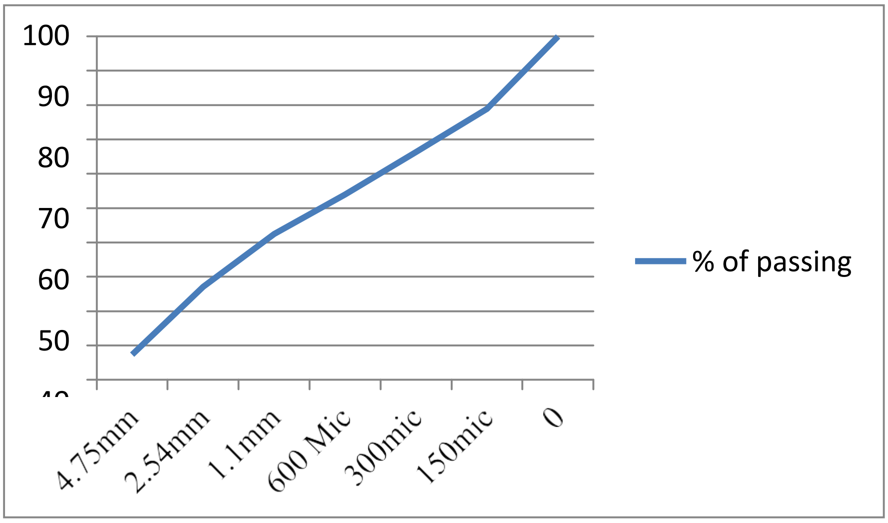
weight to give a percentage retained on each sieve.

- The size of the average particle on each sieve is then analysed to get a cut-off point or specific size range, which is then captured on a screen.
- The results of this test are used to describe the properties of the quarry dust and to see if it is appropriate for various civil engineering purposes such as selecting the appropriate aggregate for fly ash mixes and asphalt mixes as well as sizing of water production well screens.
- The results of this test are provided in graphical form to identify the type of gradation of the quarry dust.
- A suitable sieve size for the quarry dust should be selected and placed in order of decreasing size, from top to bottom, in a mechanical sieve shaker. A pan should be placed underneath the nest of sieves to collect the quarry dust that passes through the smallest.

Table 4.1: SIEVE ANALYSIS FOR QUARRY DUST

IS SIEVE DESIGNATION	WEIGHT OF RESIDUE (g)	% WEIGHT RETAINED	CUMULATIVE % WIEGHT RETAINED	% OF PASSING
4.75 mm	74	7.4	7.4	92.6
2.36 mm	197	19.7	27.1	72.9
1.18 mm	154	15.4	42.5	57.5
600 microns	114	11.4	53.9	46.7
300 microns	124 .ç	12.4	66.3	33.7
150 microns	124	12.4	78.7	21.3
pan	212	21.3	100	0

Chart 4.1: GRAPHICAL REPRESENTATION OF QUARRY



DUST

Table 4.2: SIEVE ANALYSIS FOR CERAMIC WASTE

IS SIEVE DESIGNATION	WEIGHT OF RESIDUE (g)	% WEIGHT RETAINED	CUMULATIVE % WIEGHT RETAINED	% OF PASSING
4.75 mm	-	-	-	-
2.36 mm	-	-	-	-
1.18 mm	-	-	-	-
600 microns	107	10.7	10.7	89.3
300 microns	639	63.9	74.6	25.4
150 microns	203	20.3	94.9	5.1
pan	40	5.1	100	0

