International
Journal
Of Advanced Research in Engineering & Management (IJAREM)
ISSN: 2456-2033 || PP. 41-63

Experimental Study on Concrete by Replacement of Fine Aggregate with Demolished Fly Ash Brick Powder

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Abstract: This project deals with comparative study on obtained compressive strengths between normal concrete (0% replacement aggregate) and concrete made by replacing with demolished fly ash brick powder at different percentages. This experiential study presents the variation in the strength of concrete when replacing fine aggregate by demolished fly ash brick powder from 0% to 100% in steps of 25%, 50%, 75% and 100%. M25 grade of concrete were taken for this experimental study for more % replacing the demolished fly ash brick powder. The compressive strength of concrete cubes at the age of 7, 14 and 28 days were obtained at room temperature. From test results it was found that the obtained results of 25%, 50%, 75% and 100% are more than 0% replacement of recycled fine aggregate. The maximum compressive strength is obtained only at 50% replacement of demolished fly ash brick powder at room temperature. This result gives a clear picture that demolished fly ash brick powder can be utilized in concrete mixtures as a good substitute for natural river sand giving higher strength

Introduction

1.1 GENERAL

Concrete is the most widely used composite material today. The constituents of concrete are coarse aggregates, fine aggregates, binding materials and water. Rapid increase in construction activities leads to acute shortage of conventional construction materials. It is conventional that sand is being used as fine aggregates in concrete. For the past two years, the escalation in cost of sand due to administrative restrictions in India, demands comparatively greater cost at around two to three times the cost for crusher waste even in places where river sand is available nearby.

The function of the fine aggregates is to assist in producing workability and uniformity in the mixture. The river deposits are the most common source of fine aggregate. Now-a-days the natural river sand has become scarce and very costly. Hence we are forced to think of alternative materials. The quarry dust may be used in the place of river sand fully or partly. A comparatively good strength is expected when sand is replaced partially or fully with or without concrete admixtures.

To meet the requirements of globalization, in the constructions of buildings and other structures concrete plays the rightful role and a large quantum of concrete being utilized. River sand, which is one of the constituents used in the production of conventional concrete, has become highly expensive and also scare. In the backdrop of such a bleak atmosphere ,there is large demand for alternative materials from industrial waste

It is proposed to study the possibility of replacing sand with locally available crusher waste without sacrificing the strength and workability.

1.2 Cement

Cement is a binder a substance that sets and hardens and can bind other materials together.

The history of cementing material is as old as the history of engineering construction. Some kind of cementing materials were used by Egyptians, romans and Indians in their ancient construction. It is believed that the early Egyptians mostly used cementing obtained by burning gypsum. The word ‘’cement’’ can be traced back to the roman term cementicious used to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder

Cements used in construction can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to set in the presence of water (see hydraulic and non-hydraulic lime paste)

Non hydraulic cement will not set in wet conditions or under water; rather, it sets as it dries and reacts with carbon dioxide in the air. It can be attacked by some aggressive chemicals offer settings.

Hydraulic cement (e.g., Portland cement) set and become adhesive due to a chemical reaction between the dry ingredients and water. The chemical reaction results in mineral hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack. This allows settings in wet condition are under water and further protects the hardened material from chemical attack. The chemical process for hydraulic cement found by ancient romans used volcanic as ash (activated aluminium silicates) with lime (calcium oxide)

The most important uses of cement are as a component in the production of mortar in masonry and of concrete, a combination of cement and an aggregate to form a strong building material

1.3 Sand

Sand is a natural occurring granular material composed of final divided rock and mineral particles. It is defined by size being finer then gravel and coarser than silt. Sand can also rifer to textural class of soil or soil type; i.e. a soil containing more than 85% sand –sized particles

The composition of sand varies, depending on the local rock sources and condition but the most common constituent of sand in inland continental setting and non-tropical coastal settings is silica (silicon dioxide, orsio2) usually in the form of quartz. the mostly been created, over the past half billion years by various forms of life, like coral and shellfish. It is, for example, the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean

1.4 Construction Aggregates

Construction aggregate, are simply "aggregate", is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined material in the world aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material due to the relatively high hydraulic conductivity value as compared to most soils, aggregates are widely used in drainage applications such as foundations and French drains, septic drain fields, retaining wall drains and road side edge drains. Aggregates are also used as base material under foundation, roads and railroads. In other words, aggregates are used as a stable foundation or road/rail base with predictable, uniform properties (eg.to help prevent differential setting under the road or building), or as a low cost extender that binds with more expensive cement or asphalt to form concrete.

The American society for testing and materials publishes an exhaustive listing of specifications including ASTM 692 for various construction aggregates products,

Which, by their individual design, are suitable for specific construction purposes. These products include specific types of coarse and fine aggregates designed for such uses as additives to asphalt and concrete mixes, as well as other construction uses. State transportation departments further refine aggregates material specifications in order to tailor aggregate use to the needs and available supply in their particular locations.

Sources for these basic materials can be grouped into three main areas: mining of mineral aggregate deposits, including sand, gravel, and stone; use of waste slag from the manufacture of iron and steel; and recycling of concrete, which is itself chiefly manufactured from mineral aggregates. In addition, there are some (minor) materials that are used as specialty light weight aggregates: clay, pumice, perlite, and vermiculite.

1.5 Fly Ash

Fly ash could be an expensive replacement for Portland cement in concrete and using it, improves strength, segregation and ease of pumping concrete. The rate of substitution typically specified is a minimum of 1 to 1 ½ pounds of fly ash to 1 pound of cement. Fly Ash particles provide a greater workability of the powder portion of the concrete mixture which results in greater workability of the concrete and a lowering of water requirement for the same concrete consistency. Portland cement is rich in lime (CaO) while fly ash is low. Fly ash is high in reactive silicates while Portland cement has smaller amounts.

Fly Ash in Bricks

- Fly Ash, Sand and Cement (Ordinary Portland cement) or Fly Ash, Sand, Lime and Gypsum.
- Consumption of Fly Ash to produce a single fly ash based brick is 1.250gm.

Fly Ash Based Brick Manufacturing Process:
- Raw materials stacking yard (Fly ash, Cement, Sand)
- Mixing zone of composite mortar
- Machine room
- Air dry under covered shed for 24 hours from basic stacking
- After sundry at least for 7 days, product will ready for delivery
- Curing of stacked Cement based fly ash bricks by water spraying for 21 days

Advantages:

A. In terms of usability in Concrete and Cement:
- Higher Ultimate Strength
- Increased Durability
- Improved Workability
- Reduced Bleeding
- Increased Resistance to Sulfate Attack
- Reduced Shrinkage
- Almost zero emission of greenhouse gases.

