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**RESEARCH ARTICLE**

# STUDY OF MECHANICAL BEHAVIOUR OF COIR FIBER REINFORCED CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT WITH FLYASH

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**ABSTRACT**

*The overall goal of the project is to investigate the behavioural of coir fiber reinforced concrete with partial replacement of cement with fly ash. The coir fiber recently attached an interest as a sustainable fiber composite material, due to some specific mechanical property which can be compared to an artificial fiber. The Coir fiber is treated using natural latex before using in concrete so that is not to be affected by moisture content present in concrete in this experimental study of 7,14,28 days of the compressive strength and split tensile strength are carried out using different percentage as 0.5%,0.75%. Encouragement should be given for the use of natural fibers which are locally available materials, in the field of civil engineering.*

***Index Terms****— A Design mix proposing was designed for the normally popular M30 concrete for pavement construction in India. in this Cement was replaced with percentage (30%) of Class C fly ash and coconut fibers (0.50 and 0.75%)having 30mm length were used. Test results show the replacement of 53grade ordinary Portland cement with flyash showed an increase in compressive strength and flexural strength for the chosen mix proportion.*

## I. INTRODUCTION

Concrete is now the most widely used construction material as it can be cast to any form and shape at site very easily. Cement concrete has established itself as the most preferred material.[1] The coconut coir is an important commercial product obtained from husk of coconut. The main advantages of using these two by products in improving the strength of sub grade are locally available and are very cheap. Due to the shrinkage and swelling, the pavements constructed on the black cotton sub grade results in extensive cracks and large settlements. The use of these two as a replacements have two advantages i.e.; firstly, elimination of solid waste [2]

**FLY ASH—** Fly ash is the fine powder produced as a product from the combustion of pulverized coal.The concrete containing fly ash as partial replacement of cement possesses problems on delayed early strength. But concrete containing fly ash as partial replacement of fine aggregate will

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possess no delayed early strength. [3]. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as Mineral Admixture in Concrete has two designations for Fly Ash used in concrete - Class F and C.

**CLASS C FLY ASH—**Fly ash produced from the burning of younger lignite or sub-bituminous coal, in addition to having pozzolonic properties, also has some self- cementing properties. In the presence of water, Class C fly ash will harden and gain strength over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike Class F, self-cementing Class C fly ash does not require an activator. Alkali and Sulphate (SO4) contents are generally higher in Class C fly ashes.**Class C has $SiO_2 + Al_2O_3 + Fe_2O_3 = 50\%$**

**CLASS F FLY ASH—**The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolonic in nature, and contains less than 10% lime (CaO). Possessing pozzolonic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementations compounds. Alternatively, in addition of a chemical activator such as sodium silicate (water glass) to a Class F ash can leads to the formation of a geo-polymer. (**Class F has $SiO_2 + Al_2O_3 + Fe_2O_3 = 70\%$**)[10]

**FIBER—**Fibers can be defined as a small piece of reinforcing material possessing certain dimensional characteristics. The most important parameter describing a fiber is its Aspect ratio. "Aspect ratio" is the length of fiber divided by an equivalent diameter of the fiber. The properties of fiber reinforced concrete are very much affected by the type of fiber. Fibers are secondary reinforcement material and acts as crack arrester. Coir fiber is Coconut fiber which is extracted from the outer shell of a coconut.

**COIR FIBRE—** Coir or coconut fibre belongs to the group of hard structural fibres. It is an important commercial product obtained from the husk of the coconut. Industries based on coir have developed in many coconut producing countries especially India, Kenya, Bangladesh, Thailand, Sri Lanka, etc. In India, coir manufacture is a traditional industry, which has taken deep roots in the economic structure of the rural areas in the coastal states

**BROWN FIBRE—** The fibrous husks are soaked in pits or in nets in a slow-moving body of water to swell and soften the fibres. The long bristle fibres are separated from the shorter mattress fibres underneath the skin of the nut, a process known as wet-milling. The mattress fibres are sifted to remove dirt and other rubbish, dried in the sun and packed into bales. Some mattress fibre is allowed to retain more moisture so it retains its elasticity for twisted fibre production. The coir fibre is elastic enough to twist without breaking and it holds a curl as though permanently waved.