Chart 4.2: GRAPHICAL REPRESENTATION OF CERAMIC WASTE

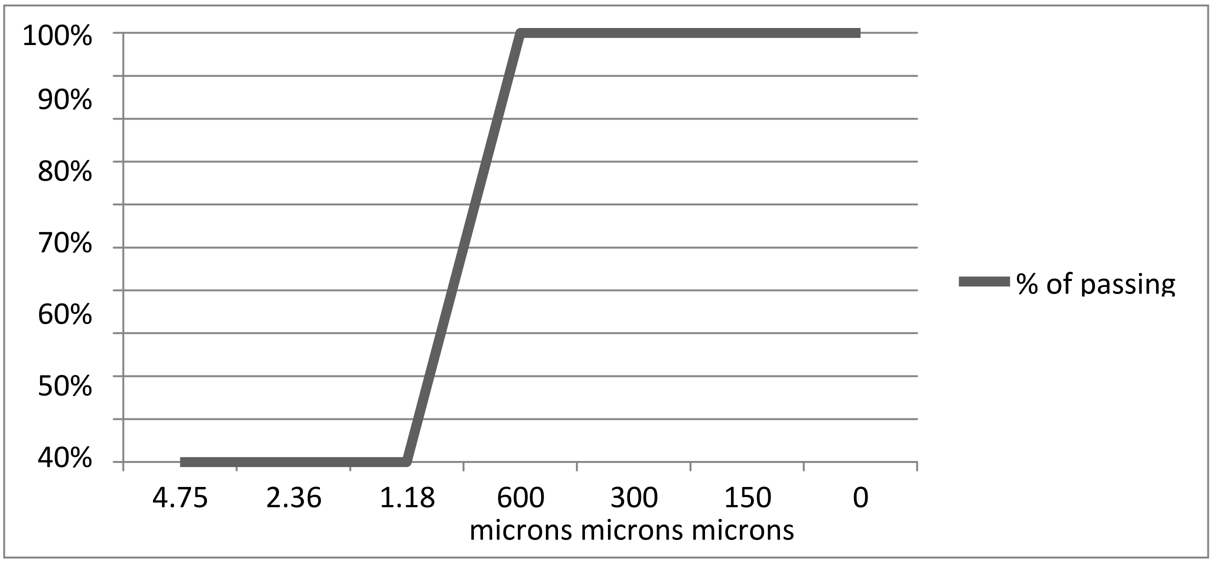
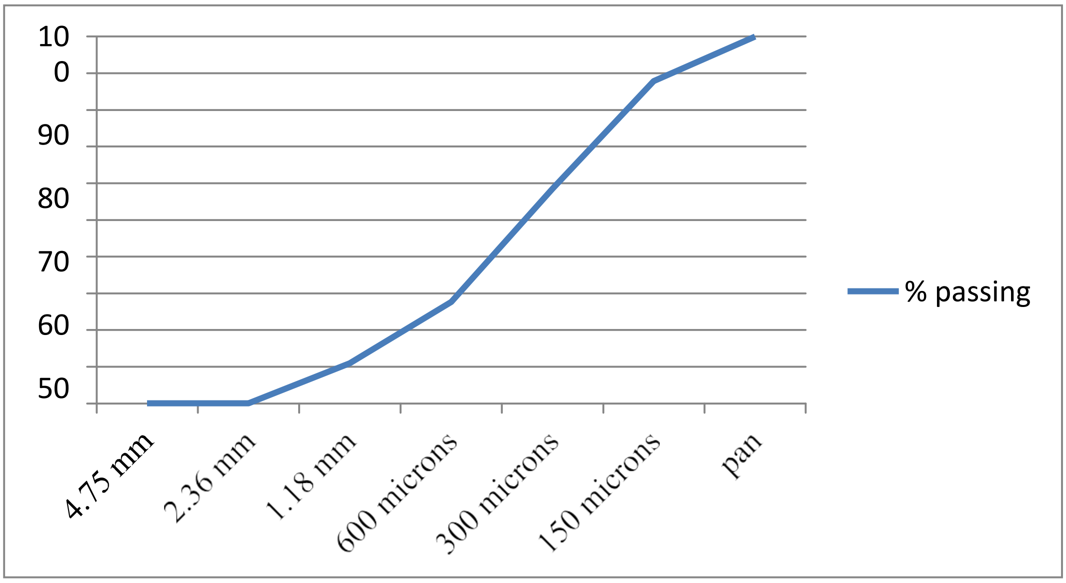