B. In terms of usage as fly ash bricks:
- Reduces excavation of clay
- Low cost of brick as compared to clay brick of same quality.
- Number of bricks required per unit volume of construction is less as dimensional accuracy is maintained
- Lesser consumption of mortar.
- Better resistance to water damage.

C. Other benefits of using fly ash:
- Reduces soil erosion by replacing top soil as ingredients for most construction mixes.
- Reduces pollution measure by re-use of wastes.
- Reduces the amount of greenhouse gases being added to the atmosphere.
- Hydrophobic nature helps in proper draining off of water from roads and structures.
- Production of crude oil from polyethylene.
- Also used in sewage treatment and generation of biofuel as an alternate source of energy resource.

Literature Review

2.1 Introduction

River sand is costly due to transportation, large scale depletion of resources and enforcement regulations. Quarry dust can be used as an alternative to the river sand. Cost analysis shows that there is 40% savings if quarry dust is used instead of sand.

Illangon.R(2000) has been done a study on 100% replacement of sand by quarry dust in concrete. The compressive strength of concrete with quarry dust has 40% more strength than that of the concrete with sand.

2.2 Quarry Fines from Various Rocks

Everton (2003) reported that knowledge gained from research should be used by quarry operators to optimize the performance of their equipment and to achieve lower quantities of quarry fines.

Petavratzi (2006) investigated that the large amount of dust fraction below 75m generated from various ores and found that the different types of rock produced different amounts of fines with physical properties

Mitchell(2007) suggested that the quarrying sector would consider using new technologies, which reduce the fines production and that further researches work is required in identifying the capital and operational costs associated with quarry fines.

The University of Leeds (2007) explored that the quarry fines are produced from various activities, but the stages of blasting are considered as the most liable in generating such fines. The amount of dust produced during blasting is estimated to be as high as 20%.

2.3 Characterization of Manufactured Sand

The International Centre for Aggregate Research (ICAR: 101-2F) has made efforts to develop a framework in regards to the classification procedure for the use of aggregates fines in concrete. The focus of this project was to examine the methods and test procedures used in the past to characterize the properties of fines, and to develop, on a preliminary basis, a framework to characterize and catalogue the properties of aggregate fines. Additionally, new methods and the test procedures were proposed that would eventually complement a set of guidelines for the use of aggregate fine in Portland cement concrete.

Mark (1995) described a method to quantify the particle shape, surface texture and grading by measuring the uncompactvoids.

Person(1998), Fletcher et al (2002) described an image analysis technique for determining the grain size and shape distributors of fine aggregate. This is a potentially useful method of classifying quarry products in order to determine their suitability for various applications including concrete.

GarboczI et al (2001) depicted how a combination of x-ray tomography, image analysis-type techniques, and spherical harmonic analysis can give a complete 3-D mathematical characterization of an aggregate particle. Databases of 3-Dimensional aggregate shape can be constructed and characterizing various aggregate sources is possible.

2.4 Sand Alternatives in Concrete

Celia and Mara (1996) used rock dust (limestone <75mm) to replace the sand in concrete for proportions up to 30%, with all other ingredients and proportions constant. They concluded that the slump and air content of fresh concrete decreased, as a percentage of dust content increased. While considering mechanical properties, the dust content up to 10% improved the compressive strength and Flexural strength of the concrete and observed that the concrete with dust content up to 5% improved the impact resistance. Dust contents higher than 15% increased the water absorption of the concrete. Water permeability of the concrete is decreased as the percentage of dust content increased. When the dust content exceeds the value of 10%, the drying shrinkage strain decreased.

Jackson and Brown (1996) stated that the percentage of Fines ranging from 5%-15% can be used in concrete.

Smith and Slaughter (1996) suggested that the quarry certified by the U.S. department of transportation are required to maintain the grading target values of 0-7% passing the # 100 (150mm) sieve and 0-2% passing the # 200 (75mm) sieve. As a result uses have been adding fines to improve the workability

Fowler (1997), Machala (1997), Watson (1999) concluded that more fines can be used in concrete than are typically permitted (in the U.S). However, the actual percentage depends on end use and fines properties.

2.5 EFFECT OF MANUFACTURED SAND IN FRESH CONCRETE

Ahmed et at 1989 considered the influence of natural and crushed stone sand of particle size less than 75 microns on the performance of fresh concrete. The ordinary stone dust obtained from crushers does not comply with IS 383-1970. The presence of flaky, badly graded and rough textured particles resulted in harsh concrete. ICAR 102 test results indicated that good quality concrete could be produced using micro fine levels up to 18 percent, when the chemical admixtures are used to increase the workability of the concrete at a fixed w/c ratio.

Zaniest al 2000 inferred that the partial replacement of sand with quarry dust without the inclusion of other admixtures resulted in enhanced workability of the concrete mixes. The cement and concrete association of Australia (CCAA)’s guide to concrete construction (2002) stated that the shape and texture of aggregate particles have an important influence on the workability of freshly mixed concrete since they affect the water demand and the water cement ratio.

Ghataoraet al (2004) used the lime stone quarry fines of size below 4mm. they suggested that the quarry fines could be pumped by hydro-transport techniques using water only. Quarry fines could be developed into cementations pastes and pumped over long distance. Breathy et al (2009) studied the performance of quarry waste in flow of fly ash-gypsum slurry. The industrial waste materials such as fly ash, gypsum and quarry waste were used in the preparation of flow of slurry. They pointed out that the quarry waste can be effectively used in flyash gypsum slurry and that edition in quarry waste content increases the water requirement.

2.6 Effect of manufactured sand in mechanical properties of concrete

Carrasquillo (1981) studied the properties of compressive strength, stress-strain behavior, elastic modulus, poison's ratio and their relations for normal strength concrete of M20 grade. They concluded that the concrete with high compressive strength and high modulus of elasticity attains higher stiffness which yields lower ductal property. If strain is low the ductility will be less. From their data for the elastic modulus and modulus of rupture, they proposed the following equations relating these properties to the compressive strength of the concrete for compressive strengths ranging from 21 M Pa to 83 M Pa:

In 1992, these equations where reported in ACI committee 363's state– of–the-art report of high-strength concrete [ACI 363R-92 1997].