**WHITE FIBRE—** The immature husks are suspended in a river or water-filled pit for up to ten months. During this time, micro-organisms break down the plant tissues surrounding the fibres to loosen them a process known as retting.

**BUFFERING—** Because coir is high in sodium and potassium, it is treated before use as a growth medium for plants or fungi by soaking in a calcium buffering solution; most coir sold for growing purposes is pre-treated. Once any remaining salts have been leached out of the coir pith, it and the coir bark become suitable substrates for cultivating fungi. Coir is naturally rich in Potassium, which can lead to Magnesium deficiencies in soilless horticultural media.Brown coir is used in floor mats and doormats, brushes, mattresses, floor tiles and sacking. A small amount is also made into twine.

**BRIEF DESCRIPTIONS OF SOME NATURAL FIBRES**

**Coir/Coconut Fibres -**Coir fibre is extracted from the outer shell of a coconut. There are two types of coir fibres, brown fibre extracted from matured coconuts and white fibres extracted from immature coconuts. Brown fibres are thick, strong and have high abrasion resistance. White fibres are smoother and finer, but also weaker.

**Sisal Fibres -**Sisal fibres are stiff fibres extracted from an agave plant. These fibres are straight, smooth and yellow in colour. Strength, durability and ability to stretch are some important properties of sisal fibres.

**Cotton Fibres -**Cotton fibre grows around the seeds of the cotton plant. It is soft and staple fibre.

**PHYSICAL AND MECHANICAL PROPERTIES OF NATURAL FIBRES**

Some fibres like coir, sisal and jute were studied by many researchers for different purposes. There is a huge difference in some reported properties of a particular fibre, for example, diameter of coir fibres is approximately same and magnitudes of tensile strength are quite different, for example, compare tensile strength of coir fibres .The reason could be the source of fibres from different regions of the world. Toledo Filo et al. (2005) mentioned the density of coir and sisal fibre as 0.67 to 10.0 g/cm$^3$ and 0.75 to 10.7 g/cm$^3$, respectively.

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**NATURAL FIBER REINFORCED CONCRETE—**The first use of fibers in reinforced concrete has been dated to 1870"s. Since then, researchers around the world have been interested in improving the tensile properties of concrete by adding, iron and other wastes.Local interest has been demonstrated through research work performed. In addition to industrial fibers, natural organic and mineral fibers have been also investigated in reinforced concrete. Wood, sisal, jute, bamboo, coconut, asbestos and Rockwool, are examples that have been used and investigated[5]

**MECHANICAL PROPERTIES OF FIBER CONCRETE**

**Compression**-The presence of fibers may alter the failure mode of cylinders, but the fiber effect will be minor on the improvement of compressive strength values (0 to 15 %).

**Natural Fibers** -The cubes tests prepared with different fibers, different fibers volumetric ratios and different reductions in coarse aggregate, showed large variations in the test results as compared to the control specimens with no fibers. The variation in the results could be attributed to the relatively small size of the cube which may result in erroneous data compared with 15x30 cm standard cylinders.

**MODULUS OF ELASTICITY IN NATURALFIBERS —** Modulus of elasticity of FRC increases slightly with an increase in the fibers content. It was found that for each 1 percent increase in fiber content by volume there is an increase of 3 percent in the modulus of elasticity.The elastic modulus of composites was determined using tensile tests. Tensile tests were performed according to ASTM D 638 specification. Tensile tests were carried out using an MTS testing machine with load cell capacity of 10kN at a cross-head speed of 5 mm/min. Tensile elastic moduli were determined from the slopes of the stress strain curves.

**FLEXURALSTRENGTH IN NATURAL FIBERS—** Flexure load involves the ability of the material to bend. Flexure loads are really a combination of tensile, compression and shear loads. When load is applied the upper surface is put into compression, the lower face is in tension, and the central portion of the partition experiences shear. [2]

**FATIGUE STRENGTH IN NATURAL FIBERS—**The use of the natural fibers in concrete mixes has beneficial effects with respect to increasing the flexural strength and providing a ductile post-cracking behaviour of the fiber reinforced concrete mix,especially for the industrial hemp samples. Similar to the compression tests, specimen prepared with 0.75 or 1% hemp fibers and 20% reduction in coarse aggregate provided relatively good results.

