

An Experimental Study of Jute Fibre Reinforced Concrete by Partial Replacement of Cement with Fly ash with addition of super plasticizer

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ABSTRACT: Today's developing world lays high emphasis on the waste management .Wastes generated through different source needs to be recycled & reuse to convert them into useful resources & hence needs to be treated well. Huge amount of waste generated through different sources are burden over our resources, occupying huge amount of land area and polluting our environment by emitting harmful gases. Construction industries provide a wide platform in reusing these waste materials as an alternative of some conventional materials. Industrial waste like fly ash, rice husk, slags etc. were found suitable for replacement of conventional materials like cement & sand in previous studies. These materials inhibit identical properties as that of conventional materials and thus can be used as substitute materials in production of concrete. Jute fibres & other waste fibre were also found useful in providing tensile strength to concrete in previous studies. In present investigation, properties of concrete prepared by partial replacement of cement with fly ash i.e. at 10%, 20% & 30% along with addition jute fibre & super plasticizer were investigated. Testing was carried out at concrete technology lab of NITTTR,Bhopal.

KEYWORDS: Fly ash, Jute Fibres, Super plasticizers, Compressive strength, Workability

I. INTRODUCTION

Concrete is a combination of binding materials, fine aggregate, coarse aggregate and water. Concrete is hard and strong like stone, this is caused by the chemical reaction which take place between water and cement. The benefit of concrete is its most multipurpose use in construction field. Concrete is the material which can be moulded in some shapes and well to cast from regular rectangular or circular structure to dome or hemispherical form .The strength of concrete regularly enhance with times up to a limit and it has minimum maintenance during the tune-up time of structure like calculate to further construction materials similar to steel, wood etc. But concrete is a brittle material and weak in tension therefore forming cracks easily. For this reason reinforcement is required to strengthen and durability of concrete. Hybrid fibre reinforced concrete is an attempt for enhancing the inherent property of concrete to make it more valuable. Fibre reinforced concrete can be considered to be a composite material made using concrete and short, discrete, and randomly distributed fibres. Research and development work in Fibre Reinforced Concrete (FRC) started in India at the early 1970. Fibre reinforced concrete was developed to overcome the problems associated with cement base materials for example low tensile strength, poor fracture toughness and brittleness of cementitious composites. Fibre reinforced concrete is use to raise the tensile strength and toughness of concrete. It is randomly distributed fibre within the concrete matrix. In the beginning, FRC was primarily used for pavements and industrial floors. But now a

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Vol. 5, Issue 10, October 2016

day, the FRC compound is being use for a broad range of application including bridges, tunnel and canal linings, hydraulic structures, pipes, slab, precast etc. Fibre concrete also used use in the repair work of structure to avoid spalling of concrete from repair structure. The use of FRC in structural members such as beams, columns, staircase, slabs and pre-stressed concrete structures is individual investigate by a number of researchers at present in India and abroad. Basically fibres can be divided into following two groups: Fibre may have various types and size, basically classified as i) Natural fibre & ii) Artificial fibre. Natural fibre like sisal, bagasse ash, banana, soya bean, animal hair etc. and artificial fibre like nylon, steel, glass, recron , polypropylene, asbestos etc. A fibre reinforced concrete enhances the compressive stress, strain and flexure & tensile strength of concrete. For comparative evaluation of performance,3 different types of sample compression strength. M20 grade concrete is prepared, 6 samples first sample D is prepared without fibre and others samples are made with the fraction of fly ash is 10%, 20%, 30% & 0% and respectively coconut coir add in the samples is 1% constant .20% water also replaced by super plasticizer .

II. LITERATURE SURVEY

Amit Kumar Ahirwar (2016) experimental investigation to study the effects of replacement of cement (by volume) with different percentage of fly ash and the effects of adding of processed natural coconut fibre on flexural strength, compressive force, split tensile force and modulus of elasticity was taken up.. In this, Cement was replaced with percentages 10, 20, 30 and 40% of Class C fly ash and of coconut fibres (0.50 and 1.0 %) having 40 mm length were used. experiment outcome show that the substitute of 43 grades ordinary Portland cement with fly ash showed an increase in compressive strength and flexural strength for the preferred mix proportion. The workability of concrete decreases with the increase in fly ash, the particle of Fly ash reduces the amount of water required to produce a given slump.