Dukatz (1995) found that the clay minerals in the natural sand reduce the strength of the concrete, whereas when manufactured sand is used, the fines are typically not clay. He suggested conducting chemical analysis to find out the presence of clay in manufactured sand.

2.7 Effect of manufactured sand in durability properties of concrete:

Ahmed and EI koura (1989) indicated that the addition of micro fines called "dust" Increased the shrinkage properties of concrete. Seven concrete mixes were made and measured over one year. In this regard, an increase in the amount of micro fines increased the drying shrinkage CelikOzyildirim(1993) probed the chloride ion penetration, corrosion and rapid permeability properties of concrete. He confirmed that these parameters depended on w/c Ratio, cement type and curing temperature. Switch and Heng (1995) observed the durability of concrete with the addition of limestone power. The durability was observed when w/c≤ 0.6. about this value, the powdered limestone has almost no essential effect.

Methodology

3.1 Introduction

Fly ash could be an expensive replacement for Portland cement in concrete and using it, improves strength, segregation and ease of pumping concrete. Fly Ash particles provide a greater workability of the powder portion of the concrete mixture which results in greater workability of the concrete and a lowering of water requirement for the same concrete consistency. Portland cement is rich in lime (CaO) while fly ash is low. Fly ash is high in reactive silicates while Portland cement has smaller amounts. Then Demolished flyash brick powder was used as a replaced aggregate while, fine aggregate.

3.2 Collections of Materials

All materials are collected from CHALAPATHI ENGINEERING COLLEGE.

Materials are:

- Cement
- Fine aggregates
- Coarse aggregates
- water.
- Recycled fine aggregates

3.2.1 Material Testing In Laboratory

Tests are conducted for materials

- Cement
- Fine aggregate
- Coarse aggregate
- Experimental testing for the above materials:
- Fineness of Cement
- Standard Consistency
- Initial Setting Time
- Final setting time
- Specific gravity of recycled fine aggregates
- Specific gravity of Coarse Aggregates
- Fineness modulus of Coarse Aggregate
- Fineness Modulus of Fine Aggregate

- Bulking of Fine Aggregate
- Bulking of Recycled fine aggregate

3.2.2 Cement

A **cement** is a binder, a substance used in construction that sets and hardens and can bind other materials together. The most important types of cement are used as a component in the production of mortar in masonry, and of concrete which is a combination of cement and an aggregate to form a strong building material. Cements used in construction can be characterized as being either **hydraulic** or **non-hydraulic**, depending upon the ability of the cement to set in the presence of water.

Fig1: Cement

Portland cement is the most common type of cement in general use around the world, used as a basic ingredient of concrete and most non-speciality grout. It was developed from other types of hydraulic lime in England in the mid 19th century and usually originates from limestone. It is a fine powder produced by heating materials in a kiln to form what is called clinker, grinding the clinker, and adding small amounts of other materials. Several types of Portland cement are available with the most common being called ordinary Portland cement (OPC) which is grey in colour, but a white Portland cement is also available.

Fig 2: Fineness of cement

Fineness of cement = 96%

Specific gravity of cement = 3.15

<u>**Standard Consistency Test**</u>

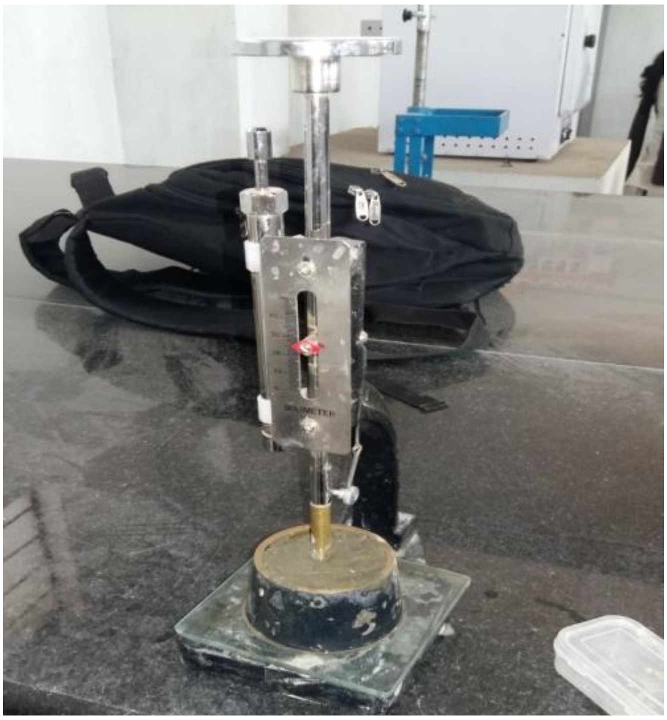

Fig 3: Standard consistency test

For finding out initial setting time, final setting time and soundness of cement, and strength a parameter known as standard consistency has to be used. It is pertinent at this stage to describe the procedure of conducting standard consistency test.

The standard consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having10 mm diameter and 50 mm length to penetrate to a depth of 33-35 mm from the top of the mould shown in fig.3. The apparatus is called Vicat Apparatus. This apparatus is used to find out the percentage of water required to produce a cement paste of standard consistency. The standard consistency of the cement paste is some time called normal consistency (CPNC).

The following procedure is adopted to find out standard consistency. Take about 500gms of cement and prepare a paste with a weighed quantity of water (say 24 per cent by weight of cement) for the first trial. The paste must be prepared in a standard manner and filled into the Vicat mould within 3-5 minutes. After completely filling the mould, shake the mould to expel air. A standard plunger, 10 mm diameter, 50 mm long is 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. Take the reading by noting the depth of penetration of the plunger. Conduct a 2nd trial (say with 25 per cent of water) and find out the depth of penetration of plunger. Similarly, conduct trials with higher and higher water/cement ratio still such time the plunger penetrates for a depth of 33-35 mm 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 is known as the percentage of water required to produce a cement paste of standard consistency. This percentage is usually denoted as ‘P’. The test is required to be conducted in constant temperature (27° + 2°C) and constant humidity (90%).

Initial Setting Time

Lower the needle (C)gently and bring it in contact with the surface of the test block and quickly release. Allow it to penetrate into the test block. In the beginning, the needle will completely pierce through the test block. But after some time when the paste starts losing its plasticity, the needle may penetrate only to a depth of 33-35 mm 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 33-35 mm from the top is taken as initial setting time.