## II. METHODOLOGY

The methodology explains about the step by step procedure that is going to be done in the project. The methodology is explained in the following figure

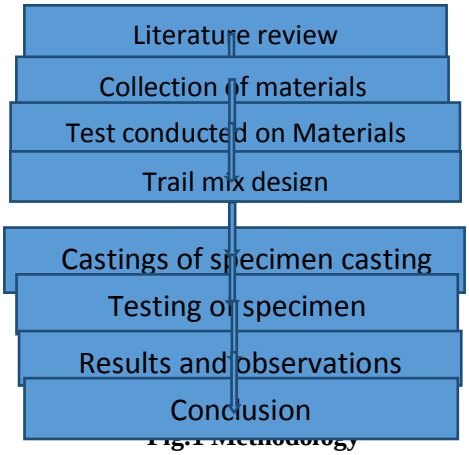


Fig.1 Methodology

## III. LITERATURE REVIEW

**Amit Rai1 and Dr. Y.P Joshi, May 2014**studied research in **"Applications and Properties of Fiber Reinforced Concrete"** micro-cracks developed before structure was loaded because of drying shrinkage and other causes of volume change. When the structure was loaded, the micro cracks opened up and propagated because of the development of such micro-cracks which resulted in inelastic deformation in concrete**.** Fiber reinforced concrete (FRC) was the cementing concrete reinforced mixture with more or less randomly distributed small fibers. Durability of the concrete was improved to reduce in the crack widths.

**SaandeepaniVajje and Dr. N. R. Krishna murthy, 11November 2013 did** a "**Study on Addition of the Natural Fibers into Concrete"** tells that basically natural fibers are of two types. Natural inorganic fibers such as Basalt, Asbestos…etc. and the other are the natural organic fibers such as coconut, palm, jute, sisal, banana, pine, sugarcane, bamboo…etc. The natural fibers are investigated by different researchers as construction materials that can be used in cement paste/mortar/concrete. This study may include the fiber properties, characteristics and compatibility between themselves. The fibers are of same order of magnitude as aggregate inclusions

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**Amit Kumar Ahirwar1, Prof. Rajesh Joshi, April 2015** did an experimental study on "**Experimental Analysis of Fly Ash & Coir Fibber Mix Cement Concrete for Rigid Pavement**" The concert of such materials can substantially be improved by introducing reinforcing element in the direction of improving its compressive and flexural strength for superior durability. These composites can be a good proposition and with this, experimental investigation to study the effects of replacement of cement (by volume) with different percentages of fly ash and the effects of addition of processed natural coconut fiber on flexural strength, compressive strength, splitting tensile strength and modulus of elasticity was taken .

## IV. STUDY AND OMPOSITION OF MATERIALS

*Cement, Fine aggregate, Coarse aggregate, Fly ash and coir are the various materials used in this project. Before casting the specimen various tests of materials has been conducted. After casting, the specimen was kept for a curing period of 7,14 and 28 days .Compression and flexural strength was tested.*

**STUDY OF MATERIALS**

**CEMENT—**The cement used was ordinary Portland cement 53 (OPC 53).All properties of cement were determined by referring IS 12269 - 1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 40 minutes and 600 minutes respectively. Standard consistency of cement was 30%.In the most general sense of the world, cement is a binder, a substance which sets and hardens independently, and can bind other materials together. The most important use of cement is the production of mortar and concrete the bounding of natural or artificial aggregate to form a strong building material which is durable in the face of normal environmental effects.

**FINE AGGREGATE —** Fine aggregate is a material that will pass seive no: 4 sieve and retained on a no: 200 sieve. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have round shape. The purpose of fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.The sand which was locally available and passing through 4.75mm IS sieve is used. The specific gravity of fine aggregate was 2.79.

