REPLACEMENT OF COARSE AGGREGATES WITH JHAMMA BRICKS FOR PREPERATION OF CONCRETE

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ABSTRACT

Concrete is considered the world's most used construction material. Typical concrete mixtures are comprised of water, sand, cement and aggregate. Many materials can be used to replace the coarse aggregate in typical concrete. This project focuses on the replacement of coarse aggregate with jhamma bricks in concrete preparation. Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens over time. The cement reacts chemically with the water and other ingredients to form a hard matrix that binds the materials together into a durable stone-like material that has many uses This will include over burnt clay brick or jhamma brick. This material was chosen because of their availability. The over burnt clay brick is available from brick manufacturing area. Also in brick-making, a large number of bricks are rejected due to nonconformity with the required specifications. One such major nonconformity is the distorted form of brick produced due to the uneven temperature control in the kiln. These rejected bricks can also be a potential source of coarse aggregate. This would not only make good use of the otherwise waste material but would also help alleviate disposal problems. This project presents the effects of Jhamma Class Brick inclusion on the mechanical properties such as (workability, characteristics compressive strength, split tensile strength, compressive strength of cylinder) of concrete matrix in wet and hardened state properties. For checking mechanical properties of Jhamma Class Brick bat based concrete used partially replacing Jhamma class brick with coarse aggregate with 0%, 10%, 20%, 30%, 40% and 50% replacement in M30 grade of concrete. It is observed that workability decreased and mechanical properties like strength also decreased with replacement of coarse aggregate.

Keywords: Jhamma class brick, Kiln, characteristic compressive strength, split tensile strength, compressive strength of cylinder.

1. INTRODUCTION

1.1 General

Concrete is produced by mixing cement, sand, coarse aggregate and water to produced material that can be moulded into almost any shape. The major volume concrete is filled with aggregate. The inclusion of aggregate in concrete reduces its drying shrinkage properties and improves many other properties such as compressive strength etc. But it is costly to transport, so local sources are needed to reduce the cost of transport, but due to geographical constraints this is not available at all places, therefore it necessitates finding other sources and alternative from local sources.

The many materials are used as a alternative source for natural coarse aggregate such as recycled low quality crushed brick, recycled coarse aggregate, coconut shell, recycled plastic aggregate, well burnt brick etc. For this work select a jhamma class brick as a alternative source for course aggregate. This material was chosen because in brick making, a large number of bricks are rejected due to non conformity is the distorted form of brick produced due to high temperature control in the kiln. These rejected bricks can also be potential source of coarse aggregate. According to general definition concrete is a composite material so by taking advantage of the situation for the people.

So in this project we replaced coarse aggregate with jhamma brick with different ratios to determine the compressive strength of the concrete.

1.2 The Aims of the Study

1) To develop a mixture proportioning process to manufacture Jhamma class brick based concrete.
2) To identify and study the effect of salient parameters that affects the properties of Jhamma class brick based concrete.

1.3 Background of Study

Coarse aggregate can be defined as inert granular materials such as gravel, crushed stone and sand. Coarse aggregate is one of the essential ingredients apart of water and cement in concrete production. It consists about 60 to *75* percent of total concrete production (Nmai, 1999). Coarse aggregate comes from particles greater than *4.75* mm but commonly in a range between *9.5* mm to *37.5* mm. Therefore, the selection of coarse aggregate is vital for a good concrete mix such as it need to be clean, tough, and strong particles that free room absorbing chemicals. Furthermore, coarse aggregate also is significant due to its properties will affect the modulus of elasticity. As the coarse aggregate that contains higher modulus elasticity will resulting the concrete stronger in strength of modulus elasticity. Conventionally, the coarse aggregates used in concrete productions are gravel, crushed stone, granite, and limestone. Aggregates properties are playing a big role in concrete as it can affect the strength, the durability and workability of plastic concrete, and density of hardened concrete (Nmai, 1999). The stripping of the land by quarrying process that keeps widespread without supervision has caused to a depletion of natural aggregate. Thus, it is affecting the environment to landslide and land erosion also to a global warming.
However, this issue that more related to environmental conservation has been gaining a vital in our society through recent year (Xue, 2009). Furthermore, more attention to environmental issues has been focused seriously by the decision makers in political, economic, and social sectors nowadays. Thus, proper waste management system has been done to synchronize in our ways of living and live. The process that most effectively as an alternative to conserve a natural resources is by reusing waste products of mental synthesis. Most authorities and researchers have lately focused more on having a privilege of reusing the wastes in environmentally and economically affordable ways (Aubert, 2006). The consumption of waste product in construction materials is one of such visionary effort. Other than that, the increasing of the cost of construction materials that keeps increasing days by days due to high demand, high price of energy and inadequacy raw materials. Moreover, the increase in transportation cost due to raw materials, demand, environmental restrictions, it is necessary to search functional replacement for conventional building materials in the construction industry (Pappu, 2006). In order of saving a conservation of natural resources, the consumption of alternative component in construction materials is a global concern now and for the bright future prospect. This resulting the development and extensive research works towards discovering a new formula and invention of ideas that required for inventing a sustainable and environment friendly construction materials. The present study and more focusing on idealized the potential use of brick wastes as a replacement in the concrete production of construction materials.