Final Setting Time

Fig. 4 Final setting time

Replace the needle (C) of the Vicat apparatus by a circular attachment (F) shown in theFig.5 The cement shall be considered as finally set when, upon, lowering the attachment gently cover the surface of the test block, the centre needle makes an impression, while the circular cutting edge of the attachment fails to do so. In other words the paste has attained such hardness that the centre needle does not pierce through the paste more than 0.5 mm.

S.no	Properties	Test Results	IS: 12269-1997
1	Normal consistency	32%	31%
2	Initial setting time	33min	Minimum of 30 Min

Table 1: Properties of Cement.

3.3 Fine Aggregate

The river sand and crushed sand was used in combination as fine aggregate conforming to the requirements of IS: 383. The river sand was washed and screened, to eliminate deleterious material and over size particle. Different tests are conducted to find out the properties of fine aggregate (sand) and for the replacement of stone dust.

Fineness modulus of fine aggregate

Fineness modulus is generally used to get an idea of how coarse or fine the aggregate is, more fineness modulus value indicates that the aggregate is coarser and small value fineness modulus indicates that the aggregate is finer.

Fineness modulus is an empirical factor obtained by adding the cumulative percentages of aggregates retained on each of the standard sieves ranging from 4.75mm to 90 microns. Fineness modulus of different type of sand is as per given below:

Type of sand	Fineness Modulus of Range
Fine Sand	2.2-2.6
Medium Sand	2.6-2.9
Coarse Sand	2.9-3.2

Table 2: Different types of sand

Sieve sizes	Weight of soil ret	Cumulative Retained	% Cumulative Retained
4.75mm	0	0	0
2.36mm	6	0.6	6
1.18mm	20	2.6	26
600microns	374	39.8	400
300microns	448	84.4	848
150 microns	146	98.8	994
90microns	6	0	1000

Table 4: Sieve Analysis for Sand

Fineness of sand = 2.26

Specific Gravity of Fine Aggregate

Fig 5: Specific gravity of sand

Empty weight of pycnometer (W1) = 0.562kgs
Empty weight of pycnometer + dry sand (W2) =1.138kgs
Empty weight of pycnometer + dry sand + water (W3) = 1.736kgs
Empty weight of pycnometer + water (W4) = 1.386kgs

Specific Gravity of Fine Aggregate = $\frac{(W2-W1)}{(W4-W1)-(W3-W2)}$

Specific Gravity of Fine Aggregate = 2.58

Bulking of Fine aggregate

The volume increase of fine aggregate due to presence of moisture content is known as bulking. Fine sand bulks more as compared to coarse sand.

The moisture present in aggregate forms a film around each particle. These films of moisture exert a force, known as surface tension, on each particle. Due to this surface tension each particle gets away from each other. Because of this no direct contact is possible among individual particles and this causes bulking of the volume.

Bulking of aggregate is dependent upon two factors,

1. Percentage of moisture content.
2. Particle size of fine aggregate.

Bulking increases with increase in moisture content upto a certain limit and beyond that the further increase in moisture content results in decrease in volume. When the fine aggregate is completely saturated it does not show any bulking. Fine sand bulks more as compared to coarse sand i.e., percentage of bulking is indirectly proportional to the size of particle.

Due to buckling, fine aggregate shows completely unrealistic volume. Therefore it is absolutely necessary that consideration must be given to the effect of buckling in proportioning the concrete by volume

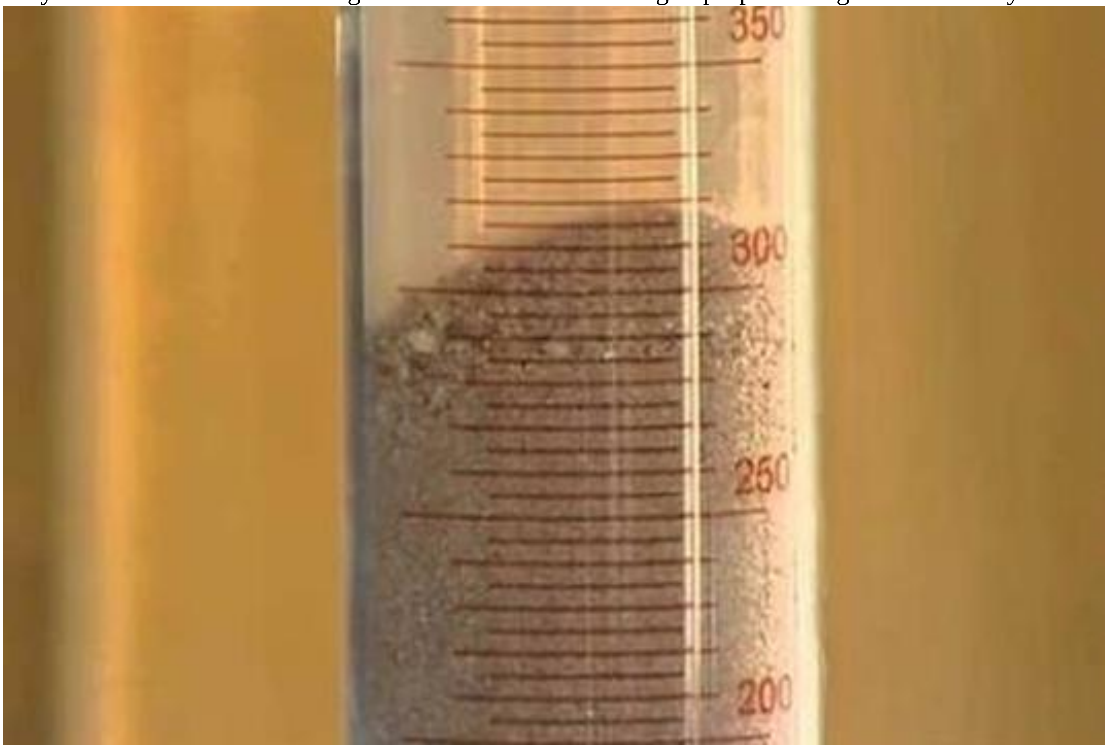

Fig 6: Bulking of sand

Weight of sand (w) = 300 grams
Height of the dry sand (h1) = 9cm
Height of the saturated sand completely offset the bulking effect =11.2 cm
Bulking value of the sand = (h2-h1)/h1 * 100
= (11.2-9)/9*100
=24.4%

3.4 Aggregates

A crushed granite rock with a maximum size of 12 mm was used as a coarse aggregate. The individual term absorption of the aggregates.