Ali Majid (2010) has concluded in his research the versatility and applications of coconut fibres in different fields is discussed in detail under the research. Coconut fibres are reported as most ductile and energy absorbent material. It is concluded that coconut fibres have the possible to be use in composite for different purposes. Coconut fibre is used as reinforcement is discussed in this work. Physical and chemical properties of coir fibre discoursed.

Baruah and Talukdar (2007) Investigated coir fibre reinforced concrete with the volume fraction 0%, 0.5%, 1.0%, 1.5%, 2.0% by the volume fraction of concrete shows compressive strength, split tensile strength, modulus of rupture, shear strength and toughness continuously increases up to 2% volume fraction of concrete.

Balaguru and shah (1992) has studied that the steel fibres influence the quality of concrete and strength. Author has observed the how the aspect ratio, volume fraction and shape of steel fibre effect the strength of concrete.

Bhupandre kumar This Research paper discusses the comparative study between Flyash base coconut fibre concrete by plain cement concrete of M40 grade. This research paper deals use of the agricultural and industrialized waste material keen on concrete, which improved the properties of concrete and make environment green. The fly ash replaces the cement by 10, 20, and 30% and coconut fibres are added additionally by weight of cement in the proportions of 1%.The diameter of coconut fibre varies between 0.25 to 1.0 cm and length is taken as 4 cm. The outcome shows increase in compressive strength of concrete by adding fly ash and coconut fibre together into concrete

III. OBJECTIVE OF EXPERIMENTAL STUDY

The objectives of present study are:

- To evaluate the compressive strength of FRC using jute fibres.
- To study the properties of concrete by variation in percentage of fly ash.
- To find out effect of super plasticizer on properties of jute fibre reinforced concrete having cement replaced with fly ash.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

IV. EXPERIMENTAL METHODOLOGY

A. MATERIALS USED:

Cement: This is the most common binding material used in concrete production. The cement used in this study is Ultra-tech OPC of 53 grade conforming to IS: 12269-1987. Physical properties of cement show in table no.1 which is given below.

Fine aggregate: Locally available fresh river sand, free from organic matter, was used. The result of sieve analysis confirms to zone-II (according to IS: 383-1970) as shown in table 1

Coarse aggregate: For this study the locally available good quality coarse aggregate is used. The size of coarse aggregate varies from 10 mm to 20 mm, means the material passed from 20mm IS sieve but retained in 10mm IS sieve.

Fly ash: Class-F Fly ash is used as a partial replacement of cement in concrete and it is passed from 600 micron IS sieve. Physical properties of fly ash which is show in table no.2.

Coconut coir: Coconut coir is a natural fibre. The length of coir used in hybrid fibre reinforced concrete is varying from 30 mm to 70mm and diameter vary from 0.2 mm to 0.45 mm the aspect ratio of coconut coir is kept between 50 to 100

Super plasticizers: Super plasticizer used in this investigation is Sikament® 3070 NS. It is a retarding Super plasticizer with Integral Water Proofing ability. It is a dark brown liquid solution approved by IS 9103-1999, ASTM C494, IS 2645.

Table- 1 Physical properties of cement

Properties	Results
Fineness	7%
specific gravity	3.15
Standard consistency	31.5
initial setting time	35min
final setting time	300min

Table- 2 Physical properties of Fly ash

Physical property	Value
Colour	Grey
Bulk density	1.12 gm/cc
Specific gravity	2.52
Fineness	351 Kg/m ²

B. EXPERIMENTAL PROGRAMME:

Slump cone test were carried out to obtain the workability and consistency of fresh concrete. The efficiency of all fibre reinforcement is depend upon obtained of a homogenous distribution of the fibres in the concrete, their reciprocal with the cement matrix, and the ability of concrete successfully cast. Basically, each individual fibre needs to be coated with cement to supply any benefit in the concrete. Standard users of fibre reinforced concrete will fully appreciate that adding more fibres in the concrete, particularly a really small diameter, results in greater negative impact on workability and the requirement for mix design changes. The slump changed because of the different type of fibres content and form. The main reason of lower slump is the fact of adding two different fibres can form a network structure in concrete, which restrain mix from segregation and movement. As results of high content and large area of fibres, fibres are certain to absorb more concrete paste wrap around and the increase viscosity of combination of mix the slump reduction.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