Table 4.3: SIEVE ANALYSIS FOR CERAMIC POWDER

IS SIEVE DESIGNATION	WEIGHT OF RESIDUE (g)	% WEIGHT RETAINED	CUMULATIVE % WIEGHT RETAINED	% OF PASSING
4.75 mm	-	-	-	-
2.36 mm	-	-	-	-
1.18 mm	109	10.9	10.9	89.3
600 microns	168	16.8	27.7	72.3
300 microns	308	30.8	58.5	41.5
150 microns	294	29.4	87.9	12.1
pan	122	12.2	100	0

Chart 4.3: GRAPHICAL REPRESENTATION OF DEBRIS POWDER



4.4 WATER ABSORPTIONTEST

Water absorption test is conducted to determine the consistency of each raw material used and the required water content is obtained.

PROCEDURE

1. The fly ash passing through IS 10 mm sieve is taken about200g
2. They are dried in an oven at a temperature of 100OC for 24hours.
3. The fly ash is cooled to room temperature.
4. It is weight is taken as W1 in grams.
5. The dried fly ash is immersed in clean water at the temperature 27oc for 24hours.
6. The fly ash is removed from water and wiped out of traces of water with a cloth.
7. Within three minutes from the removal of water, the weight of fly ash W2 is found out.

4.4.1 TEST ONFLYASH

Table 4.4: WATER ABSORPTION TEST ON FLYASH

TRIAL	WEIGHT OF DRIED SPECIMEN (W1) g	WEIGHT OF SATURATED SPECIMEN (W2) g	WEIGHT OF WATER ABSORBED W3=W2-W1g	% OF WATER ABSORPTION = (W3/W1) x 100
1	104	170	66	63.46
2	104	151	47	45

CALCULATION:

Weight of dried specimen (W1)= 104g
Weight of the saturated specimen (W2)= 151g
Weight of the water absorbed (W3)=W2-W1= 47g
Percentage of the water absorption = W3/W1 x 100 Thus the percentage of the water absorbed is45%

4.4.2 TEST ON CERMAICPOWDER

Table 4.5: WATER ABSORPTION TEST ON CERAMIC POWDER

TRIAL	WEIGHT OF DRIED SPECIMEN (W1) g	WEIGHT OF SATURATED SPECIMEN (W2) g	WEIGHT OF WATER ABSORBED (W3=W2-W1) g	% OF WATER ABSORPTION=(W3/ W1) x 100
1	110	147	37	33.6
2	90	118	28	30.1

CALCULATION:

Weight of dried specimen (W1) = 90g

Weight of the saturated specimen (W2) =118g

Weight of the water absorbed (W3) =W2-W1= 28g

Percentage of the water absorption = W3/W1 x 100

Thus the percentage of the water absorbed is30.1%

4.4.3 TEST ONDEBRIS

Table 4.6: WATER ABSORPTION TEST ON DEBRIS POWDER

TRIAL	WEIGHT OF DRIED SPECIMEN (W1) g	WEIGHT OF SATURATED SPECIMEN (W2) g	WEIGHT OF WATER ABSORBED (W3=W2-W1) g	% OF WATER ABSORPTION =(W3/W1) x 100
1	100	128	28	28
2	100	125	25	25

CALCULATION

Weight of dried specimen (W1) = 100g

Weight of the saturated specimen (W2) = 125g

Weight of the water absorbed (W3) =W2-W1=25g

Percentage of the water absorption = W3/W1 x 100

Thus the percentage of the water absorbed is25%

4.4.4 TEST ON QUARRYDUST

Table 4.7: WATER ABSORPTION TEST ON QUARRY DUST

TRIAL	WEIGHT OF DRIED SPECIMEN (W_1) g	WEIGHT OF SATURATED SPECIMEN (W_2) g	WEIGHT OF WATER ABSORBED ($W_3=W_2-W_1$) g	% OF WATER ABSORPTION =(W_3/W_1) x 100
1	104	114	10	9.6
2	104	116	12	11.5

CALCULATION:
Weight of dried specimen (W1) = 104g
Weight of the saturated specimen (W2) = 116g
Weight of the water absorbed (W3) =W2-W1=12g
Percentage of the water absorption = W3/W1 x 100
Thus the percentage of the water absorbed is11.5%

4.5 SPECIFIC GRAVITYTEST

PROCEDURE

To determine the specific gravity of ceramic waste.