Specific Gravity Of Coarse Aggregate

Fig 7 : Specific gravity of coarse aggregate

Empty weight of pycnometer (W1) = 0.566kgs
Empty weight of pycnometer + dry coarse aggregate (W2) =0.982kgs
Empty weight of pycnometer + dry coarse aggregate + water (W3) = 1.645kgs
Empty weight of pycnometer + water (W4) = 1.384kgs
(W2-W1) / (W4-W1)-(W3-W2)
Specific Gravity of Coarse Aggregate = 2.68

Fineness modulus of coarse aggregate

A crushed granite rock with a maximum size of 12 mm was used as a coarse aggregate. The individual term absorption of the aggregates

sieve size	Weight retained (kg)	Cumulative weight retained (kg)	Cumulative % weight retained	Cumulative% passing
80 mm	_	0	0	100
40 mm	_	0	0	100
20 mm	3.040	3.040	60.8	39.2
16mm	1.390	4.430	88.6	11.4
13.2 mm	0.408	4.838	96.76	3.24
10 mm	0.128	4.966	99.32	0.68
6.3 mm	_	4.966	99.32	0.68
4.75 mm	_	4.966	99.32	0.68

Fineness modulus=sum of cumulative %weight retained/100
=544.12/100
=5.44

3.5 Replaced Aggregate:

Demolished flyash brick powder used as a replaced aggregate while, fine aggregate. The Demolished flyash brick powder was washed and screened, to eliminate deleterious material and over size particle. Different tests are conducted to find out the properties of demolished flyash brick powder and for the replacement of fine aggregate.

Specific Gravity of Replaced Aggregate

Empty weight of pycnometer (W1) = 0.564kgs
Empty weight of pycnometer + dry replaced aggregate (W2) =1.058kgs
Empty weight of pycnometer + dry replaced aggregate + water (W3) = 1.686kgs
Empty weight of pycnometer + water (W4) = 1.386kgs

$$\text{Specific Gravity of Replaced Aggregate} = \frac{(W2-W1)}{(W4-W1)-(W3-W2)}$$

Specific Gravity of Replaced Aggregate = 2.54

Bulking of Replaced aggregate

Weight of replaced aggregate (w) = 300 grams
Height of the dry replaced aggregate (h1) = 10cm
Height of the saturated replaced aggregate completely offset the bulking effect =12.4 cm

$$\text{Bulking value of the replaced aggregate} = \frac{h2-h1}{h1} \text{ X } 100$$

$$= \frac{12.4-10}{10} \text{ X } 100$$

$$= 24$$

3.6 Mixing

3.6.1 Mix Ratio

We are using the grade of concrete is M25

Grade	Proportion	w/c ratio
M25	1:1:2	0.45

Table 5: Mixing proportion

Material calculation:

0% Recycled fine aggregates replacing

Cement =6.5kgs
Fine aggregates =6.5kgs
Coarse Aggregates =13.0kgs

25% Recycled fine aggregates replacing

Cement =6.5kgs
Fine aggregates =4.875kgs
Coarse Aggregates =13.0kgs
Recycled fine aggregates =1.625kgs

50% Recycled fine aggregates replacing

Cement =6.5kgs
Fine aggregates =3.25kgs
Coarse Aggregates =13.0kgs
Recycled fine aggregates =3.25kgs

75% Recycled fine aggregates replacing

Cement =6.5kgs
Fine aggregates =1.625kgs
Coarse Aggregates =13.0kgs
Recycled fine aggregates =4.875kgs

100% Recycled fine aggregates replacing

Cement =6.5kgs

Fine aggregates =0.0kgs
Coarse aggregates =13.0kgs
Recycled fine aggregates =6.5kgs

Total quantities of materials used:
Total cement quantity = 32.5kgs
Total sand quantity = 16.25kgs
Total aggregate quantity = 65kgs
Total Recycled fine aggregates =16.25kgs

3.6.1.1 Mixing

Thorough mixing of the materials is essential for the production of uniform concrete. The mixing should ensure that the mass becomes homogeneous, uniform in colour and consistency. There are two methods adopted for mixing concrete:

- Hand mixing
- Machine mixing

We are choosing the hand mixing

Fig 8: Mixing of concrete

3.6.1.2 Hand Mixing:

Hand Mixing: Hand mixing is practised for small scale unimportant concrete works. As the mixing cannot be thorough and efficient, it is desirable to add 10 per cent more cement
to cater for the inferior concrete produced by this method. Hand mixing should be done over an impervious concrete or brick floor of sufficiently large size to take one bag of cement. Spread out the measured quantity of coarse aggregate and fine aggregate in alternate layers. Pour the cement on the top of it, and mix them dry by shovel, turning the mixture over and over again until uniformity of colour is achieved. This uniform mixture is spread out in thickness of about 20 cm. Water is taken in a water-can fitted with a rose-head and sprinkled over the mixture and simultaneously turned over. This operation is continued till such time a good uniform, homogeneous concrete is obtained. Its of particular importance to see that the water is not poured but it is only

sprinkled. Water in small quantity should be added towards the end of the mixing to get the just required consistency. At that stage, even a small quantity of water makes difference.

3.6.1.3 Measurement of Workability

It is discussed earlier that workability of concrete is a complex property. Just as it eludes all precise definition, it also eludes precise measurements. Numerous attempts have been made by many research workers to quantitatively measure this important and vital property of concrete. But none of these methods are satisfactory for precisely measuring or expressing this property to bring out its full meaning. Some of the tests, measure the parameters very close to workability and provide useful information. The following tests are commonly employed to measure workability.

- Slump Test
- Compacting Factor Test

3.6.1.4 Slump Test

Fig 9: Slump test

The result for the slump test of the fresh concrete is shown in Figure 5. The slumps obtained are in the medium range (35– 70mm). The highest slump was obtained with concrete made with river gravel. River gravel has a relatively smooth surface and round in shape, being water-worn due to the action of running water and thereby enhanced the workability of fresh concrete. This aggregate requires less amount of paste to coat its surface and thereby leave more paste for lubrication so that interactions between aggregate particle during mixing is minimized (Mindess, Young, and Darwin, 2003). Quartzite and granite aggregates are crushed from rock fragments and this gives the aggregate a characteristic rough and fairly angular in shape. Aggregate of this nature requires more amount of water when used for concrete work to provide for aggregate coating and lubrication (ACI Committee 211.1-91). The concrete containing crushed quartzite and granite aggregates therefore shows lower workability compared to concrete made with river gravel.