**COARSE AGGREGATE —** It gives body to the concrete, reduces shrinkage and effect economy, the aggregate occupy 70%-80% of volume of concrete. As with fine aggregate, for increased workability and economy as reflected by the use of less cement, the coarse aggregate should have a rounded shape. The coarse aggregates with size of 20mm were tested and the specific gravity value of 2.75 and fineness modulus of 7 was found out. Aggregates were available from local sources.

**COIR FIBRE—** Coir fibre belongs to the group of hard structural fibres. It is an important commercial product obtained from the husk of the coconut. Individual fibres are 0.3-1.0 mm long and 0.01-0.0.2 mm in diameter; the ratio of length to diameter being 35. Length of the fibre determines its spin ability and commercial utility. White coir also is used to make fishing nets due to its strong resistance to saltwater.

**COMPOSITIONOF MATERIALS**

*Adding coir fiber in the ratio of 0.25%, 0.5%, 0.75% with cement and 30% of the cement is replaced with fly ash. M30 mix design was adopted and the ratio has been obtained.*

**FRESHCONCRETEPROPERTIES**

Setting of Concrete,Water Cement Ratio, Amount and type of Aggregate

**Workability—**The property of fresh concrete which is indicated by the amount of useful internal work required to fully compact the concrete without bleeding or segregation in the finished product.\ 3.2.1 Segregation And Bleeding "Segregation in concrete is commonly thought as separation of some size groups of aggregates from cement mortar in isolated locations with corresponding deficiencies of these materials in other locations.

**Slump Test—** Fresh concrete when unsupported will flow to the sides and sinking in height will take place. This vertical settlement is known as slump. The workability (ease of mixing, transporting, placing and compaction) of concrete depends on wetness of concrete (consistency) i.e., water content as well as proportions of fine aggregate to coarse aggregate and aggregate to cement ratio. The slump test which is a field test is only an approximate measure of consistency defining ranges of consistency for most practical works.

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## V. TESTING OF MATERIALS AND CASTING

**Tests for cement -Fineness Test**

*The fineness test of cement has an important on the rate of hydration and hence on the rate of gain of strength .To find the fineness of the given cement, the equipment required is IS Sieve: 90 micron.*

**Fineness test for cement**

% of fineness of cement = $(W_2/W_1)$ x100 = 6/100x100 = 6%

% of fineness of cement = $(W_2/W_1)$ x100 = 7/100x100 = 7%

Average of fineness cement = (6+7) / 2 = 6.5%

**Analysis of result —**Thus requirement of cement as a residue should not exceed 10% for ordinary from the results we infer that the fineness of cement is 6.5 % and the fineness Portland cement.

**Consistency Test —** For finding out initial setting time, final setting time and soundness of cement, and strength, standard consistency has to be used. The standard consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having 10mm diameter and 50mm length to penetrate to a depth of 33 – 35 mm from the top of the top of the mould. Take about 500g of cement paste.. After completely filling the mould, shake the mould to expel the air. A standard plunger, 10 mm diameter, 50 mm long is attached and bought down to touch the surface of the paste.

**Consistency of cement**

Standard consistency

$$= \frac{\text{Quantityofwater}}{\text{Weightofc ementtaken}} \text{x100}$$

Weight of cement taken= 400g

Quantity of water (g) taken for 28% = (28/100) x400 = 112g

Quantity of water (g) taken for 30% = (30/100) x400= 120g

Quantity of water (g) taken for 32% = (32/100) x400 = 128g

Quantity of water (g) taken for 34% = (34/100) x400 = 136g

The percentage of water required for obtaining cement paste of standard consistency = 34%

**Initial Setting Time and Final Setting Time**

**Initial setting time—**This is used to find out the minimum time taken by the concrete paste to start setting. For that, lower the needle of the Vicat apparatus gently andbring it in contact withthe surface of the test block and quickly release.. 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 the initial setting time.