1.4 Problem Statement

The scarcity of good and quality coarse aggregates has now become an issue that keeps pressing hard to construction sector mostly in many construction processes. So using jhamma brick s a alternative of coarse aggregate may be effective. As stated above it seems that the use of jhamma as alternative coarse aggregate for concrete production is one of the good alternatives to overcome the problem stated. It has actually been applied in many countries, and including in Australia. The use of recycled waste has been proven to be practical for low strength concrete and for a limited extend for some structural grade concrete (Author, 2008). Instead of minimizing the brick waste produced, it can increase the strength and performance of concrete production. While it also helps minimize the land fill scarcity problem.

1.5 Objectives of Study

The aim of this study is to investigate the use of coarse aggregate in concrete production. Jhamma bricks are broken into sizes ranging from 2.36 to 20 mm. Three objectives have been listed as shown below to achieve the aim of this study;

Objective 1: To determine the suitability of jhamma brick as partial replacement of coarse aggregate in concrete production.

Objective 2: To investigate the mechanical and physical properties of brick waste concrete

Objective 3: To compare the performance between concrete with jhamma brick as coarse aggregate partial replacement and conventional concrete (control concrete).

1.6 Significance Study

Determining the suitability of jhamma brick as alternative coarse aggregate in concrete is very important for these researches convince people that brick waste material can be reused in the construction process. The analysis of the test is required to identify the result whether it is satisfactory the requirement or not. This is due to result from the test will show that whether jhamma brick can achieve the minimum required for compressive strength test and even higher. The compressive strength will be present for age 7, 14 and 28 days, respectively. The test to identify physical and mechanical properties of jhamma brick concrete is vital to improvisation the properties of coarse aggregate by jhamma brick alternative in concrete production. By carrying on the flexural strength test, the ability of concrete to resist distortion under load can be set. We can conclude that how many in per cent brick waste is needed to make its properties in brick concrete strong and can achieve the resistance to deformation load.

The entire test was conducted for both jhamma brick concrete and control concrete. This test is very important to distinguish the result for both conventional and control concrete due to make a concrete conclusion on jhamma brick as a good alternative for coarse aggregate replacement. If the test doesn't achieve the requirement, then to objective propose will be effected. To overcome this situation, brick waste quality was chosen wisely to make a good outcome during the test. Most of the entire test is following the requirement according in the British Standard

2. LITERATURE REVIEW

Patil et.al concluded that The compaction factor decreased as the percentage of Jhamma class brick increases and increased in comparison with the conventional concrete.

The unit weight also decreased as the percentage of Jhamma class brick and decreased in comparison with the conventional concrete.

NORDIN et.al concluded that The alternative for replacement of coarse aggregate actually has been introduced since *50* years ago after a second world war. It is due to materials disposal problem that has happened when there many concrete stacks after the war.

Thus, they come out with the ideas to use waste, construction materials as a new aggregate as a choice to cast aside the waste materials for construction. It was reported in 2009 Malaysian construction industry productivity increased to a *5* per cent (Malaysia Productivity Corporation, 2009). This statistic shows that the construction waste generation will keep increasing year after year. If this situation is not being overcome, it will result landfilling is full with construction waste and more landfilling needed to be produced to fulfil the require construction waste.

In addition, many landfills have decided to close rather than receiving new waste due to the number of waste generated yearly is far more rapidly than the natural degradation process (Idrus, 2008).

From a researchers conduct on 30 construction sites, six types of materials were identified, such as concrete (12.32%), metal (9.62%), brick (6.24%), plastic (0.43%), woods (69.10%), and other waste (2%) (Faridah, 2004). Even though brick waste is not the higher amount of waste in construction, but it contributes an increasing of waste material from construction. More likely this waste can be treated by reusing for construction. The issue, scarcity of landfill also will put a decision maker in local and state authorities in critical situations to a make a tough decision to prevent these problems. Thus, waste utilization has become an alternative solution to overcome the problem for disposal of waste (Bahoria, 2013).

3. MATERIALS USED

3.1 Cement

Cement is one of the binding materials in this project. Cement is the important building material in today's construction world 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989. Ordinary Portland cement, 53Grade conforming to IS: 269 – 1976.Ordinary Portland cement, 53Grade was used for casting all the Specimens. Different types of cement have different water requirements to produce pastes of standard consistence. Different types of cement also will produce concrete have a different rates of strength development. The choice of brand and type of cement is the most important to produce a good quality of concrete. The type of cement affects the rate of hydration, so that the strengths at early ages can be considerably influenced by the particular cement used. It is also important to ensure compatibility of the chemical and mineral admixtures with cement.