Compressive strength

The strength of concrete is generally defined and determined by the crushing strength of cube 150mm x 150mm x 150mm, at age of 7 and 28 days. It is the most frequent test conducted on hard concrete as it is an easy test to perform and also most of the desirable characteristics properties of concrete are related to its compressive strength. This test is conducted for cube after the completion of curing age and cubes are taken away from the curing tank and wiped the water with dry cloth. Take the weight of specimen to determining the density of sample cube. Now keep the sample into the compression testing machine. Measure the dimension of load bearing area. Load is apply step by step till the specimen fails to obtain further load and note down the maximum load taken up by the cube. Also other specimens are tested and load is taken down. Compressive Stress is considered by load separated by load bearing area, also compressive stress is calculate for every specimen and average value is determined. Compressive strength is denoted by Greek letter sigma (σ).

Testing of specimen

Total 24 number of cube were casted for the experimental analysis of result. Tests are conducted in two different period of time. At the age of seven days of curing three cubes specimen of every sample are in use away from curing tank and compressive test is conducted. All six samples undergo compression test on the time of seven days and reading are recorded. Remain specimens are kept in curing for 28 days conducted for cubes followed by compression test of cubes. Test sequence is similar for all the six samples, results are carefully recorded for each specimen and tabulated. Material mix proportions per cubic meter draw on table no.3 which is this type:

Table-3 Material Mix Proportion per Cubic Meter

Sample Name	Water (Lit./m ³)	Cement (kg/m ³)	Fly ash (kg/m ³)	F.A (kg/m ³)	C.A (kg/m ³)	Coirfibre (kg/m ³)	Super Plasticizer (Lit./m ³)
D	149.33	414.81	-	674.66	1351.11	-	-
D1	149.33	373.33	41.48	674.66	1351.11	1.7	5.42
D2	149.33	331.85	82.96	674.66	1351.11	1.7	5.42
D3	149.33	290.37	124.44	674.66	1351.11	1.7	5.42

V. RESULT & DISCUSSIONS

The experimental investigation has done by testing of cubes. Three different type of samples are prepared in laboratory, each sample has six specimens of cube. Three samples have different fibre content but each sample replace 10%, 20%, 30% & 0% cement by fly ash. Before going for the compression strength of specimens are tested for

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

destructive test for each cube. Then out of these six specimens of each sample, three are tested for 7&28 days compressive strength of cube.

A. SLUMP CONE TEST RESULTS:

The slump test outcome performed on the various sample of concrete of M20 grade be given in Table -4 for the suitable workability of the jute fibre reinforced concrete. The slump test results it be experimental that the same as the amount of jute fibre improved as 1% constant and fly ash vary 10%; 20% and 30% in the concrete mix, then the slump value decreased. Slump cone test result show in table no.4 & bar chart of slump value show in figure.1.

Table- 4 Slump Cone Test results

Mix	Jute fibre (%)	Fly ash (%)	Slump value (mm)
D	1	0	25
D1	1	10	24
D2	1	20	18
D3	1	30	13