1. Weigh the empty pycnometer.
2. Transfer the specimen (oven dried or containing natural moisture) into thepycnometer.
3. Add distilled water to fill the pycnometer about full or halffull.
4. Fill the pycnometer completely with distilled water (up to the mark) and up to theweight.
5. Remove all the sand particles and wash the pycnometer and rinse it with distilled water. Then fill the pycnometer with distilled water, completely clean and dry the pycnometer with clean dry cloth and weight it.

Table 4.8: SPECIFIC GRAVITY OF CERAMIC WASTE.

DESCRIPTION	TRAIL 1	TRAIL 2
Weight of Pycnometer in g	636	636
Weight of dry ceramic waste (W_1) in g	500	500
Weight of pycnometer + ceramic waste + water (W_2), in g	1970	1980
Weight of pycnometer + water (W_3), in g	1611	1600

Specific aggregate = W1 / (W1+W3-W2) Specific gravity of Ceramic waste =3.3

4.6 TESTS FORBRICK

Compressive strength of the brick is obtained using universal testing machine.

4.6.1 TEST FOR CONTROL @ 0.4 AND 0.5 W/CRATIO

Table 4.9: AMOUNT OF RAW MATERIALS USED FOR 6 BRICKS OF 0.4 WATER CEMENTRATIO.

MATERIALS	WEIGHT OF MATERIALS (g)	WEIGHT OF WATER ADDED (ml)
CEMENT	2130	852
FLYASH	8526	3836.7
DUST	12792	1279.2

Table 4.10: AMOUNT OF RAW MATERIALS USED FOR 6 BRICKS OF 0.5 WATER CEMENTRATIO.

MATERIALS	WEIGHT OF MATERIALS (g)	WEIGHT OF WATER ADDED (ml)
CEMENT	2130	1065
FLYASH	8526	3836.7
DUST	12792	1279.2

Table 4.11: COMPRESSIVE STRENGTH (N/mm2)

WATER CEMENT RATIO	5 DAYS CURING	7 DAYS CURING	14 DAYS CURING
0.4	4.4	4.89	5.4
0.5	3.13	3.9	4.4

From the above result we have found that high strength is obtained by using 0.4 w/c ratio so we have used 0.4 w/c ratio for our study.

4.6.2 TEST FORREPLACEMENT

Table 4.12: AMOUNT OF MATERIALS USED FOR REPLACEMENT IN VARIOUS PROPORTIONS

MIXTURES	WEIGHT OF CEMENT (g)	WEIGHT OF FLYASH(g)	WEIGHT OF QUARRY DUST (g)	WEIGHT OF DEBRIS (g)	WEIGHT OF CERAMIC WASTE (g)
R 1	2130	8560	6390	6390	-
R 2	2130	8560	5112	7668	-
R 3	2130	8560	3840	8950	-
R 4	2130	8560	6390	-	6390
R 5	2130	8560	5112	-	7668
R 6	2130	8560	3840	-	8950

Table 4.13: COMPRESSSIVE STRENGTH (N/mm2)

SPECIMEN	5 DAYS CURING	7DAYS CURING	14DAYS CURING
R 1	3.5	4.75	4.9
R 2	3.6	4.5	5.2
R 3	3.2	3.9	4.25
R 4	3.6	4.0	5.2
R 5	4.2	4.3	5.1
R 6	4.4	4.5	5.4