In other words Portland cement is the most common type of cement in general usage. It is a basic ingredient of concrete, mortar and many plasters. British masonry worker Joseph Aspdin patented Portland cement in 1824. It was named because of the similarity of its color to Portland limestone, quarried from the English Isle of Portland and used extensively in London architecture.

In modern cement kilns many advanced features are used to lower the fuel consumption per ton of clinker produced. Cement kilns are extremely large, complex, and inherently dusty industrial installations, and have emissions which must be controlled. Of the various ingredients used to produce a given quantity of concrete, the cement is the most energetically expensive. Even complex and efficient kilns require 3.3 to 3.6 gigajoules of energy to produce a ton of clinker and then grind it into cement. Many kilns can be fueled with difficult-to-dispose-of wastes, the most common being used tires. The extremely high temperatures and long periods of time at those temperatures allows cement kilns to efficiently and completely burn even difficult-to-use fuels

Figure 3.1 Cement

3.2 Aggregate

Fine and coarse aggregates make up the bulk of a concrete mixture. Sand, natural gravel, and crushed stone are used mainly for this purpose. Recycled aggregates (from construction, demolition, and excavation waste) are increasingly used as partial replacements for natural aggregates, while a number of manufactured aggregates, including air-cooled blast furnace slag and bottom ash are also permitted.

The size distribution of the aggregate determines how much binder is required. Aggregate with a very even size distribution has the biggest gaps whereas adding aggregate with smaller particles tends to fill these gaps. The binder must fill the gaps between the aggregate as well as pasting the surfaces of the aggregate together, and is typically the most expensive component. Thus variation in sizes of the aggregate reduces the cost of concrete.[30] The aggregate is nearly always stronger than the binder, so its use does not negatively affect the strength of the concrete.

Redistribution of aggregates after compaction often creates in homogeneity due to the influence of vibration. This can lead to strength gradients.

Decorative stones such as quartzite, small river stones or crushed glass are sometimes added to the surface of concrete for a decorative "exposed aggregate" finish, popular among landscape designers.

In addition to being decorative, exposed aggregate may add robustness to a concrete.

3.2.1 Fine Aggregate

Locally available river sand conforming to Grading zone II of IS: 383 –1970. Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens.

Figure 3.2 Fine Aggregate

3.2.2 Coarse Aggregate

Crushed granite aggregate with specific gravity of 2.77 and passing through 4.75 mm sieve and will be used for casting all specimens. Several investigations concluded that maximum size of coarse aggregate should be restricted in strength of the composite. In addition to cement paste – aggregate ratio, aggregate type has a great influence on concrete dimensional stability. Locally available crushed blue granite stones conforming to graded aggregate of nominal size 20 mm as per IS: 383 – 1970.Crushed granite aggregate with specific gravity of 2.77 and passing through 4.75 mm sieve and will be used for casting all specimens. Several investigations concluded that maximum size of coarse aggregate should be restricted in strength of the composite. In addition to cement paste – aggregate ratio, aggregate type has a great influence on concrete dimensional stability.

Figure 3.3 Coarse Aggregate

3.3 Jhamma Class Brick

Bricks are a versatile and durable building and construction material with good load bearing properties. Various researchers have been carried out in porosity, permeability and absorption of brick. The traditional clay bricks are manually produced by pressing clay with certain amount of sand in the wooden mould. Then the wet bricks are first dried in the sun and air and then transported to the brick kiln for subsequent burning process. The bricks are burnt up to temperature of 800-900C in the brick kiln. If the temperature in the brick kiln is uncontrolled then the bricks are burnt excessively up to the temperature 1100-1200C. Due to this the bricks are sold at cheaper rate as they become out of shape. Therefore this type of brick is known as over burnt brick. These bricks are also known as Jhamma bricks. These bricks, however, possess higher strength than the normal burnt clay bricks. Therefore one of the cheaper alternative for brick foundation, floors, roads etc. because of the fact that the over burnt bricks have a compact structure and hence they are sometimes found to be stronger than even the first class brick. Over burnt bricks have high compressive strength between 120 to 150 Kg/cm^2. However they have very poor shape. Brickwork using these bricks utilizes 40% of more mortar than traditional brickwork. However this cost is offset by the price at which over burnt bricks are available. Due to over burnt, the bricks become black and its edges also become curved. It is not used in brick work of building main wall, partition wall and some other purposes

Figure 3.4 Jamma brick

3.4 Water

Casting and curing of specimens were done with the potable water that is available in the college premises.

Combining water with a the material forms a cement paste by the process of hydration. The cement paste glues the aggregate together, fills voids within it, and makes it flow more freely.

As stated by Abrams' law, a lower water-to-cement ratio yields a stronger, more durable concrete, whereas more water gives a freer-flowing concrete with a higher slump. Impure water used to make concrete can cause problems when setting or in causing premature failure of the structure.

Hydration involves many different reactions, often occurring at the same time. As the reactions proceed, the products of the cement hydration process gradually bond together the individual sand and gravel particles and other components of the concrete to form a solid mass.