Test no	% of recycled fine aggregates	Slump value (mm)	Type of slump
1	0%Recycled fine aggregates	20	True slump
2	25% Recycled fine aggregates	15	True Slump
3	50%Recycled fine aggregates	10	True slump
4	75% Recycled fine aggregates	10	True slump
5	100% Recycled fine aggregates	15	True slump

Table 6: Slump test results

3.7 Casting of Cubes

After the sample has been mixed, immediately fill the cube moulds and compact the concrete, either by hand or by vibration. Any air trapped in the concrete will reduce the strength of the cube. Hence, the cubes must be fully compacted. However, care must also be taken not to over compact the concrete as this may cause segregation of the aggregates and cement paste in the mix. This may also reduce the final compressive strength.

3.7.1 Hand Compaction:

Hand Compaction: Hand compaction of concrete is adopted in case of unimportant concrete work of small magnitude. Sometimes, this method is also applied in such situation, where a large quantity of reinforcement is used, which cannot be normally compacted by mechanical means. Hand compaction consists of rodding, ramming or tamping. When hand compaction is adopted, the consistency of concrete is maintained at a higher level. The thickness of the layer of concrete is limited to about 15 to 20 cm. Rodding is nothing but poking the concrete with about 2 metre long, 16 mm diameter rod to pack the concrete between the reinforcement and sharp corners and edges. Rodding is done continuously over the complete area to effectively pack the concrete and drive away entrapped air. Sometimes, instead of iron rod, bamboos or cane is also used for rodding purpose. Ramming should be done with care. Light ramming can be permitted in unreinforced foundation concrete or in ground floor construction. Ramming should not be permitted in case of reinforced concrete or in the upper floor construction, where concrete is placed in the formwork supported on struts. If ramming is adopted in the above case the position of the reinforcement may be disturbed or the formwork may fail, particularly, if steel rammer issued.

Fig.10 Compacting the concrete in the cube mould (For 150 mm cube at least 25 tamps per layer).

ISSN: 2456-2033 || PP. 41-63

Tamping is one of the usual methods adopted in compacting roof or floor slab or road Pavements where the thickness of concrete is comparatively less and the surface to be finished smooth and level. Tamping consists of beating the top surface by wooden cross beam of section about 10 x 10 cm. Since the tamping bar is sufficiently long it not only compacts, but also levels the top surface across the entire width.

Fig.11 Finishing and casting cubes

3.7.2 Precautions to be taken while making of Cubes

While finishing off the surface of the concrete, if the mould is too full, the excess concrete should not be removed by scraping off the top surface as this takes off the cement paste that has come to the top and leaves the concrete short of cement. The correct way is to use a corner of the trowel and dig out a fair sample of the concrete as a whole, then finish the surface by towelling.

Once a specimen has been compacted, it should not be left standing on the same bench as another specimen that is being compacted. If this is done, some vibration will be passed on to the first specimen and it will be more compacted than the other. In extreme cases some re-arranging of the particles may result and segregation will occur.

Fig:11Casted Cubes

Recycled fine aggregates Replacement	0%	25%	50%	75%	100%
No of cubes	3	3	3	3	3

Table.9 Different % of R.A replacement and No of cubes casting

3.7.3 Curing Of Cubes

Curing is the process in which the concrete is protected from loss of moisture and kept within a reasonable temperature range. The result of this process is increased strength and decreased permeability. Curing is also a key player in mitigating cracks in the concrete, which severely impacts durability.

Fig.12 Curing of cubes

3.8 Compressive Strength Of Cubes

Compressive 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, tensile strength, compressive strength, and shear strength can be analyzed independently.

Compressive strength can be measured by plotting applied force against deformation in a testing machine, such as a universal testing machine.

Some materials fracture at their compressive strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load. Compressive strength is a key value for design of structures. Measuring the compressive strength of a steel drum.

Fig. 13 Compression testing machine

Compressive strength is often measured on a universal testing machine; these range from very small table-top systems to ones with over 53 MN capacity. Measurements of compressive strength are affected by the specific test method and conditions of measurement. Compressive strengths are usually reported in relationship to a specific technical standard.

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 either tension or 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, components, and structures.

By definition, the ultimate compressive strength of a material is that value of uniaxial compressive stress reached when the material fails completely. The compressive strength is usually obtained experimentally by means of a compressive test. The apparatus used for this experiment is the same as that used in a tensile test. However, rather than applying a uniaxial tensile load, a uniaxial compressive load is applied. As can be imagined, the specimen (usually cylindrical) is shortened as well as spread laterally. A Stress–strain curve is plotted by the instrument and would look similar to the following:

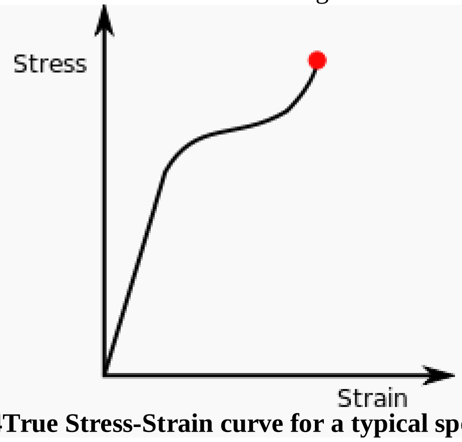

Fig. 14True Stress-Strain curve for a typical specimen

The compressive strength of the material would correspond to the stress at the red point shown on the curve. In a compression test, there is a linear region where the material follows Hooke's Law. Hence for this region $\sigma = E\epsilon$ where this time E refers to the Young's Modulus for compression. In this region, the material deforms elastically and returns to its original length when the stress is removed.

This linear region terminates at what is known as the yield point. Above this point the material behaves plastically and will not return to its original length once the load is removed.