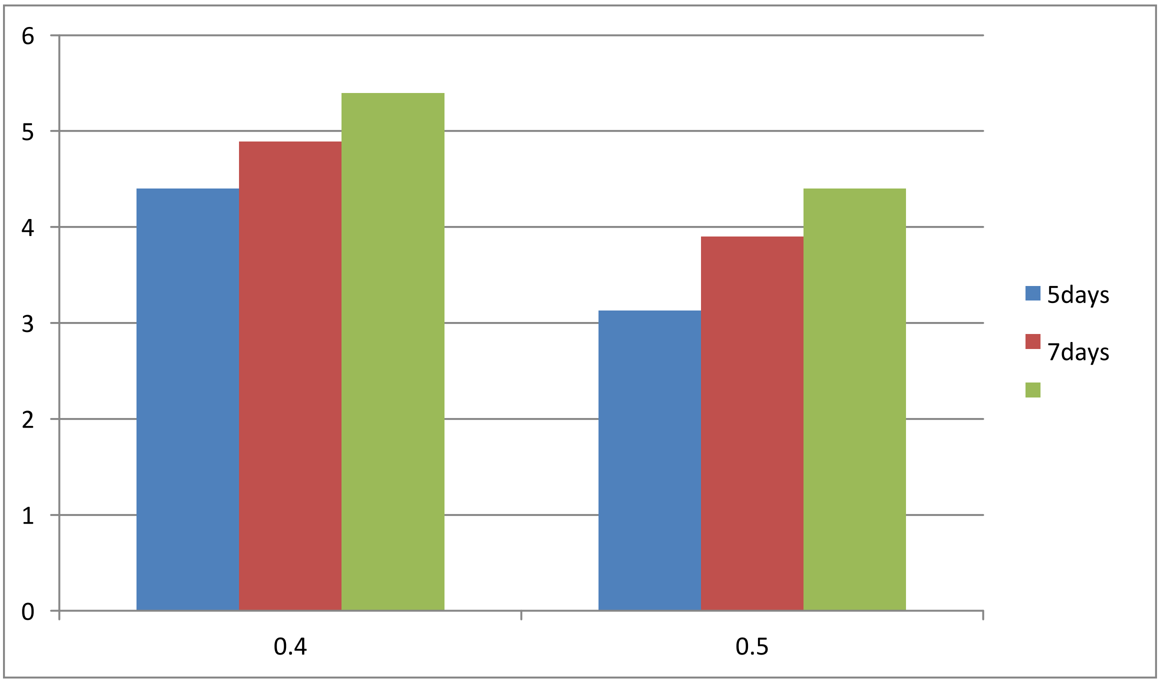
RESULT

5.1 : FOR CONTROL @ 0.4 AND 0.5 WATER CEMENT

Table 5.1: COMPRESSIVE STRENGTH (N/mm2)

WATER CEMENT RATIO	5 DAYS CURING	7 DAYS CURING	14 DAYS CURING
0.4	4.4	4.89	5.4
0.5	3.13	3.9	4.4

Chart 5.1: COMPARISON OF COMPRESSIVE STRENGTH FOR 0.4 AND 0.5 W/C RATIO.