Reaction:
Cement chemist notation:
$C_3S + H \rightarrow C\text{-}S\text{-}H + CH$
Standard notation:
$Ca_3SiO_5 + H_2O \rightarrow (CaO)\cdot(SiO_2)\cdot(H_2O)(gel) + Ca(OH)_2$
Balanced:
$2Ca_3SiO_5 + 7H_2O \rightarrow 3(CaO)\cdot 2(SiO_2)\cdot 4(H_2O)(gel) + 3Ca(OH)_2$
(approximately; the exact ratios of the CaO, SiO_2 and H_2O in C-S-H can vary.

Chemical admixtures

Chemical admixtures are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes. In normal use, admixture dosages are less than 5% by mass of cement and are added to the concrete at the time of batching/mixing.[33] (See the section on Concrete Production, below.)The common types of admixtures [34] are as follows:

Accelerators speed up the hydration (hardening) of the concrete. Typical materials used are $CaCl_2$, $Ca(NO_3)_2$ and $NaNO_3$. However, use of chlorides may cause corrosion in steel reinforcing and is prohibited in some countries, so that nitrates may be favored. Accelerating admixtures are especially useful for modifying the properties of concrete in cold weather.

Retarders slow the hydration of concrete and are used in large or difficult pours where partial setting before the pour is complete is undesirable. Typical polyol retarders are sugar, sucrose, sodiumgluconate, glucose, cit ric acid, and tartaric acid.

Air entraining agents add and entrain tiny air bubbles in the concrete, which reduces damage during freeze-thaw cycles, increasing durability. However, entrained air entails a trade off with strength, as each 1% of air may decrease compressive strength 5%.[35] If too much air becomes trapped in the concrete as a result of the mixing process, Defoamers can be used to encourage the air bubble to agglomerate, rise to the surface of the wet concrete and then disperse.

Plasticizers increase the workability of plastic or "fresh" concrete, allowing it be placed more easily, with less consolidating effort. A typical plasticizer is lignosulfonate. Plasticizers can be used to reduce the water content of a concrete while maintaining workability and are sometimes called *water-reducers* due to this use. Such treatment improves its strength and durability characteristics. Superplasticizers (also called *high-range water-reducers*) are a class of plasticizers that have fewer deleterious effects and can be used to increase workability more than is practical with traditional plasticizers. Compounds used as superplasticizers include sulfonated naphthalene formaldehyde condensate, sulfonated melamine formaldehyde condensate, acetone formaldehyde condensate and polycarboxylate ethers.

Pigments can be used to change the colour of concrete, for aesthetics.

Corrosion inhibitors are used to minimize the corrosion of steel and steel bars in concrete.

Bonding agents are used to create a bond between old and new concrete (typically a type of polymer) with wide temperature tolerance and corrosion resistance.

Pumping aids improve pumpability, thicken the paste and reduce separation and bleeding.

4. MATERIAL CHARACTERISTICS

CEMENT:

The type of cement used was Portland Pozzalona Cement.

1. Specific Gravity

The density bottle was used to determine the specific gravity of cement. The bottle was cleaned and dried. The weight of empty bottle with brass cap and washerW1 was taken. Then bottle was filled by 200 to 400g of dry cement and weighed as W2.The bottle was filled with kerosene and stirred thoroughly for removing the entrapped air which was weighed as W3.It was emptied, cleaned well, filled with kerosene and weighed as W4.

Portland cement is the most common type of cement in general usage. It is a basic ingredient of concrete, mortar and many plasters. British masonry worker Joseph Aspdin patented Portland cement in 1824. It was named because of the similarity of its colour to Portland limestone, quarried from the English Isle of Portland and used extensively in London architecture. It consists of a mixture of calcium silicates (alite, belite), aluminates and ferrites - compounds which combine calcium, silicon, aluminium and iron in forms which will react with water. Portland cement and similar materials are made by heating limestone (a source of calcium) with clay or shale (a source of silicon, aluminium and iron) and grinding this product (called *clinker*) with a source of sulfate (most commonly gypsum)

2. Fineness (By Sieve Analysis)

The fineness of cement has an important bearing on the rate of hydration and hence on the rate of gain of strength and also on the rate of evolution of heat. Finer cement offers a greater surface area for hydration and hence faster development of strength. 100 grams of cement was taken on a standard IS SieveNo.9(90 microns). The air-set lumps in the sample were broken with fingers. The sample was continuously sieved giving circular and vertical motion for 15 minutes. The residue left on the sieve was weighed.

3. Consistency

The objective of conducting this test is to find out the amount of water to be added to the cement to get a paste of normal consistency. 500 grams of cement was taken and made into a paste with a weighed quantity of water (% by weight of cement) for the first trial. The paste was prepared in a standard manner and filled into the vicat mould plunger, 10mm diameter, 50mm long and was attached and brought down to touch the surface of the paste in the test block and quickly released allowing it to sink into the paste by its own weight. The depth of penetration of the plunger was noted. Similarly trials were conducted with higher water cement ratios till such time the plunger penetrates for a depth of 33-35mm from the top. That particular percentage of water which allows the plunger to penetrate only to a depth of 33-35 mm from the top.