**Final Setting time —** Replace the needle of the apparatus by a circular attachment. 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.Final setting time for the given sample of cement = 10 hrs

| Sl no: | Wt of sampletaken ($W_1$ g) | Wt of residue ($W_2$ g) | % wt of residue $(W_2/W_1)$x 100 |
|---|---|---|---|
| 1 | 100 | 6 | 6 |
| 2 | 100 | 7 | 7 |

**Specific gravity test —**This test is done to determine the specific gravity of cement by density bottle method. Specific gravity is the ratio of the weight in air of a given volume of a material at a standard temperature to the weight in air of an equal volume of distilled water at at the same stated temperature.

**Specific gravity of cement**

Weight of empty pycnometer ($W_1$) = 566g

Weight of pycnometer + cement ($W_2$) = 1138g

Weight of pycnometer + cement + kerosene ($W_3$) = 1754g

Weight of pycnometer + kerosene ($W_4$) = 1412g

Weight of cement in the pycnometer($W_2 - W_1$) = (1138 – 566)

Weight of equal volume of water= 572g

$(W_4 - W_1) - (W_3 - W_2)$ = (1412– 566) – (1754– 1138)

= 230

Specific gravity of cement =dry wt of cement / wt ofequalvol of water

$$= \frac{(W2-W1)}{(W4-W1)-(W3-W2)\times 0.79}$$

Specific gravity of cement = 3.15

**Test for fine aggregate**

**Specific gravity test -** This test is done to determine the specific gravity of fine grained sand by density bottle Method. Specific gravity is the ratio of the weight in air of a given volume of a

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material at a standard temperature to the weight in the air of equal volume distilled water at the same stated temperature.

**Specific gravity of Fine aggregate:**

Weight of empty pycnometer ($W_1$) = 566g

Weight ofpycnometer + Fine aggregate (F.A) ($W_2$) = 991g

Weight of pycnometer + F.A + water ($W_3$) = 1733g

Weight ofpycnometer + water ($W_4$) = 1478g

Weight of F.A in the pycnometer($W_2 - W_1$) = (991 – 566)

Weight of equal volume of water = 425g

$(W_4 – W_1) – (W_3 – W_2)$

= (1478 – 566) – (1733 – 976)

= 165g

Specific gravity of fine aggregate

$$= \frac{\text{Dry wt.of sand}}{\text{wt.of equal volume of water}}$$

$$= \frac{(W2-W1)}{(W4-W1)-(W3-W2)} = 2.75$$

**Sieve Analysis Test -** Sieve analysis is a practice or procedure used to assess the particle size distribution of a granular material. The size of distribution is often of critical importance to the way the material performance in use. The grain size analysis is widely used in classification of soil.

**TESTS FOR COURSE AGGREGATE**

**Specific gravity of coarse aggregate:**

Weight of empty pycnometer ($W_1$) = 566 g

Weight of pycnometer + C.A($W_2$) = 977g

Weight of pycnometer + C.A + water ($W_3$) = 1731 g

Weight of pycnometer + water ($W_4$g) = 1478 g

Weight of C.A in the pycnometer($W_2 – W_1$) = 411g

Weight of equal volume of water $(W_4 – W_1) – (W_3 – W_2)$ = 158 g

Specific gravity of coarse aggregate

$$= \frac{\text{Dry wt.of coarse aggregate}}{\text{wt.of equal volume of water}}$$

Specific gravity of coarse aggregate

$$= \frac{411}{158} = 2.7$$

**Casting of Specimen** -The concrete after workability was used for casting specimens. Moulds were used to cast the specimen. Since maximum size of aggregate is 20mmcube moulds of the size 150x150x150 mm were used. The cube moulds were used for compression test specimens the inner surface of the mould was coated with thin layer of waste oil in order to help the remoulding easy and to have sharp corners. Before applying oil inner surface was cleaned and freed from moisture.

**Curing -** Curing is the process in which the concrete is protected from loss of moisture and kept in within a reasonable temperature range. The result of the process is increased strength and decreased permeability. Curing is also key player in mitigating cracks in the concrete, which severely impact durability. The mould is kept for 24 hours and is removed. The concrete is cured for 7 days and 28 days.