There is a difference between the engineering stress and the true stress. By its basic definition the uniaxial stress is given by:

$$\sigma = \frac{F}{A}$$

Where, F = Load applied [N],

A = Area [m^2]

Fig. 15Testing of cubes

RESULTS

4.1 Results

Compression test results

0% replacement of Recycled fine aggregates compressive strength

SI.No	Days	Strength (N/mm2)
1	7	15.42
2	14	19.55
3	28	24.76

25% replacement of Recycled fine aggregates compressive strength

SI.No	Days	Strength (N/mm2)
1	7	16.10
2	14	30.10
3	28	32.25

50% replacement of Recycled fine aggregates compressive strength

SI.No	Days	Strength (N/mm2)
1	7	16.85

2	14	27.31
3	28	34.12

75% replacement of Recycled fine aggregates compressive strength

SI.No	Days	Strength (N/mm2)
1	7	17.32
2	14	24.62
3	28	33.48

100% replacement of Recycled fine aggregates compressive strength

SI.No	Days	Strength (N/mm2)
1	7	19.87
2	14	20.26
3	28	28.64

GRAPHS

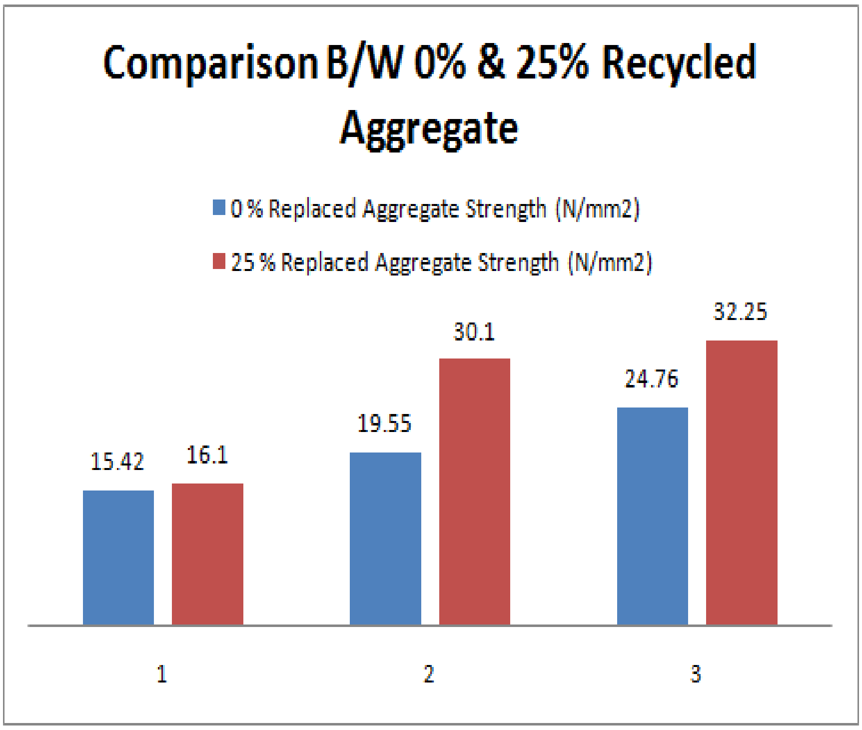

Fig-1: Comparison B/W 0% & 25% Recycled Aggregate

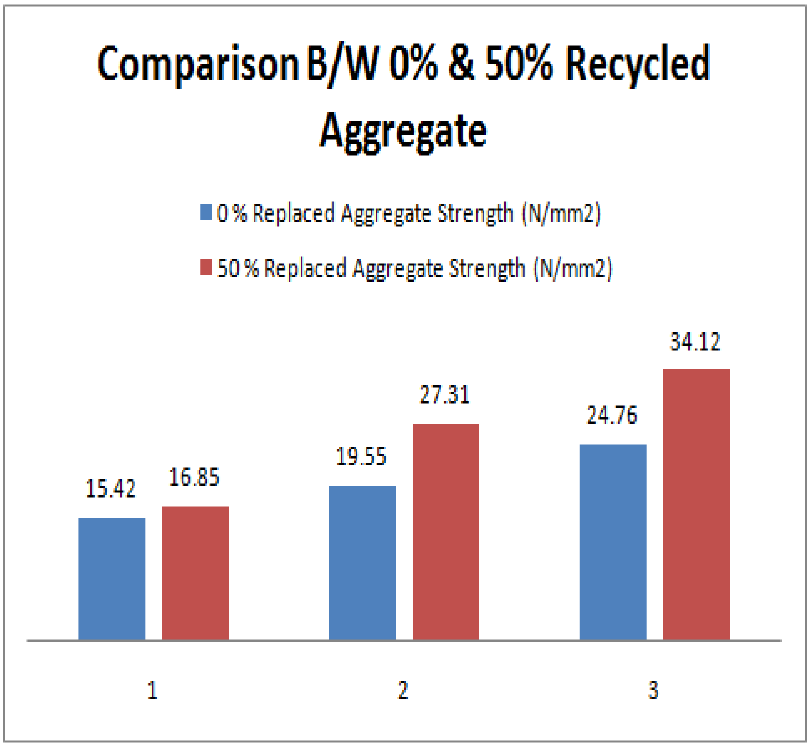

Fig-2: Comparison B/W 0% & 50% Recycled Aggregate

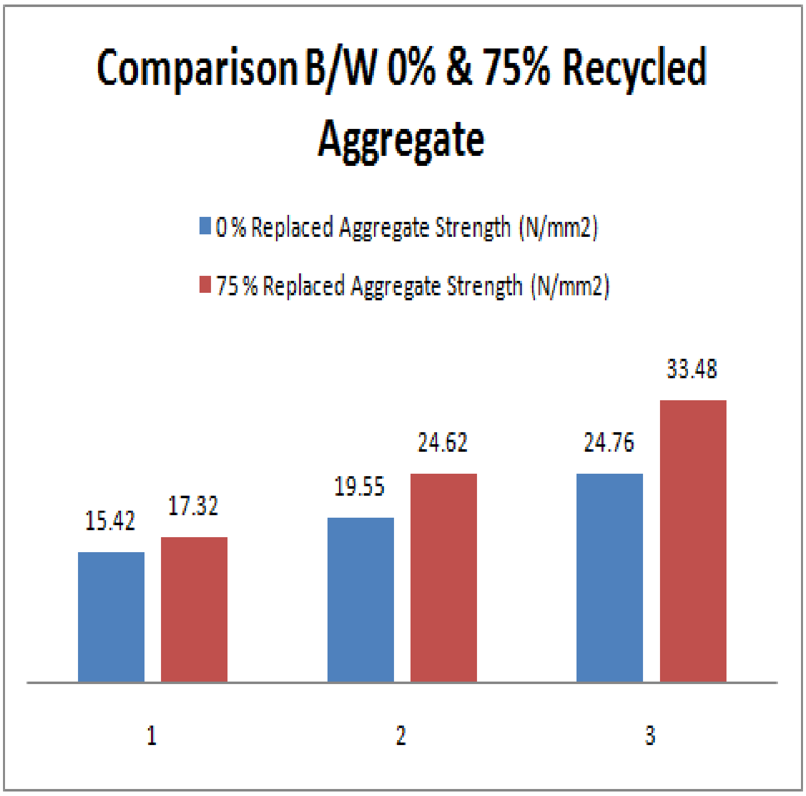

Fig-3: Comparison B/W 0% & 75% Recycled Aggregate

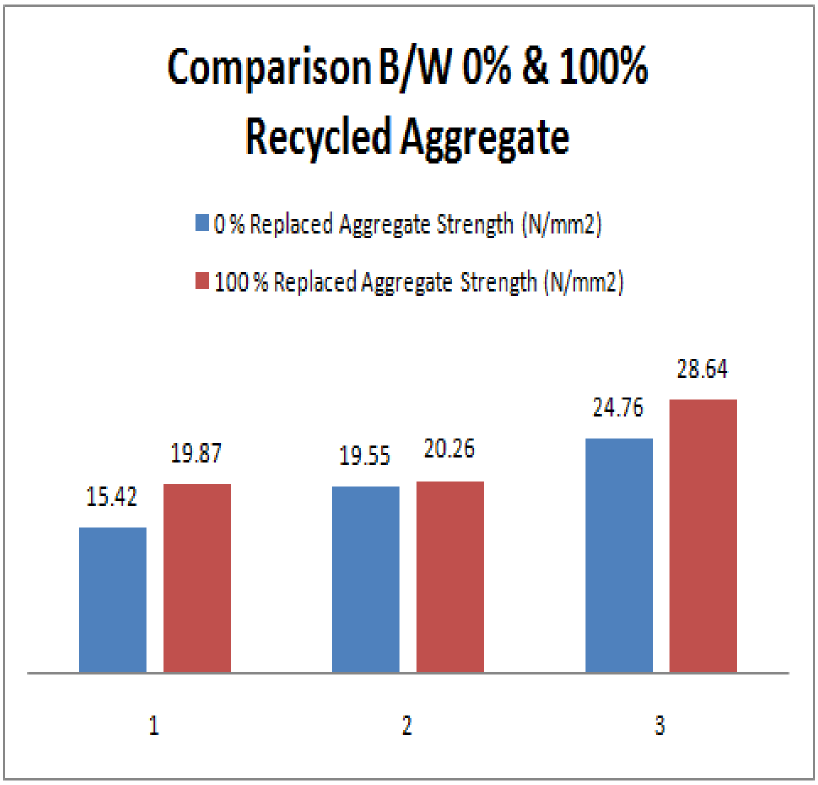

Fig-4: Comparison B/W 0% & 100% Recycled Aggregate

CONCLUSIONS

Based on above results, following conclusions are drawn;

- We compare the obtained compressive strengths between normal concrete (0% replacement aggregate) and concrete made by replacing with demolished fly ash brick powder at different percentages.
- The compressive strengths are obtained for every 7, 14 & 28 days curing of casted cubes of normal concrete and concrete made by 25%, 50%, 75% and 100% replaced by demolished fly ash brick powder.
- The obtained compressive strengths of 0% replacement of recycled fine aggregate after 28days curing is 24.76 MPa.
- The obtained compressive strengths of 25% replacement of recycled fine aggregate after 28days curing is 32.25 MPa.
- The obtained compressive strengths of 50% replacement of recycled fine aggregate after 28days curing is 34.12 MPa.
- The obtained compressive strengths of 75% replacement of recycled fine aggregate after 28days curing is 33.48 MPa.

- The obtained compressive strengths of 100% replacement of recycled fine aggregate after 28days curing is 28.64 MPa.
- Compressive strength for replacement of recycled aggregates for 25%, 50%, 75% and 100% are more than 0% replacement of recycled fine aggregate.