4. Initial Setting Time

The needle of the Vicat apparatus was lowed gently and brought in contact with the surface of the test block and quickly released. It was allowed to penetrate into the test block. In the beginning, the needle completely pierced through the test block. But after sometime when the paste starts losing its plasticity, the needle penetrated only to a depth of 33- 35mm from the top. The period elapsing between the time when water is added to the cement and the time at which the needle penetrates the test block to a depth equal to 33-35mm from the top was taken as the initial setting time.

COARSE AGGREGATE

20mm down size aggregate was used.

1. Specific Gravity

A pycnometer was used to find out the specific gravity of coarse aggregate.

Specific gravity is the ratio of the **density of** a substance to the **density of** a reference substance; equivalently, it is the ratio of the mass of a substance to the mass of a reference substance for the same given volume.

2. Water Absorption

100g of nominal coarse aggregate was taken and their weight was determined, say W1. The sample was then immersed in water for 24 hours. It was then taken out, drained and its weight was determined, says W2. The difference between W1 and W2 gives the water absorption of the sample.

3. Fineness Modulus

The sample was brought to an air-dry condition by drying at room temperature. The required quantity of the sample was taken (3Kg). Sieving was done for 10 minutes. The material retained on each sieve after shaking, represents the fraction of the aggregate coarser then the sieve considered and finer than the sieve above. The weight of aggregate retained in each sieve was measured and converted to a total sample. Fineness modulus was determined as the ratio of summation of cumulative percentage weight retained (F) to 100.

5. METHODOLOGY

5.1 General

This presents the details of development of the process of making Jhamma class brick bat based concrete. The materials that are required for making the Jhamma class brick bat based concrete, coarse aggregates, sand and the Jhamma class brick coarse aggregate as per design of mix proportion M35 are clearly mentioned in a tabular format as per IS 1026-2008.

Preparation, Casting and Curing of Jhama class brick bat based Concrete:-

1. Mix Preparation:-

The batching of all the ingredients will be performed by weight. The sand was air dried in the laboratory before mixing.

First the surface will be damped with water then all the aggregates (Natural Coarse Aggregate, Fine Aggregate and Jhamma class brick coarse Aggregate) are to be spread on the surface area till the aggregates. After thorough mixing of aggregates cement will bw introduced on the ground surface and water will be added slowly as per W/C ratio. The concrete will be mixed for approximately three minutes after the water is added.

2. Specimen Casting:-
Jhamma brick-bats based Concrete is dark in colour and is cohesive. The amount of water in the mixture plays an important role on the behaviour of fresh concrete. When the mixing time is long, mixtures with high water content bled and segregation of aggregates and the paste will appear. This phenomenon is usually followed by low compressive strength of hardened concrete. From the preliminary work, it is decided to observe the following standard process of mixing in all further studies,
1) Take the suitable proportion of the ingredients of the concrete.
2) Spread the fine aggregate on the ground,
3) After that put the coarse aggregate as well as Jhamma brick-bats,
4) After that add the water in suitable quantity.
5) And continue the wet mixing for another four minutes.

3. Curing:-
All the moulds will be cured by immersing in a curing tank in the lab. The specimens were brought out from water approximately 24 hours before testing and kept at room temperature till testing.

Jhamma brick-bats based Concrete
Following test were conducted for this experimental work,
a) Workability test
b) Compressive Strength Test
c) Split Tensile Strength Test.

Concrete production
Concrete production is the process of mixing together the various ingredients—water, aggregate, cement, and any additives—to produce concrete. Concrete production is time-sensitive. Once the ingredients are mixed, workers must put the concrete in place before it hardens. In modern usage, most concrete production takes place in a large type of industrial facility called a concrete plant, or often a batch plant.

In general usage, concrete plants come in two main types, ready mix plants and central mix plants. A ready mix plant mixes all the ingredients except water, while a central mix plant mixes all the ingredients including water. A central mix plant offers more accurate control of the concrete quality through better measurements of the amount of water added, but must be placed closer to the work site where the concrete will be used, since hydration begins at the plant.

A concrete plant consists of large storage hoppers for various reactive ingredients like cement, storage for bulk ingredients like aggregate and water, mechanisms for the addition of various additives and amendments, machinery to accurately weigh, move, and mix some or all of those ingredients, and facilities to dispense the mixed concrete, often to a concrete mixer truck.Modern concrete is usually prepared as a viscous fluid, so that it may be poured into forms, which are containers erected in the field to give the concrete its desired shape. Concrete formwork can be prepared in several ways, such as Slip forming and Steel plate construction. Alternatively, concrete can be mixed into dryer, non-fluid forms and used in factory settings to manufacture Precast concrete products.