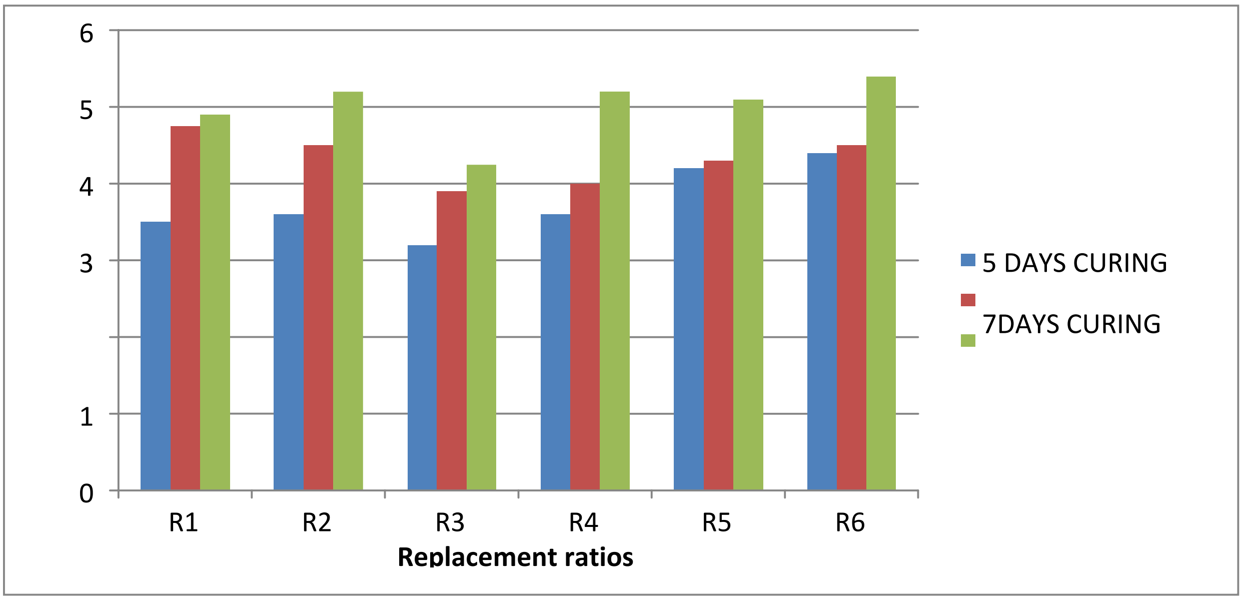


5.2 : FORREPLACEMENT:

Table 5.2: COMPRESSSIVE STRENGTH (N/mm2)

SPECIMEN	5 DAYS CURING	7DAYS CURING	14DAYS CURING
R 1	3.5	4.75	4.9
R 2	3.6	4.5	5.2
R 3	3.2	3.9	4.25
R 4	3.6	4.0	5.2
R 5	4.2	4.3	5.1
R 6	4.4	4.5	5.4

Chart 5.2: COMPARISON OF COMPRESSIVE STRENGTH FOR VARIOUS MIXTURES (N/mm2)



PHOTOGRAPHS

FIG6.1

FIG6.2

FIG 6.1 & FIG 6.2 SAMPLES OF DIFFERENT MIXTURES

FIG6.3

FIG6.4

FIG 6.3 & FIG 6.4 TESTING OF SAMPLES

FIG 6.3 READINGS ON UTM

CONCLUSION

In partial replacement of the conventional raw materials in our study of fly ash bricks, we have found that relatively higher strength in bricks can be achieved and the outputs are way better than the expected. As the replacement materials are easily available and cheaper in costs, this makes the bricks more economical too. Use of construction debris mean that, by replacing, solid waste can be effectively utilized and to a smaller extent it helps in solid waste management.

In manufacture plants, hydraulic press is commonly used to compress the mix in the moulding process. In our study due to unavailability we made it manually and we believe still better results could be achieved with the use hydraulic press in the moulding process.

REFERENCES

1. Basic Civil Engineering: Theory and Experiments 2013 by Anuj Kumar Purwar and Prashant Mukherjee.
2. H N Rajendra Prasad, H G Vivek Prasad, Chetana Hamsagar (2014) ‘An Approach for Alternative Solution in Brick Manufacturing’, International Journal of Science, Environment and Technology, Vol. 3, No 3,2014.
3. Jayesh Pitroda, Prof. Sameer Mistry, Dr. L. B. Zala, Prof. Samip Patel (2011) ‘Fly Ash Bricks Masonry: An Experimental Study’ National Conference on Recent Trends in Engineering & Technology May2011.
4. Nutan C. Patel, Prof. Jayesh kumar Pitroda (2013) ‘Fly Ash Brick: Glass Fibre The InnovativeConceptForGettingHigherStrengthBr

ick'International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 3 March2013.

5. Obada Kayali ,'High Performance Bricks from Fly Ash 2005', World of Coal Ash (WOCA), April 11-15, 2005, Lexington, Kentucky, USA.

6. Saurabh Samander, Dr. Arun Kumar Dwivedi, & Sangeeta D.Agarwal (2013) 'Effect of Silica Fume on Fly Ash Cement Bricks - An Experimental Study' OSR Journal of Mechanical and Civil Engineering Volume 6, Issue 4 (May. -Jun.2013).

7. Tabin Rushad S, Abhishek Kumar, Duggal S. K, Mehta P.'Experimental Studies onLime- Soil-Fly Ash Bricks', International Journal Of Civil And Structural Engineering Volume 1, No 4, 2011.

8. http://www.google.com/