**Testing Of Specimen -** The specimens are casted and cured for 28 days. After that the specimens are tested in strength of materials lab. Compressive test is conducted for cubes and the split tensile test is conducted for cylinder specimens.

**Testing Of Cube Specimen-** The concrete cubes placed in water are taken out and the surface water and grid is wiped off. The areas of the cubes are calculated. The cube is kept on the bottom plate of the machine and is at centre of it. The cube is tested on its side as cast and load applied perpendicular to the direction of casting.. The loading is continued and the maximum load is applied on the specimen is noted. The load by area gives the compressive strength of concrete. 3 cubes are tested and the average is taken.

## VI. MIX DESIGN

**Mix design procedure —** *Indian standard recommended method of concrete mix design. This mix design procedure covered in IS 10262 – 82. The method given can be applied for both medium and high strength concrete.*

**Target mean strength for mix design -** The target mean compressive ($f_{ck}$) strength at 28 days is given by$f_{ck} = f_{ck} + t_s$Where, $f_{ck}$ = characteristic compressive strength at 28 days S is the standard deviation. The value of standard has to be worked out from the trails conducted in the laboratory or field.

$$f_a = f_{ck} + 1.65s$$

**Selection of water / cement ratio -** Various parameter like type of cement , aggregate , maximum size of aggregate , surface texture of aggregate etc are influencing the strength of concrete , when water / cement ratio remains constant , hence it is desired to establish a relation between concrete strength and free water cement ratio with materials and condition to be used actually at site . However this will need at least 28 days for testing the strength of cement, thereby delaying the whole process by 28 days. Accelerated test may be adopted to cut down the delay.

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**Selection of water content and fine to total aggregate ration-** The water content and percentage of sand in total aggregate by absolute volume are determined. For medium (below grade M35) and high strength are based on the following conditions.

a) Crushed (angular) coarse aggregate, conforming to IS 383 – 1970.
b) Fine aggregate consisting of natural sand zone. It of table of IS 383 - 1970

**Calculation of cement content -** The cement content per unit volume of concrete may be calculated from free water cement ratio and the quality of water per unit volume of concrete (cement by mass = water content / water cement ratio)

**Calculation of aggregate content -**

Aggregate content can be determined from be following equipment's

$$V = [W + \frac{C}{Se} + \frac{1}{p}\frac{fa}{Sfa}]\frac{1}{1000}$$

$$C_a = \frac{1-P}{P} \times fa \times \frac{Sca}{Sfa}$$

**Actual quantities required for mix-** It may be mentioned that above mix proportions has been arrived at on the assumption that aggregate are saturated and surface dry. For any deviation from the condition i.e, when are moist or air by bone dry; Correction aggregate has to be applied on quantity of mixing water as well to the aggregate.

**The calculate mix proportions -**Shall be checked by means of trial batches, Quantities of materials for each trial shall be enough for at least three 150mm size cubes and concrete required to carry out workability and freedom from segregation and bending and its finishing property.If the measured workability is different from the assumed in the calculation, a change in the water content has to done and the whole recalculated by keeping water / cement ratio constant. This will comprise trial mix number 2. Now water / cement ratio is changed by ±10 per cent of per selected value and mix proportions are recalculation. These will from trial mix number 3 and 4. Testing for trial mix number 2, 3,4 are done simultaneously.

**MIX DESIGN CALCULATION**

Type of cement = OPC 53 grade
Max size of aggregate = 20mm
Specific gravity of cement = 3.15
Specific gravity of coarse aggregate = 2.75
Sieve analysis of fine aggregate = 2.79
Workability = 25 to 75mm
=50mm
Exposure condition = mild
Type of miner admixture = fly ash

**From table IS 456:2000**

Target strength for mix proportion
Determination of water cement ratio $M_{30}$ = 0.45

Determination of water and sand content = 35+.5
= 35.55%

**Using Table 2 IS 1062:2009**

Maximum water content = 186 Kg/$m^3$

**Calculate the cement content**

Water cement ratio = 0.45

Cement content = Max water / Water cement ratio
= 186/0.45 = 413.15
413.15 >320 Hence the condition is ok

fck′ = fck+1.653
Fck = 30
S = from table 1 (mix design code)
S = standard deviation
S = 5N/$mm^2$
fck′ = 38.25