A wide variety of equipment is used for processing concrete, from hand tools to heavy industrial machinery. Whichever equipment builders use, however, the objective is to produce the desired building material; ingredients must be properly mixed, placed, shaped, and retained within time constraints. Any interruption in pouring the concrete can cause the initially placed material to begin to set before the next batch is added on top. This creates a horizontal plane of weakness called a *cold joint* between the two batches.[46] Once the mix is where it should be, the curing process must be controlled to ensure that the concrete attains the desired attributes. During concrete preparation, various technical details may affect the quality and nature of the product.

When initially mixed, Portland cement and water rapidly form a gel of tangled chains of interlocking crystals, and components of the gel continue to react over time. Initially the gel is fluid, which improves workability and aids in placement of the material, but as the concrete sets, the chains of crystals join into a rigid structure, counteracting the fluidity of the gel and fixing the particles of aggregate in place. During curing, the cement continues to react with the residual water in a process of hydration. In properly formulated concrete, once this curing process has terminated the product has the desired physical and chemical properties. Among the qualities typically desired, are mechanical strength, low moisture permeability, and chemical and volumetric stability.

Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens over time. Most concretes used are lime-based concretes such as Portland cement concrete or concretes made with other hydraulic cements, such as calcium aluminate cements. However, asphalt concrete, which is frequently used for road surfaces, is also a type of concrete, where the cement material is bitumen, and polymer concretes are sometimes used where the cementing material is a polymer.

When aggregate is mixed together with dry Portland cement and water, the mixture forms a fluid slurry that is easily poured and molded into shape. The cement reacts chemically with the water and other ingredients to form a hard matrix that binds the materials together into a durable stone-like material that has many uses.[2] Often, additives (such as pozzolans or superplasticizers) are included in the mixture to improve the physical properties of the wet mix or the finished material. Most concrete is poured with reinforcing materials (such as rebar) embedded to provide tensile strength, yielding reinforced concrete.

Many types of concrete are available, distinguished by the proportions of the main ingredients below. In this way or by substitution for the cementitious and aggregate phases, the finished product can be tailored to its application. Strength, density, as well chemical and thermal resistance are variables.

Aggregate consists of large chunks of material in a concrete mix, generally a coarse gravel or crushed rocks such as limestone, or granite, along with finer materials such as sand.

Cement, most commonly Portland cement, is associated with the general term "concrete." A range of other materials can be used as the cement in concrete too. One of the most familiar of these alternative cements is asphalt concrete. Other cementitious materials such as fly ash and slag cement, are sometimes added as mineral admixtures (see below) - either pre-blended with the cement or directly as a concrete component - and become a part of the binder for the aggregate.

To produce concrete from most cements (excluding asphalt), water is mixed with the dry powder and aggregate, which produces a semi-liquid slurry that can be shaped, typically by pouring it into a form. The concrete solidifies and hardens through a chemical process called hydration. The water reacts with the cement, which bonds the other components together, creating a robust stone-like material. Chemical admixtures are added to achieve varied properties. These ingredients may accelerate or slow down the rate at which the concrete hardens, and impart many other useful properties including increased tensile strength, entrainment of air and water resistance.

Reinforcement is often included in concrete. Concrete can be formulated with high compressive strength, but always has lower tensile strength. For this reason it is usually reinforced with materials that are strong in tension, typically steel rebar.

Mineral admixtures have become more popular over recent decades. The use of recycled materials as concrete ingredients has been gaining popularity because of increasingly stringent environmental legislation, and the discovery that such materials often have complementary and valuable properties. The most conspicuous of these are fly ash, a by-product of coal-fired power plants, ground granulated blast furnace slag, a byproduct of steelmaking, and silica fume, a byproduct of industrial electric arc furnaces. The use of these materials in concrete reduces the amount of resources required, as the mineral admixtures act as a partial cement replacement. This displaces some cement production, an energetically expensive and environmentally problematic process, while reducing the amount of industrial waste that must be disposed of. Mineral admixtures can be pre-blended with the cement during its production for sale and use as a blended cement, or mixed directly with other components when the concrete is produced.

Mixing concrete

Thorough mixing is essential for the production of uniform, high-quality concrete. For this reason equipment and methods should be capable of effectively mixing concrete materials containing the largest specified aggregate to produce *uniform mixtures* of the lowest slump practical for the work.

Separate paste mixing has shown that the mixing of cement and water into a paste before combining these materials with aggregates can increase the compressive strength of the resulting concrete.[47] The paste is generally mixed in a *high-speed*, shear-type mixer at a w/cm (water to cement ratio) of 0.30 to 0.45 by mass. The cement paste premix may include admixtures such as accelerators or retarders, superplasticizers, pigments, or silica fume. The premixed paste is then blended with aggregates and any remaining batch water and final mixing is completed in conventional concrete mixing equipment.[48]

Curing

A common misconception is that concrete dries as it sets, but the opposite is true - damp concrete sets better than dry concrete. In other words, "hydraulic cement" needs water to become strong. Too much water is counterproductive, but too little water is deleterious. Curing allows concrete to achieve optimal strength and hardness.[52] Curing is the hydration process that occurs after the concrete has been placed. In chemical terms, curing allows calcium-silicate hydrate (C-S-H) to form. To gain strength and harden fully, concrete curing requires time. In around 4 weeks, typically over 90% of the final strength is reached, although strengthening may continue for decades. The conversion of calcium hydroxide in the concrete into calcium carbonate from absorption of CO_2 over several decades further strengthens the concrete and makes it more resistant to damage. This carbonation reaction, however, lowers the pH of the cement pore solution and can corrode the reinforcement bars.