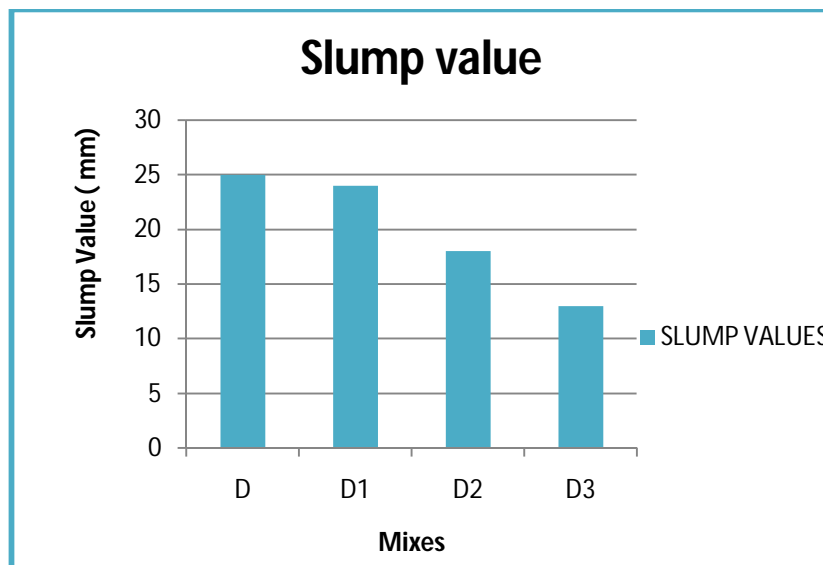


Figure-1 Slump bar chart

5.2 COMPRESSIVE STRENGTH TEST RESULTS: Total 24 cubes i.e. 6 samples for each trial mix (3 for 7 days & 3 for 28 days) was tested. Compressive strength results were obtained by testing cubes under compression in UTM.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

The average 7 days strength results and 28 days strength results are shown in table-5 for each mixes. Compressive strength of different of mixes show in below Table-5 and Graph for 7 & 28 days compressive strength show in figure-2.

Table-5 Compressive strength of different mixes

Samples	Sample	Sample	Sample	Sample
	D	D1	D2	D3
Compressive strength at age of 7 days(N/mm ²)	14.09	18.33	22.08	16.19
Compressive strength at age of 28 days(N/mm ²)	26.63	26.49	34.98	21.42
Change In percentage	–	+30.09	+20.45	-34.85

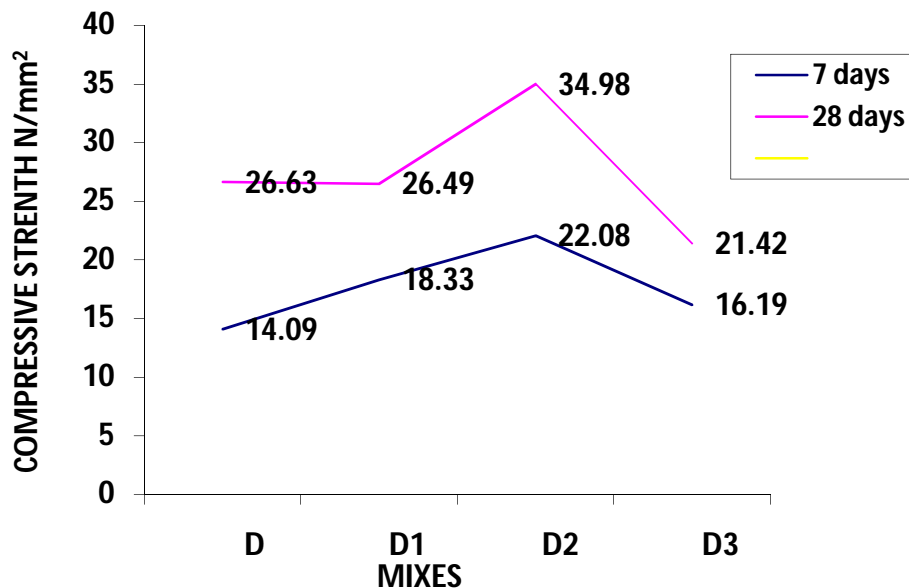


Figure-2 Graph for 7 & 28 days compressive strength

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

VI. CONCLUSION

Following conclusion can be drawn from previously discussed results:

- Sample D1 shown increase in compressive strength as compare to sample D which is control mix sample. It shows 30.09 % increment.
- Sample D2 shown increase in compressive strength as compare to sample D1 which is control mix sample. It shows 20.45% increment.
- Sample D3 shown increase in compressive strength as compare to sample D2 which is control mix sample. It shows 20.45% degradation.

Hence 20 % replacement of cement was found to be the optimum percentage of replacement with fly ash with addition of jute fibre and super plasticizers.

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