- From the above, maximum compressive strength obtained at 50% replacement of recycled fine aggregate.
- The percentage of increase in strength with respect to control concrete in M25 respectively.

The above conclusion gives clear picture that Demolished Fly ash brick powder can be utilized in concrete mixtures as a good substitute for natural river sand with higher strength at 50% replacement.

REFERENCES

[1]. M.S shetty, concrete technology theory and practice, 5thedition, s.chand and Colt, NEW DELHI.
[2]. I.R.MITHANTHAYA, JAYAPRAKASH NARAYAN, replacement of sand by quarry dust for plastering and in the pavement design, proceedings of national symposium at karnunya institute of technology on 20-21, December 2002, pp. 9-15.
[3]. B.P.Hudson, manufactured sand for concrete, the Indian concrete journal, May 1997, pp237-240
[4]. M.S.Jaafar , W.A.Thanoon, M.R.A.Kadir and D.N.Trikha, strength and durability characteristics of high strength autoclaved stone dust concrete, the Indian concrete journal, December 2002, pp771-774.
[5]. A.K.Sahu, Sunil Kumar and A.K.Sachan, crushed stone waste as fine aggregate for concrete, the Indian concrete journal, January 2003 pp845-847
[6]. IS 456-2000 Indian standard code of practice for plain and reinforced concrete, bureau of Indian standards, New Delhi?
[7]. Md.Safiuddin, S.N.Ranman and M.F.M. Zane, utilization of quarry waste fine aggregate in concrete mixtures 2007 journal of applied sciences research 3(3):202-208
[8]. Appukutty .P. and murugesan .R "Substitution of quarry dust to sand for motor in brick masonry works" International Journal on design and manufacturing Technologies, vol.3,No.1, January 2009
[9]. Harish chary stone dust using in concrete.The report by brahma chary, Beer USANi.
[10]. Ilangovana. R, Mahendrana.N and nagaamani.K. "Strength and durability properties of concrete containing quarry rock dust as fine aggregate". ARPN Journal of engineering and applied sciences. Vol.3 no.5, October 2008
[11]. Lorain T.K., Pasha M.,Dash K.P.,Jenna's "optimum utilization of quarry dust as partial replacement of sand in concrete"Int. Journal of applied sciences and engineering research , vol. 1 , no. 2, 2012.
[12]. Mahendra.R.C and prakash.S.P. "Strength Appraisal of Artificial sand as fine aggregate in SFRC" ARPN Journal of engineering and applied sciences vole 5, no.10, October 2010.