Hydration and hardening of concrete during the first three days is critical. Abnormally fast drying and shrinkage due to factors such as evaporation from wind during placement may lead to increased tensile stresses at a time when it has not yet gained sufficient strength, resulting in greater shrinkage cracking. The early strength of the concrete can be increased if it is kept damp during the curing process. Minimizing stress prior to curing minimizes cracking. High-early-strength concrete is designed to hydrate faster, often by increased use of cement that increases shrinkage and cracking. The strength of concrete changes (increases) for up to three years. It depends on cross-section dimension of elements and conditions of structure exploitation. Addition of short-cut polymer fibers can improve (reduce) shrinkage-induced stresses during curing and increase early and ultimate compression strength.

Properly curing concrete leads to increased strength and lower permeability and avoids cracking where the surface dries out prematurely. Care must also be taken to avoid freezing or overheating due to the exothermic setting of cement. Improper curing can cause scaling, reduced strength, poor abrasion resistance and cracking.

Curing techniques

During the curing period, concrete is ideally maintained at controlled temperature and humidity. To ensure full hydration during curing, concrete slabs are often sprayed with "curing compounds" that create a water-retaining film over the concrete. Typical films are made of wax or related hydrophobic compounds. After the concrete is sufficiently cured, the film is allowed to abrade from the concrete through normal use.

Traditional conditions for curing involve by spraying or ponding the concrete surface with water. The picture to the right shows one of many ways to achieve this, ponding – submerging setting concrete in water and wrapping in plastic to prevent dehydration. Additional common curing methods include wet burlap and plastic sheeting covering the fresh concrete.

For higher-strength applications, accelerated curing techniques may be applied to the concrete. One common technique involves heating the poured concrete with steam, which serves to both keep it damp and raise the temperature, so that the hydration process proceeds more quickly and more thoroughly.

6. TESTS CONDUCTED

Compressive strength or compression strength is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression (being pushed together), whereas tensile strength resists tension (being pulled apart). In the study of strength of materials, tensile strength, compressive strength, and shear strength can be analyzed independently. When a specimen of material is loaded in such a way that it extends it is said to be in tension. On the other hand, if the material compresses and shortens it is said to be in compression. On an atomic level, the molecules or atoms are forced apart when in tension whereas in compression they are forced together. Since atoms in solids always try to find an equilibrium position, and distance between other atoms, forces arise throughout the entire material which oppose both tension and compression. The phenomena prevailing on an atomic level are therefore similar. The "strain" is the relative change in length under applied stress; positive strain characterises an object under tension load which tends to lengthen it, and a compressive stress that shortens an object gives negative strain. Tension tends to pull small sideways deflections back into alignment, while compression tends to amplify such deflection into buckling. Compressive strength is measured on materials. **Tensile testing** also known as **tension testing** is fundamental materials

Science and engineering test in which a sample is subjected to a controlled tension until failure. Properties that are directly measured via a tensile test are ultimate tensile strength, breaking strength, maximum elongation and reduction in area.[2] From these measurements the following properties can also be determined: Young's modulus, Poisson's ratio, yield strength, and strain-hardening characteristics. *Uniaxial tensile testing* is the most commonly used for obtaining the mechanical characteristics of isotropic materials. Some materials use biaxial tensile testing. A tensile specimens is a standardized sample cross-section. It has two shoulders and a gage (section) in between. The shoulders are large so they can be readily gripped, whereas the gauge section has a smaller cross-section so that the deformation and failure can occur in this area. The shoulders of the test specimen can be manufactured in various ways to mate to various grips in the testing machine (see the image below). Each system has advantages and disadvantages; for example, shoulders designed for serrated grips are easy and cheap to manufacture, but the alignment of the specimen is dependent on the skill of the technician. On the other hand, a pinned grip assures good alignment. Threaded shoulders and grips also assure good alignment, but the technician must know to thread each shoulder into the grip at least one diameter's length, otherwise the threads can strip before the specimen fractures.