Cementious content Material = 413.3 x 1.10= 454.6

**Fly ash-** Already in the ordinary Portland cement there is including of 5 % of flyash in it.
So adding of 25% flyash instead of 30%

**Fly ash @ 25%**

Total cementious content = 454.16 X 0.25 = 114.15 Kg/$m^3$

**Properties as volume of coarse and fine aggregate**

Aggregate for water cement ratio
Volume of coarse aggregate = 0.6

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Volume of fine aggregate = 1-0.6 = 0.4

**Mix calculation**

Volume of cement = $1m^3$

Volume of cement = (Mass of cement / Specific gravity of cement) x (1/1000)
= 0.131 $m^3$

Volume of fly ash = (mass of fly ash / specific gravity of fly ash ) x (1/1000)
= (114.15/ 2.21) x (1/1000)
= 0.0516 $m^3$

Volume of all aggregate = (1-(0.31+0.136+0.0516))
= 0.6314

Mass of cement = Volume of cement – volume of fly ash
= 454.6 – 114.15
= 340.45 $kg/m^3$

Mass of course aggregate = 0.6314 x volume of course aggregate x specific gravity of coarse aggregate x 1000 = 0.6314 x 2.75 x 1000 x 0.6
= 1041.81 $Kg/m^3$

Mass of fine aggregate = 0.6314 x volume of fine aggregate x specific gravity x1000 = 0.6314 x 0.4 x 2.79 x 1000
=704.64 $Kg/m^3$

**Mix ratio**

| Cement | Fine aggregate | Course aggregate | Water | Fly ash |
|---|---|---|---|---|
| 340.4 / 340.45 = 1 | 704.64 / 340.45 = 2.07 | 1041.81/340.45 = 3.06 | 186/340.45 = 0.546 | 114.15/34 0.4 = 0.335 |

## VII. RESULT AND DISCUSSION

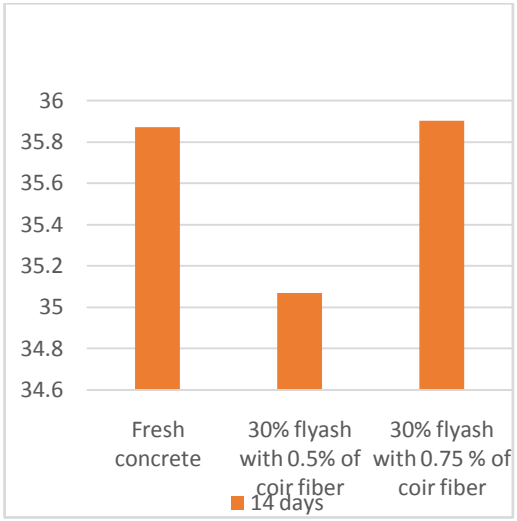
**COMPRESSIVE STRENGTH TEST ON CUBE–**

- Compressive strength for fresh concrete at 14 days at 30% fly ash and 0.5% fiber

Average Compressive Stress = 35.87 $N/mm^2$

- Compressive strength of cube in 14 days at 30% fly ash and 0.75% fiber

Average Compressive Stress = 35.07 $N/mm^2$




COMPRESSIVE STRENGTH FOR CUBE

## VIII. CONCLUSION

The concrete mix is done by M30 mix and 53 grade ordinary Portland cement has been used. The addition of coir fibres into the concrete mixture gives satisfactory improvement in the compressive strength at 28 days. As the percentage of fly ash increases, the performance of the concrete decreases. We have replaced cement by 30% of fly ash and added coir fibre in various proportions. We have done compressive strength test for cubes and split tensile strength test for cylinder. By using fly ash the waste disposal problem can be solved and savings in cost of construction can be achieved. Maximum compressive strength for cube specimen is obtained at 30% replacement of cement with fly ash and 0.5% & 0.75% fiber. Similarly maximum split tensile strength for cylinder specimen is obtained at 30% replacement of cement with fly ash and 0.5% & 0.75% fiber.

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