Figure 6.1 Tensile Testing

7. RESULT AND DISCUSSION

Table 7.1 Test Result

MIX	COMPRESSIVE STRENGTH OF CUBE	COMPRESSIVE STRENGTH OF CYLINDER	SPLITTING STRENGTH
0%	34.5	2.9	22.3
10%	28.4	2.6	20.2
20%	26.5	2.3	19.4
30%	23.3	1.9	18.3
40%	20.7	1.7	16.8
50%	18.6	1.6	15.3

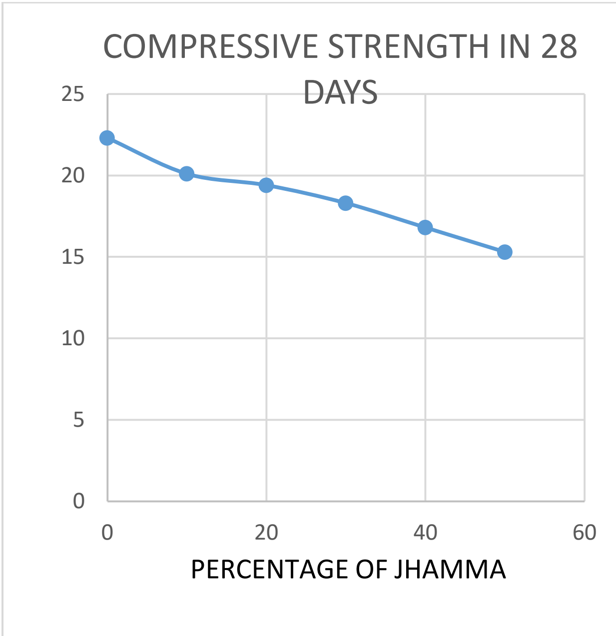

Figure 7.1 Compressive strength in 28 days cylinder

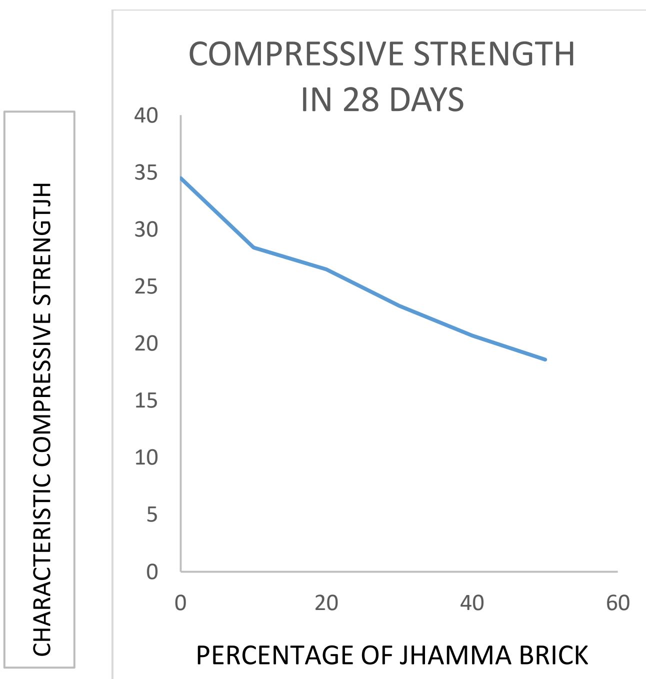

Figure 7.2 Compressive strength in 28 days cube

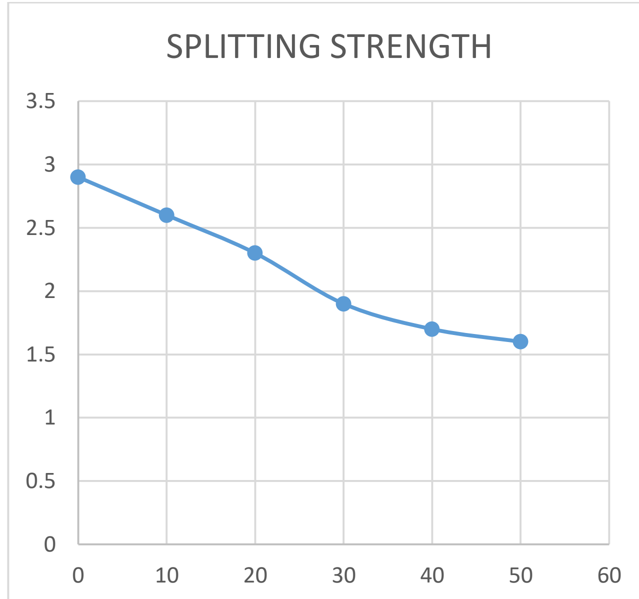

Figure 7.3 Split tensile strength results in 28 days

8. CONCLUSION

A great deal of experimental research has been conducted and reported in the literature to improve the understanding of the general behaviour of Jhamma brick based concrete. We found that the properties like characteristic compressive strength, split tensile strength etc were low when compared to conventional concrete. Also we concluded that Jhamma brick based concrete was of light weight but the mechanical properties were low as compared to normal conventional concrete.

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9. FUTURE SCOPE

There will be a test that will be conducted to estimate the effectiveness of Jhamma brick as a replacement for natural coarse aggregate such as compressive strength test, flexural strength test, water absorption test and water penetration test. The test is conducted to estimate the result of the performance, durability and limitation of conventional concrete compare with control concrete.

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